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A Comparative Analysis of Wind Energy Development in Norway and India: Mitigating the Environmental Concerns

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Abstract

Wind projects are the fastest growing form of renewable industry, and they have recently played a significant role for development of clean energy production. In comparison with fossil fuels, wind power is an environmentally friendlier alternative; however; its relevant onshore and offshore projects contain less discussed hazards for the surrounding environment. Therefore, addressing the harmful environmental impacts of wind energy projects is of significant importance, and from the legal aspect, it becomes inevitable to consider the effectiveness of the legal instruments to ensure that wind projects are safe for the environment. The main objective of this study is to find a suitable benchmark for addressing the environmental risks of wind energy development. To fulfil this end, the study seeks to examine the suitability of regulatory frameworks of Norway and India, to control the environmental hazards of their current and future wind sites.

Keywords: Environmental concerns, offshore, onshore, policy strategy, wind projects

INTRODUCTION

During the past decades, renewable sources of energy have attracted increasing attention around the world, and become fundamentally important for the members of the United Nations Framework Convention on Climate Change as well as Kyoto Protocol and the Paris Agreement on climate change to reduce carbon emissions. As the fastest growing form of renewable industry, wind projects have recently played a significant role in shift towards the clean energy production [1]. This form of energy is more suitable than other renewables, because the produced energy based on the cost of generation is highly efficient [2]. Moreover, wind installations are capable to complement other systems (e.g., solar and hydropower) to assure a stable and reliable power supply [3].

Regarding the use of renewable energy, the great interest of Norway, as one of the recognized energy exporters, is noteworthy. This country has produced almost 100% of its needed electricity from renewable sources [4], and it has considerable potential for wind development [5]. Even though the current share of energy generation from wind resources has remained limited, Norway has a strong plan to accelerate the extension of wind sector in the near future [6]. Moreover, the Norwegian government is trying to introduce offshore wind sites to generate electricity for oil platforms which is a novel idea to find the most sustainable way to supply energy for offshore petroleum activities [7].

In a similar vein, India has a strong plan to enhance energy self-sufficiency from renewable

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industry [8]. This country is one of the major economies in the world that has struggled with the energy production. Many people in India do not access the electricity, and the rate of power consumption is fast-growing [9]. Therefore, finding a clean source of energy could play an important role to balance the energy requirements and create secure and low-carbon power system for this country. Given the considerable wind potentials in various geographical areas, the Indian government has been motivated to set high targets for wind sector, and become a leading nation (i.e., fourth place) in land-based wind projects in the world [10]. Moreover, the government has embraced the offshore wind development [11], alongside a possibility of wind-solar hybrid system in the coastal areas [12]. These governmental plans could reveal the strong desire of the country to promote renewable energy growth in the near future.

Having considered the great interest of Norway and India for wind development, it becomes important to consider the suitability of the governmental supervision systems and policy strategies of these two countries to address the challenges of wind industry. One of the major challenges is the environmental concern of the projects. That is, even though wind industry is an environmentally friendlier alternative to fossil fuels, various stages of its projects could affect the surrounding environment negatively [13]. These potential risks are probable for both onshore and offshore wind sites. The potential risks are mainly due to the fact that new technology can also lead to new hazards. Wind power generation is a new industry; and from the legal aspect, it becomes inevitable to consider the effectiveness of the legal instruments to ensure that wind projects are safe for the environment. Given the expected fast growth of wind sector in the future, and the significance of the inherent environmental concerns, various researches has been conducted in different countries for the environmental hazards of the onshore and offshore wind installations [14, 15]. This study has an objective to consider the main policy strategies of Norway and India regarding the environmental concerns of their current and future wind projects. The study aims to find the issues that require specific regulatory attention, and to concentrate on the important points that could promote both systems to effectively control the environmental harmful consequences of their relevant sites.

To achieve this goal, the second part of the article, in two sections deals with the main regulatory frameworks of Norway and India for licensing the wind installations in order to have a general prospect of the governing rules in both legal systems. Moreover, the importance of the Environmental Impact Assessment (IEA) in the Norwegian and Indian licensing systems for wind projects is studied separately. The main focus of this part is how the policy measures could enable the States to monitor; directly or indirectly, the environmental effects of the wind sites, and to oblige the applicants to address the environmental risks.

