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Public Perception and Policy Implications Towards the Development of New Wind Farms in Ethiopia

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Abstract

As part of the global effort in the development and deployment of renewable energy, Ethiopia is aggressively working to increase the share of those energy resources into the energy mix. Ethiopia is known for the use of hydropower generation systems but recently the country is introducing wind energy technologies and developed wind farms that started power generation in 2011. However, the public perception towards this new entrant of power generation system is not well understood. This paper therefore explores the perception of the public living within the wind farms. This is achieved through structured survey and conducting household level discussions with the community. The results showed that generally the public is supportive of such development but critical issues have been raised such as lack of prior consultation with the community by the developers, fairness of land compensation and generally lack of inclusive benefit packages from the wind farm development for the community. With the country planning for new wind farm development, it is crucial to devise comprehensive solutions and consider the recommended policy directions in this paper in order to develop public confidence and ownership for sustainability of the developed power generation systems.

Keywords: Wind farm; Public perception; Compensation; Community consultation; benefits; Impacts

1. Introduction

There is high-level of agreement on two energy policy goals for Africa, embodied not only in the Paris Agreement and the SDG's, but also in agreements among

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African leaders [1]. The first is the provision of universal access to modern energy and energy services, reflecting scientific results identifying affordable energy access as a core factor enabling the achievement of a wide range of development goals [2, 3]. The second is for the complete decarbonization of the energy sector, reflecting the (near) global consensus on the need to limit climate change to well below $2^{\circ}C$, a target that is incompatible with CO_2 emissions from fossil fuels continuing past mid-century [4, 5].

As part of the global effort in the development and deployment of renewable energy, Africa is aggressively working to increase the share of clean energy in its energy supply. To achieve this, there are different initiatives such as the Africa Renewable Energy Initiative (AREI), which is planning to generate 10 GW power from renewable energy by 2020, and 300 GW by 2030 across the continent [1]. This initiative is expected to massively support the policies of the continent and support much needed investment in socially acceptable and environmentally sensitive projects. As part of such on-going initiatives and addressing the energy poverty prevalent in the continent, many of the African countries such as Ethiopia are introducing and developing renewable energy power plants. Considering the current Ethiopia's context, the energy demand is increasing from time to time jointly with the growing economy and industrial diversification. However, energy access in Ethiopia stands at 44% with 33% supplied through the grid system and 11% supplied through off-grid system according the Multi-Tier Framework (MTF) Energy Access household survey conducted in 2017 [6]. In order to fulfil the growing demand, the Ethiopian government has launched National Electrification Program (NEP) in 2019 laying out the country's ambition towards universal access by 2025 through integrated planning of grid and off-grid energy systems [6]. As part of this plan, Ethiopia is mobilizing resources for large-scale centralized grid power generation systems from diversified energy sources such as wind energy in order to supply electricity to around 65% by 2025 and to 96% by 2030 as grid system represents the least cost solution for most of the population [6]. However, wind energy is new to Ethiopia and currently there are two wind farms developed in the country though the wind energy industry has grown rapidly in the past 40 years [7–9]. The first wind farm developed in Ethiopia is Ashegoda wind farm with a capacity of 120 MW commissioned in 2011 and the second wind farm is Adama I (51 MW) and Adama II (153 MW) with a combined capacity of 204 MW, which was commissioned in 2012. This generation is less than 1% of the country's exploitable potential of 1,350 GW wind power [6]. The development of wind energy in the country is considered as a departure from the traditionally known large-scale hydropower plants.

The introduction of new power generation systems to the country opens a lot of questions particularly in the perspective of public acceptance. There are several studies conducted in different countries of the world indicating different factors that affect the decision of the public whether to accept or oppose wind farm developments [10, 11]. The proximity of the wind farm to the communities have huge factor in the level of resistance and these close to the wind farm development have low level of support [12]. One of the key factors that affect public acceptance is lack of developing comprehensive ownership models with different benefit packages for the local community [13–17]. A study in France shows that social resistance to wind farm development remains one of the obstacles [18–20]. Dealing with the public perception towards the development of wind energy is becoming challenging as indicated by several studies in different countries [21–23].

