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A MAJOR GEOGRAPHICAL HUB FOR INSTALLATION OF WIND FARM SITES DHULE & NANDURBAR DISTRICT MS. (INDIA)

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abstract-

Over utilization of conventional energy resources creates environmental problem such as global warming, depletion of ozone, climatic changes etc. This ultimately led to use of alternate sources of energy which include non-conventional sources of energy e.g. solar energy, wind energy, tidal energy etc. Growing concerns over climate change, rising energy prices and access to electricity helped renewable energy grow faster than non-renewable energy in 2004 and 2005. The fastest growing renewable energy technology over the last ten years has been wind energy; this grew by an average of 18.4 percent per year between 1995 and 2005. In 2006, wind energy installed of 14,900 MW out of total installed capacity of 73,904 MW worldwide wind energy.

Wind energy is not only the power generation technology that can deliver the deep cuts in CO2 emissions the world needs to combat the worst effects of climate change, it also provides numerous other environmental benefits. It has a positive effect on air pollution, which is choking cities around the world, by not emitting dangerous air pollutants as other generation technologies. Wind energy does not produce any toxic waste. And in addition, wind energy uses virtually no water, which, in an increasingly water stressed world, is a major environmental consideration.

Key words- Wind Energy, CO2 emissions, Wind Resource Assessment (WRA), Mean Wind Speed m/s, Wind Turbine Generator (WTGs), Wind Power Density (WPD).

Intorduction-

Development of any nation depends on availability of its natural resources. Among of all natural resources, an energy resource is significant one. This is because almost all the developmental activities are depending upon energy. Dynamic development, demands of growing population, agriculture, transportation, industry, mining etc. need energy. Therefore, energy is the most significant factor for all purposes.

Now a day's conventional energy resources like coal, oil and natural gas are being utilized on large scale. Due to over utilization of conventional energy resources these are not going to last for many more years. Non-conventional energy sources provide adequate amount of energy over a long period of time and they can be used again and again. Among these sources of energy, wind energy is important one.

Wind Energy is the energy created due to heating of the Earth's surface and rotation of Earth. Uneven heating of different parts of the Earth causes difference in the air pressure, which causes air to flow from high-pressure region to low pressure region. This phenomenon is termed as 'wind'. Wind contains tremendous amount of energy and is utilized to generate power on a large scale.

Wind energy technology is a mature technology and is the most promising renewable energy technologies. Wind energy technology can be considered least expensive compared to other renewable technologies. Environmentally also it is a clean source of energy. Wind power has become established in the Indian energy sector also.

Wind energy is very useful because it does not cause air pollution. There are many wind energy projects in our country. One of the wind energy projects is introduced in Dhule and

Nandurbar district researcher has selected the same study area which lies in the north of Sahyadri ranges.

Motivation and objectives of the paper:-

The present paper study objectives are as follows:

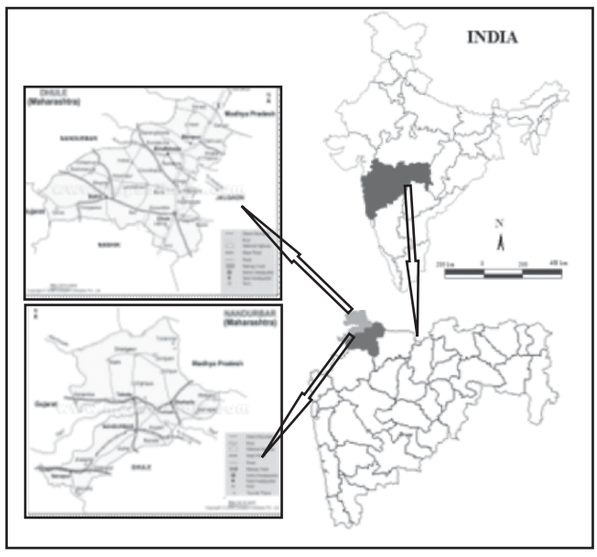
1) To the present paper study main objective of Wind Resource Assessment (WRA) programme is to select suitable windy site location for study, the wind direction, wind speed and wind power density etc.
2) To understand respective location for declaration of the feasibility of the site for development of wind farm in Dhule & Nandurbar District.

Study methods and material:-

The present paper study is based on primary and secondary sources of data. Primary data was collected by visiting Wind Tower Generator (WTGs) company and observation of physical fact at Dhule and Nandurbar District wind energy project area. Secondary data was collected of various sources of information such as topographical maps (in India, Survey of India map), there is 1:2,50,000 scale map and Climatologically data from meteorological stations (e.g. India Meteorological Department), an instrumented mast (tower) needs to be installed at selected sites for collection of monitoring wind data. Wind speed and direction parameters are measured. Preparation of Wind Energy density map, Wind Atlas and reference wind data and satellite imageries, etc. A site visit was conducted at this stage and a representative location for wind measurement identified.

