# MONITORING AND ANALYZING THE SUSTAINABILITY PERFORMANCE OF A RENEWABLE ENERGY INVESTMENT WITH A CASE STUDY-TUGRA HEPP

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**MONITORING AND ANALYZING THE SUSTAINABILITY PERFORMANCE OF A RENEWABLE ENERGY INVESTMENT WITH A CASE STUDY-TUGRA HEPP**

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## ABSTRACT

## MONITORING AND ANALYZING THE SUSTAINABILITY PERFORMANCE OF A RENEWABLE ENERGY INVESTMENT WITH A CASE STUDY-TUGRA HEPP

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To reach the sustainable development idea, the energy usage and services are in a critical position that most of the announced "Sustainable Development Goals" (SDGs) are somehow related to energy services, especially renewables. But SDGs alone are not sufficient for sustainable development and investment, even in the hydroelectric source, since wrong and erroneous decisions taken at the project stages undermine other potential investments. This thesis aims to encourage the realization of the hydroelectric potential in Turkey, which is following the SDGs, with the help of an evaluation methodology to be made to hydroelectrical power plant (HEPP) investments using the concept of "monitoring and analyzing the sustainability performance."For this purpose, a case study is conducted in the Tuğra HEPP Project in the Black Sea Region among the guidelines determined in the "Hydropower Sustainability Assessment Protocol" HSAP a total of four titles, one for each reflecting the social, economic, environmental, and technical perspectives. Consequently, by such a comprehensive sustainability analysis specific to the investment, it is realized that problems in these types of investments can be identified before they arise, or solutions to existing problems can be found. Additionally, this analysis allows new investments using the experiences gained from similar former ones. The study is concluded with a new legal act offer for Turkey, which has limited financial resources, deep biodiversity, and a versatile social structure in terms of demographics, to be able to evaluate the new investments to be made as sustainable as possible.

Keywords: Hydropower, Sustainability, HSAP, SDG

# ÖZ

## YENİLENEBİLİR ENERJİ YATIRIMLARININ SÜRDÜRÜLEBİLİRLİK PERFORMANSININ BİR VAKA ANALİZİ İLE İZLENMESİ VE ANALİZİ- TUĞRA HES

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Enerji kullanımı ve hizmetleri, açıklanan “Sürdürülebilir Kalkınma Amaçları”’nın (SKA) çoğunun bir şekilde özellikle de yenilenebilir eneji ile ilgili olduğu göz önünde bulundurulduğunda, sürdürülebilir kalkınma fikrine ulaşmak için kritik önemdedir. Ancak proje aşamalarında alınan yanlış ve hatalı kararlar diğer potansiyel yatırımları engellediği için, hidroelektrik sektöründe bile sürdürülebilir kalkınma ve yatırım için SKH'ler tek başına yeterli değildir. Bu tez, SKA'larını benimseyen Türkiye’nin hidroelektrik potansiyelinin, hidroelektrik santral (HES) yatırımlarında "sürdürülebilirlik performansının izlenmesi ve analizi" kavramı kullanılarak yapılacak bir değerlendirme metodolojisi yardımıyla gerçekleştirilmesini teşvik etmeyi amaçlamaktadır. Bu amaçla Karadeniz Bölgesi'ndeki Tuğra HES Projesi'nde “Hidroelektrik Sürdürülebilirlik Değerlendirme Protokolü”nde belirlenen kılavuzlar arasından sosyal, ekonomik, çevresel ve teknik koşulları yansıtan toplam dört başlıkta bir vaka çalışması yapılmıştır. Sonuç olarak, yatırıma özel böylesine kapsamlı bir sürdürülebilirlik analizi ile bu tür yatırımlarda sorunların daha ortaya çıkmadan tespit edilebileceği veya mevcut sorunlara çözüm bulunabileceği anlaşılmaktadır. Ek olarak bu analiz, yeni yapılacak yatırımlar için, yapılmış olan benzerlerinde kazanılan tecrübelerin kullanılmasına da olanak sağlamaktadır. Çalışma, finansal kaynakları kısıtlı, biyolojik çeşitliliğe sahip ve demografik açıdan çok yönlü bir toplumsal yapıya sahip olan Türkiye'nin yapılacak yeni yatırımları mümkün olduğunca sürdürülebilir olarak gerçekleştirebilmesine imkan verebilecek yeni bir kanun teklifi ile sonuçlandırılmıştır.

Anahtar Kelimeler: Hidroelektrik, Sürdürülebilirlik, HSAP, SKH

Dedication

## ACKNOWLEDGMENTS

The author wishes to express his deepest gratitude to his supervisor Prof. Dr. Bülent G. Akınoğlu for his guidance, advice, criticism, encouragements and insight throughout the research.

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| | |
|---|---|
| EIA: | Environmental Impact Assessment |
| EMRA: | Energy Market Regulatory Authority |
| AUESARC: | Ankara University Earth Sciences Application and Research Center |
| ETL: | Energy Transmission Line |
| FOS: | Flow Observation Station |
| GPR: | Ground Penetration Radar |
| HEPP: | Hydro Electrical Power Plant |
| HSAP: | Hydropower Sustainability Assessment Protocol |
| IEA: | International Energy Agency |
| IHA: | International Hydropower Association |
| kV: | Kilovolt |
| LV: | Low Voltage |
| METU: | Middle East Technical University |
| MPa: | Megapascal |
| MV: | Medium Voltage |
| MW: | Megawatt |
| $MW_{e}$: | Megawatt (Electrical) |
| $MW_{m}$: | Megawatt (Mechanical) |
| NGO: | Non-Governmental Organizations |
| PIF: | Project Introduction File |
| R&D: | Research and Development |
| SDG: | Sustainable Development Goals |
| SHP: | Small Hydro Electrical Power Plant |
| SHW: | State Hydraulic Works |
| T.R.: | Turkish Republic |
| TL: | Turkish Lira |
| TW: | Terawatt |
| TWh: | Terawatt-Hour |
| UN: | United Nations |
| USD: | United States Dollars |
| VAT: | Value-added Tax |

# CHAPTER 1

# INTRODUCTION

Sustainable development, which is a model development method embodying an ethical perspective for both human and environmental rights, stated its main foundations on the famous report of Gro Harlem Brundtland in the World Commission on Environment and Development in 1987. Following the publication of this renowned report, which included one of the essential definitions of sustainability (the Bruntland definition), many international meetings were held to develop this concept, and with the announcement of "Sustainable Development Goals" (SDG) at the UN Sustainability Summit in 2015, the structure of this idea was conceptualized under 17 topics[1].

To reach the sustainable development idea, the energy usage and services are in a critical position that most of the announced SDGs are somehow related to energy services. Under this reality, renewable energy sources become crucial in transitioning to a more sustainable world.

In our country, especially following the law numbered 5346, “Law On The Use Of Renewable Energy Sources For Electric Energy Generation,” published on 10/5/2005 and entered into force, private sector investments in particular intensified in the field of renewable energy. In the course of the investment period, especially since 2008, the potential of renewable energy resources in our country has been realized very quickly in solar, wind, geothermal, and biomass resources, starting with

[1] “THE 17 GOALS | Sustainable Development,” accessed January 12, 2022, https://sdgs.un.org/goals.

hydroelectricity. This situation both increased the localization rate in energy production and contributed to the sustainable development of our country in line with the SDGs mentioned above.

Nevertheless, notwithstanding this contribution, it is noteworthy that the rate of new investments in hydroelectric resources, which is summarized as the concept of hydroelectrical power plants (HEPPs) in the public opinion, decreased due to some mistakes and wrong decisions made in private sector investments during this rapid development period. In general, the commissioning of power plants with higher "economic efficiency" in the country in the first place and then the shrinking of the credit pool in the following years, especially with the effect of the global economic fluctuation of 2008, can be counted as the reasons for this retardation in new investments. However, even in the changing investment climates in the country, the fact that the interest of investors and financial institutions in HEPPs decreased. This shows the fact that starting new hydroelectric power plant investments is also problematic in terms of its social and environmental dimensions. Moreover, new regulations introduced at bureaucratic stages such as curbing incentives, new permits, approval, license phases, etc., make it difficult to realize these projects. Especially in some regions such as the Black Sea region, approaches such as not realizing projects are becoming a general trend. Also, canceling project licenses by investors, rather than seeking a rational response to the public reaction and a solution that satisfies the stakeholders, have often been chosen by investors in recent years.

In this regard, the fact that the source used is suitable for the SDGs alone is not sufficient for sustainable development and investment, even in the hydroelectric source, which is a renewable energy source. As a matter of fact, as stated in the cases mentioned above, wrong and erroneous decisions taken at the investment stage also undermine other potential investments. This is largely due to financial institutions are reluctant to support such projects considering them as "risky." This situation may pose problems in the evaluation of other renewable resources over time, some examples of which were reflected the public in geothermal investments.

At this point, it is of critical importance whether the new renewable energy-based investments that were or will be realized are sustainable within themselves. It is also a fact that the sustainability of such investments, which usually involve long years in terms of both construction and operation times, may change according to changing processes and conditions. In this case, it is considered that a holistic sustainability perspective will be needed for both shareholders and all other stakeholders to obtain maximum benefit from such projects and to reduce possible risks.

In general, regardless of the type of resource, the fact that all such investments to be made abide by the sustainability criteria within themselves can prevent many problems that will be experienced and likely to be experienced and increase the benefits to be obtained from such investments. Such a holistic sustainability perspective is considered to be an inclusive solution proposal in order to overcome the problems summarized above.

## 1.1 Thesis Question

*Can monitoring and analyzing the sustainability performance of investments at predetermined stages and scopes increase the benefits that shareholders and can stakeholders derive from these investments while at the same can reduce the risks associated?*

Principally, with this thesis, it is aimed both to seek an answer to this question and to encourage the realization of the hydroelectric potential in our country in accordance with the SDGs regarding HEPP investments, to the problems of which are described in the first chapter.

With the evaluation to be made using the concept of "monitoring and analyzing the sustainability performance" mentioned in the question, the main framework of this thesis will be to offer a solution to the need for a holistic perspective. This will help reduce the stated problems of HEPP investments and generally cope with such problems in all similar investments.

Therefore, to clarify the proposed perspectives, a case study will be conducted in the Tuğra HEPP Project in the Black Sea Region, whose investment has been completed and is still in operation. In addition, the "Sustainability Performance" of this investment will be monitored and analyzed.

## 1.2 Structure of The Thesis

This thesis consists of six chapters, including the introduction. A brief description of hydropower will be made in the second part following the introduction. Subsequently, information about the International Hydropower Association (IHA) will be given, and the Hydropower Sustainability Assessment Protocol (HSAP) published by this institution will be introduced.

In the third part, which is the literature review section, firstly, some published articles on the sustainability problems/difficulties in the hydroelectric sector in our country will be compiled. Then the information will be provided about the studies on the use of HSAP in the hydropower sector worldwide.

The fourth part will offer introductory and general information about Tuğra HEPP, on which a case study will be conducted.

In the fifth part, the analysis part of the thesis will be discussed and given. In this section, the analysis methodology will be introduced first. Then, within the scope of this methodology, the relevant topics selected from the HSAP, in which the sustainability performance of Tuğra HEPP will be examined and analyzed, will be introduced. Next, what has been done at Tugra HEPP for these selected topics will be explained individually for each stage of the investment (preparation, implementation, and operation) in chronological order. This section will be finalized with the general analysis and comparison summary in which the performance of Tuğra HEPP is evaluated under selected HSAP titles

In the sixth and final part, firstly, the results of this thesis will be evaluated, and subsequently, the thesis study will be concluded with a proposal of a new legal regulation model for future investments in our country to serve sustainable development.

# CHAPTER 2

# HYDROPOWER AND HYDROPOWER SUSTAINABILITY ASSESSMENT PROTOCOL (HSAP)

## 2.1 Definition of Hydropower

The term ‘hydro’ is the Greek word for water, and hydropower is the energy contained in water as a potential energy source due to its mass and the vertical elevation distance[2]. The power is harnessed by converting this potential energy into kinetic energy by hydraulic turbines, then into electrical energy via generators and transformer units. The power output of this system is directly correlated with the design discharge multiplied by gravitational acceleration “g” as the *mass component*. The net *head* is the vertical *elevation* component. Finally, through the conversion into mechanical and electrical energy,the overall efficiency of the system is reached.

The hydroelectrical power systems are subdivided in terms of their characteristics according to the power output capacity (from large to pico), transmission (on or off-grid) or head (high to low), etc. Because of this multi-dimensional separation, a particular hydropower project can be detailly termed by using these subdivisions together, e.g., a *high head off-grid small hydropower project*.

For the project, which will be detailly analyzed further in this thesis, it is essential to describe one of these subdivisions, which is according to storage. Mainly depending on the selected facility purpose and geography of the project location, hydroelectric

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[2] “Hydropower,” in *Wikipedia*, December 31, 2021, https://en.wikipedia.org/w/index.php?title=Hydropower&oldid=1062910567.

projects can either have reservoirs like dam structures or they can be run-off river type with limited storage inside the project components. The typical layouts and structural elements for such systems can be seen in Figure 2.1

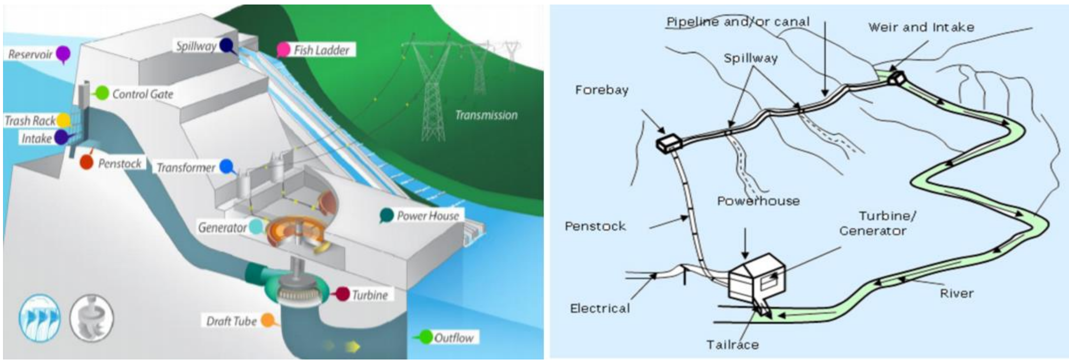


Figure 2.1 Typical Reservoir (Left) and Run-Off River (Right) Hydropower Project Layouts[3]

## 2.2 Hydropower Sustainability Assessment Protocol (HSAP)

Being one of the earlier and mature sources among renewables, hydropower projects are widespread worldwide, depending on the countries' potential. Sharing the international and regional experiences of the hydropower sector was started in 2000, by the beginning of the liberalization period, and matured between 2006 and 2010 throughout multinational stakeholders' meetings formed by several banks, environmental and social non-governmental organizations (NGO's), and government representatives[4]. Finally, this detailed experience shares merged into "The Hydropower Sustainability Assessment Protocol (HSAP)" in late 2010 and was announced by International Hydropower Association (IHA)[5]. HSAP mainly guides

[3] "Wasserkraftwerk-Physik-Mg," prezi.com, accessed January 7, 2022, https://prezi.com/p/7tf5j4trxk-z/wasserkraftwerk-physik-mg/.
[4] "Assessment Protocol (HSAP) — Hydropower Sustainability," accessed January 5, 2022, https://www.hydrosustainability.org/assessment-protocol.
[5] "Assessment Protocol (HSAP) — Hydropower Sustainability."

and addresses the hydropower investments to several guidelines that cover almost every crucial aspect to make them feasible, socially accepted, and eco-friendly for achieving goals among sustainable development criteria.

Before going into detail about the protocol's structure, it's important to note that the protocol is free to use for hydropower stakeholders, subject to some restrictions announced by the "HSAP Council" in 2011[6]. The main limitation disclosed is that using the HSAP guidelines, one cannot generate an assessment report of a hydropower project claiming that it is (certified) sustainable or not. In other words, it cannot be utilized as a certification process[7]. Still, professionals can use this protocol and its associated measures to address problems, enhancements, and so on for that specific project while keeping copyrights into account[8].

An official protocol assessment is carried out by both the contribution of the Project owner and IHA[9]. The steps of this procedure and the parties' responsibilities for each step are summarized in the figure below.