However, perception of the public towards new wind energy power generation systems in Ethiopia remains unknown, as there is no comprehensive study conducted in the communities living within these wind farms. This paper therefore explores the public perception towards the development and implementation of wind farms in order to understand the key challenges for developers and the community. It also recommends policy directions that can contribute to the development of successful policies by the regulators to accelerate the deployment of wind energy in Ethiopia, in ways that offer significant development co-benefits.

2. Methodology

2.1. Description of the study area

There are only two wind farms commissioned in Ethiopia and this study was conducted in one of these wind farms called Ashegoda wind farm, which has the capacity of 120 MW power generation (Figure 1). The wind farm is located near Mekelle city, the capital of Tigray region state, approximately 780 km north of the Ethiopian capital Addis Ababa as indicated in the graph (Figure 2). It is situated 21 km south east of the city. Spatial distribution of the surveyed households are given in Figure 2, which was collected with the support of GPS and generated with Arch GIS.

2.2. Source of data

The main source of data to be used for this survey is both primary and secondary data. Primary data was collected through questionnaires from the communities living within the Ashegoda wind farm. In addition, secondary data was gathered from national and international research results and reports.



Figure 1: Ashegoda wind farm [24]

2.3. Survey design

This survey was designed to collect cross sectional data concerning various socio-technological issues of wind farm developments. As the survey covered all households within the Ashegoda wind farm, it is deemed representative.

2.4. Research Approach

This study implemented the two basic research approaches called quantitative and qualitative approaches. The Quantitative approach involved the generation of data in quantitative form, which was subjected to rigorous quantitative analysis. The Qualitative approach to research is concerned with subjective assessment of opinions of the respondents. Research in such a situation is a function of researcher's insights and impressions. Such an approach to research generates results either in non-quantitative form or in the form which are not subjected to rigorous quantitative analysis. Under the qualitative approach, general information that is not addressed in the quantitative form were collected and analysed. This information was gathered from the opinions of respondents. Researches by [25] indicate that qualitative research provides a more realistic feel of the conditions under study by providing flexible ways of collecting, analysing, and interpreting

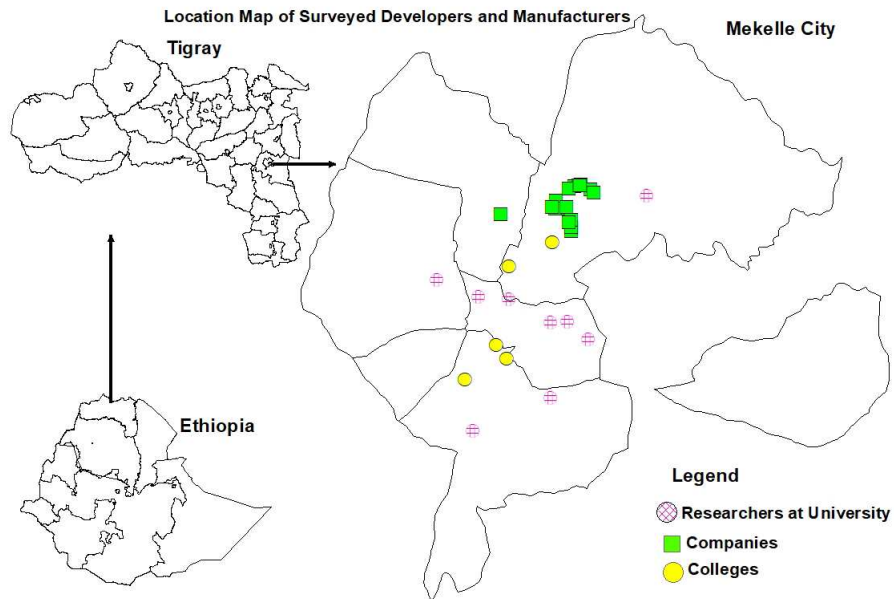


Figure 2: Location of surveyed households

data and information. However, the use of both qualitative and quantitative data can provide complete and synergistic utilisation of data by ensuring that the limitations of one type of data are balanced by the strengths of another [26]. This mixed approach ensures that understanding of the subject matter under study is improved by integrating different approaches. Considering that this research work focuses on the perception of the community, it is important to use both approaches in order to completely understand the opinions of the community towards wind farm

2.5. Survey instruments

The study employed structured questionnaire to gather the necessary information from the households. The questionnaire was pilot tested by undertaking a pretest to assess the level of understanding of the enumerators and respondents, clarity of the questions and omission of important questions. Based on the result of the pilot testing, the content, logical flow, layout and presentation of the questionnaire was amended. The questionnaire was developed using the powerful on-line LimeSurvey tool [27] and the data collection was conducted by visiting and interviewing each households.

