SYNOPSIS

A STUDY ON SOCIO-ECONOMIC SUSTAINABILITY OF WIND POWER IN TIRUNELVELI DISTRICT

INTRODUCTION

The world today is behind two resources - Energy and water. The supremacy of a nation is measured increasingly in terms of these two resources. India ranks sixth in the world in total energy consumption. Energy is measured in the terms of Electricity. Energy is one of the most important building blocks in human development, and as such, acts as a key factor in determining the economic development of all the countries. In an effort to meet the demands of a developing nation, the energy sector has witnessed a rapid growth. Energy resources are broadly classified into two types- Renewable and Non-renewable sources. It is important to note that non-renewable resources are significantly depleted by human use, whereas renewable resources are produced by ongoing processes that can sustain indefinite human exploitation. The use of renewable resources of energy is rapidly increasing worldwide. India is currently facing a peculiar problem of demand-supply gap in power. The power scenario in India continues to be grim even as the country gears up to expand its power supply to bridge the large demand- supply gap. The peak hours demand and supply gap is also experienced in the Indian power sector. But now-a-days, these gaps are reducing a lot due to the increasing installation of power plant in many sources including in the renewable sector also. Wind is one of the most cost effective in the renewable energy technologies. Power generation from wind has emerged as an economically viable option to meet the current energy deficit in the country. India's renewable energy sector is amongst the world's most active players in renewable energy utilization, especially solar and wind electricity generation. Wind power is the largest renewable energy source. New wind is

created everyday by heating and cooling of the earth. The price of wind power is not affected by fuel price increases or supply disruptions. Thus wind appears to be promising.

Wind power is the conversion of wind energy into useful forms of energy, such as using wind turbines to make electricity, wind mills for mechanical power, wind pumps for pumping water or drainage or sails to propel ships. Improving efficiency and falling costs of wind turbine production and installation will make wind power more price competitive. The worldwide installed capacity of wind power is 539,581 MW. At the end of March 2018, 119 countries around the world are using wind power on a commercial basis. It is supplying nearly 10 per cent of world's electricity. The industry of wind energy is therefore becoming one of the most promising solutions to the current world energy concerns.

Wind energy is the fastest growing renewable energy sector now in India, which is, the world's 4^{th} largest wind power nation. The largest wind power generating state is Tamil Nadu accounting for nearly 23 per cent of installed capacity, followed in decreasing order by Gujarat, Maharashtra, Rajasthan and Karnataka.

STATEMENT OF THE PROBLEM

Climate change is happening faster than expected. The world will need to reduce CO_2 emissions, without stalling the economic growth. There is a bright spot on the rural economic development horizon: wind energy. Wind Power is a 70 billion dollar industry that employs over half a million people worldwide. Wind energy is associated to job creation mainly in the manufacturing sector and locally during the construction stage and running of the project. It will provide nearly 50 construction jobs for 6 months and 2 long years for many sustainable jobs. This time is ripe to invest in wind energy as it has proved its economic and social sustainability over the last two decades. The sustainability is the core principle of livelihood security and well being.

The primary objective of the sustainability is to reduce the absolute poverty, resource depletion, environmental degradation. These can be made to some extent by the wind power industries.

Economic sustainability is achieved when a given level of expenditure can be maintained over time. It also considers the economic viability of the units. It attracted a significant investment of capital in a developing region. The past investors who merely invested in this sector experienced the fruitfulness of their investments. It creates more employment opportunities directly and indirectly. This will positively influence the country's economy.

Social sustainability involves ideas of human knowledge, quality of life and social skills which maintain a society and equip the people of local community with the development of a particular area of concern. It helps to alleviate poverty, removing social disparities and contributing to provision of basic amenities. Wind energy projects provide new jobs, a new source of revenue for farmers and ranchers, and an increased local tax base for rural communities. Wind energy projects create new jobs in rural communities in manufacturing, transportation, and project construction. Local labour is often used for project construction, like building roads and erecting turbines. Once the projects are complete, jobs are created in the operation and maintenance of the projects. Wind turbines have a minimal effect on farming and ranching operations. The turbines have a small foot print, so crops can be grown and livestock can be grazed right up to the base of the turbine. Property tax payments from utility-scale wind projects provide much-needed revenue to rural communities for building new schools, roads, bridges and other community infrastructure. In order to find out the sustainable position, an in depth study in these areas are needed. **"A Study on Socio-Economic Sustainability of Wind Power in Tirunelveli District" is** made to know the economic sustainability among the investors point of view by the analyzing the feasibility of the project and social sustainability in the study area.