[6] Rikard Liden, Kimberly Lyon, "THE HYDROPOWER SUSTAINABILITY ASSESSMENT PROTOCOL FOR USE BY WORLD BANK CLIENTS" (The World Bank, June 30, 2014).
[7] Rikard Liden, Kimberly Lyon, "THE HYDROPOWER SUSTAINABILITY ASSESSMENT PROTOCOL FOR USE BY WORLD BANK CLIENTS."
[8] Rikard Liden, Kimberly Lyon.
[9] Rikard Liden, Kimberly Lyon.

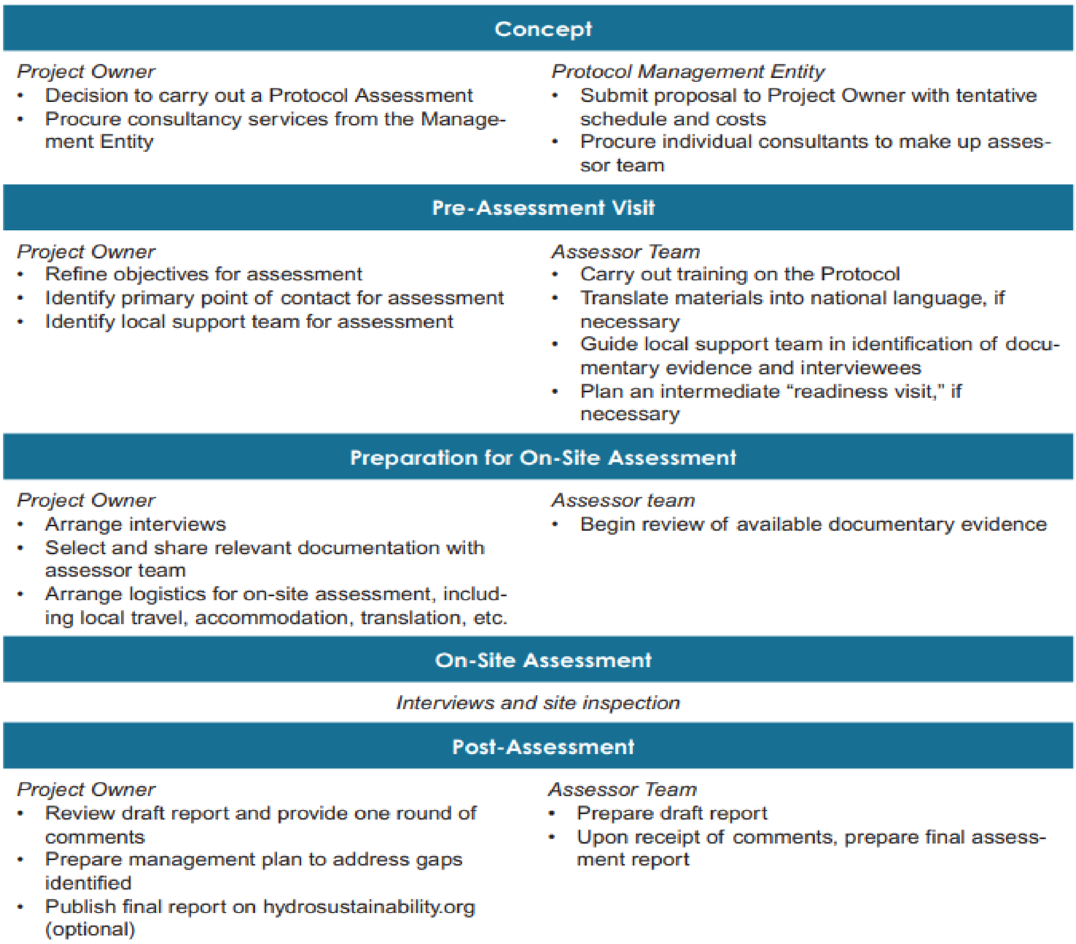


Figure 2.2 HSAP Official Assessment Steps Summary[10]

As the summary shows, the primary responsibility of the Project owner is to provide a suitable environment and logistics for data access and to cover all costs of the assessment procedure[11]. On the other side, the assessor team mainly focuses on data mining and comparing these data with the project's actual situation with the help of site visits and interviews[12]. Depending on the performance of both parties and the size of the project, the entire procedure takes a considerable time to be followed [13].

[10] Rikard Liden, Kimberly Lyon.
[11] Rikard Liden, Kimberly Lyon.
[12] Rikard Liden, Kimberly Lyon.
[13] Rikard Liden, Kimberly Lyon.

The structure of the protocol is based on the natural four periods of the project; "Early Stage," "Preparation," "Implementation," and "Operation," as shown in the figure below[14].

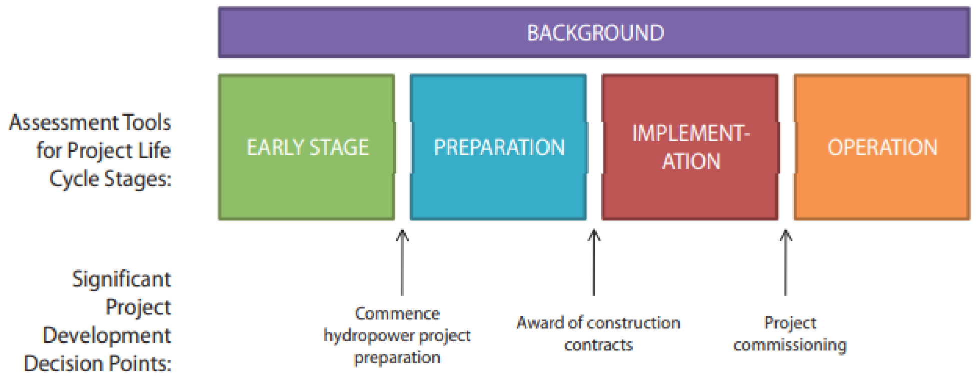


Figure 2.3 Stages of a Project According to HSAP[15]

Assessments can be made specifically to the stage of the project at that moment, regardless of whether they were carried out for prior stages or not[16]. But to get more precise assessment results, the assessor is advised to monitor ongoing processes made until that relevant stage to catch the improvements[17]. Aside from the last three steps, the Early Stage, which is a decision stage for whether or not to start a project, assessment is not aiming to score the project's sustainability[18]. Instead, using the methodology at this point may simply serve to clarify this decision from a basic sustainability approach[19]. However, after the project has been decided to be invested in, thus the Preparation Stage begins[20]. At his stage, broad investigations and

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[14] International Hydropower Association, "Hydropower Sustainability Assessment Protocol," November 2010.
[15] International Hydropower Association. (?)
[16] International Hydropower Association.
[17] International Hydropower Association.
[18] International Hydropower Association.
[19] International Hydropower Association.
[20] International Hydropower Association.

technical analyses are carried out to form a basis for a more accurate assessment to be made[21]. Following the preparation stage, at the implementation stage, the assessment mainly focuses on the construction and the application of the project[22]. In the final stage, the operation begins with the project's commissioning, sustainability measures and assessments are evaluated to track and optimize the investment throughout its lifespan[23].

To attain a holistic evaluation of a project's sustainability, the protocol suggests conducting assessments from four different perspectives: environmental, social, technical, and economical[24]. The evaluation topics, in other words, guidelines, were defined for each stage which covers these perspectives, are shown in the following figure[25].

[21] International Hydropower Association.
[22] International Hydropower Association.
[23] International Hydropower Association.
[24] International Hydropower Association.
[25] International Hydropower Association.

| ES - Early Stage | P - Preparation | I - Implementation | O - Operation |
|---|---|---|---|
| ES-1 Demonstrated Need | P-1 Communications and Consultation | I-1 Communications and Consultation | O-1 Communications and Consultation |
| ES-2 Options Assessment | P-2 Governance | I-2 Governance | O-2 Governance |
| ES-3 Policies and Plans | P-3 Demonstrated Need and Strategic Fit | | |
| ES-4 Political Risks | P-4 Siting and Design | | |
| ES-5 Institutional Capacity | P-5 Environmental and Social Impact Assessment and Mgmt | I-3 Environmental and Social Issues Mgmt | O-3 Environmental and Social Issues Mgmt |
| ES-6 Technical Issues and Risks | P-6 Integrated Project Management | I-4 Integrated Project Management | |
| ES-7 Social Issues and Risks | P-7 Hydrological Resource | | O-4 Hydrological Resource |
| ES-8 Environmental Issues and Risks | | | O-5 Asset Reliability and Efficiency |
| ES-9 Economic and Financial Issues and Risks | P-8 Infrastructure Safety | I-5 Infrastructure Safety | O-6 Infrastructure Safety |
| | P-9 Financial Viability | I-6 Financial Viability | O-7 Financial Viability |
| | P-10 Project Benefits | I-7 Project Benefits | O-8 Project Benefits |
| | P-11 Economic Viability | | |
| | P-12 Procurement | I-8 Procurement | |
| | P-13 Project Affected Communities and Livelihoods | I-9 Project Affected Communities and Livelihoods | O-9 Project Affected Communities and Livelihoods |
| | P-14 Resettlement | I-10 Resettlement | O-10 Resettlement |
| | P-15 Indigenous Peoples | I-11 Indigenous Peoples | O-11 Indigenous Peoples |
| | P-16 Labour and Working Conditions | I-12 Labour and Working Conditions | O-12 Labour and Working Conditions |
| | P-17 Cultural Heritage | I-13 Cultural Heritage | O-13 Cultural Heritage |
| | P-18 Public Health | I-14 Public Health | O-14 Public Health |
| | P-19 Biodiversity and Invasive Species | I-15 Biodiversity and Invasive Species | O-15 Biodiversity and Invasive Species |
| | P-20 Erosion and Sedimentation | I-16 Erosion and Sedimentation | O-16 Erosion and Sedimentation |
| | P-21 Water Quality | I-17 Water Quality | O-17 Water Quality |
| | | I-18 Waste, Noise and Air Quality | |
| | P-22 Reservoir Planning | I-19 Reservoir Preparation and Filling | O-18 Reservoir Management |
| | P-23 Downstream Flow Regimes | I-20 Downstream Flow Regimes | O-19 Downstream Flow Regime |
| | P-24 Climate Change Mitigation and Resilience | I-21 Climate Change Mitigation and Resilience | O-20 Climate Change Mitigation and Resilience |

Figure 2.4 HSAP Guidelines due to Project Stages[26]

[26] International Hydropower Association.

As can be seen above, some of these guidelines may be unique for a specific perspective (like Financial Viability for Economic Perspective) or may cover two or more perspectives at the same time (like Downstream Flow regimes for Environmental, Social, and Technical Perspective.). Additionally, some titles (except for the early stage) are for different project stages, while others are specific to that project stage. Also, it is impossible for all of these titles to be valid for every project because each has its own particular conditions. Therefore, before starting the assessment for any stage, firstly, the guidelines that are relevant to the project are selected from these topics for each perspective[27]. And after the completion of the assessment framework by setting the guidelines, the assessor assigns scores to each guideline ranging from Level 5 (best) to Level 1 (worst) based on the criteria outlined in the HSAP[28]. The studies are then reported as a final document that includes all of the scores for each guideline in order to arrive at an integrative result for the project's overall sustainability scheme[29].

[27] International Hydropower Association.
[28] International Hydropower Association.
[29] International Hydropower Association.

# CHAPTER 3

# LITERATURE REVIEW

## 3.1 Literature Review About Sustainability Problems/Challenges In Turkey's Hydropower Sector

According to the IEA Turkey Energy Policy Review, which was published in 2021 as one of the studies that best reflects Turkey's status in energy, the country's hydroelectric potential and targets are summarized in the table below[30].

Table 3.1 Hydropower in Turkey, Summary Table

| Hydroelectric Potential (TWh) | Technically Available Potential (TWh) | Economically Available Potential (Twh) | Hyrdo generation in 2019 (TWh) | Share of hydro in electricity generation by 2019 (%) | Total Capacity to be installed by 2023 (TW) |
|---|---|---|---|---|---|
| 433 | 216 | 160 | 89 | 29 | 32 |

As indicated in the table, due to this enormous hydropower potential, the private sector has shown solid interest in investing in this field, especially since the implementation of the new energy market law in 2001. However, several confusions committed during these investments have resulted in conflicts and complaints regarding whether this resource can be effectively utilized in accordance with sustainable development goals. At this point, the literature review in this chapter has been made using important studies that reflect this framework in general.

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[30] International Energy Agency"", "Turkey 2021 - Energy Policy Review" (International Energy Agency, 2021).

*Ozcan,2019*[31]: In this study, when considering climate change and environmental impacts, Turkish people will prefer electricity production from which source (nuclear or renewable), and their orientations on this issue have been examined. According to the results, it is seen that approximately two-thirds of the participants are against nuclear-based electricity generation facilities and that renewable resource-based facilities should be preferred instead. Additionally, more than eighty percent of those who made this choice stated that they thought that renewable electricity-based facilities would increase electricity production costs, and this would be reflected directly in their expenses. However, they were also willing to bear this price since the environmental impacts of renewables are very low, and they will reduce foreign dependency on energy.

One of the most striking results of the study is that approximately 67 percent of the people who are in favor of renewable energy were against hydroelectric power plants. Based on this opposition, the opinion that such power plants harm the environment comes to the fore. This opinion is drawn by the growing public reaction, especially in the Black Sea region. As examples of the problems at the center of these reactions, the ignoring of the local people in the decision mechanisms of the projects and the situations that harm sustainable development, such as the damage to vital water resources are given.

*Kentel and Alp, 2013*[32]: In this article, they look at Turkey's energy resources, and they stated that hydropower comes to the forefront as the main source of local energy besides imported resources such as natural gas and coal. Therefore, it is obvious that energy imports will decrease proportionally with the increase in the use of this

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[31] "Factors Influencing the Electricity Generation Preferences of Turkish Citizens: Citizens' Attitudes and Policy Recommendations in the Context of Climate Change and Environmental Impact | Elsevier Enhanced Reader," accessed December 27, 2021, https://doi.org/10.1016/j.renene.2018.08.006.

[32] Elçin Kentel and Emre Alp, "Hydropower in Turkey: Economical, Social and Environmental Aspects and Legal Challenges," *Environmental Science & Policy* 31 (August 2013): 34–43, https://doi.org/10.1016/j.envsci.2013.02.008.

resource. However, it has been underlined that, especially after privatization, some run-off river-type power plant investments (most of them are small HEPPs with less than 10 MW's of installed power) caused social and environmental problems and harmed the sustainable development goals. From an environmental point of view, problems such as dust and air pollution caused by excavations and operations during construction processes or landslides in some places come to the fore. In the operation period following the construction period, it was mentioned that the ecological life in the relevant parts of the stream/river was damaged since such power plants divert the natural water flow through conveyance structures as the main environmental problem. In addition to the environmental problems, the economic and social damages suffered by the local people who benefit from these waters through activities such as irrigation and fishing, etc., due to the prevention of natural water flow, are shown as the primary social problem. It was stated that there was a serious public reaction against small HEPPs, as these types of issues continued to increase significantly in the rapid investment period after 2001, and it was revealed that some projects were canceled as a result of these reactions. However, as they stated at the beginning, it is said that the construction of such power plants is critical for the country to establish the energy balance feasibly and sustainably. In addition, the authors believe that paying attention to the needs of local rights and ensuring the participation of other stakeholders in the relevant processes of the investment will contribute to the implementation of projects in a way that will serve sustainable development.

*Kaygusuz,2019*[33]: According to the author, hydropower is gaining importance in developing countries as a sustainable resource. Particularly in these kinds of countries, the importance of harnessing indigenous resources such as hydropower comes into focus in order to assure rapid economic development and to avoid energy

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[33] K. Kaygusuz, "Potential and Utilization of Hydroelectric Energy in Turkey," *Journal of Engineering Research and Applied Science* 8, no. 1 (June 30, 2019), http://journaleras.com/index.php/jeras/article/view/155.

access crises. Also, within developing countries, where financial considerations frequently take precedence over environmental concerns, hydropower investments provide work possibilities for locals and raise the welfare level of people living in rural areas through local production. Additionally, regarding the benefits of these types of power plant investments, it has been stated that hydropower is basically a clean and domestic energy source that minimizes reliance on energy exports. When discussing the difficulties of this resource, issues such as complicated construction processes and the inability of energy production to be consistent due to water cycle dependence arise. In addition to the various advantages and disadvantages mentioned, the fact that energy production costs are low compared to other sources is particularly appealing to such countries. As a result, the utilization of this resource is critical for Turkey as a developing country. However, in addition to the problems identified in earlier articles, such as ignoring local people and harming river ecosystems while constructing such power plants during the rapid investment period, the author believes that energy efficiency was also not considered within these projects.