Then, in the third and fourth parts, the main environmental risks of the current (i.e., onshore) and the future (i.e., offshore) wind projects in Norway and India are considered in different sections. In addition, the role of environmental effects on social acceptance of the current wind parks is studied briefly in order to examine how the balance between the societal acceptance and the environmental risks could be achievable for the future wind development. By the comparative analysis, the research will dedicate to the issues that need specific regulatory attention to make a conclusion in the fifth part.

THE REGULATORY FRAMEWORK OF WIND PROJECTS IN NORWAY AND INDIA, AND THE IMPORTANCE OF ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

In Norway

Based on the EU Directive 2014/52/EU that is incorporated into Norwegian legislations (i.e., Norway's Nature Diversity Act 2009) through EEA agreement, and following some international instruments (e.g., the Convention for the Protection of the Marine Environment of the North-East Atlantic 1998), the EIA is an important part of the Norwegian licensing system [16]. EIA is a key regulatory mechanism to inform the authorities about the potential environmental effects of a proposed project or its probable impacts in case of future development [17].

Regarding wind industry, the EIA is required in various stages of the Norwegian licensing system; particularly the strategic EIA before opening a new area, and the specific EIA after the license is awarded for the development of a wind project.

The strategic impact assessment to open a new area is done by the Norwegian Water Resources and Energy Directorate (NVE), a directorate under the Ministry of Petroleum and Energy (OED), which is the competent authority to grant license for all wind projects. The NVE usually conducts the strategic impact assessment through the consultancy companies based on the received input from the public hearing process [16]. Moreover, the Ministry of Climate and Environment (KLD), and its directorate (i.e., the Norwegian Environment Agency) may advice the NVE if it is necessary.

When a license is awarded, a specific EIA is required for further development. The applicant is asked to conduct this specific EIA, but the NVE could specify the main aspects of the assessment.

The governing rule for the onshore wind projects in Norway (i.e., inside the baseline of the sea territory) is the Energy Act 1990 that obliges the EIA for all plans over 10 MW electricity production [18]. The process is determined by the EIA Guidelines of the Norwegian Planning and Building Act. Considering environmental consequences of onshore wind, projects vary based on their locations, the national actors at the regional and local levels as well as various environmental NGOs are active to guide the onshore wind siting [16].

On the other hand, based on "a white paper on Norwegian climate policy", the Offshore Energy Act 2010 becomes the governing rule for offshore wind projects in Norway (i.e., outside the baseline including the continental shelf). The Act obliges a licensing system; containing the EIA, for all offshore sites in order to ensure that the consequences of the mentioned projects are not harmful for the environment and other business interests (e.g., fishery and maritime navigation). At the time being, the strategic impact assessment for three proposed areas; "Utsira Nord", "Sørlige Nordsjø II" and "Sandskallen-Sørøya Nord", have been finalized by the NVE, and the first two ones are now open for the application process. Moreover, regarding some probable shortcomings of the Act for the future specific impact assessments, a new proposed regulation provides more detailed sections about the EIA [19].

In India

In order to tackle the climate change concerns, wind Industry in India is growing at an exponential rate [20]. This country has tried to promote renewable power utilization via a "National Action Plan on Climate Change", and the role of wind industry is significantly highlighted [21]. The licensing of wind projects in this country is not confined to a single legislation. Instead, regulatory requirements for wind projects, pertaining to ecological aspects, are derived from several key environmental legislations. These include the Environment Protection Act 1986, the Forest Conservation Rules 2003, the Wildlife Protection Act 1972, the Costal Regulation Zone (CRZ) Notification 2011, the Air (Prevention and Control of Pollution) Act 1981, Water (Prevention and Control) Act, Hazardous Wastes Management Rules 2016, the Environmental Impact Assessment Notification 2006 and 2020, and the Territorial Waters, Continental Shelf, Exclusive Economic Zone and other Maritime Zones Act, 1976. Moreover, the nodal agency (i.e., the National Institute of Wind Energy, as a research and development body under the Ministry of New and Renewable Energy (MNRE)) provides technical assistance to incorporate such projects in the mainstream electrical mix and overall increase the renewable energy capacity.