2.6. Sample size

The survey sample size is commonly determined by taking into account both the required level of precision and the amount of resources needed to conduct the survey. In the different studies conducted to understand the perception of communities towards wind farms, there are different data sampling methods employed. For example: The total number of households within the Ashegoda wind farm were considered in this study. A total of 67 households were participated with 28 of these households own a land that is affected by the wind farm development.

2.7. Data analysis procedures

To address all of the objectives of the study descriptive method of data analysis was employed. The responses from the households were feed-in to the on-line LimeSurvey tool and the data was automatically analysed on-line within the LimeSurvey tool. The analysed data in the form of percentages and frequencies were exported to MS Excel. The data was then manually edited, summarized and rearranged according to the obtained responses. After having done such process it was converted to percentages that finally lead to data interpretation and description of the entire problem using tables and graphs.

3. Results and Discussions

The questions to the community living within the Ashegoda wind farm was designed to explore the developers engagement during planning, implementation and operation of the wind farm. Accordingly, several issues that include consultation of the community, land compensation, effect of the wind to the natural beauty and habitants, benefits of the wind farm to the local communities are explored in detail. The public perception towards these issues are compared with international experiences and the details are given in subsequent sections. Based on the public perception and international experiences, policy recommendations are also given in section 4.2 to support the regulators in Ethiopia to develop inclusive policies that provide significant co-benefits to the developers and the public.

3.1. Public consultation during the wind farm planning

The Ethiopian Electric Power (EEP), which is a government owned entity, is mostly responsible for the development of power generation systems in Ethiopia. Thus, the two new wind farms in Ethiopia are developed by EEP and in such large-scale wind farm development, the communities living within the area of interest are expected to be consulted in advance on several issues. The communities

living within the Ashegoda wind farm were asked about their involvement and participation during the planning of the wind farm project. More than 64% of the respondents said they were not consulted about the wind farm development as shown in Table 1 but less than 36% of the respondents said they were consulted. Similarly, more than 70% of the community said they are not satisfied with the consultation, though nearly 83.3% of the consulted community said they are satisfied.

| Questions | Percentage | |
|--|------------|-------|
| | Yes | No |
| Was the local community consulted prior to approval of the wind farm? | 35.82 | 64.18 |
| Are you satisfied with the consultation provided to the community? | 29.85 | 70.15 |
| Did the consultation include information regarding the route/design of new electricity transmission lines? | 5.97 | 94.03 |
| Was the community offered an opportunity to comment on the design/layout of the wind farm? | 7.46 | 92.54 |
| Did you formally object to planning permission being granted to the project? | 1.49 | 98.51 |

Table 1: Consultation of community during planning of the wind farm

The consultation conducted doesn't even include the critical issues that need to be discussed with the communities. More than 94% of the respondents said they were not consulted about the route/design of the electricity transmission lines, and similarly nearly 92.54% said they were not consulted about the design/layout of the wind farm. What is interesting in this result is that majority of the community (98.51%) did not object to the planning and development of the wind farm. This contradicts to the lack of consultation of the community as it is naturally expected that the community will object to any wind farm development if they were not well consulted on the critical issues of wind farm development. However, lack of objection by the community may be due:

- Eagerness of the community to get new wind farm technologies that are not common in Ethiopia
- Eagerness to get electricity supply
- Lack of awareness by the community on the social and environmental impact of wind farms, which is evidenced in the subsequent discussion on different societal issues associated with the development of wind farms.