*Avci and Kaygusuz,2019*[34]: The measures that Turkey should adopt in order to achieve energy sustainability after the Paris Agreement are examined in this article. Accordingly, it has been proposed that energy supply can be given entirely from renewable resources, with a focus on efficiency in both consumption and generation, as well as on reducing the social and environmental risks. They stated that governmental institutions also follow a similar point of view within this framework. Additionally, they regard that the lessons learned from the negative examples encountered throughout the use of hydroelectric resources feed this point of view,

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[34] A. Coskun Avci and K. Kaygusuz, “Renewable and Sustainable Energy Policies in Turkey after the Paris Agreement: Economic and Environmental Analysis,” *Journal of Engineering Research and Applied Science* 9, no. 2 (December 31, 2020), http://www.journaleras.com/index.php/jeras/article/view/223.

and resultingly related laws and regulations were enacted in order to avoid future problems. Approaches that serve sustainable development, such as

- Not having projects built in places that need to be protected,
- Taking stakeholders' opinions when deciding on projects
- Taking additional measures to reduce environmental and social impacts can be shown as examples of these regulations.

*Yaka,2020*[35]: The author conducted analyses and evaluations of popular movements opposing hydroelectric power plant projects, particularly in the Black Sea Region. Yaka participated in such a movement for a period. Beyond the environmental and ecosystem damages as a result of misapplications in the projects, which are also mentioned in other articles, the author has focused on the social traumas and problems in this regard. As a result, it is claimed that interrupting kilometers of natural flow by diverting rivers in this manner, particularly in the Black Sea Region, produces significant socio-psychological problems for the people who live there. Because the local people living there are in very difficult geographical conditions, and at this point, the socio-natural structure of the rivers is described with examples that offer them sometimes peace and sometimes a kind of socialization. At this point, the author has proposed the concept of "socio-ecological justice" in order not only to focus on ecosystem protection but also to consider the sociological effects of the event. The author thinks that it is essential to evaluate the projects at this point. It is also explained that the people's movements in the Black Sea Region started as simple people's movements in the İkizdere Valley before privatization but turned into more organized public movements in the rapid investment periods that followed. With these organized public movements, many projects were legally canceled, and in many of them, the violent conflicts that emerged as a result of the protests made it

[35] Özge Yaka, "Justice as Relationality: Socio-Ecological Justice in the Context of Anti-Hydropower Movements in Turkey," *Justice as Relationality: Socio-Ecological Justice in the Context of Anti-Hydropower Movements in Turkey*, 2020, https://doi.org/10.12854/erde-2020-481.

difficult to carry out the projects, and thus the investors had to give up on these projects. In summary, it has been revealed that considering the people's demands at least as much as environmental conditions should be seen as one of the most critical conditions for the realization of the projects.

*Acikgoz,2010*:[36] The author states that renewable energy implementation playing an important role in the sustainable development of Turkey is not only a commercial and technical formation between the investor and the state but also a process that requires the participation of the people. In this context, it is stated in this article that by arranging a renewable energy training program particular to Turkey, it should be targeted to raise public awareness on this issue. In this way, it is thought that more logical and rational solutions will be found in both environmental and social issues with the conscious participation of stakeholders. It was also underlined that this program should have both practical and theoretical aspects adding that it would be more appropriate to choose the trainers among those who have experience at this point.

*Yüksek et al.,2020*: This article is a study that focuses on the idea that small hydroelectric power plants (SHP), especially due to the absence of reservoirs, cover limited areas, but when it comes to environmental effects, they are seen in borders that cover much more of these areas. For this purpose, the authors explained the damage caused to the environment during the construction and operation periods of SHP's built in Turkey with examples. Afterward, they presented a solution proposal consisting of six items in total. As one of these solution proposals, they think that "Cumulative Environmental Impact Assessments (EIA)s" should also be made for SHP's, whose EIAs are made on a particular basis, in order to see the collective effects of the projects on the water basin where they are built. In addition, they also revealed the necessity of making "Integrated River Basin Management Plans" to

[36] "Renewable Energy Education in Turkey | Elsevier Enhanced Reader," accessed December 27, 2021, https://doi.org/10.1016/j.renene.2010.08.015.

analyze the collective impact in water basins further. Finally, they offered a checklist based on the solution suggestions they demonstrated throughout the study and suggested that SHP investments be designed and made in accordance with the criteria in this checklist.

## 3.2 Literature Review Regarding HSAP Applications

In this section, studies conducted in two big hydroelectric power plants in China and Tajikistan, as well as the World Bank's perspectives on the implementation of this protocol will be presented to demonstrate how HSAP is applied to real projects.

Sustainability in hydropower development—A case study

*Liu et al.,2013*[37]: The Three Gorges Dam, the largest HPP globally, is located in the Yangtze River of central China with an installed capacity of 22,5 TW (Figure 3.1)[38]. Besides having a huge dam body and enormously large reservoir capacity (almost 40 $km^3$), it also has a drainage basin catchment area of around one million square kilometers[39].

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[37] Jian Liu et al., "Sustainability in Hydropower Development—A Case Study," *Renewable and Sustainable Energy Reviews* 19 (March 2013): 230–37, https://doi.org/10.1016/j.rser.2012.11.036.
[38] "Three Gorges Dam," in *Wikipedia*, December 27, 2021, https://en.wikipedia.org/w/index.php?title=Three_Gorges_Dam&oldid=1062219624.
[39] "Three Gorges Dam."

Figure 3.1 Three Gorges Dam[40]

For this power plant, which was commissioned in 2009 with 26 units and produced approximately 365 TWh of electricity, the authors examined how it progressed in environmental, economic, and social issues, which are the three main pillars of sustainability under the context based on HSAP. While conducting this research, they used both interviews with experts involved in the design and construction phase of the project and the information they obtained from open sources.

When the outcomes and evaluations of this research are considered, the most important benefit from an environmental standpoint seems to be the reduced quantity of carbon output in exchange for equivalent energy production.

From a societal perspective, the reservoir's flood control capability for previous Yangtze River flood disasters stands out as a very significant gain. Furthermore, it is noted that leaving water from the reservoir for the continuation of economic

[40] "Three Gorges Dam."

activity downstream during dry periods is another important benefit for the people who live in this region and depend on this river economically. Also, it was stated that the government showed careful attention to the relocation issue and that modern structures and infrastructure facilities were constructed for new settlement areas.

Economically, apart from its contribution to the country's electricity production, it is also precious that it works in coordination with other large fossil fuel power plants in the region. This allows "peak load shifting," thus preventing grid bottlenecks in the transmission system. Additionally, the reservoir area also offers important job opportunities for the people living upstream, especially in tourism.

In addition to all these positive achievements that contribute to sustainable development, the authors also sought an answer to the question of what could be done better. One of the most valuable answers to this question is the belief that using the HSAP as a guide from the very beginning of the project can make the steps taken throughout the project more balanced and complete. In this way, it has been realized that many environmental and social problems can be seen beforehand, and precautions can be taken. Another essential answer is that this sustainability analysis should be done again in certain periods. Thus, both the development of the project in the field of sustainability and the transfer of these experiences to other future projects will be ensured.

*Xu et al.,2020*[41]: In Tajikistan, which is the eighth country with the highest hydroelectric potential in the world, the state is taking important steps to reduce foreign dependency in the energy sector until 2030 by evaluating this potential. Rogun Hydroelectric Project is one of these steps. Although the construction of this project, whose planning phase started 40 years ago, the project could not continue due to problems with neighboring countries, then, as of the beginning of 2016, the

[41] Zhao Xu et al., "The Integrated Hydropower Sustainability Assessment in Tajikistan: A Case Study of Rogun Hydropower Plant," *Advances in Civil Engineering* 2020 (September 10, 2020): 1–18, https://doi.org/10.1155/2020/8894072.

construction of the remaining part was continued. The table showing the phase developments of the facility, the first phase of which was commissioned towards the end of 2019, is presented below.

Table 3.2 Rogun HEPP Properties and Development of Phases

TABLE 2: Main parameters of the phased development scheme of Rogun HPP.

| Parameters | Phase 1 | Phase 2 | Phase 3 |
|---|---|---|---|
| Height (m) | 225 | 285 | 335 |
| Normal reservoir level (m) | 1180 | 1240 | 1290 |
| Minimum operating level (m) | 1120 | 1180 | 1230 |
| Initial capacity ($km^3$) | 2.78 | 6.76 | 13.3 |
| Initial effective capacity ($km^3$) | 1.92 | 3.98 | 10.3 |
| Total installed (MW) | 1200 | 2400 | 3600 |
| Installed unit number (pcs) | 3 | 4 | 6 |
| Annual generating capacity (TWh) | 6.7 | 11.6 | 14.5 |
| Vakhsh cascade increases annual power generation (TWh) | 0.4 | 0.9 | 1.2 |

In this article, the authors made a case study analysis at Rokun HEPP, centered on the work done for this power plant, and made a sustainability analysis with the opinions and ratings of ten experts. They used the HSAP for the guidelines used in this analysis but modified these titles according to the specific needs of the country and the project. Then by using the evaluation criteria and checklist they determined throughout the data obtained, they had these ten experts to score the sustainability performance of the project related to each title. While making this scoring, they used the same scoring system in HSAP (Level 1-5). Finally, according to the results obtained, the spider graph showing the sustainability performance of Rogun HEPP was formed as follows.

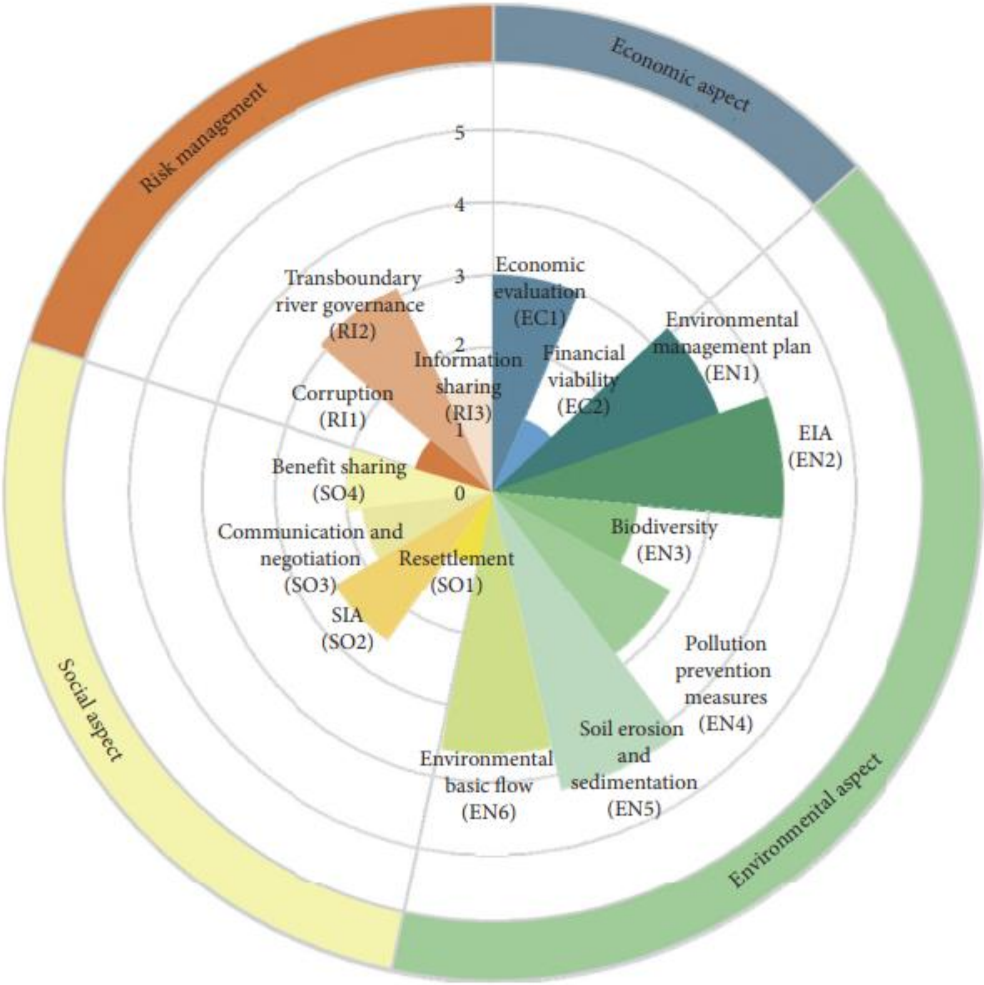


Figure 3.2 Spider Graph of Rokun HEPP's Sustainability Performance

# CHAPTER 4

## CASE STUDY: TUGRA HEPP GENERAL PROPERTIES

Tuğra HEPP Project is located in the Black Sea Region, in the Eastern Black Sea Basin, on the Karaovacık River within the Espiye district of Giresun province. It was constructed between the altitudes of 1600 meters and 600 meters above sea level. The final design is a cascade system of two individual hydro systems and powerhouses, Tuğra-I and Tuğra-II, to benefit from intermediate basin flow between the diversion weirs of these two. The generation license of this facility is issued by Energy Market Regulatory Authority (EMRA), and the investor company Vira Electrik Uretim Inc. was granted a 49- year license with No: EU / 1845-23 / 1317 on 20/11/2008. According to the most recent update to this license, the total installed capacity of this power plant is 18.5 MW, with 6 MW installed in Tuğra-I and the remaining 13 MW installed in Tuğra-II. The construction of this plant started with the excavation works of the access roads in May 2010 and was finished by the final provisional acceptance of the Tuğra-II Section, which was held on 28/10/2014. The general properties of the system and the structures constructed are provided in the summary table below.

Table 4.1 Tuğra HEPP Summary Table

| | **Tuğra-I** | **Tuğra-II** |
|---|---|---|
| Installed Power | 6,15 $MW_m$ / 6,00 $MW_e$ | 12,85 $MW_m$ / 12,50 $MW_e$ |
| Diversion Weir Type | Tyrolean | Tyrolean |
| No of Diversion Weirs | 2 | 1 |
| Conveyance System | Reinforced Concrete Box Channel – Tunnel - Steel Pipe | Reinforced Concrete Box Channel – Tunnel |
| Cpnveyance Length (Total) | 5220 m | 6280 m |
| Reinforced Concrete Box Channel | 3070 m | 5870 m |
| Tunnel | 810 m | 330 m – 80 m |
| Steel Pipe | 2150 m | 0 |
| Penstock Length | 1125 m | 1505 m |
| No of Turbines | 2 | 2 |
| Turbine Type | Pelton | Pelton |
| Net Head | 436,95 m | 527,14 m |
| Design Discharge | 1,80 $m^3$/sec | 2,80 $m^3$/sec |

# CHAPTER 5

# ANALYSIS FOR THESIS QUESTION

## 5.1 Methodology For Analysis

In this case study, for the guidelines to be used for the analysis to be made, HSAP, an aggregative resource introduced in detail above and reflects the worldwide industry experience in the hydropower sector, has been used. Interviews were conducted with the officials of Vira Elektrik Üretim Inc. at both the shareholder level and the project management level regarding the studies, decisions, and measures taken specifically for Tuğra HEPP, and important events related to the selected principles. Apart from that, as another main source, the company's entire incoming/outgoing document database was accessed, and the results obtained by overlapping with the data mining carried out and the data obtained in the interviews are presented. However, since many of the information and documents obtained, especially for the financial title, have the characteristics of trade secrets, only the information and documents approved by the company authorities could be compiled.

In addition, in this analysis methodology, as described in the first section, whilst the actions taken at the three stages of the investment (since there is no need for the pre-stage part) for each of the headings are specified, no scoring has been made in contrast to the HSAP. Because the essence of this study is to show how sustainability develops and changes in the project, rather than scoring. Evaluations and inferences made in this sense are also included in the last part of the relevant section.