The Environment Protection Act 1986 mandates environmental clearance including EIA for general projects. The Ministry of Environment Forest and Climate Change (MoEFCC) is the central authority in India to facilitate the planning, promoting, communicating and environmental protection. MoEFCC promulgated the EIA Notification in 2006 with an objective to assess and avert any probable environmental damages to the region [4]. Nonetheless, the mentioned Notification obliges the EIA, only for the projects within two main risk categories (i.e., A and B). Given the fact that wind projects are considered as being "green", they are excluded from the environmental clearance [22]. In other words,

conducting an EIA for wind projects is not mandatory in India. The idea that wind installations do not make substantial negative impacts for the environment negates the power of the central agency to limit a new project or elaboration of existing projects based on their harmful environmental effects. Therefore, the immunity of EIA for wind energy projects is a significant regulatory gap in the licensing system which hampers the current and future progress of wind sector in India. It is important to note that even though the government has recently adopted several policy strategies in order to encourage private and international investments and facilitate the procedure of onshore and offshore wind permissions [23], the environmental protecting requirements have remained unchanged.

Another important point is that the licensing procedure for onshore wind energy projects are different based on their locations. It seeks to address negative consequences of land-based wind parks on various components of the environment. For instance, if an onshore wind site is located in a coastal zone, it will require clearance under CRZ Notification 2011. Similarly, onshore wind installations located in forest areas and in protected areas require clearances as per the requisite law. Furthermore, wind energy projects demand concession to construct and permission to operate by respective State Pollution Control Boards (SPCB) under laws pertaining to air, water and hazardous materials. Therefore, addressing the environmental aspects of an onshore wind site needs an integrated regime. The situation for offshore wind projects is even worse, because the competent authority for conducting EIA is unclear. Keeping this in view that for promotion of offshore projects, the government formulated the "National Offshore Wind Energy Policy, 2015" and the "Draft Offshore Wind Energy Lease Rules, 2019" in order to clarify the institutional mechanism. Based on the former policy document, the management and conservation of marine eco-systems should be conducted prior to delimiting the blocks for offshore wind installations. To this end, the National Institute of Oceanography, Goa was appointed from the MNRE in 2020 to conduct a rapid EIA in Gulf of Khambhat, off the coast of Gujarat. Nevertheless, the mentioned EIA was limited to the consideration of the oceanographic characteristics of the site location, and it is still unclear how the conservation of marine life mentioned in the "National Offshore Wind Energy Policy, 2015" will be assessed [24]. In addition, the content of the environmental survey and the applicable regulations are completely vague [25]. Therefore, the amendment in the regulatory framework is necessary for improvement of wind industry and the licensing system for wind projects in India.

THE ENVIRONMENTAL CONCERNS OF CURRENT WIND PPROJECTS IN NORWAY AND INDIA (ONSHORE WIND PARKS)

In Norway

The current wind sites in Norway are all land-based, and generated about 6.4 of the total power production of the country in 2020 [26]. The environmental negative impacts of land-based wind installations have always been problematic around the world [27], and onshore wind industry in Norway is not an exception. The preservation of the undisturbed nature and biodiversity have been the main concerns [28]. It has been considered that the construction and operational stages of onshore wind farms may affect birds, bats and other species due to the loss of habitat, barriers to movement, increasing risk of collision with the rotor blades [29], as well as the harmful impacts of barotrauma resulted from turbulences and the pressure drop behind the rotor blades on animals' foraging and breeding grounds [30]. Regarding the decommissioning of wind installations, the waste generation, particularly turbine blade waste, is a significant point, and ensuring optimal recycling of the waste materials for the final stage is of environmental interest [31].

An additional concern about current wind projects in Norway is that some wind parks are in areas with high birds' diversity containing some Red List groups [32]. This matter could negatively impact birds' species richness of Norway, which is vital for various other ecosystems. On the other hand, the quality of water in some watersheds next to the wind turbines has been examined during the past years. The research by May *et al.* [33] shows a degradation in the quality of water, which may affect the water reserves and fishing industry in the future [34]. The light pollution that makes visual changes exacerbated by noise pollution causes further problematic issues. Even though the harmful

consequences of noise pollution resulting from the wind turbines on human beings and species have not been proved with certainty yet, this problem, in addition to the other environmental concerns have recently formed the main roots of strong protests regarding the development of onshore wind projects in Norway [16]. For example, Wind Park in Storheia and Roan in the Fosen region of Trøndelag County, which was the biggest land-based wind site in the EU, and the relevant case [35] has been brought to the Supreme Court.