Location of study region:

map no.01: location map of wind farm



Details of physical location the project activity involves installation of windmills located at Sakri Tahsil in Dhule district and Nandurbar tehsil in Nandurbar District in the state of Maharashtra, India. The nearest connectivity is National Asian Highway No 46. Wind tower generator WTG's wise location details are as follows. The Dhule district is situated in the northern part of Maharashtra and

extends over an area of 8063.11 sq. km. between latitudes 200 38' and 210 39' North and longitudes 730 50' and 75013' East. And Nandurbar district is also situated in the northwestern part of Maharashtra (Map No.01), extends over an area of 5034.23 sq. km. between latitudes 210 00' and 220 03' North and longitudes 730 34' and 740 47' East. Physical factors play an important role for the establishment of wind energy project in Dhule and Nandurbar Districts.

Discusion:-

The Dhule and Nandurbar Wind Farm are Asia's largest wind farms with an installed capacity in excess of 875 MW. Identification of feasible sites wind measurement have been carried out so far at 72 locations in Maharashtra out of which 33 locations are declared feasible for setting up wind power project in the state. The distribution of these 4 sites in The Dhule and Nandurbar districts is as follows (Table No.01).

This project is located in Sakri tehsil in the Dhule district and Nandurbar tehsil in the Nandurbar district. The site in Brahmanvel, Raipur and Jaibhim is located in Sakri tehsil Dhule district. Chakala is located at Nandurbar tehsil the region in Maharashtra these projects have come up during 1999-2015.

Table No.01: Dhule and Nandurbar districts Site wise Wind Farm Installations (30 Sep 2014)

Name of site	District	No. of Wind Turbines	Wind Turbine Make	Capacity kW per Turbine	Total Capacity MW
Brahmanwel	Dhule	5	Windia	600	3.000
		4	Windia	750	3.000
		20	NEG - Micon	750	15.000
		23	NEG - Micon	1650	37.950
		16	Suzlon Energy	600	9.600
		377	Suzlon Energy	1250	471.250
		4	Suzlon Energy	1500	6.000
		1	Suzlon Energy	2100	2.100
Sub -total		**450**			**547.900** MW
Jaibhim	Dhule	16	Suzlon Energy	2100	33.6
Sub -total		**16**			**33.600** MW
Chakala	Nandurbar	154	Suzlon Energy	1250	192.500
		66	Suzlon Energy	1500	99.000
		10	Suzlon Energy	2100	21.000
Sub -total		**230**			**312.500** MW
Total=		**696**			**894.000** MW

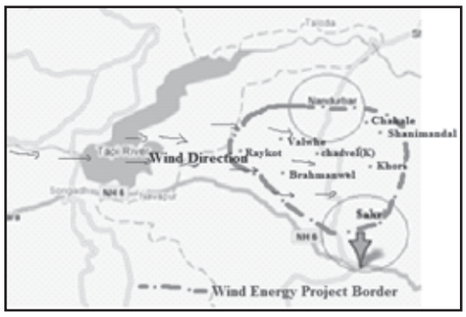
Source: - Maharashtra Energy Development Agency (MEDA)

Sakri tehsil is the north part hilly region and the wind speed is always very high, thus, mean annual wind speed 23.1 km/h at 30m height. Mean annual wind power density 324 w/m2 at 50m

height and 278 w/m2 at mast. Some villages are selected for plan establishment e.g. Chadvel, korde, Amkhel, Basar, Valwhe, Kaltek, Navapada, Brahmanwel, Khori, Titane, Pagan, Panalipada, Achaia, Indve, Dusane. Some southern part of Nandurbar tehsil included in this project, some villages covered by wind energy plan in same Dist. i.e. Shanimandal, Thanepada, Vavad, Dhandane, Rajale, Balwand, Cakale, Aakhatwada etc.

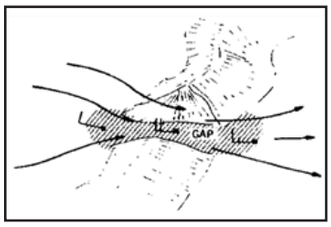
These wind energy project site are above 1000 Wind Mill tower installation. There installed wind farm wind turbines are 600 kW, 750kW, 1250 kW, 1500 kW, 1650kw and 2100 kW capacity. This site following more Geographical favorable condition is affecting the attractiveness of Wind Mill Installation in this region.