Among the guidelines determined in the HSAP  (see Figure 2.5), for the assessment to be carried out in the next chapter, those that are valid for all three project phases were given priority. Then, a total of four titles, one for each reflecting the social, economic, environmental, and technical perspectives, were selected among them within the framework of the general definition of sustainability. Guidelines selected according to these perspectives and their brief explanations are listed below.

- *Environmental and Social Impact Assessment and Management:* This guideline is selected for reflecting the environmental perspective of the assessment. The main aim is to find out mainly the environmental impacts of the project as well as the precautions needed to be taken to minimize these effects.
- *Indigenous Peoples*: By this guideline selected, the actions which were taken during the project's lifecycle related to the social perspective will be examined. The core of this analysis is based on the interactions between the local people in the place where the project is carried out.
- *Infrastructure Safety*: All kinds of safety measures technical designs, starting from the engineering of hydromechanical structures up to the implementation of them, will be analyzed to reflect the technical perspective of the assessment.
- *Financial Viability*: The economic perspective of sustainability will be assessed throughout this guideline by reflecting the financial situations and actions during the project's lifecycle.

The assessment in the following chapter will be carried out individually within these guidelines, and for each guideline, the Project's preparation, implementation, and operation stages (see Figure 2.4) will be assessed separately.

## 5.2 Assessment Of The Case Study's Stages For Selected Guidelines

### 5.2.1 Environmental and Social Impact Assessment and Management

#### 5.2.1.1 Preparation Stage

Following the approval by the Board's Decision of the Energy Market Regulatory Authority dated 30.07.3008 and numbered 169-8 to carry out the Tuğra HEPP Project, the "Water Use Rights Agreement " was signed between the company and the General Directorate of State Hydraulic Works (SHW). With the contract signed within the scope of the Electricity Market Law No. 4628, provided that the water elevations previously determined by the company are to be the border, the hydroelectric potential of the Karaovacık River, where the facility will be built, has been allowed to be evaluated. However, the permit granted within the scope of the same contract urges the company to assume some critical environmental and social obligations such as protecting the downstream and upstream water rights, not preventing or limiting the natural life in the river, not deteriorating the quality of the water, undertaking all kinds of hydrological, geological, technical, environmental, economic and financial risks and natural disaster risks. In addition to this contract, within the scope of the relevant regulation amendment published in the Official Gazette dated 18.08.2009 and numbered 27323, for the sake of protecting the natural life in the river bed. It has been made obligatory to leave a minimum of ten percent of the average water flow of the last ten years based on the project, excluding ecological and other additional amounts, if needed and necessary. In addition, if there is less than the specified amount of flow in the relevant river, it has been made mandatory to leave all the incoming water downstream, aiming that the natural life in the river will continue uninterrupted.

For the Environmental Impact Assessment phase of the project, an agreement has been made with one of the authorized consultancy firms, Ay-Mel Çevre Müşavirlik Co. Ltd., according to the project formulation determined within the scope of the final feasibility report submitted to the State Hydraulic Works on 12.08.2008. According to the "Environmental Impact Assessment Regulation", which was valid at the time of the said agreement and put into force after being published in the Official Gazette dated 16.12.2003 and numbered 25318, the Tuğra HEPP project was included in the Annex-II list of this regulation in terms of its installed capacity. Therefore, in order to evaluate the environmental impacts of the project, a "Project Introduction File" was submitted to the T.R Giresun Governorship Provincial Directorate of Environment and Forestry, within the framework of the terms and protocol determined in the same regulation. Within the scope of this file, apart from the general and technical features of the project, crucial issues such as the natural resources to be used, the amount of waste production, the risks of accidents that may occur during the project, whether the project is within the “sensitive areas", the important environmental impacts of the project and precautions to be taken against them, and reflecting the opinions of the people who are likely to be affected by the project, were examined. As a result of all these studies and evaluations, the "Environmental Impact Assessment Document" was granted to the project with the date 02/09/2008 and the number 2008/08 by the relevant institution.

The necessary application was filed to the T.R. Giresun Governorship Special Provincial Administration on 21.01.2010 to have the zoning plans of the project drawn up, and herein, a number of institutions were consulted in order to evaluate the possible effects of the project. Among these institutions, it was stated by the 22nd Regional Directorate of State Hydraulic Works that the project is located outside of both the areas determined by the institution for irrigation and the Karaovacık (Gelivera) River aquifer area, and thus declared to be free of problem. However, in the course of the design and construction of the project, warnings were also expressed on the issues such as taking the necessary flood protection measures determined by this institution, leaving sufficient operating roads for the project, and taking the necessary measures to prevent the creek bed from being polluted by possible wastes during the construction. In response to the letter of opinion asked to T.R. Giresun Governorship Provincial Directorate of Culture and Tourism, it is stated that the project area is not within the archaeological area deemed necessary to be protected according to the Law No.1010 and that there is no relic and cultural heritage subject to the Code of Protection of Cultural and Natural Properties. In the response letter of T.R. Giresun Governorship Provincial Directorate of Agriculture, it was confirmed as a result of investigations conducted in the coordinates of the project that the area in question was outside the scope of Law No. 5402 on Soil Conservation and Land Use. Hence, the project did not threaten any agricultural land. Finally, according to the reply of the 10th Regional Directorate of the General Directorate of Highways of the Ministry of Transport, it was stated that there was no objection to the construction of the project since the project area was outside the responsibility of this institution. As a result, within the scope of all these positive institutional opinions and evaluations, the zoning plan of the project was approved by the Giresun Special Provincial Administration Provincial General Assembly with the decision dated 09.04.2010 and numbered 71.

Since the project area is entirely on state-owned forest land, the company made the necessary applications and ensured that this area was allocated to them during the license period. In this sense, in accordance with article 17/3 of the Forestry Law No. 6831, in favor of public interest, final permission was granted by the T.R. Ministry of Environment and Forestry, General Directorate of Forestry, Cadastre and Property Department on 07.07.2010 for a total area of 180.084 $m^2$ where the aforementioned project will be built. As part of this permission, the company has entered into some environmentally critical obligations regarding the forest areas for which it has secured permission, with the final permit commitment letter submitted by the company to the relevant administration. The foremost of these obligations urges that although the permission has been given for the forest area when trees are to be cut in the relevant area, permission is to be obtained from the local forest administration to cut the trees in question after they are duly stamped within the scope of this permission. Moreover, it has also been stated that following the completion of the construction works, the unused areas should be arranged and afforested immediately. In addition to these, it is underlined that the company cannot keep the construction wastes/residues in the permit area and dump them into the forest and that at the end of the work, the construction site facilities should be dismantled and removed, and if any, together with the construction wastes/residues, they should be transported outside the forest borders; otherwise, it has been expressly declared that these operations will be conducted by forest administration and the fee will be charged to the permit holder at a 50 % additional cost. In addition to its legal obligations, in order to further reduce the environmental impact of the project and not to harm the natural life in the forest area, the company also ensured that the relevant structures of the facility were buried under the ground or designed as a tunnel as much as possible. In this context, the relevant parts of the conveyance channels of both Tuğra-I and Tuğra-II projects are designed as tunnels, and the remaining parts are buried under the ground in the form of a closed box. Similarly, penstock systems were designed to be buried underground. In this way, during the operation phase of the project, it was aimed not to hamper the lives of animals living in the forest but also to reintroduce the resulting areas to the forest as a transportation road or afforestation zone.

#### 5.2.1.2 Implementation Stage

After the construction of the project started, due to the fact that the necessary material shipment was carried out under more difficult conditions than planned and anticipated, and especially due to the disruptions in the transportation roads, with the decision taken by the project management, it was deemed appropriate to produce the concrete to be used at a suitable point close to the project site instead of outsourcing it. As a result of the calculations, it was planned to establish a crushing and screening plant with a capacity of 90 tons/h and a mobile ready mixed concrete plant with a capacity of 60 m3/h in an area of approximately 11.000 $m^2$. In this sense, the opinions of Giresun Regional Directorate of Forestry of the T.R. Ministry of Environment and Forestry were asked for the application area, which was determined as a result of the technical and environmental preliminary analyzes and remained in the forest area, but lost its forest quality and did not have agricultural characteristics. As a result of the evaluation report they drew, it was stated in the letter dated 01.09.2010 that their institution did not see any environmental or social objection to the allocation of the mentioned land for this purpose.

Within the framework of this positive opinion, the "Project Introduction File" (PIF) was prepared by the consultant firm Ay-Mel Environment in accordance with the 17th article of the EIA regulation dated 17.08.2008 and numbered 26939, which was then in effect. Just like in the preparation phase of the project, a similar study done for the entire Tuğra HEPP has been undertaken, and only the potential impacts of the mentioned crushing, screening, and ready-mixed concrete plant on the environment, and critical issues such as waste management, emission values to arise during production, energy use, risk management, etc. were examined and/or calculated and submitted within the PIF in all details to Giresun Governorship Provincial Directorate of Environment and Forestry. As a result of the examination and evaluation carried out by the said institution, the decision of "EIA Not Required" was made on 21.12.2010 for the "Tuğra Ready-Mixed Concrete Facility", provided that the conditions and plans presented in the PIF are complied with. Hereby, a major obstacle to the completion of the project in the planned time was surmounted by constructing the facility, which directly affects the construction planning and duration of the project.

During the construction period of the project, especially in the Black Sea region, a highly negative atmosphere began to form in the public opinion against HEPP projects due to the mistakes made by other HEPP projects under construction at that time and environmental/social negativities, which in turn brought about the obligation of both the public side and the private companies that own the project to conduct more rigorous and careful studies and/or inspections, especially on environmental and social issues. In this context, although the permissions, opinions, and evaluations required by all applicable legal environmental regulations were obtained during the pre-construction period (as explained above) for the Tuğra HEPP project, by carrying out two more important studies during the construction period.

It was ensured that the negative perception during the period in question was eliminated and that the project was re-evaluated by a third party, especially in the environmental field, through a more detailed and scientific methodology.

As the first of these studies, an authorized agricultural engineer prepared a "Downstream Water Rights" report in 2012. The main objective of this report was to re-check the previously done feasibility study and water use rights agreement and the calculations made for this purpose within the PIF given for EIA and to investigate whether there is any downstream water rights arose in the interim period when the study was done, and the said report was prepared.

In this sense, detailed studies such as

- Determining the agricultural lands currently irrigated in the basins of the Karaovacık River, which is the main water source of the project, and the side rivers included in the project,
- The structures that irrigate these lands,
- Calculating the amount of water needed by these areas by months by determining the plant pattern in the irrigated lands in the project area in the current situation
- Determining irrigation structures and capacities, if any, in the project area,
- Calculating the amount of water required to be released downstream for the mills to operate by determining the existence of destroyed or operating mills that were built in previous years,
- Determining whether there are fish production farms, facilities made for agriculture and livestock activities, and industrial investments across the project area and, if so, determining whether they have water usage rights,
- Conducting the status evaluation of groundwater reserve area, caisson or deep well for drinking water supply, mills in operation or fish farms, if any, in the project area, and if there are any of these facilities, calculating the amount of water required to be released downstream so that they can continue to function, were carried out.

As a result of all these studies and the opinions of the official institutions, it was determined that the amount of water calculated to be released downstream at the beginning of the project was sufficient and that no additional right or need arose. After the report was completed, it was submitted to the 22nd Regional Directorate of the General Directorate of State Hydraulic Works on 14.11.2012.

The second study is the Ecosystem Evaluation Report, the preparation and completion phase of which continued between 2012 and 2014. As is known, the foremost criticisms made towards HEPP projects are the views that there has not been enough evaluation in terms of ecosystem needs and that integrated water basin planning based on the holistic approach is not considered. Besides, the issue of the amount of environmental/ecosystem water to be released into the riverbed within the scope of HEPP projects will constitute one of the most important parameters of the sustainable ecosystem approach. While making these calculations, riverbeds are not assumed as concrete channels with definite cross-sections. Moreover, the change in width, evaporation, infiltration, pollution density, temperature increase, water depth, water temperature, water quality, particulate matter in the water, pH change, which are altogether extremely important for aquatic organisms, are all considered. Hence, the amount of water to be released to the riverbed is indicated numerically in lt/sec on a seasonal and monthly basis based on local measurements and investigations. Environmental/ecosystem water amounts calculated based on scientific methods provide prevention of possible destruction of the ecosystem and better protection. In this respect, this ecosystem assessment report, which takes into account the needs of the aquatic ecosystem in the river bed, has been prepared by experts (ecologist, hydrobiologist, and hydrogeologist) working as academicians at Karadeniz Technical University. With this report, as a main output, the environmental ecosystem water that should be released downstream in order to ensure the continuity of biological diversity has been revealed. Additionally, the effects of the activity to be made on the ecosystem have been discussed, and solution proposals for these effects have been included. The review part of the report is composed of three main parts. In the first part, the endemic rare and endangered plant species in the project area and the possible effects of the project on them were examined by the ecologist. He foresaw that the negative effects of the project in terms of floristic diversity would be minimal if necessary precautions were taken for the construction period. In the second part, in which the hydrobiologist made the evaluation regarding the effects on the same species (endemic, rare, and endangered), it has been concluded that no adverse effects are expected on the fauna during the operation phase after the construction phase. Additionally, there will be no problem in terms of fauna provided that both measures to prevent erosion and soil loss are taken after the construction phase, and the environmental/ecosystem water is left in accordance with the rule. In the third part, the hydrogeologist stated that it is not expected to have any effect on the meteorological situation due to the very limited spatial scale of the accumulation parts (lake area) of the Tuğra HEPP Project, and additionally, since the geological units in this area are generally impermeable and/or low permeability, there will be no significant interaction between surface water and groundwater. In the tripartite evaluation in the final part of the report, calculating the amount of previously stated ecological flow that should be released to nature with their own scientific methods, all three expert units compared the results on a monthly basis with the calculations made within the framework of the PIF and water usage right agreement. As a result, they concluded that the anticipated amount of ecological flow (10% of natural flow) would be insufficient, especially for the spring months, and it would be healthier in terms of sustainability and ecosystem balances if this amount was between 13% and 16% depending on the months. In addition, it has been stated that the water flows from the side rivers will support the environmental/ecosystem water. Thus, it will be possible to produce energy without harming the ecosystem. Finally, in the field observations made by the experts for the preparation of the said report, it was stated that the ongoing construction activities at the time and the operational activities for the part that was put into operation were carried out in accordance with the report. After its completion, the report was submitted to the Giresun Branch Directorate of the T.R. Ministry of Forestry and Water Affairs on 27.11.2013 for examination and evaluation and then presented to the General Directorate of Nature Conservation and National Parks of the same ministry on 17.12.2014.

During the construction of the project, the meticulous attention of the project management to inform the stakeholders about the project was also noteworthy. Progress reports, demanded by EMRA from the licensed companies and which are required to be submitted in January and July of each year, containing all the details of the project, have been submitted not only to this institution but also simultaneously to the Ministry of Environment and Forestry, State Hydraulic Works and SHW 22nd Regional Directorate and Giresun Provincial Directorate of Environment and Forestry. Since the mentioned stakeholders have been able to control the course of the project thanks to these progress reports, many environmental problems have been prevented before they arise through verbal and direct interventions at times under the coordination of the project management.

#### 5.2.1.3 Operation Stage

The operation period of the project was realized in two phases as mentioned before (Tuğra-I and Tuğra-II HEPP ). In the temporary commissioning required for both phases, the water structures parts of the facilities up to the power plant buildings were held by the 22nd Regional Directorate of SHW, the power plant buildings, turbine mechanical and electronic parts were held by the Ministry of Energy officials, and the Energy Transmission Lines (ETL) were held by distribution and transmission companies since it varies according to the relevant legal legislation of each period. During these commissions, "temporary acceptance stage" deficiencies were reported to the company in minutes by these administrations in order to reduce the environmental impacts of the facilities during the operation phase and/or to reduce the possible environmental accident risks. Details of these notifications are given below.

*Tuğra HEPP- Yaglidere Transformer Center Energy Transmission Line (30.11.2012)*: For this line, which is approximately 21 km long with 36 kV 2x(3x477) MCM conductor, in the commission by Turkish Electricity Distribution Corporation General Directorate R&D Planning and Foreign Relations Department TEDAŞ Coruh Representative it has been stated that there are no deficiencies that may have environmental effects in the power transmission lines of the facility.