The formal disagreements have been formed by local authorities, indigenous people, environmental NGOs and other local resistance. The host municipalities as the key local actors have played important role in affecting the licensing process. In this way, an analysis on relevant concessions in Norway between 2000 and 2019 shows that the local authorities based on the environmental concerns pertinent to their regions could influence the approval of the EIA and the licensing final decisions [16]. It can be interpreted as their informal veto rights.

The indigenous people have also challenged the decisions concerning the local wind projects. In other words, Sámi people in the northern parts of Norway, have criticized the projects that could change their feeding pastures and endanger their traditional way of life. The other social movements against the development of wind parks in Norway have been conducted by environmental NGOs and other resistance.

In 2019, the OED asked the NVE to prepare "a long-term National Framework for land-based Wind Power" in order to consider the feasibility of the future wind parks, the procedural efficiency, addressing the local conflicts in balance with the stakeholders' interests, and mitigating the environmental concerns. The prepared report identified 13 geographical areas as the most suitable ones for the future onshore wind projects, and it contained 25 district recommended measures for changing in the licensing process, in addition to some suggestions about reducing conflicts and increase the local trust. However, via the hearing for the delivered report, 49 municipalities said no to the wind developments in their municipalities [36]. As a result, the OED in the 2020 report of "Wind power on land changes in the licensing process" stated that the Norwegian authorities will not make progress with the suggested locations for onshore wind sites. Even though the Norwegian government has decided recently to resume licensing for some new onshore projects [37], the balance between the growth of wind installations and the protection of the environment has still remained as a challenging task. It seems that the informal veto rights of the local authorities to affect the licensing process could be the crucial point to prevent opening new projects that have negative effects on the environment.

In India

India is among the leadings of onshore wind generators in the world with a cumulative installed capacity of approximately 39 GW in 2021. The land-based wind projects contribute about 41% of total installed capacity of renewable energy production and enable the country to show a strong presence in the global wind energy market. The main wind sources are found in the south, west and north regions, and the current onshore wind projects in order of size are: Tamil Nadu (in the Kanyakumari district with 1,500 MW installed capacity), Gujarat (with 8.30 GW installed capacity and 142.56 GW potential), Maharashtra (including three main wind sites: Brahmanvel wind farm in Dhule with 528 MW installed capacity, Dhalgaon wind farm in Sangli with the 278 MW installed capacity, and Vankusawade wind park in Satara with the 259 MW installed capacity), Karnataka that has 4.9 GW capacity and 124.155 GW future potential), and Rajasthan (with 4.32 GW capacity and 127.756 GW potential) [24].

Very similar to Norway, the onshore wind projects in India have caused noticeable noise and visual pollution, and the negative impacts of wind installations on biodiversity have made serious concerns. In this way, different research have been conducted about the environmental consequences of onshore wind parks in India. For example, the negative consequences of wind turbines for the migratory birds and mammals in central Karnataka has been studied from January 2016 to May 2018 [38]. A significant

concern about the current projects is the fact that many wind sites are located in forest and ecologically sensitive areas [39]. Therefore, the construction and operational challenges of land-based wind projects, have higher ecological impacts on wildlife there. Indian forests are rich in wildlife biodiversity, and the onshore wind development could drastically affect a variety of livelihoods. On the other hand, the construction of the wind installations and building the necessary infrastructures have led to land degradation and massive soil erosion in forested areas. The additional concern is the fact that more forestlands are expected to divert into onshore wind parks in the future [40].

Even though the EIA is not mandatory for the wind projects in India, the threat to the ecology of the landscape and other environmental risks of the current wind sites have attracted so much attention among the local communities and active NOGs (e.g., Kalpavriksh Environmental Action Group) in the country. They have tried to influence governmental and non-governmental actors to prevent harmful environmental effects. As an example, the case of local protest to an onshore site with 113 MW capacity next to Bhimashankar Wildlife Sanctuary located in the Western Ghats of India was an important attempt [41].