A study on the wind energy development in Germany suggested that public participation in the early stages of planning wind energy projects is an opportunity

and can lead to positive perception by the community[28, 29]. Similarly, a study in New Zealand suggested that public participation and consultation should not be overlooked during the early stages of wind farm development [10]. This is a clear indication that the developer in Ethiopia need to consider international experiences and positively engage with the communities to avoid increasing public resistance to wind farm developments.

3.2. Land compensation

Land is an important asset of the communities as their livelihood totally depends on it. According to [30], wind energy land footprint requires around 242811 m^2 of land per megawatt power generation, which is mainly due to the need for turbine to turbine spacing. However, the permanently disturbed land is nearly 14164 m^2 for the same power generation. In the case of the Ashegoda wind farm, the farmers continue to utilize the land footprint for agricultural purposes except the disturbed land. Therefore, land compensation is commonly given for the permanently disturbed land. Ethiopia has a land compensation policy if the land of farmers is utilised for any development such as the wind farm. The communities where their land was used for the wind farm development was asked about the compensation and nearly 96.55% of the farmers confirmed that they are compensated as indicated in Figure 3. This shows that the developer is applying the compensation policy of the country.

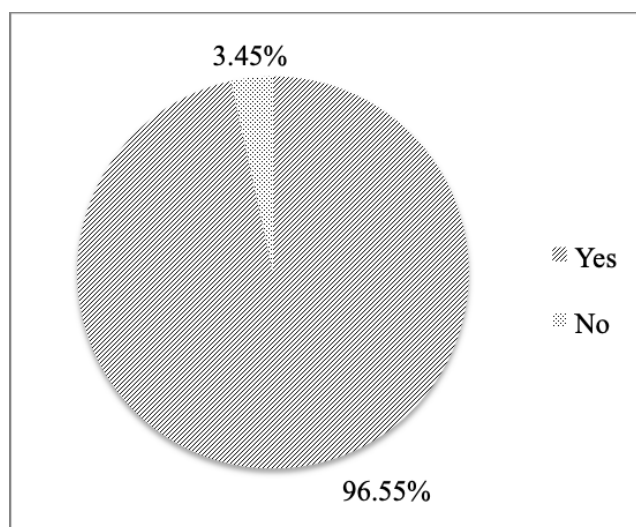


Figure 3: Paid compensation for farmers for their occupied land by the wind farm

However, the amount of compensation paid to the farmers is one of the prevalent issues frequently raised even with other types of developments. This means it is not about payment of compensation but about the satisfaction of the farmers with the amount of compensation paid. This was clearly showed during the survey and nearly 55.17% of respondents are below neutral, meaning unsatisfied and strongly unsatisfied. Only 13.79% confirmed that they are strongly satisfied as shown in Figure 4. There is a study conducted in Ontario, Canada, that proved there is minimal impact of wind farms on the property value [31], which is positive for the communities as they can easily sale their property at a fair value though they are not satisfied with the compensation paid for their disturbed land.