*Tuğra-I HES SHW Commission (12.12.2012)*: Temporary commission examination and evaluation was carried out with the participation of the company and the 8-member interim commission committee consisting of engineering experts in various fields, including the chairman formed with the consent of the 22nd Regional Directorate of SHW, dated 10.12.2012 and numbered 599331. According to this examination, it was determined that the conveyance structures of the facility were constructed in accordance with the science and engineering rules, with less than 5% of deficient and defective manufacturing. However, these defective and incomplete productions, which are related to the company's commitments related to possible effects on the environment, presented in the previous stages, will be listed here.

According to the findings of the commission committee, since the amount of natural light received by the fish pass that was built was found to be low, a warning was given to expand the entrance structure by breaking it in order to increase this amount of light. At the same time, it was deemed appropriate to make roughening on the bottom of the fish channel and to add a gurgling pipe so that the species feel like they are in their natural habitat.

In another determination, although the company previously determined suitable places for surplus excavation wastes and dumped these wastes there during this construction, it was recommended to plant afforestation in these dumping areas. At the same time, it was pointed out that the necessary environmental arrangements should be made for the powerhouse and its surroundings, the provisional acceptance of which had not been completed until that time.

*Tuğra-I HEPP Commission by the Ministry of Energy (29.12.2012)*: Tuğra-I Powerhouse, two water turbines and their associated generator groups, two step-up transformers, medium voltage (MV) and low voltage (LV) cells of these systems and their auxiliary facilities have been temporarily accepted by the 13-person commission committee, including the chairman and company officials, convened with the order of the T.R. Ministry of Energy and Natural Resources dated 24.12.2021 and numbered 7492-15719. Dry and wet load tests carried out in the units were carried out successfully, and at this point, the facility was put into operation since no deficiencies were detected that prevented production. However, in the minutes of this provisional acceptance, deficient and faulty productions related to the facility were identified, and the first of these shortcomings related to environmental impacts, which is the elimination of assembly residues, flammable, explosive, and combustible materials, waste, etc. was recommended to be eliminated. As another critical warning, it was pointed out that necessary measures should be taken to prevent the free slope rubbles in the slopes and penstock route behind the power plant of the facility from turning into a landslide in the future and thus not harming the natural life and the environment, and the necessity of taking measurements and having engineering analyzes made at these points, if necessary.

*Tuğra-II HEPP SHW Commission (17.10.2014)*: Temporary commission examination and evaluation were carried out with the 9-member temporary commission committee consisting of engineering experts in various fields, including the chairman, created with the consent of SHW 22nd Regional Directorate dated 26.09.2014 and numbered 606797, and company officials, just as in the commission of Tuğra-I HEPP. In this commission, some determinations were made that the work did not have deficiencies, defects, and malfunctions that could prevent temporary commission, but a large part of it needed improvement or risk reduction during the operation phase of the facility. The foremost determinations among these related to the environmental issues are the fortification on the right and left beds downstream of the diversion weir in order to reduce the damage to the environment and possible risks to the structures in case of a possible flood, to provide a section suitable for the flood flow by removing the excavation across the left coast, and to arrange the river bed. Another warning is that the lake area of the same regulator is surrounded by wire fences, taking into account the maximum water level since the forest animals are on the transition route.

*Tuğra-II HEPP Commission by Ministry of Energy (28.10.2014)*: Tuğra-II Powerhouse, two water turbines and their associated generator groups, two step-up transformers, MV and LV cells of these systems, and their auxiliary facilities have been temporarily accepted by the 11-person commission committee, including the chairman and company officials, convened with the order of the T.R. Ministry of Energy and Natural Resources dated 24.12.2021 and numbered 7492-15719. In this temporary acceptance, all electromechanical tests of the facility were carried out successfully, and the operation was commissioned. Following the commission granted almost two years after the partial temporary admission of Tuğra-I HEPP, since the construction of the entire facility was completed, no minor deficiencies regarding environmental issues were found in this acceptance annex. When the attachment of the minute is examined, it is seen that all of the deficiencies are simple and minor deficiencies related to the electromechanical parts of the plant.

After the approval of Tuğra-II HEPP by the Ministry of Energy, the plant went into the operation phase, and environmental obligations/commitments were meticulously followed throughout this period.

In particular, most of the deficiencies related to environmental issues stated by the institutions at the commission stages were remedied. In this context, afforestation works on the penstock route (Figure 5.1), afforestation terraces on routes with slope debris and landslide potential (Figure 5.2), left bank river bed reclamation between Tuğra-I Powerhouse and Tuğra-II Diversion weir, which was built to prevent potential flooding (Figure 5.3) and environmental safety fence (Figure 5.4) built according to the maximum water level of the Tuğra-II diversion weir lake area are presented with their images below.

Figure 5.1 Tuğra-I Penstock Route

Figure 5.2 Terraces for Slopes

Figure 5.3 River Bed Reclamation

Figure 5.4 Environmental Safety Fence

Also, flow observation stations (FOS) were installed in appropriate places both in Tuğra-I and Tuğra-II, which are determined by the above-mentioned studies during the pre-construction and construction period from the partial temporary acceptance of the facility (Tuğra-I HEPP, Ministry of Energy) until the day this thesis was written,  are available to control of the amount of water that must be left to the river bed for the continuation of the natural life. Flow values are transmitted online from these stations to the 22nd Regional Directorate of State Hydraulic Works and are operated under their supervision. In addition, the company made an agreement with a consultancy firm (Karadeniz Hydro Engineering Consultancy Co. Ltd.) regarding this issue as of the commissioning of Tuğra-I, and both the operation, maintenance, and repair services of FOSs are received by this company, and the failures or technical studies (battery depletion, flood-overflow cases, chart-key curve studies, etc.) that are required to be reported during operation are forwarded to the relevant institution.

Another environmental application in the operation phase is the annual technical and environmental inspections conducted with the experts of the General Directorate of Nature Conservation National Parks and the General Directorate of Forestry, and the Provincial Directorate of Environment and Urbanization under the coordination of the General Directorate of State Hydraulic Works, within the scope of the relevant legal regulations, just as applied to other private sector HEPP projects. With these inspections, which have been carried out regularly every year since 2018, both the operation phase of the facility is observed, and warnings are made against possible environmental impacts. These inspections also foster the environmental obligations of the Tuğra HEPP project on more specific issues and facilitate taking precautions against potential accidents or errors.

### 5.2.2 Indigenous Peoples

#### 5.2.2.1 Preparation Stage

Boncukçukur Village, the closest village to the project site, is connected to the Güce district of Giresun province (Figure 5.5). It is 22 km from the town center and 61 km from the city center. The land structure of the village is rugged, and the settlement area has an altitude of between 570 and 800 meters.

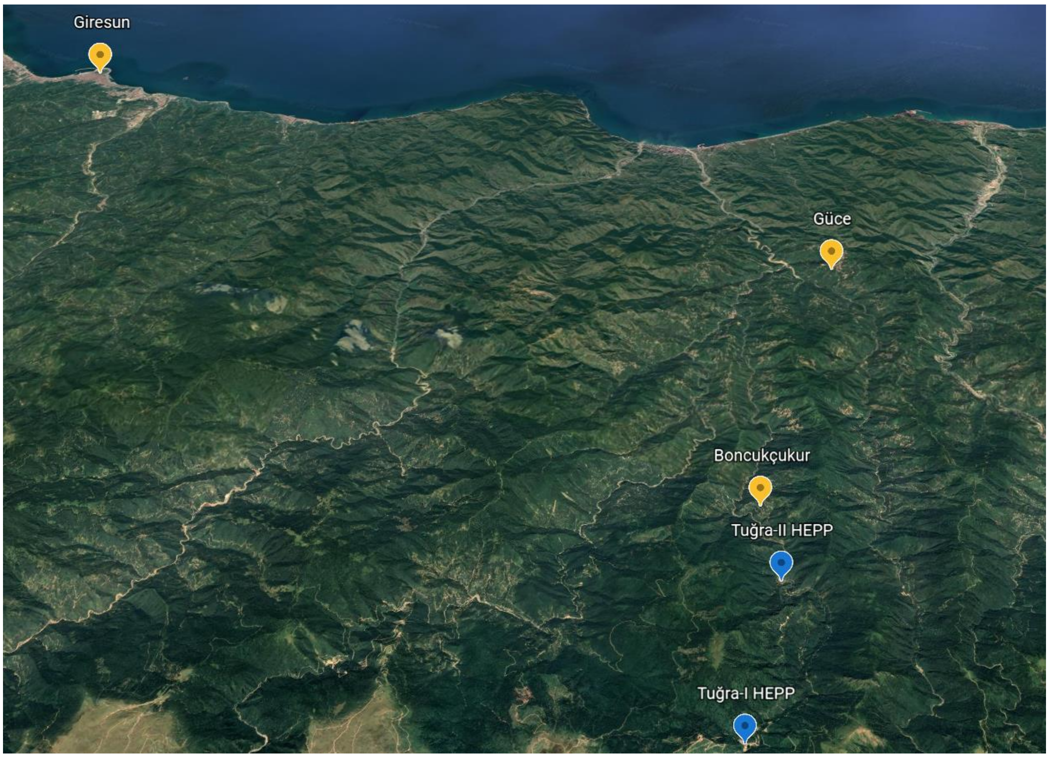


Figure 5.5 Location of Boncukçukur Village

The number of households in the village is 100. The population by year is as follows (see Table5.1).

Table 5.1 Population of Boncukçukur Village by Years[42]

| 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 | 2007 | 2000 | 1990 | 1970 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 275 | 369 | 380 | 383 | 408 | 427 | 428 | 457 | 787 | 581 | 555 | 624 |

[42] "Boncukçukur Köyü," accessed November 16, 2021, http://www.guce.gov.tr/boncukcukur-koyu1#_ftnref2.

Due to the fact that the region is in a forest area and has harsh natural conditions, the livelihoods of the villagers have been limited to forest activities, hazelnut cultivation, and animal husbandry. Due to these constraints, as can be seen from the table above, the population is very low and continues to decrease over the years due to out-migration. Due to such a small number of residents and the economic conditions mentioned, the region did not receive any outside investment until the Tuğra HEPP project. This environment also affected public investments and caused simple and needed infrastructure investments such as roads, energy, and communication lines to be made in a very rudimentary manner.

Especially the issue of transportation routes was very important for the people living in the region. Because even the closest district, Güce, could only be reached by a motor vehicle journey of approximately 1.5 hours, even though the distance was 22 km. The fact that this road, which passes through a compelling route in a mountainous area, is both stabilized and single-lane also created a security risk.

When the Tuğra HEPP project was first announced during the environmental impact assessment, there was a reservation among the local people about the obscurity of the project. However, these reservations gradually decreased due to the reality that such a large investment in the region along with the additional roads to be made for construction and operation would reduce such a big problem as transportation. In addition, through information and projections offered by project management, thoroughly explaining the idea that the project would have positive economic benefits to the region was seen as a favorable stride on behalf of finding a solution to the second biggest problem of the local people.

With this positive approach, before the project started, the project management recruited a competent person from the village people to coordinate and contact the local people during the field visits to be made for the preliminary studies to be carried out in the region and especially for the technical analyzes at the design stages. The design teams, who reached the project site (diversion weirs, power plant sites, transmission routes) under the guidance of this official, obtained important technical information by accessing the project areas, which had no access roads at the beginning, through the paths in the forest only known by the local people.

However, especially during the geological studies, with the proposal of the design team to the project management, in order to provide access to these construction sites on behalf of eliminating the geological risks of important structures before the construction starts, the need to construct a new road with the permission of the forest administration arose. At this point, while evaluating the roads and alternatives to be opened, the opinions of the local people were also taken. In line with these views, it was decided to build the road with yellow borders below, which would reduce the road distance from three hours to one hour and which would ease to reach the region where their highland houses in which most of them stay in the summer are located (Figure 5.6)


Figure 5.6 The Access Road Route for Geological Surveys

In 2010, before any construction work of the project started, in fact, despite the risk of cancellation of the project in case of any technical obstacles, the fact that this road was opened to meet the needs of the local people greatly strengthened the reputation of the investor company in the eyes of the local people. This serious approach and preliminary investment was the first proof that the company's approach that prioritizes the needs of the local people during the project presentation would be real as well.

#### 5.2.2.2 Implementation Stage

The construction of the project took place in extremely tough physical conditions. The number of working days during the year was very limited due to the fact that the project is located in a completely forested area and at an altitude of between 1600 m and 590 m above sea level and due to the weather conditions it caused. At the same time, the fact that the main transportation road that connects the project with the city and the road used by the local people is the same resulted in the traffic being quite intense and problematic, especially during these limited construction periods. Moreover, the deterioration of these already stabilized forest roads due to the heavy tonnage of vehicles and mechanical equipment needed during construction adversely affected the transportation of the local people. Once the construction of the project started, in order to ensure coordination regarding mainly this problem and the workforce provided by the local people during the construction of the project, consulting the headman of the village, a representative from the villagers was assigned full time to liaise and coordinate with the villagers and was allocated an office within the construction site management units. Thanks to this coordination, it was ensured that the transportation routes in question were kept open and well-maintained, and possible problems with the local people were prevented in advance.

During the construction of the project, lasting for about four years, the workforce of the local people was utilized, especially in the construction and landscaping works, and an economic cycle was created for them. In addition, with the decision of the project management, some needed simple tools, machinery, and equipment (wood cutting equipment, service vehicles, construction materials, etc.) were rented from the inventory of the local right.

On the other hand, the trees that were stamped duly and in line with permissions, purchased and cut in the forest within the project area, were given to the local people free of charge upon needed. To be used in commercial activities, the trees that are not needed were sold at affordable prices to the region’s various entrepreneurs in the sector. Thus, it was ensured that the local people benefited first and most from the sub-economy the project created.

#### 5.2.2.3 Operation Stage

Just before the commissioning phase of the project, during the establishment of the operation team, training of auxiliary operation personnel was provided to four local people who worked during the construction of the project and stood out with some skills. Within the scope of this training, the personnel was taught about the operation, maintenance, and repair of the diversion weir, transmission channels, and hatches in the forebay, as well as the general operating principles of the power plant and the operation plans of the enterprise. Mentioned personnel, who have successfully completed the training, have been working within the company to date. This arrangement and working environment have been one of the most excellent examples of the perspective that the company has drawn since the beginning of the project management, which prioritizes the participation of the local people in the project and enables them to benefit from the project in a positive way. The fact that the company largely fulfilled the commitments it had made to the local people before the onset of the work also enabled the people in question to adopt the project as their own. In addition, workers who took part in simple construction, repair, and afforestation works in the forest (also mentioned in the environmental heading) were recruited from the local people during the operation period.

In addition, this sense of adoption and cooperation with the local people, besides enabling the project to have a positive operation period in terms of social effects, has proved to be highly invaluable in terms of the safety of the enterprise as well, taking an important event that took place on May 22, 2019, into account. On this date, a terrorist organization member who infiltrated the project area, taking advantage of the fact that the project was located in the forest area, was handed over to the security forces without any conflict, with the meticulous and careful coordination of the local people and business employees.[43] This remarkable event, also reflected in news sources, unveiled that the dynamic relations established by such projects, especially with the local people, are highly crucial and indispensable not only in terms of social gains but also in terms of security.

During the operation period (up till this thesis was written), the heavy equipment that the enterprise possesses for both maintenance and repair needs and for the prevention of a possible flood has also been in service for the needs of the local people at times, such as various road repairs, building repairs and renovations. In particular, keeping the transportation roads open all the time and repairing the ground deteriorated by floods and snowfalls make a very valuable contribution to both the business and the local people.

### 5.2.3 Infrastructure Safety

#### 5.2.3.1 Preparation Stage

During the design phase of the HEPP, the issue of building safety was the one that the project management sensitively attached importance to the most. Contracts have been signed with expert project units in order to design all the water structures, conveyance systems (with or without pressure), power plant buildings, and transmission systems to be built by expert teams. (Hidromark for hydraulic and structural systems, Si-Al for geological surveys, Ozburak for energy transmission lines).