It is noteworthy that the government of India has considered the land acquisition as the main obstacle preventing the onshore wind development. Therefore, it has been assumed in the policy strategies of the country that facilitating the procedure of forestland clearance could accelerate project commissioning and promote private sector incentives for further investments. In this way, the government has introduced standardized land-allocation policies in the states of Madhya Pradesh Rajasthan, Gujarat and Maharashtra in order to simplify the land approval system [24]. However, streamlining the land clearance process should not endanger the forest life, and the regulatory framework should take the environmental risks as serious as other economic aspects. To make a balance between securing the economic interests and addressing the environmental challenges, an obligatory EIA has been recommended as a key solution in the land acquisition formalities [40].

THE ENVIRONMENTAL CHALLENGES OF FUTURE WIND PROJECTS IN NORWAY AND INDIA (OFFSHORE WIND FARMS)

In Norway

The visual impact, noise pollution and other environmental concerns of land-based wind parks have promoted the Norwegian government to embrace offshore wind projects more than onshore ones, and try to reduce spatial conflicts in the future [42]. In addition to a probable higher social acceptance, there are other advantages for electricity production through offshore wind industry; such as the existence of better wind resources at sea that could lead to more predictable production, having access to greater space for extended wind farms, and the opportunity of building larger turbines for more cost reduction [43]. Norway has 28,953 km coastline with immense wind potential in various parts, and it is expected that the offshore wind becomes one of the main sources of electricity exportation for this country in the near future. To this end, mitigating the environmental negative consequences of such projects should obtain the same significant importance.

The research regarding various stages of offshore wind projects around the world has shown some probable negative effects on marine environment [44–46]; mainly including disruption of birds', fish and marine mammals' migration paths, change in water flows, destruction of seabed during the construction phase, loss of seabirds due to collision with the wind turbine, noise pollution and various electromagnetic consequences generated from submarine cables on squids' behaviors, harbor seal populations, etc. Therefore, the environmental consequences of offshore wind farms in Norway should be assessed carefully. In this vein, the strategic impact assessment for 15 geographical zones [47] suited for offshore wind farms was finalized in 2012 and reviewed without any material changes in 2018 by the NVE [48]. Based on the prepared report, five areas were in the first priority list, among which Utsira Nord, Sandskallen-Sørøya Nord and Sørlige Nordsjø II were proposed by OED in 2019 for public consultation and except Sandskallen-Sørøya Nord, the other two areas have been opened for the application process since 2020 [49]. Even though the proposal for northern part of Norway was not

accepted, the relevant environmental concerns are very important. Because the main reason preventing Sandskallen-Sørøya Nord from opening for the application process is the grid limitation [49], and it is probable that the area will be opened as soon as the connection problem will be solved. Thus, the environmental risks of all three target locations are considered in this part.

The grid accessibility and connection to the onshore power system were the essential points for the location of two areas of Sandskallen-Sørøya Nord and Utsira Nord to be proposed close to the shore [49]. But it is significant to note that, raptors and seabirds are highly susceptible to constructing activities in coastal areas [33]. Regarding Sandskallen-Sørøya Nord project, the seabirds' diversity is more significant because the seabirds in this area include some of the main puffin colonies in the country [50]. It seems that the research experience on seabirds' diversity from onshore wind projects that are close to the shore could help the estimation and reduction of negative impacts of future coastal wind sites. In this way, the Norwegian Institute for Nature Research (NINA) has a critical view regarding the unchanged IEA reflected in the NVE report in 2018. The NINA believes that the knowledge base for impact assessment of the offshore wind projects has changed dramatically since 2012 when the first survey was conducted by the NVE, and a review with the latest knowledge about seabirds and migrating birds for the proposed areas is necessary [49].