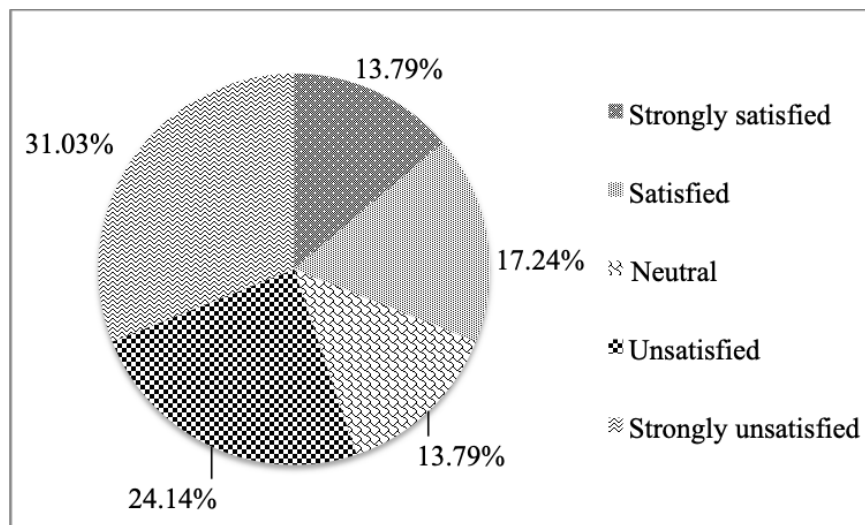


Figure 4: Community satisfaction on the paid compensation

There are always critical issues surrounding compensation when the land of farmers is utilised for any development including wind farms. However, there are two frequently raised arguments and counter-arguments by the developer and receivers on the amount of compensation paid. The receivers argue that the money paid by the government is much lower than the land value but the government argues that is not about the amount of money but the way the receiver uses the money. The government believes that the receiver need to get further training and guidance on how to utilise and create business using the paid money as the experiences shows that no one is properly utilising the money other than spending it for day to day unnecessary activities. In any case, this low satisfaction of the farmers shows there is a need for immediate solution on this issue in order to

continue developing wind farms to improve energy security in the country. One solution could be applying the concept of royalty where communities get continued royalty payments, which could minimize the issue of mismanagement of the one off compensation payments.

3.3. Advantages of the wind farm to local community

Any wind development projects are expected to benefit the local community in order to encourage ownership for sustainability. One of the issues discussed with the community was therefore the benefit of the wind farm to the local community. Majority of the respondents confirmed that they are not being benefited from the wind farm development during and after the project. Nearly 60% of respondents said they did not benefit from the wind farm and only 7.5% said they benefited from the project as shown in Figure 5.

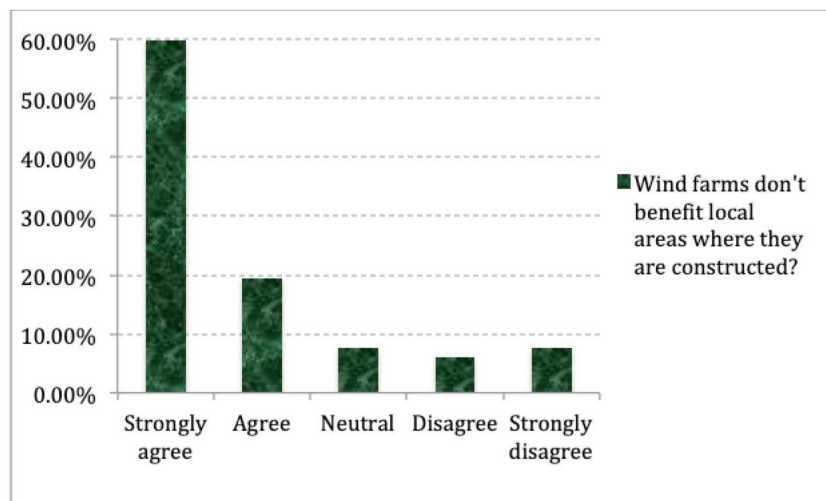


Figure 5: Benefit of local community from the wind farm

Surprisingly, 96% of the respondents said they did not get electricity supply from the wind farm as indicated in Figure 6. This is a huge policy and strategy gap on the side of the government as the consequence of lack of ownership by the community living within the wind farm is substantial. Though it is known that the wind farm development is government owned in Ethiopia, several lessons can be drawn from experiences in other countries that suggests public perception towards wind energy can be improved by the development of community owned wind farms [32, 33].