SCOPE OF THE STUDY

The present study aims to cover the wind power projects which are installed in the Tirunelveli District alone. The study focuses on the development of that area due to the installation of wind power from 1980's onwards. There is two dimension of analyzing the development of the industry and its sustainable position in the years to come. It is done by economic analysis for the benefits achieved by the investors who invested in the wind project and social analysis by studying the development of that areas by assessing their expenditure and assets possession of the people residing in that area. Their sustainable position paves the way for future generation to prevail in the green clean energy which protects the environment.

OBJECTIVES OF THE STUDY

The following are the objectives of the present study:

- To describe the growth and development of wind power in general.
- To analyse the economic viability by measuring cost of wind energy.
- To assess the economic sustainability of the wind project over its lifetime.
- To examine the social sustainability of wind power by measuring the betterment of the society in the study area.
- To offer suitable suggestions based on findings to make the wind power more sustainable in future.

METHODOLOGY

The present study is a descriptive and empirical study. Descriptive study is a fact finding investigation with adequate interpretation. It is designed to gather descriptive information and provides information for formulating more sophisticated studies. Data were collected by using various appropriate

methods like observing, interviewing and scheduling to the people residing that area. The necessary facts and figures were collected through 'desk research' from libraries. This study envisages both primary data and secondary data.

Primary data consists of figures collected first hand in order to satisfy the purpose of a particular statistics enquiry. For obtaining the facts relating to the objectives of the study, primary data were collected from the people of Tirunelveli district with the help of well structured interview schedule prepared for the purpose.

The secondary data was collected from the field directly by the researcher and from the monthly reports, annual reports, bulletins of Central Statistical Authority related to energy. The other sources such as souvenirs, publications and articles in journals, magazines are also used for this study. Reference of newspapers, brouchers, pamphlets and surfing through the internet are also made for this study. In the present study, out of the total population of 3,077,233 in Tirunelveli, a sample of 385 respondents was determined as sample size using Raosoft Calculator. But the researcher is able to collect 396 respondents from the study area. The sampling size includes Male and Female respondents and respondents from various age groups and Education. Willingness of the respondents was considered essential for the study. Hence, those respondents who felt convenient and interested were included in the study. In the present study, the survey envisaged the application of proportionate random sampling technique. Out of this total population of 3077233 in Tirunelveli district, the samples are selected from the 11 taluks. The field work for collecting the primary data is carried out by the researcher between April 2016 and May 2017 covering a period of 13 months.

LIMITATIONS OF THE STUDY

Limitations of the present study are:

- Out of four passes receiving wind energy in Tamilnadu state, the sample study is based on Tirunelveli District only.

- Among the various capacities of Wind Electric Generator, only 225 KW, 600 KW, 750KW and 1 MW capacities of Wind Electric Generators are studied.

- Changes in the government policies regarding wind project at any time might have impact on the study result.

- The main limitation of the study relates to the qualitative nature of several responses which are analyzed on the basis of scoring or ranking accorded by the study participants. The result is limited to the reliability of the respondents' rating made in the study area.

CHAPTERISATION

The present study entitled **"A Study on Socio-Economic Sustainability of Wind Power in Tirunelveli District"** has been organized into six chapters.

- The first chapter has presented "**Introduction and Design of the Study**".

  This chapter covers the introduction, statement of the problem, scope of the study, objectives of the study, methodology, hypotheses, conceptual definition, limitations of the study and chapterisation.

- The second chapter entitled the "**Review of Literature**",

  This chapter reveals the review of literature about wind energy and review of literature about the sustainability of wind power to find the research gap.