On the other hand, opening the areas for offshore wind projects close to the shore may have particular impact on fisheries and negatively affect the fishing right of the coastal lands' people in the future [51]. About Sandskallen-Sørøya Nord, a very rich biological production and natural diversity have made the location valuable and vulnerable. Cod, haddock, saithe, herring, and capelin are only some examples of fish species in this area [52]. Sandskallen-Sørøya Nord is also environmentally valuable and vulnerable, because it shares a border with Lopphavet marine protected area. The situation is similar for Utsira Nord, that is overlapping to a large extent with the Karmøyfeltet bank area [53]. Due to the considered risks of wind farms on fisheries, the Ministry of Fisheries, the Norwegian Fishermen's Association, and Finnmark county have strongly disagreed with the proposal for Sandskallen-Sørøya Nord, and based on the Ministry of Fisheries opinion about the Utsira Nord, only the northeast parts of the planned location could be used [49]. Considering that a careful selection of the location of a wind farm is vital to minimize the potential environmental impacts of the project [44], the NVE believes that environmental consequences for the Sandskallen-Sørøya Nord seem to be addressable by using only parts of the area [49].

Another important point about the proposed areas is unlike Utsira Nord, which is too deep for the fixed bottom wind projects, Sørlige Nordsjø II and Sandskallen-Sørøya Nord suit for both fixed and floating farms [49]. From the environmental aspect, floating wind installations are less threatening to the seabed's life [54]. This point could be positive for Sørlige Nordsjø II project, since the area overlaps with Tobisfelt sør that is a well-recognized habitat for Sandeels. Sandeels are among key seabed species in the North Sea ecosystem and that the destructive constructional activities of the fixed bottom projects could endanger their habitats seriously [49].

Despite various probable environmental risks associated with offshore wind projects that have been considered above, the total impacts of the proposed projects have not been evaluated to cause significant damages to the marine life [55]. This evaluation is quite similar to the EIA of another offshore wind project conducted by the Norwegian state owned company (i.e., Equinor) in Scotland [56]. It seems that the main reason for such evaluation is the fact that environmental consequences of the wind projects are examined in comparison with the offshore petroleum projects. In this way, the impacts of wind sites are clearly less harmful for the environment due to the absence of the oil spill and well blowout risks that are present in oil exploration activities [57]. Nevertheless, it should be notable that wind projects contain various sources of pollution (e.g., noise pollution and barotrauma resulted from turbulences), and it has some complicated technology (e.g., long term underwater electrical operations in the construction stage) [58] compared to offshore petroleum projects. The effects of such operational activities and technology on the environment is not completely recognized. Moreover, the change in the

marine life usually happens during a long period of time. This point has a particular significance for the northern part of Norway, because the environment of the Arctic is unique and fragile. It is home to a rich array of mostly endangered animals, which have longer lifespans and slower generational turnover [59]. Therefore, it is expected inevitably from the NVE to ensure that the safety of wind projects is controlled properly for the environment. The NVE should have a careful consideration of the specific EIA that will be presented by the applicants, and it should adopt a robust monitoring system for assessment of the environmental consequences of the projects in the future.

In India

India has strong incentives to increase the momentum behind the blue economy, and exploit oceans' sources of energy [60]. To this end, offshore wind projects could contribute positively to alleviate the problem of land acquisition and other environmental harmful impacts of onshore wind parks [24]. India has a coastline with 7600 km length with suitable wind potentials in various parts [61]. The government has proposed ambitious for 30 GW power generation by 2030, and the National Institute of Ocean Technology has identified two feasible sites close to the coastlines of Gujarat and Tamil Nadu for the future [62]. "The First Offshore Wind Project of India (FOWPI)" with a 200 MW target generation has been defined next to the coast of Gujarat since 2018, and it aims to use the outputs of the "Facilitating Offshore Wind project in India (FOWIND)". FOWPI is a part of "the Energy Cooperation with India" program, and it is funded by the European Union [25]. The research planning regarding various aspects of the project has shown encouraging results, and the oceanographic as well as other seabed surveys have been continuing [63].