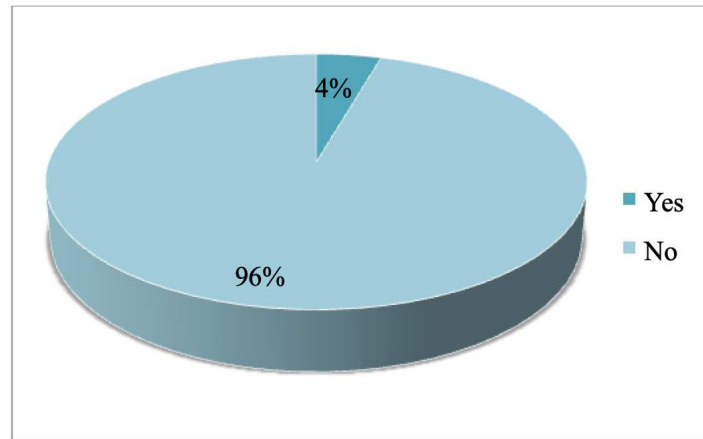


Figure 6: Supply of electricity from the wind farm to the local community

In the case of Ethiopia, the development of wind farms requires huge investment, which couldn't be developed by communities as is the case in the United states [34] but the trust could be developed by engaging the communities at different levels of the wind farm development and developing comprehensive benefit packages to the community from the wind farm in different forms. One benefit package could be financial support to develop community owned mini-grid power generation systems such as wind turbines or small scale solar farms or through solar household systems. This kind of development model can enhance the public trust and reduce opposition to wind farm developments, which have been proved by several researches [14–17]. Wind farm developers have introduced different benefits to local communities in several countries of the world, though this is not the case in the Ashegoda wind farm, but these benefit tools have less impact in the local economic development [35]. Even with different packages of benefits, developers have hard time to get trust from the communities [14]. Therefore, this needs to be properly addressed by developing appropriate policies and strategies by the Ethiopian government in order to expand and sustain wind farm developments in the country. This can avoid a storm of resistance from the community as seen in the UK and other countries of the world [36].

3.4. *Wind farm impact on the habitants and noise*

One of the environmental impacts commonly raised by residents within or near wind farms is noise [37–40] and the opinion of population living within or near wind turbines is negative due to the noise. This is mainly because noise of

wind turbine has harmful impact on human health [41] such as depression, anxiety and insomnia, and physical symptom [42, 43], sleep-related problems, headache, tinnitus and vertigo [44]. This is found to be not an issue with the communities living in the Ashegoda wind farm as 92.54% of respondents strongly disagree when they were asked that wind farm noise is a huge issue and is a danger for habitants such as birds (Table 2). This is not a matter of contradiction between the results of this study and the studies conducted in other parts of the world communities living within or close to wind turbines but the issue appears to be the lack of understanding of the impact of noise by experts. This should further be studied in detail by experts to explore the impact of noise in the communities living within and close to the Ashegoda wind farm and take measures to minimise its impact on the communities health.

| Questions | Percentage | | | | |
|--|----------------|-------|---------|----------|-------------------|
| | Strongly agree | Agree | Neutral | disagree | Strongly disagree |
| Wind farm noise is a huge issue in this area? | 0.00 | 1.49 | 4.48 | 1.49 | 92.54 |
| Wind farms are affecting natural habitats and are a danger to birds and animals? | 0.00 | 0.00 | 4.48 | 2.99 | 92.54 |

Table 2: Community perception towards the effect of wind farm on the habitants and noise

Similarly, they were asked if the wind farm has an impact for habitants such as birds but the response showed that there is no danger to birds. This is in contradiction to several other research outputs that proved otherwise [45–47] because of bird collision with the rotating blades. It is recommended that the development of wind farms need to be avoided in places where there are vulnerable bird species [48].

3.5. *The effect of wind farm to the natural beauty*

The effect of wind farm on the local area is characterised using different parameters and collectively, the communities living in the Ashegoda wind farm have positive impression. As indicated in Figure 7, nearly 70.15% respondents said the wind farm has minimum effect on the local area. Only 14.93 said they have neither positive nor negative perception.

Generally, the community living within the Ashegoda wind farm have positive attitude towards the wind farm. More than 91% said that the wind farm has not damaged the scenic beauty of the local area including the confirmation of low visual impact with nearly 89.55% respondents agreeing to this notion, which is similar perception with other communities around the world[49]. This is not always the case though if there is poor aesthetic integration of the installed wind turbines into the landscape [50].