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[43] "'Gri Kategori'de Yer Alan PKK'lı Terörist Giresun'da Yakalandı - Son Dakika Türkiye Haberleri | NTV Haber," accessed November 18, 2021, https://www.ntv.com.tr/turkiye/gri-kategoride-yer-alan-pkkli-terorist-giresunda-yakalandi,X3ZgqszL7kONrpyERsEciA.

The designs made by these companies, which are competent in their field, according to the technical specifications and codes published by the relevant institutions of the state, were approved by the relevant institutions without any problems (approvals can be provided in tabular form). However, although these approvals constitute proof that the projects were carried out duly and taking into account all risks, the relevant parts of the projects were re-examined by purchasing third-party consultancy services or taking expert opinions against risks even greater than the anticipated risk factors that may arise during the operation phase. These related parts handled for structural safety are listed under the headings of geological studies, hydrology and hydromechanics, and power transmission line load parameters.

*Geological Surveys*: The most difficult and technically risky part during the design phase of the project was the geological surveys. The lack of any access road at the beginning and the bureaucratic process of the construction permit stages made it impossible to plan a drilling-based geological survey for all structures at this stage, where the structural design should also have begun.

As mentioned under the Indigenous People guideline, within the framework of the permits that could be obtained by building the "geological survey road" for which permission was obtained from the forest administration before the construction and design of the project, reaching at least most of the structures physically became possible. However, due to the inadequacy of this road for the boring machines and the limited conditions, a geological survey plan was made according to the current situation by the experts of Si-Al company and the joint decision of the project management. In line with this plan, first of all, geological and geotechnical studies were carried out with the vertical electric drilling method in order to determine the geological and geotechnical characteristics of the building sites and the field. Additionally, by performing laboratory tests and topographic slope measurements and observations of potential building sites on soil samples taken from the building sites, the soil safety stresses were calculated to be given to the project design team for the building stability, and within this scope, a geological and geotechnical report was drawn. According to this report, although drilling could not be carried out, the very high performance (>4 MPa) of soil samples taken from potential tunnel locations and powerhouse locations in laboratory tests stood out as a very valuable and risk-reducing parameter for the structural safety of the project. Moreover, the fact that the thickness of the talus (free material) determined by the vertical electric drilling method is less than the thickness of the excavation to be made for the construction of the structures in general, and thus the structures would sit on rock floors rather than these tali was technically an absolutely positive indicator. In the topographical slopes and observations, the project site was divided into two depending on whether the natural ground slope is more than 20% or not. And for the structures (transmission channels, forebays, penstocks, etc.) at the locations where the slope is more than 20%, a warning was made annotating on-site observation during construction and additional ground measures (slope stabilization, shotcrete, wire cage/mesh, additional ground improvement, etc.) where and when needed.

*Hydromechanical and Hydrological Surveys*: The most critical issues in terms of structural risk are the ability of conveyance structures and power plant buildings to withstand possible floods and the dimensioning of water transmission structures with a capacity to carry the design flow to the power plant under all conditions. In this context, although the hydromechanical and hydrological calculations of the project were made by the Hidromark company in accordance with the existing specifications and technical principles as explained above, in line with the decision taken by the project management, they were reviewed again with the consultancy service received from the Middle East Technical University (METU) Civil Engineering faculty members. On 21.12.2009, a contract was signed with Prof. Zafer Bozkuş and all hydromechanical calculations made up to that point in the project began to be reviewed in detail. At the same time, within the framework of the hydrological assessment report completed in March 2010, both the design flow and the flood flow rates of the project were recalculated with different methods. For the design flow rates, apart from the hydrological calculation methods stipulated by the specifications of SHW, the snowfall and melting model based on the geomorphological characteristics of the precipitation basin of the project was utilized. As for the flood flow rates, the calculations previously made with Mockus and SHW methods were recalculated with the regional flood frequency analysis method. The discrepancies emerging with this report were evaluated by Zafer Bozkuş, project management, and Hidromark company experts, and project revisions resulting from the changing design parameters in this context were undertaken before the construction and during the construction process until they were sent to the field to be implemented. At the same time, utilizing these hydromechanical calculations as well as HEC-RAS modeling for the flood performances of diversion weirs and powerhouses, the suitability of the regions selected as the application site at the pre-construction stage was also tested, and possible revision areas were revealed.

*Energy Transmission Lines Load Parameters*: At this point, the snow and ice load calculations made for the main energy transmission lines of the project with a length of approximately 21 km were made in accordance with the TEDAŞ and TEİAŞ specifications available for that period, and the project was approved with the resulting pole types. However, the project management received proposals for the project to be reconsidered in that this line passes through a very mountainous region, with above 2100 m altitude and areas with serious local wind and snow load potential. Due to the unsuitability of the proposals received and the fact that the consultants working in the market were reluctant to examine a project made by others and even suggested redoing a project, no control was made in this sense, and the construction phase was commenced with the existing project.

#### 5.2.3.2 Implementation Stage

Due to possible revisions to be made in the application projects resulting from carrying out geological surveys without drilling at the final project time, while the construction works continued, revisions were made at the same time in the application projects with the data coming from the field. Therefore, the project design duties of project management, project designers, and consultants proceeded almost until the end of the work. The changes made with the data collected from the field were either due to structural risk or economic reasons. For instance, due to the changes in steel prices during the pre-construction period of the project and during the construction, the powerhouse, which was originally designed as reinforced concrete, was revised as steel for economic reasons during the implementation and built in this way. Apart from such economy-based revisions, the changes made for structural risk almost completely altered the general layout and structure dimensions of the projects. As can be understood from the general layout diagrams presented in the Appendix, extensive changes were made in both the Tuğra-I and Tuğra-II projects, both in the transmission channels and tunnels and in the dimensioning of the forebay and penstock, especially in line with the geological data from the field.

In addition to the relatively minor revisions (such as shifting the diversion weirs to the upstream or downstream at 15-20 m distances, changes in the excavation slope of the conveyance channels and forebay ponds), the main revisions made in terms of structural risk assessment can be summarized under the following headings:

*Conveyance System Revisions*: In both Tuğra-I and Tuğra-II projects, the conveyance systems were extremely long, and the geological and topographical difficulties encountered during the construction of these systems called for changes in the lengths of channels and tunnels originally envisaged for these systems (see Table 5.2).

Table 5.2 Tuğra HEPP Summary Table

| | ORIGINAL | | REVISED | |
|---|---|---|---|---|
| | CONVEYANCE CHANNEL LENGTH (M) | CONVEYANCE TUNNEL LENGTH (M) | CONVEYANCE CHANNEL LENGTH (M) | CONVEYANCE CHANNEL LENGTH (M) |
| TUĞRA-I HEPP | 3600 | 115 | 2251 | 806 |
| TUĞRA-II HEPP | 5714 | 855+187=1042 | 6280 | 330+80=410 |

The 115 m tunnel was foreseen in the initial planning and final project in Tuğra-I, with the data collected after the transportation roads opened in the field , revised and increased to 806 m due to the fact that the open excavation to be made in this region. The reason for this change was the exit of the diversion weir, which was quite risky in terms of slope and channel stability. In Tuğra-II, on the contrary, the originally foreseen tunnel lengths were recalculated with the field data and were reduced from 1042 m to 410 m in total, especially due to the geological risk (the low rock class predicted for the tunnel).

*Forebay Revisions*: At this point, the most major change was in Tuğra-II. In particular, after the cancellation of the tunnel foreseen at the end of the Tuğra-II conveyance system in the initial projects, the forebay area was reached by open excavation, but the location of this structure was shifted to 300 m upstream due to the geological risk of this area. In this way, the Tuğra-II forebay was built on relatively solid ground.

*Penstock Changes*: The fact that the steel prices foreseen in the final phase of the project decreased during the construction phase necessitated revisions in the dimensions of the penstocks. In both Tuğra-I and Tuğra-II, the initial penstock diameters (0.65 m/0.85 m) were increased (0.80 m/1.2 m), thus reducing not only the pressure of the system but also the structural risks with the lessening of the excess pressure occurring in the calculation of the water hammer stroke. However, the relocation of the forebay at Tuğra-II affected the water hammer calculations negatively by extending the penstock length at Tuğra-II by 300 m and revising these calculations, the pipe wall thicknesses to meet the pressure was revised. At the same time, for both penstock systems, during the order of turbine mechanical parts, after the positive technical development that reduced the water hammer stroke related to the closing time (1 minute) of the Pelton turbines, the water hammer strokes of the systems were revised, and the risk in this sense was considerably reduced. Apart from pressure-based (static+dynamic) wall thickness calculations and revisions of penstock systems, with the joint decision of the project management and Hidromark and Zafer Bozkuş, although both systems were initially designed on the ground, it was found appropriate to build them underground. In this way, it was ensured that neither system would be affected by atmospheric conditions, and some structural features that may cause an accident risk in the future, such as the absence of the need for expansion gaskets, were eliminated. However, it is a technical requirement that buried steel systems also need cathodic protection under the ground, and at this point, the steel pipes of both systems were both covered with an insulated polyethylene coating, and the necessary productions were designed and made within the framework of cathodic protection measures for both systems.

*Slope Stability Precautions*: In line with the precautions in the geological report stated at the final project stage, shotcrete and wire mesh measures were taken in the excavations in the project area with a slope exceeding 20%. Despite adversely affecting the cost of the project, since they are essential in terms of structural risk, these productions, which were initially forecast to be fewer and had to be made with the data collected from the excavation sites, were made cautiously in order to prevent risks such as potential landslides and slope shifts. As an example of these measures, shotcrete and ground stabilization productions at the Tuğra-I tunnel exit (Figure 5.7), Tuğra-II 1st tunnel portal (Figure 5.8), Tuğra-II 2nd tunnel exit (Figure 5.9), and behind the Tuğra-II powerhouse (Figure 5.10) are seen below.

Figure 5.7 Slope Stability Precautions-Tuğra-I Tunnel Exit

Figure 5.8 Slope Stability Precautions -Tuğra-II First Tunnel Portal

Figure 5.9 Slope Stability Precautions -Tuğra-II Second Tunnel Exit

Figure 5.10 Slope Stability Precautions -Tuğra-II Powerhouse

#### 5.2.3.3 Operation Stage

Although highly advanced engineering was carried out in both the design and construction phases of the project and most of the structural risks were eliminated, some accidents caused by natural weather events during the operation phase resulted in material damage to the structures. The important ones of these accidents are listed below in chronological order.

*Tuğra-I Powerhouse Damage (10.03.2015)*: Due to the flood disaster that occurred in the power plant basin on this date, Karaovacık River overflowed, and all water structures successfully survived this flood. However, due to excessive precipitation (especially thick tree trunks carried from the forest by flooding) experienced in Çayır River, which is located right next to Tuğra-I Power Plant and has almost one-third the capacity of Karaovacık River and joins the Karaovacık River just upstream of the Tuğra-II diversion weir, the water level on the right bank of the river exceeded the elevation of the power plant and the flood from this river directly entered into the power plant. In this flood, which was at a level higher than the HEC-RAS models developed during the design phase, the turbine mechanical parts were not damaged as a result of the precautions taken, and only material damage occurred in the structural part of the power plant.

For Tuğra-I HEPP, which was repaired in a short time and put into operation again, the calculations were revised, the environmental elevation of the power plant was increased, and with an extra stone wall built on the right bank, a possible flood risk to be caused by Çayır was almost completely eliminated (see Figure 5.11).

Figure 5.11 Tuğra-I HEPP Stone Wall

*Tuğra-II Conveyance System Landslide Damage (05.04.2017)*: As a result of the heavy rains that took place on this date, a landslide occurred at the 3rd km of the Tuğra-II Conveyance system. However, it is a rocky area, and excavations were carried out in accordance with the points noted in the geophysical and geological studies. Although it was built underground, as a result of the rock pieces breaking off from the slope reaching the ground quickly by breaking off from the upper parts of the slope, about 20 m. of the concrete conveyance channel broke and became completely unusable.

After this accident, the repair works started immediately, but in this region where transportation is problematic, the repairs were carried out in a period of two weeks, which is more than the estimated time. During this period, generation halted at the Tuğra-II Power Plant, and the loss of generation was quite high due to the high precipitation season. In order to prevent the financial losses experienced after this event from being experienced again at any structure of the power plant, a need arose to determine the possible landslide risk to the structures and to carry out a detailed research study on the precautions to be taken. As a result of technical discussions with competent consultancy companies in the process, which lasted for more than a year, methodically and financially most suitable solution for this research study and risk analysis was presented the joint initiative of Ankara Earth Sciences R&D Co. Ltd and Ankara University Earth Sciences Application and Research Center.

According to the proposed solution, Ground Penetrating Radar (GPR) study (see Figure 5.12), one of the Geophysical research methods, has been found suitable for investigating the access roads, conveyance channels, berms in the power plant area, and the in-ground structural condition of 3 tunnels, geotechnical risks, and possible discontinuities of Tuğra – 1 and Tuğra – 2 HEPPs.  Considering the level of ground and surface waters and seasonal variables in particular, the study was carried out on a 7-month calendar spread. In this context, studies were carried out on the water transmission structures of about 10 km and the upper levels of the berths consisting of 4 lines and the tunnel walls. In this study, GPR (Ground Penetration Radar)/Structure radar was used as shown in the figure below.


Figure 5.12 Ground Penetration Radar (GPR)/Structure Radar

GPR/Ground and Structure radar is a geophysical survey method that works by sending electromagnetic waves of different frequencies to the surface and recording the waves that return directly, reflected, or refracted in a recorder.

These records form a radagram. The interpretation of the study is made by subjecting the Radagram to a special data-processing program. The GPR/Ground Radar consists of two parts, the system (the recorder) and the antenna. Antennas of different frequencies are used for studies for different purposes. Compared to many other geophysical survey methods, it is called a superficial method. However, since it works at high frequencies, it provides results in high resolution. As a result of the studies carried out in all the conveyance structures of Tugra-1 and Tugra-2, geological discontinuities and geotechnically risky areas have been determined, and a colored "Risk Rating" has been made. This rating map is presented below.


Figure 5.13 Risk Rating Map of Tuğra HEPP

It has been observed that measures have been taken to protect the conveyance structures in places such as roads, bends, transitions, and where the slope is steep at a sharp angle, and thus the structures are protected. Then, the calculated overall risk ratio is at a reasonable level of 7%, a maximum of 10%. When the precipitations of the last 5 and 10 years are examined, the measures are taken, and the low-risk level is considered reasonable. Provided there is not an unexpected situation other than seasonal normals, the risk level can be kept in a low band through an annual planned overhaul. Following the studies carried out in the tunnels, no part considered as "risky" was observed in tunnels 1 and 2. It is thought that the observed cracks-fractures do not pose a threat to the tunnels' static. It has been determined that partial water inflows fill cracks-fractures and thus prevent the formation of free spaces, considering the back unit strength consisting of granites. This reduces the tension behind the tunnel wall. In addition, Ankara University Earth Sciences Application and Research Center (AUESARC) Director Prof. Dr. Yusuf Kağan Kadıoğlu reported that he did not observe any structural risk in the tunnels and the strength of the units was extremely sufficient against tunnel stress. Thus, it is suggested that there is no geotechnical risk in the tunnels.

### 5.2.4 Financial Viability

#### 5.2.4.1 Preparation Stage

Since the project is basically a private sector investment project, even when it was in draft form (before the application to SHW), studies on income/expense projection and cash flow were started. At first, staying on the safe side due to limited technical information, calculations were made on both the income side (energy production and price estimation) and expense side (all kinds of construction, operational and financial costs). A total analysis of these calculations was submitted to SHW as a feasibility report. In the presented report, the hydrological data of the project were calculated according to the SHW specifications and principles, and separate energy production estimates and income amounts were found for the different design flow rates. The structures corresponding to these flow rates and the resulting installed power probabilities were also pre-sized (by using SHW unit prices), the costs corresponding to each design flow option, that is, expenses, were calculated. And the data from all these income and expense calculations were compared using an optimization program, and the installed power and design flow of the project were unveiled in this way.

In the following stages, as both the hydrological and technical data of the project became clear, the energy production and cost calculations in the existing installed capacity were updated accordingly. After all these studies, towards the end of 2009, that is, just before the search for financial resources for the project, an investment report of the project was prepared by a third-party consulting firm, competent in both technical and financial matters, in the light of all the available data until that time. In the financial part of the report, the potential annual income and annual expense amounts of the facility were calculated. Then by implementing the possible credit conditions to these values, a cash flow projection through tax calculation was created. The considerations and calculation methodologies in these calculations are as follows.