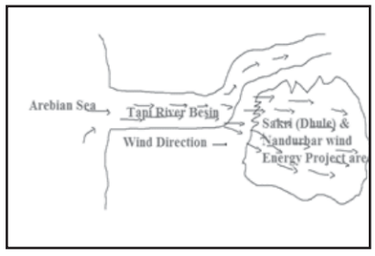
The Ideal Condition for Wind Mill Installation in Dhule and Nandurbar Districts

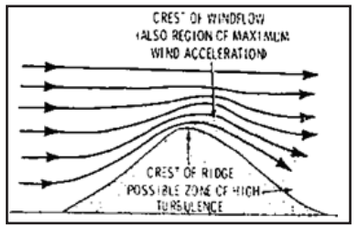


1. Wind without barrier flowing from the Arabian Sea motion besides to Tapi river basin provides wind gap portion, mean the speed of wind is greater than the general surroundings. Where local winds can funnel the partic ular wind mill area.

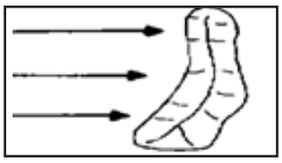
2. The site can be in upper Sahyadrian ranges, orographical hilly homogeneous topographical region 300 to 600 meter elevation within a given area.



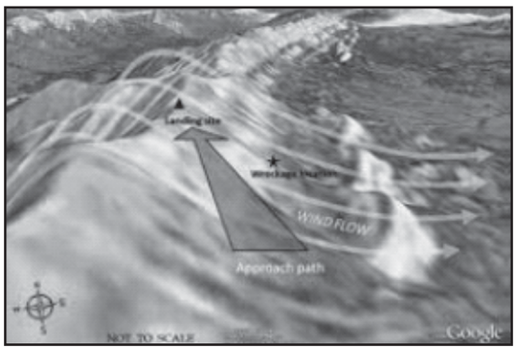




3. This region is ridges oriented at right angles to the prevailing wind direction. Wind arising the ridge top for that atmospheric pressure reason wind compresses the particular way as wind speed is almost high.



4. The site should not be in forest area with scanty vegetation cover very high roughness that retards wind also forest areas with open appearance that subsequently may not be available for power project should not be considered. However such areas in case available can be considered for assessment of the wind potential in the region.



3. It should have open environment all around rocky soils the sectors of prevailing wind direction. So that the many places of this region also made favorable condition for the establishment of wind mill tower.
4. Sites with sufficient available land area for commissioning of power projects of MW capacity needs to be given preference.
5. The sites being selected in non-flat terrain, sites needs to be located in probable locations which have the advantages of accelerate flow due to the complexity of the region. The probable locations in this region could be ridges, hills and mountains that are suitable to the prevailing wind direction. Passes, gaps and valleys that can enhance winds also can be considered.
6. These Sites are not prone area to environmental hazards such as frequent thunderstorms, severe icing and snow, floods, lands slides, severe salt spray and areas of blowing dust; earth quake etc. can be avoided to a certain extent if better alternatives are not available.
7. Easy accessibility to the site is an important criterion. The site offers good potential with considerable area availability but lacks accessibility in the beginning; this is to be considered as road formation at a later stage may be viable. The wind power project site nearest connectivity is National Asian Highway No 46 and Nandurbar-Solapur state highway connected this wind mill area.
8. The area should not be very close to habitation to avoid flying objects causing damages to life and property as wind farms come up.
9. Concern of ecological indicators like the deformation of vegetation by winds in regions.
10. Areas of high turbulence, strong wind shear and extreme winds are to be considered with caution. A displaying a year of wind data is a wind frequency distribution, which shows the percentage of time that each wind speed occurs. Western direction is major wind direction in these sites.
11. The direction of wind is also an important factor that dictates the location of the wind farm. For example, if the site receives major share of wind energy from a specific direction, then it is crucial to avoid any barrier to wind flow in that particular direction.
12. Analysis of all available data of the region considered along with contour maps is to be studied to locate probable windy locations for detailed wind monitoring. Wind power density is a useful way to evaluate the wind resource available at a potential site. The wind power density, measured in watts per square meter, indicates how much energy is available at the site for conversion by a wind turbine. The Wind power density (WPD) is 312 watts per square m/sec at 20/25 m height in Brahmanwel Site.