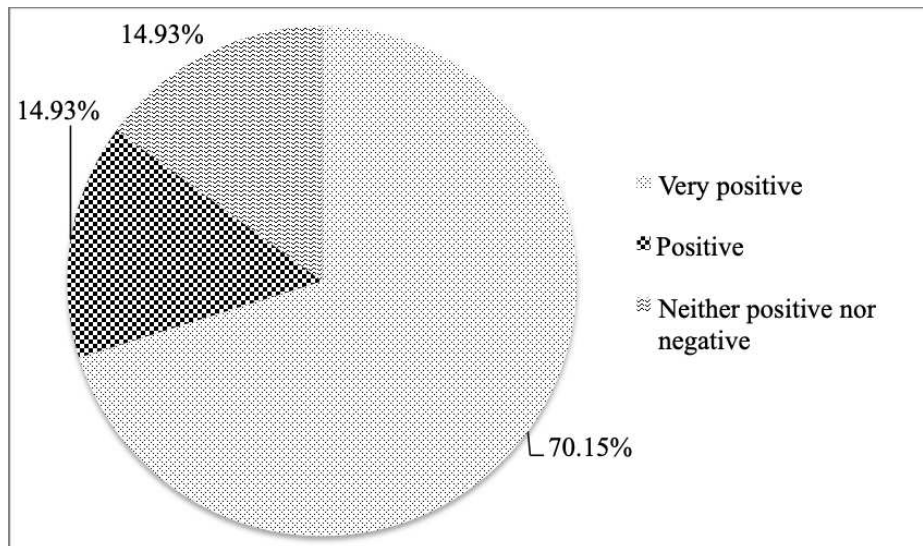


Figure 7: Effect of wind farm on the local area

| Questions | Percentage | | | | |
|---|----------------|-------|---------|----------|-------------------|
| | Strongly agree | Agree | Neutral | disagree | Strongly disagree |
| The wind farm has damaged the scenic beauty of this area? | 2.99 | 0.00 | 0.00 | 5.97 | 91.04 |
| Wind farms are an eyesore on the landscape in general? | 0.00 | 1.49 | 1.49 | 1.49 | 89.55 |

Table 3: Community perception towards the effect of wind farm on the natural beauty

It is not clear if aesthetic integration of the installation of Ashegoda wind farm was considered during the planning phase. Considering that the wind farms are new to Ethiopia, it is doubtful that this was the case as most of the time the developers focus on the availability of resources and ignores most of the environmental impacts due to the eagerness to generate power as there is acute shortage of electricity in the country. However, such critical issues will be noticed by the communities as the wind energy development expands and will be a setback for the developers as public resistance will eventually grow. Therefore, the wind farm developments need to have greater aesthetic integration to the landscape, which can be assisted by using different tools during the planning phase [50–52].

3.6. Public support for wind farm development

As discussed in the aforementioned sections, some of the wind farm development issues such as consultation with community, satisfaction level of land compensation, benefit of the wind farm to local community are rated as low. De-

spite these, the community strongly supports the development of wind farms, with 99% of respondents in favour as shown in Figure 8. This is a positive indication for the government to expand wind farm developments. However, the critical issues raised by the respondents should be addressed at the policy level in order to improve ownership of the communities who live within or nearby the wind farms. This will help in the sustainability of the projects and subsequently improve energy security of the country.

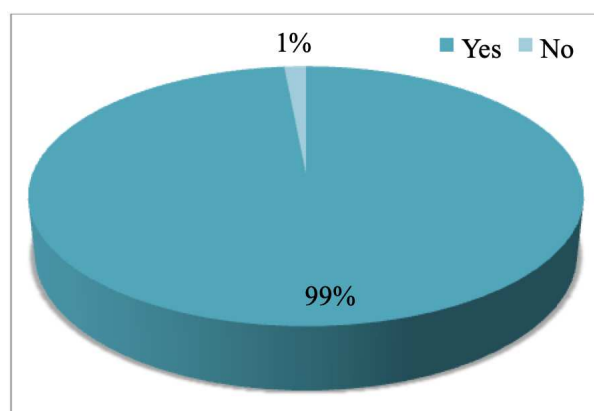


Figure 8: Community support towards wind farm development

4. Conclusion and Policy Implications

4.1. Conclusions

The public perception to the new development of wind farms in Ethiopia showed interesting outputs with some of the issues being in contradiction to the public perception in other countries of the world. Some of these contradictions include on the issues of noise, natural beauty, impacts on the natural habitants such as birds, and visual impacts. On the issue of natural beauty, 91.04% of respondents strongly disagreed when they were asked that the wind farm damaged the scenic beauty of the area and 92.54% of respondents strongly disagree when they were asked that wind farm noise is a huge issue and is a danger for habitants such as birds. In addition, 89.55% said that there is less visual impact. In addition, nearly 98.51% said they did not object to the development of the wind farm. However, the outputs of this research clearly showed some of the critical issues that need further consideration by the developers. Some of these include less consultation of the communities during planning of the project with 64% of respondents indicated that