- The third chapter throws light on the **"Wind Power Scenario".**

  This chapter deals with history and development of wind power, significance of wind power and its installation at Global, National and Tamilnadu level and also at Tirunelveli district.

- The fourth chapter focuses attention on the "**Economic Sustainability of Wind Power**".

  This chapter deals an analysis on the economic feasibility of the wind power for the investors who can sustain economical for many years in the wind power project by analyzing through Pay Back Period, Debt Service Coverage Ratio, Internal Rate of Return (IRR), Equity IRR, Net Present Value, Benefit Cost Ratio, Net cash Accruals.

- The fifth chapter focuses attention on the **"Social Sustainability of Wind Power**".

  This chapter deals about the social sustainability of the wind power for the people who are residing in the study area by analyzing betterment of their livelihood and satisfaction they get due to the installation of wind power in their area.

- The fifth chapter discloses the "**Summary of Findings, Suggestions and Conclusion**".

  This chapter presents summary of findings done in the research and some suggestions to the government and investors to maintain a sustainable position for the future generations to live without harnessing the environment by providing a clean energy with the use of wind power.

FINDINGS OF THE STUDY

- The economic viability of the project is analysed by computing the Payback period, Debt Service Coverage Ratio, Internal Rate of Return, Net Present Value, Benefit Cost Ratio and net cash accruals. The project cost for different capacity of Wind Electric Generators (WEG) is collected from the wind mill investors in the study area for the purpose. Mainly these four capacities (225KW, 600KW, 750 KW, 1MW) are in use in the study area.

- The opinion of the respondents regarding improvement in basic facilities after the installation of wind mill is analysed using t-test.
- The t value of all the basic facilities is less than 0.05. Hence the null hypothesis is rejected at 5% level of significance. There is a significant difference in the opinion of the respondents regarding improvement in basic facilities after the installation of wind power.
- To test whether there is any change in the expenditure pattern of the respondents at present compared to 10 years before, paired t –Test is applied
- The study reveals that the significant value of all the 11 items considered is less than 0.05. Hence, null hypothesis is rejected at 5% level of significance. It is concluded that there is a significant difference between the expenditure pattern of the respondents before 10 years and at present.
- It also shows that the mean value of each item at present is higher than the mean value of respective items before 10 years. Overall, it indicates that there is an increase in the level of expenditure on various items at present.
- To test whether there is any change in the asset possession of the respondents at present compared to 10 years before, paired t –Test is applied. The test signifies that the significant values of all the items are less than 0.05. Hence, null hypothesis is rejected at 5% level of significance. There is a significant difference between the asset possession of the respondents before 10 years and at present.
- It is found that the mean value of each item at present is higher than the mean value of respective item before 10 years. Overall, it indicates an increase in the level of asset possession on various things at present.

- To find the factors which are positively contributing towards the satisfaction of the respondents due to installation of wind power, Multiple regressions is used in this study.

In a nut shell

- Environment protection by way of clean energy contributes towards the satisfaction of the respondents due to installation of wind power to the extent of 17.8 per cent.
- Procurement of own house contributes towards the satisfaction of the respondents due to installation of wind power to the extent of 9.7 per cent.
- Upgradation of road facilities contributes towards the satisfaction of the respondents due to installation of wind power to the extent of 8.6 per cent.
- Increased number of water tanks contributes towards the satisfaction of the respondents due to installation of wind power to the extent of 8.4 per cent.
- Improvement in life style contributes towards the satisfaction of the respondents due to installation of wind power to the extent of 7.2 per cent.
- Better sanitation facility contributes towards the satisfaction of the respondents due to installation of wind power to the extent of 6.8 per cent.
- Improved transport facility contributes towards the satisfaction of the respondents due to installation of wind power to the extent of 6.3 per cent.

- Shift to Comfortable house contributes towards the satisfaction of the respondents due to installation of wind power to the extent of 6.1 per cent.
- Based on standardized coefficient value, X_6 Procurement of own house is the most important factor on the satisfaction due to wind power followed by X_{14} Increased number of water tanks, X_7 Improvement in life style, X_1 Upgradation in road facilities, X_{13} Better sanitation facility, X_5 Shift to comfortable house, X_{18} Environment protection by way of clean energy, X_{11} Improved banking service, X_8 Savings grown, X_{10} Improved medical service, X_{15} Community halls, X_{17} Increased number of retail shop, X_4 Fair distribution of income, X_2 Improved education facilities, X_3 Creation of job opportunities, X_{12} Improved post office service and X_{16} Recognition of wind power.