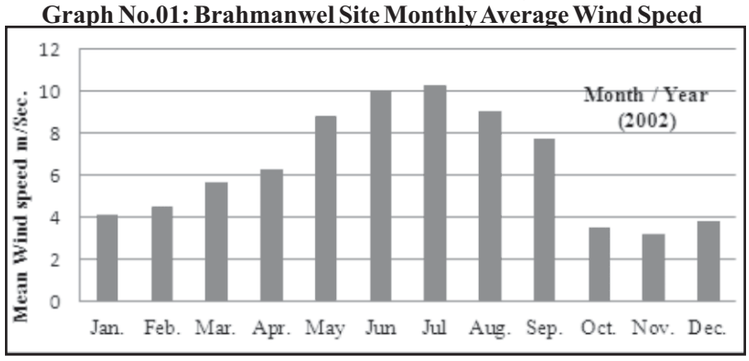
13. In the wind mill project area wind is a changeable in varies time and place. It is mostly driven by the monsoon and winds in these region are influenced by strong South-West summer monsoon month of April to September and weaker North-East winter Monsoon October to February the below numbers shows the wind speeds.

Table No.02: Monthly mean wind speeds m/sec at 20/25 m height of Brahmanwel Site:

Month/year	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul	Aug.	Sep.	Oct.	Nov.	Dec.
Mean wind speeds m/s	4.14	4.51	5.66	6.26	8.85	10.07	10.32	9.06	7.76	3.50	3.23	3.79

Source: Determination of PLF for Wind Turbine Generators.

Graph No.01: Brahmanwel Site Monthly Average Wind Speed



Source: Complier by Researcher

It is clear that wind speed is enough to the wind energy production in Brahmanwel site and there surrounding places. This figure shows that the wind speed is above 3m/s Cut-in wind speed, the month of March to September is good wind speed in the production of wind energy.

The details of wind turbine generators are compare to two various Manufacturers of WTGs Company as follows.

Table No.03: Specification of the wind turbine generators

Name of the Manufacturer of WTGs	**Suzlon Energy Ltd.**	**Vestas RRB Pvt. Ltd.**
Model	S 70	P S600
Capacity	1.25 MW	0.600 MW
Cut - in wind speed	3m/s	4m/s
Cut - off wind speed	25m/s	25m/s
Rotor Diameter (meter)	69.1	47
Hub Height (meter)	74.5	48

Source: Determination of PLF for Wind Turbine Generators.

The table shows that both Manufacturers of WTGs Company the generating wind power Suzlon Energy Ltd. WTGs model no S70, Capacity is 1.25MW stated Cut-in wind speed 3m/s. Vestas RRB Pvt. Ltd WTGs Company model no PS600 their wind power capacity is 0.600MW it Cut-in wind speed 4 m/s.

Table No.04: power curve of Suzlon S70 MW WTG

Wind Speed in m/sec	3	4	5	6	7	8	9	10	11	12	13	14 to 20
Power in kW	0	41	92	160	307	492	686	899	1074	1184	1222	1250

Source: Determination of PLF for Wind Turbine Generators.

The power curves of these wind turbine generators used for energy estimation are shown in the figure given above power production start Cut-in wind speed 3m/s and Cut-off wind speed of above 14 m/s.

Conclusion:

1. The Dhule and Nandurbar districts wind energy project region the wind direction is an important factor that dictates the location of the wind farm. For example, this site receives Tapi river basin gap provides wind, major share of wind energy from a particular direction, then it is important to avoid any barrier to wind flow in that particular direction.
2. The wind energy project region is good annual average wind power density (WPD) at 50 M height is found to be above 200 W/M2 and then the site was declare for wind power project development.
3. The wind energy project is enough essential requirements for an installation of Wind farm. The following essential requirements for establishment of a wind farm for most favorable exploitation of the wind are the:

i. High wind resource at particular site,
ii. Adequate land availability,
iii. The range of several square kilometers area available.
iv. Suitable terrain and good soil condition,
v. Maintenance access to site,
vi. Suitable power grid nearby,
vii. Suitable nearby road connectivity,
viii. Techno-economic selection of specific turbines,
ix. Scientifically prepared layout etc.

Wind energy generation has influence the extent and type of role it will ultimately play in overall generation of electricity in our country. Being a wind energy renewable resource, using wind energy to generate electricity contributes to resource conservation.

Abbreviations and Acronyms	
CO_2	Carbon dioxide
kW	kilowatts
km/h	kilometer per hour
MEDA	Maharashtra Energy Development Agency
MW	Mega Watts
m/s	meter per second
PLF	Plant Load Factor
W/M^2	Watts per square meter
WPD	Wind Power Density
WRA	Wind Resource Assessment
WTG	Wind Tower Generator

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