*Annual Income Calculations*: In the report, first of all, hydrological calculations made for the project up to that stage were checked, the Tuğra-I and Tuğra-II diversion weir location flows were recalculated, and energy generation graphs were created retrospectively in line with the hydrological data at hand, according to the selected design flow rates. (see Figures 5.14 and 5.15)

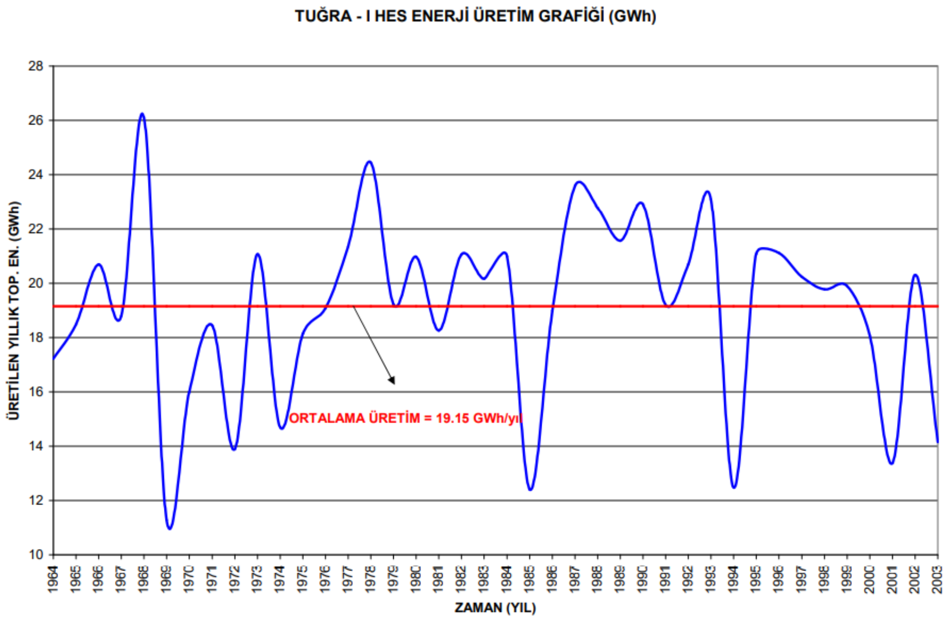


Figure 5.14 Tuğra-I Energy Generation Graph (1964-2003)

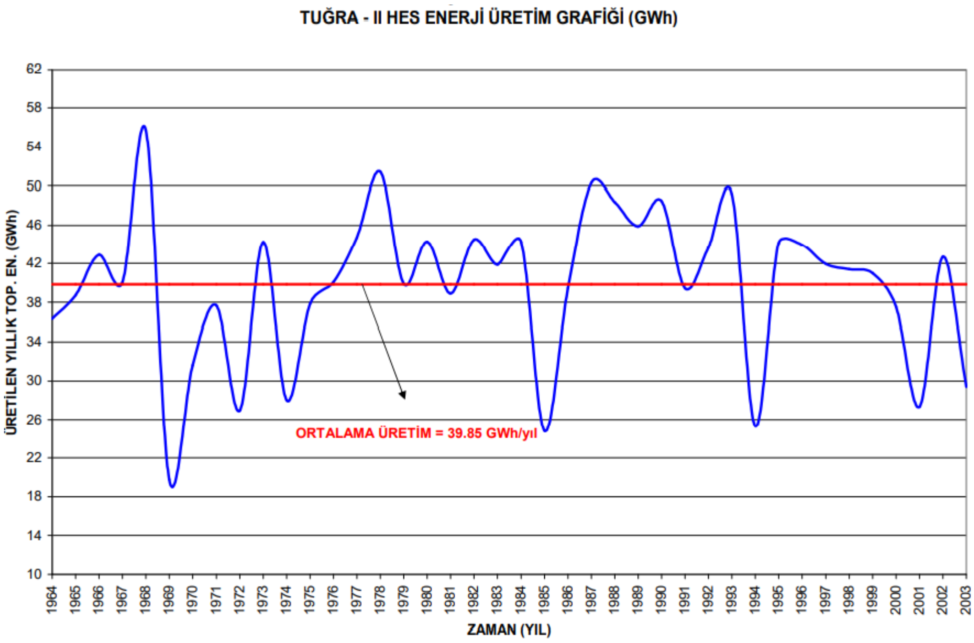


Figure 5.15 Tuğra-II Energy Generation Graph (1964-2003)

In fact, the energy generation values of the project based on the water data of the past years, seen in these graphs, reveal an important concept for the future: In this type of river type non-storage generation facilities based on hydroelectric source, annual energy production varies considerably depending on the years due purely to natural factors (precipitation amount). For this reason, taking the long-term average rather than annual production and income into account provides healthier results for both this facility and other similar facilities. These long-term averages are also included in the graphs above.

*Annual Expense Calculations*: The detailed projects prepared by the project company for the proposed facilities in the calculation of the estimated costs of the facilities in the Tuğra-I and II HEPP projects were utilized, and the yardages and estimates of all the facilities were calculated individually depending on these projects. Since the electromechanical equipment would be procured from abroad, the estimation of this equipment was prepared by considering the prices received from foreign companies during the feasibility stage. The cost of the covers, gratings, control panels, cranes, cables, and valves to be supplied domestically was determined by conducting market research from domestic manufacturers. Energy transmission line costs were calculated by using the unit prices prepared and issued by TEDAŞ.

In the preparation of the estimations, the 2009 unit price table of the General Directorate of State Hydraulic Works, Project and Construction Department, and the 2009 unit price table of the Dam and HEPP Department were used. Excavation, flat formwork, curved formwork, and concrete quantities of the buildings were specified, and other items were calculated in line with the assumptions made. While calculating the costs, firstly, the main dimensions constituting the main items of each structure were found. Based on these, the construction costs of the structures were calculated according to the unit prices of SHW in 2009. Then to reach a close estimation to real market conditions, discount rates of 45% for excavations, 10% for cement, 15% for iron, 30% for concrete, formwork, and joints, and 45% for other items were applied to these costs to find general contracting pricing, At this stage, to find the dollar value of the facility estimations issued in Turkish Lira, the currency rate of that period was specified as 1 $ = 1.55 TL. In Tuğra-I and II HEPP projects, 10% of unanticipated expenses in construction works were added to the estimated cost in TL, and US Dollars, and the facility cost was formed. Unanticipated expenses were added at the rate of 5% for electromechanical equipment. In addition to the cost of the buildings, by utilizing the coefficients determined by SHW over the facility costs for such expenses, the cost of access roads and energy transmission lines, survey projects, and inspection expenses were unraveled, whereby the total construction cost of the project was calculated. Then, the VAT (18%) of the construction costs and the cost of the electro-mechanical equipment purchased from the manufacturer was added to this value, and the total project investment amount was calculated. While converting this total investment amount to annual expense, firstly, the depreciable investment amount was found. In these calculations, first of all, the amount not included in depreciation (VAT) was subtracted from the total project cost, and the investment amount subject to depreciation was calculated. Next, the investment amount subject to depreciation was taken under the headings of civil works, electromechanical equipment works, and other items (expropriation, ETL, etc.), and the depreciation year and rate for each item were calculated. Then, annual depreciation expenses were found according to normal assumptions.

Another annual expense item is operating costs. At this point, the company that prepared the report determined the annual operating expenses by taking into account the operating expenses and experiences of similar-sized facilities that it had previously examined and evaluated and the coefficients published by SHW in the realm.

*Cash Flow Statement*: The cash flow statement of the project was prepared by using the annual expenses and incomes calculated according to the methodologies explained above. All calculations in the said cash flow plan were made in US dollars ($) for the sake of integrity, and while creating the cash flow statement, it was foreseen that 25% of the ultimate cash need for the investment period would be met from equity, while the rest would be provided under two different loans. Accordingly, it was agreed that all of the electro-mechanical equipment, with the exception of the energy transmission line, would be supplied with foreign (export) credit, and the remaining part would be covered by commercial credit. Therefore, it was envisaged that 25% of the total investment and the loan expenses and interest for the investment period would be covered by equity and 75% by loans. Including the investment period loan costs and interests, the ratio of equity to the total project cost exceeds 25%. The fixed interest rate and the expenses (for once only) of the loan were assumed to be 6.5% and 1.5%, respectively. It was accepted that the loan to be taken would be repaid in seven years in equal installments, with a grace period of two years, assuming that the investment period would last two years, according to the market conditions of that period.

First of all, the annual average income was calculated, and the pretax profit was calculated by deducting the business, depreciation, and loan interest from this value. If the pretax profit were positive in the operating period, the loss, if any, was deducted from this value retrospectively for five years, and the corporate tax rate was calculated by finding the amount that is the basis for corporate tax. Depreciation expense and VAT receivable, if any, were added to the post-tax profit amount, and finally, the ultimate cash and cumulative cash amounts of the project for that year were calculated by subtracting the loan principal repayment of the relevant year. As a result of the study, it has been evaluated that apart from the investment period, the project hardly needs any equity contribution, and taking into account the financial situation of the investor group, the resulting cash flow statement presents a risk-free result for financial institutions.

As a result of the accelerated financial negotiations following this report, the project management started to negotiate loan terms with indicative offer letters from three different financial institutions, and at the end of March 2010, a project finance loan agreement was signed with the most suitable one of these institutions.

According to the details in this signed contract, more favorable terms than the credit conditions in the report, the details of which have been explained above, both in terms of maturity and credit rate, have been granted: While a total of 8-year agreements were made with a 2-year grace period, the interest in dollars remained below the of 6.5% value in the report. Under these conditions, the cash flow of the project, with already a positive outlook, became even more risk-free. The equity/loan ratio, on the other hand, was 25%, as foreseen in the report. Other details of the contract, apart from the price and rates, can be summarized as the investor's giving the requisite guarantees and commitments, mainly to spend the loan given by the financial institution and to repay on the due date. For example, while extending the loan, it was stipulated that the loan be released in tranches under the control of the financial institution, taking into account the progress payment documents approved by a 3rd party technical consultant in parallel with the physical progress of the project. At the same time, it was requested that these progress payment documents be officially documented with invoices. In this way, not only was it guaranteed that the investor spent the loan received only in this business, but also the equity contribution of the company was ensured at every stage while these debts were paid, as a result of being indebted to the market since the expenses were made upfront. As a guarantee of repayment of the loan, the financial institution received a conveyance in its favor in accordance with all kinds of income generated by the project, in accordance with Article 162 of the Code of Obligations of the Republic of Turkey and other related conveyances. Another guarantee received in addition to this conveyance was the mortgages on the real estate belonging to the investor company and its owners against the possible cancellation risk of the project. As a condition for the lifting of these mortgages, the condition that the facility should be completed and started to generate electricity was put forward. Finally, with reference to another article in the contract, it was stated that the entire burden of possible cost increases that might occur in the project was left to the investor, and no additional credit would be granted. Thus, the financial institution considerably reduced its financial risk related to the project through both in-project and non-project guarantees, and almost all technical, administrative and financial risks were assumed by the investor.

#### 5.2.4.2 Implementation Stage

Some of the bureaucratic processes to be completed and the permits that had to be taken before the construction phase of the project could not be finalized as of the signing date of the loan agreement. For example, the "explosive substance use license" application, required for tunnel excavation and obtained from the local administration, was made to the Giresun Special Provincial Administration on 20.01.2010, whose approval process was assumed to be far shorter and not to affect the duration of the project; however, it was not until 07/07/2010 the approval could be granted, which hindered the tunnel constructions in the construction site to be started for that year, which already in the mountainous region and can only be worked on in June and October of the year. Even this situation alone delayed the opening of the project by one year.

As in this example, the disruptions mainly experienced in bureaucracy, independent of the investor and project management, increased the project completion duration to approximately four years, which was foreseen as two years. This loss of time naturally affected the financial structure the most. The USD/TL exchange rate changes experienced during the process, the additional costs incurred due to the prolongation of the construction period, and the increases in the material and labor prices that were anticipated at the beginning adversely affected the financial cash flow expectation of the project. In addition, the fact that these unexpected cost increases had to be covered by the investor in accordance with the relevant article of the loan agreement, as mentioned above, placed a financial burden on the investor.

In addition to all these drawbacks, citing the prolongation of the project, the financial institution made loans available to the investor differently from the loan terms it had committed. As explained above, for the loan tranches released with progress payments, loans were offered to the investor, sometimes in Euros and sometimes in Dollars, with even higher interest rates than in the contract. Although due to obstacles, the majority of which were beyond their control, the prolongation of the project period and the market conditions (the reaction to HEPP projects throughout the country at that time and the reluctance of financial institutions to give loans to such projects) forced the investor to use these loans. Both the increases in cost and some of the repayments of the loan started during the construction process brought the initially anticipated 25% equity ratio to almost 35%.

Despite this negative picture, the construction of the project continued without interruption due to the financial strength of the investor. At this point, one of the ongoing Tuğra-I and II projects, Tuğra-I, was given priority and completed at the end of December 2012, and with the "Partial Provisional Acceptance" issued by the Ministry of Energy officials, the facility started electricity generation as of 29/12/2012.

Later, while the remaining construction of Tuğra-II was accelerated in the ongoing process, the fact that Tuğra-I generated electricity at values almost close to the feasibility and subsequent inspection reports proved the technical adequacy of the project. This situation created an important positive development and opportunity for the investor to improve the current financial conditions.

#### 5.2.4.3 Operation Stage

By 2014, it became clear in the first months of the year that the Tuğra-II project would be commissioned by the end of that year, and from this point on, negotiations began between the investor and the financial institution regarding the refinancing of the project by closing the existing risky loan tranches. Especially due to the high performance received from Tuğra-I, indicative offers were received from 3 different financial institutions that showed interest in the project and demanded funding from them in order to refinance the entire project under favorable credit terms (long term and low interest). Due to the competitive environment, about one month after the Tuğra-II project's commissioning on 28.04.2014, the maturity of the loans was extended to 8 years on average, with the current financial institution's favorable loan offer. Furthermore, an agreement was reached on a loan interest rate that would stay constant for these eight years, giving the company an advantage in terms of market conditions. Also, all mortgages taken by the financial institution in accordance with the contract at the beginning of the project financing were terminated with this new refinancing agreement.

In addition to this refinancing and financial restructuring, the general loan borrowing of the project dropped to 60% due to the fact that the investor did not revise the increased equity ratio during the project period, and the revenues yielded from the Tuğra-I project during the construction period between 2013 and 2014. The project's cash flow turned out to be very positive as the maturity was extended, and the sales revenue was cleared from the USD/TL exchange rate risk by making use of the company's feed-in tariff (7.3 Usd cents) for ten years as of 2013. As a result of the information received from the project management and the investor and the documents examined, it was seen that the production and loan repayments were realized very close to the cash flow predicted after the refinancing, and the project proceeded smoothly in this sense, from the beginning of 2014 up to the date this thesis was written.

## 5.3 Assessment of The Case Study’s Stages for Selected Guidelines

### 5.3.1 Environmental and Social Impact Assessment and Management

For this heading, which has a very wide impact area, it has been very beneficial, for the sake of sustainability, that the project management communicated with as many stakeholders as possible at almost every stage. In addition, it is noteworthy that the actions taken regarding this heading are not confined to legal obligations. For example, although there is no legal obligation as in the decision to prefer buried systems, thanks to these preferred approaches, proactive measures could be taken against environmental problems that may arise in the future. Similarly, the additional environmental impact observed in the Ecosystem Evaluation Report, which was prepared without any obligation in the relevant period, and the measures taken with the recommendation of this report are quite remarkable.

Although meticulous work was carried out, there were also incomplete constructions unnoticed by the project management and those that could have led to environmental damage, especially during the construction period when temporal problems were experienced. However, these faulty constructions were specified by the relevant institutions in the minutes of the commissioning processes, and in the following process, the project management corrected these constructions as much as possible during the operation period.