SUGGESTIONS

Based on the findings of the study, the researcher has made some suggestions to the government, manufacturers and investors.

To the Government

- Government can declare wind as a priority sector.
- Government can encourage the alternate power generation (solar, natural gas, bio-mass, etc) units of smaller capacities to make up the reduction in generation from wind energy to have continuous flow of supply and assured quantum at all times.
- The transmission line shortage during high wind season can be overcome by erecting adequate high- tension (HT) lines, sub-stations and grid.
- Power Grid Corporation can develop more transmission lines and additional central grid to minimize local grid drops. Further such facilities may assist to get higher cost per unit by sale of generated power to the user of other states.

- Most of the wind turbine design and supply are from foreign countries. Indian government has to support Research and Development in wind mill to develop the domestic technology.
- Tariff by Tamilnadu government for wind power can be increased at par with other states.
- Installation of windmills by the cluster of investors to be encouraged.
- Lengthy formalities for the installation of windmills to be minimized
- Policy relating to installation of wind mills to be liberalized.

To the Manufacturers and Service Providers

- Many industries have to be developed to manufacture indigenously wind turbine design and components under 'Make in India' scheme which will improve availability of components at comparatively low cost.
- The manufacturing of components for Wind Electric Generator by small scale industries must be motivated to promote MSMEs.
- Bird repellent can be attached at the corner of the blades to avoid the impact on birds.
- Lift Mechanism and Rope-climbing Robot can be installed by adopting new technologies to avoid endanger of the workers who are climbing the tower for maintenance or repair works.
- Adequate number of operators should be appointed to enhance proper maintenance. Maintenance Registers should be counter checked by the authorities regularly. These measures will surely reduce and prevent noise pollution.

To the Investors

- After the designed project period, the generation from the machines will be low and comparatively maintenance cost will be higher. To improve the productivity and to reduce the cost with available wind resource the investors may consider replacement of lower capacity old technology machine with higher capacity hybrid machines.

- Re-powering of old machines can be made to reduce the installation cost of new machines.

- By making use of Remote Machine Operational Monitoring System, the operation conditions can be improved. Maintenance cost can be reduced which will result in improved generation and optimum profit.

CONCLUSION

The installation of wind power in the study area provides a lot of job opportunities in the private sector which in turns makes the people socially sustainable in the society. Their expenditure and assets possession is increased considerably their standard of living paves the way for development of many aspects in their livelihood. The installation of wind power provides many infrastructural developments like road facilities, common water tanks, transport, sanitation facilities etc. The land used for wind turbines can also be used for other purposes such as grazing and farming activities which does not affect the income of the farming families. Wind power project yields sufficient rate of return for the investments to the investors. Wind energy is economically sustainable and investment in wind power projects is therefore most attractive in long-term perspective with initially lower but subsequently higher and assured return during 20 years.

Wind power is playing a key role in the development of the country's economy by facilitating production of electric power in reliable, secure and most economical manner and reduces the environmental pollution. The wind power installed in the study area proved that it maintains a sustainable position for the future generations to live without harming the environment by providing a clean energy.

SCOPE FOR FURTHER RESEARCH

It is hoped that the present study would open avenues for further research in the area under investigation. The research study is particularly useful to those future researchers to serve as guidance and probe deep into the wind power sector. The economic and social sustainability of the wind power is analysed by the researcher in detail. On the basis of findings of the present study, the researcher would like to suggest the following for future research.

- A study on Technical and Environmental Sustainability of Wind Power.
- A Study on Socio-Economic Conditions of the Wind Mill Workers in Tirunelveli District.
- A Comparative Study on Investment Cost for Solar and Wind Power.
- A Study on Renewable Energy Sources of Electric Generation in Tamilnadu.