Considering, offshore wind farms could pose various risks to the marine life and eco-systems [64], a rapid EIA was conducted in 2020 for the Gujarat recommended site. One of the goals of the research was to examine the probable environmental consequences of different stages of the project (specifically commissioning, seabed constructions, operational activities and decommissioning). The intended site for the future Gujarat offshore wind farm is located in the Gulf of Khambhat, which is one of the critical vulnerable coastal areas in India [65]. It is habitat to a wide range of plants, animals, and migratory and non-migratory birds. As a considerable dynamic ecosystem, the Gulf of Khambhat is rich in coral reefs, and represents breeding and feeding ground for sea animals (e.g., whale sharks). It also hosts to a number of endangered species (namely include mangroves) [26]. Therefore, a detailed EIA is necessary to ensure the safety of future installations for the surrounding environment [66]. It is notable that the government has recently shown greater interest for Tamil Nadu proposal compared to Gujarat one due to the better resources and more favorable conditions from the geotechnical aspects [26], but a careful EIA for the prioritized project is still required before implementing such project.

On the other hand, significant risks regarding the negative impacts on fisheries are associated with project development in both Gujarat and Tamil Nadu. The hazards are more concerning in Tamil Nadu proposal since the location is the second fish production area in the country [67], and the livelihood of approximately 1.2 million people there is dependent to fishing activities [26]. Moreover, the ocean-based tourism, as an important source of revenue in India, could be influenced negatively by offshore wind development in the proposed locations. To address such concerns, "the National Offshore Wind Energy Policy, 2015" as well as FOWIND have emphasized the importance of the social considerations. However, the societal impacts of the sites have been poorly assessed yet [26]. Therefore, a substantial study is expected from the decision makers in order to analyze two main aspects of social impacts of the wind development in India (i.e., fishing and coastal tourism), and to provide necessary policy guidelines.

THE COMPARATIVE ANALYSIS AND CONCLUSION

The main concentration of this study was on addressing the environmental concerns of wind development, and the relevant policy strategies of Norway and India were studied as the reference. In order to conduct a comparative analysis between the mentioned systems, the wind industry in both countries have been divided into two main clusters of the current and future wind projects, and various

environmental hazards of each project have been studied separately. Moreover, the policy strategy of each country to address the environmental risks for the relevant cluster has been considered.

Regarding the current wind projects that are all land-based in both countries, there are similarities regarding the harmful effects on the undisturbed nature and biodiversity as well as a probable degradation in the quality of water and soil erosion close to the wind sites. The research also shows that the environmental concerns in addition to the change in visual impacts and noise pollution have formed some social unacceptance for further development of onshore projects in both Norway and India. However, given in Norway the EIA is mandatory for the licensing of the onshore wind parks, the oppositions have been more successful in this country. Moreover, the public consultation, as a significant part of the EIA procedure in Norway, gives the national actors at the local level a semi veto right to consider the environmental effects into account, and indirectly affect the final decision regarding the licensing of a new project. Therefore, the regulatory amendment in the licensing system of India for onshore wind development is necessary to provide the possibility of environmental protecting measures and reduce the relevant social conflicts as effective as the situation is under the Norwegian licensing system.

Regarding the future wind projects, which are planned to be mainly offshore in both countries, various negative consequences of wind sites on marine life that have been considered in this study could reveal the importance of an in-detailed environmental and social impact assessment when the location of the farms are specified in the future. As a general point for both countries, a higher societal acceptance is predicted for offshore wind projects due to the decrease in noise and light pollution in addition to the absence of some land acquisition problems. However, in Norway, the probable environmental harmful impacts do not seem to form the fundamental basis to change the final decision regarding the wind development in practice. In this way, despite various disagreements of the component authorities and associations, there is an underestimation about the negative environmental impacts of the offshore wind projects, specifically for the proposed area in the northern part of the country. In order to mitigate the environmental concerns, it is necessary for the Norwegian government to consider the environmental risks of the wind projects by their own specific hazards, and a comparison with other marine projects (i.e., mainly offshore petroleum installations) leads to an incorrect result.

On a similar basis, the wind projects in India are considered as being “green” and not seriously harmful for the environment. Therefore, the main policy initiatives in this country have a focus on the economic aspects of the future wind projects, and assessing the potential impacts on the environment is ignored. Thus, it is highly required for the Indian government to coordinate the policy strategies in a way that economic and environmental aspects are properly balanced. It seems that the development of a mandatory EIA regime containing the clarification in the institutional mechanism to carry out such assessment is the first step.

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