It can be said that this investment, which was accomplished in extremely harsh geography, serves sustainable development since it sufficiently displays sensitivity to environmental conditions in all three stages, specifically under this heading. However, due to the cheapening of methods that can determine environmental effects together with both changing bureaucratic obligations and developing technologies, it is necessary to continue the sustainability follow-up on environmental effects, which is enormously complex and has interactions in abundance. Continuing this follow-up also ensures that concrete data are obtained on whether the project will have long-term environmental impacts in line with the evaluations of the reports made in the past, and thanks to the transfer of experience gained, measures regarding the possible environmental impacts of new investments to be made in the future will be taken much earlier.

### 5.3.2 Indigenous Peoples

In the event of erroneous process management regarding this heading, even the realization of investments could be hampered, examples of which in our country are both reflected in open sources, and such examples are given in the literature review section. For this reason, it can be stated that successful process management has been carried out for this challenging heading by displaying a sustainable approach in the Tuğra HEPP project. At this point, the project managers, even during the period before the investment, foresaw the main needs of the local people and their expectations from the project and made decisions by always prioritizing these needs and expectations proved to be remarkably effective. In addition, the fact that the project management was in constant contact with the local people and their representatives and positively distinguishing them from other stakeholders has enabled the process management to be much easier. By this means, the decisions and wishes of the local people were somehow met within the project in all three phases. In addition, another reason why the problems encountered in other projects were not experienced can be shown as the elimination of obscurities by providing accurate and timely information about the project, thus raising awareness of the local people about the project.

Due to the fact that the region has very limited economic resources, the approaches of the project management, which enabled local people to obtain economic contributions from the project, have also made the public embrace the project even more. Similarly, as under other headings, the difficulties experienced, especially in transportation during the compelling construction period, were solved rationally before they deteriorated through the method of continuous dialogue.

During the operation period, although it was a very technical investment, local people who could be trained specifically were identified and recruited to the operation team. This situation made the contact at the beginning of the project to be permanent and ensured that the Tuğra HEPP project was embraced even more by the local people.

### 5.3.3 Infrastructure Safety

Although there were justifications such as costs and permits, completing the geological studies without drilling at the design stage and commencing the construction phase with this risk of completing the designs in such a way could have driven the investment into trouble irreversibly. Subsequently, while the construction phase continued, this risk was reduced through the constant revisions of the application project. However, this complex arrangement caused some constructions to be interrupted during the already restricted construction season. Additionally, with these changes made in the projects, major revisions occurred in the originally planned general layout design, which was reflected in the project costs. Indeed, such a change in the project caused the cost-benefit analyzes made at the feasibility stage to change and also changed the financial balance of the project.

Despite all these negativities, both the technical background and experience of the shareholders and the successful interventions of the project management as well as the reduced construction risks reduced through the third-party consultancy support, seem to have prevented a major accident during the operation period (up till to this thesis was written). Undoubtedly, in a project spreading over such a vast area, it is not possible to calculate and eliminate every risk beforehand. Within this scope, the experience gained from the disruptions and accidents that occurred during the operation period notwithstanding is of critical importance in order to avoid such disruptions later on. After all, in projects with such a long lifecycle, natural disasters such as larger overflow, floods, etc., may occur over time. In this sense, it is obvious that the continuous follow-up of the measures taken and to be taken for this heading is highly critical for the sustainability of the business.

### 5.3.4 Financial Viability

This is the heading where the most serious problems of the project are experienced. Since it is basically an investment project, the calculations made from the very beginning, and at this point, getting third-party consultancy support and having the project reviewed, as was done in other headings, were indeed positive in terms of reducing the risks before the investment and determining the framework. As a matter of fact, with this framework, loan negotiations and the signing of the contract took place in a very smooth and fast process. Nonetheless, the prolongation of the construction period as a result of both technical and bureaucratic developments left the investor unilaterally vulnerable in the relationship with the financial institution. The financial institution's already taking a large number of mortgages from the investor in order to reduce the project risks had minimized the risks on their part. However, even in this case, the financial institution's unilateral decisions to shorten the credit terms and change the interest rates during the construction period, which is the most difficult period of the project, adversely affected the trade and finance balances of the investor at that time. If the investor had been in delinquency to pay for these increases in financing costs that occurred during this period, perhaps this project would have been left unfinished and could not be completed. In this sense, both the financial strength of the investor and the two-stage nature of the project, together with the commissioning of the first stage within two years actually provided a temporary solution to the problem. As the project finished and finally started to generate electricity correlated with the pre-calculated values, other financial institutions showed their interest in participating. Thus, this situation mainly triggered the initial financial institution to offer a better financial model than the previous one, including canceling the previously taken mortgages.

### 5.3.5 General

In general, it is very important to follow and monitor the processes in the sustainability of the project under the headings examined in order to use the experiences gained from the project for other projects. Besides, particularly foreseeing the problem peculiar to this project, which was experienced under the financial heading and was somehow solved by internal dynamics, and, since, after all, it is an investment project, the state intervenience with its relevant institutions in order to eliminate the obstacles and overcome the difficulties so that the project could be realized, can prevent such disruptions in projects with simple and effective interventions without the need for long legal processes.

Basically, the transparent progress of the processes in investments is very valuable in terms of raising awareness and directing all stakeholders and shareholders in such projects in general. Putting forward a problem that sometimes starts very simply with such a follow-up mechanism and comparing it with other examples may perhaps make an important contribution to solving potential problems before they emerge. Through this method, some wrong projects can be terminated before they start, problems of some unfinished ones can be resolved, and projects can proceed. As a result, more robust and sustainable investments can be made in general. Especially in countries like ours, which have limited resources and generally have to make such investments with foreign financing, both time and financial gain of this type of follow-up mechanism are very valuable as it prevents many problems in advance. No matter how technical or how prejudiced the public is to the project, it is a very obvious fact that the follow-up of the projects with such a transparent mechanism will eliminate the question marks in the minds of all parties and thus will result in a healthier construction and operation process.

# CHAPTER 6

# CONCLUSION

## 6.1 ABOUT THESIS RESULTS

In general, as mentioned in the first chapter, independent from the source type, all investments to be made in compliance with the sustainability criteria will prevent many problems from being experienced and likely to be experienced and will ensure that investors and stakeholders derive the maximum benefit from the projects. However, in order to design the said investments in a way that will give the maximum total benefit in technical-economic, social, and environmental issues, which are the main sustainability heading, first of all, they must be monitored at all stages of investment in respects that can be elaborated such as

*From a technical-economic point of view;*

a) Configuration of the project components by experts in the relevant realm in order to prevent possible mistakes that can be made in the design, construction, and commissioning processes at every stage of the investments, especially in the technical stages

b) Investors having strong and solid institutional structures and investments having financial structures with economic reality with the contribution of financial institutions

*From a social point of view;*

d) Determining and ensuring the potential contributions of the investments to the social needs of the region where they are located

e) Involving the stakeholders of the investments in the investment process by informing them transparently at every stage of the investment

*From an environmental point of view;*

f) Sharing the monitoring and prevention of the environmental impacts of investments determined by the provisions of the current legislation through platforms accessible to the public

g) Detailed determination and monitoring of the specific and regional environmental impacts of investments by relevant fields of expertise (biodiversity, endemic species, etc.) with up-to-date parameters. With the comprehensive sustainability analysis specific to the investment to be made in this way, problems in many types of investments can be identified before they arise, or solutions to existing problems can be found and set an example for other new investments to be made.

## 6.2 NEW LEGAL ACT TO BE OFFERED FOR TURKEY

As can be seen from this case study, sustainable development goals can not only help to mitigate climate change or ensure the success of investments but also, from another point of view, they can prevent false investments from being made or make investments much more accurate and rational. Precisely at this point, the role of establishing supervisory and regulatory mechanisms, which is one of the main duties of governments, gains great importance. With a strong and beneficial legal infrastructure to be established, auditing the investments to be made in sectors that directly affect the gross national product such as energy, agriculture, mining, transportation, etc. within the framework of sustainability, can prevent major financial, economic, and social problems that may be created by projects in the short term and will significantly improve the development of the country in the long term. When it comes to Turkey particularly, it is essential to establish new legal infrastructure for this country, which has limited financial resources, deep biodiversity, and a versatile social structure in terms of demographics, to be able to evaluate the new investments to be made as sustainable as explained above. Thus, now, as an offer, possible principles and thoughts needed to develop for this new legal model will be introduced:

a) Establishing an independent regulatory authority (like Energy Market Regulatory Authority) consisting of experts which will ensure that investments are structured with specified new sustainable development goals (all of which can be defined specifically for Turkey) and will regulate and supervise changes at this point,

b) Determination of the critical sectors' (such as energy, agriculture, etc.) priority in terms of investment by this authority and then for these; forming the sector-specific basic sustainable development guidelines based on field studies, surveys, and past experiences, etc. with the participation of stakeholders such as relevant departments of universities, non-governmental organizations, and financial institutions mainly in three pillars: technical, economic and social,

c) Calculation of the impact factors of these guidelines, taking into account the characteristics of the regions and the investments to be made,

d) Issuing basic sustainability criteria for planned investments with a map-based software which will be created by using the outputs of the studies described above,

e) Potential investors to benefit from this map-based software service provided by the relevant authority and to create a pre-sustainability report of their investments before starting their early designs,

f) Preparing investment-specific sustainable development reports by considering the reports such as EIA, Occupational Safety Plan, Project Schedule, which the shareholders of the project are already legally obliged to prepare up to the final permit and license stages of the investment,

g) Submitting this report to the relevant authority and finalizing the project-specific criteria within the framework of this report and after negotiating with the shareholders, granting the investor with a Sustainability Certificate,

h) Finally, following and supervising the liabilities to be made at every stage of the investment with the Sustainability Certificate and sustainable development report by the relevant authority.

## 6.3 FINAL REMARKS

Under the context of the case study and the legal act offer described above, regardless of the investment field, the essay will be concluded by adding final remarks on the idea of reaching sustainable investments for our country.

a) At every stage of the investments, especially in technical stages, the project components are needed to be structured by the experts of that relevant field to prevent potential mistakes from being made in design, construction, and commissioning.

b) Investors should have strong corporate structures to fulfill the liabilities of investments at every point.

c) A sound financial structure is a necessity to be established by the shareholders for each investment.

d) Before the decision, it can be a good idea to determine the potential contributions of the new investments' to the sustainable development of our country.

e) The stakeholders of the investments should be informed at every stage of the investments to provide their contribution.

f) The legal structure offered previously, or another model of this structure is supposed to be established specifically for sustainable development to ensure government participation.

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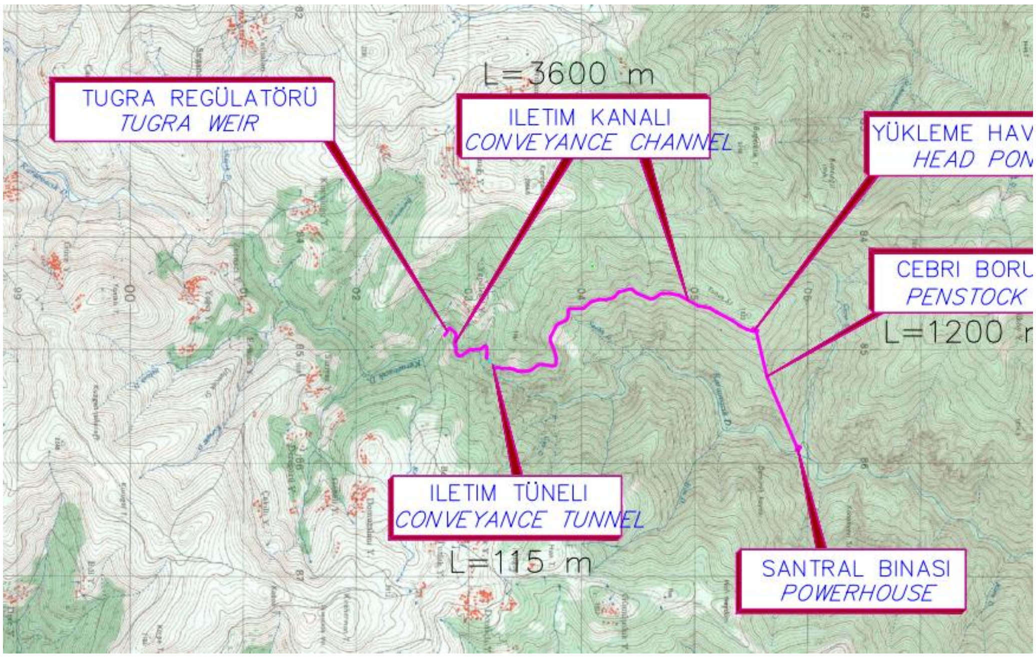
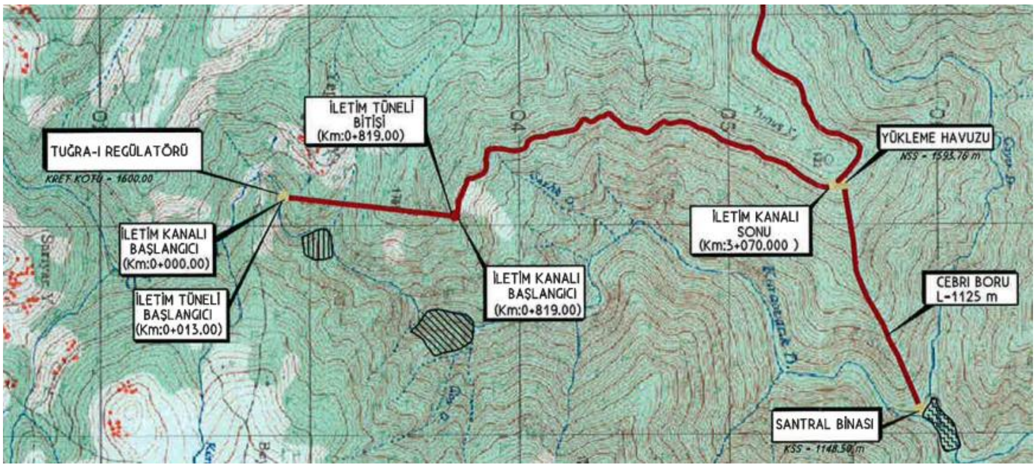
## APPENDICES

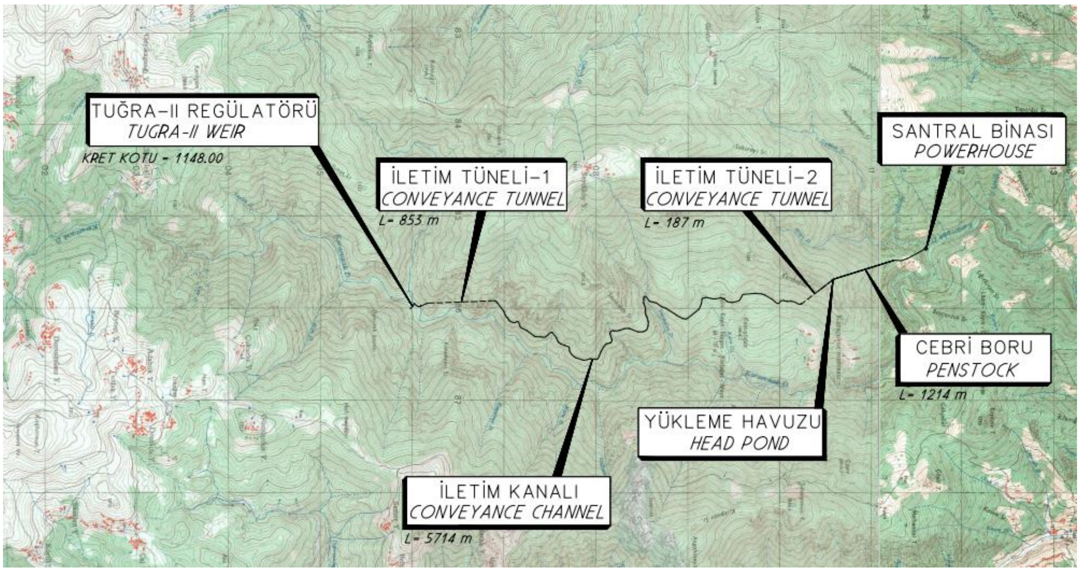
### A. Tuğra-I (Former) General Layout Plan




### B. Tuğra-I (Latest) General Layout Plan



## C. Tuğra-II (Former) General Layout Plan




## D. Tuğra-II (Latest) General Layout Plan