there need to be consultations during planning and development. Nearly 55% of respondents are unsatisfied on the amount of compensation paid though more than 96.55% said they are compensated. Nearly 60% of the communities living within the Ashegoda wind farm said that they are not getting necessary benefits with 96% of respondents having no access to electricity. Despite all these concerns, more than 99% of the communities are supportive of wind farm developments. Though this is good news for the developers, there were still significant concerns of the communities, which need to be addressed with appropriate policies and strategies. Therefore, the government need to introduce additional polices and strategies such as the once suggested in section 4.2.

4.2. Policy implications and recommendations

Ethiopia is planning to add around 500 MW power generations from wind energy in the next five years to its existing generation from the two wind farms, which will increase the wind energy generation capacity of Ethiopia to 824 MW. However, these plans need to be supported by policies that take into consideration the issues raised by the communities living within the Ashegoda wind farm. Though the communities are generally supportive of wind farm development, at some point there will be resistances as the negative impacts become known through time to the public as shown in the rest of the world. Therefore, in any future planned wind farm development, the government need to develop inclusive policies in order to solve raised concerns by the communities. Based on the results and discussions and best practices applied in other countries, different policies are recommended as shown below in order to support the country's plans of developing additional wind farms.

Address the lack of public consultation during planning

Public consultation is one of the key tools to reduce public resistance to wind farm development and thus developers should be aware of this issue and involve the local communities in:

- The planning of the project
- The development and enriching of layout of the wind farm
- The route design of the transmission lines
- The benefit packages and other related issues that directly affect the communities

This will improve confidence and ownership by the public and reduce the possible resistance to wind farm developments as proved in different countries such as Denmark.

Improve land compensation

Revise rate of land value and pay the community accordingly and develop business plans to encourage communities to utilise the money for income generating activities

Develop public benefit packages

Involve local communities in different income generating activities during the construction of the wind farm. In addition, Benefit packages such as supply of electricity, employing members of the community during operation of the wind farm shall be developed.

Address the lack of awareness on the merits of wind energy

Develop mechanisms to create awareness of the local community on the positive and negative impact of wind farms during development and operation. Particularly, the public need to get enough information about the merits of developing renewable energy technologies such as wind energy systems.

Address environmental impacts

Based on the results of this study, most of the environmental impacts such as noise, natural beauty, effect on habitants are considered relatively low in the Ashegoda wind farm. However, as the public gets full awareness of these issues the resistance will increase. This can only be avoided by developing and implementing international best practices in the development of wind farms in order to address the possible environmental impacts.

Implementation of the Independent Power Producers (IPPs) policy

The Ethiopian Electric Power (EEP) is charged for the generation and transmission of electricity while the Ethiopian Electric Utility (EEU) handles distribution and sales. This is a clear indication that the main players in the energy sector have been mainly government owned organisations. However, recently this scenario is changing due to the dynamics and enablity of the government to fulfil the ever growing energy demand because of the vast industrialisation and economic growth of the country. Regulatory frameworks are being developed and implemented to encourage private sectors to be involved through the Power Purchase Agreements (PPAs), where private developers sell electricity to the government. The involvement of Independent Power Producers (IPPs) in the energy market is supported through the electricity operations regulations (49/1999). This is being strongly encouraged as the involvement of private sector has huge impact in creating the options for financing of energy development projects. However, this has not been materialised

and the government should implement this policy as quickly as possible so that private sectors and communities will have the chance to involve and own wind farm power generation systems. This will have significant co-benefits in one hand the advantages of community owned wind farms will be realised as experienced in other countries, and on the other hand this will facilitate and improve access to electricity because of the diversified financing options.

With the implementation of these recommended policies in synergy with the existing national policies, there is huge opportunity for Ethiopia to fulfil the ambition of becoming wind capital of Africa considering the immense resource available in the country.

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