New Location Selection Criterions for Solar PV Power Plant

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Abstract- India is the seventh largest country in the world map on the basis of size and blessed with adequate solar radiation, therefore to setting up a Photovoltaic power plant is a lucrative option. Indian climatic conditions vary enormously from east to west and north to south due to its geographical position in the world map. It is also observed that in actual field conditions the performance of the PV modules vary significantly when compared to Standard Test Condition (STC) due to large change in environmental conditions. Now it is very important to study the exact meteorological parameters for different locations in India before installation of a Photovoltaic power plant. In this paper, the long-term meteorological parameters for the seventy considered locations in India from National Aeronautics and Space Administration (NASA) renewable energy resource website (Surface Meteorology and Solar Energy) are collected and analyzed in order to study the behaviour of solar radiation, insolation on an equator-pointed surface that is tilted at latitude angle, insolation clearness index, daylight hours, air temperature and relative humidity of India to select an ideal location for installation of PV power plant. Latitude angle tilted fixed PV panel is considered here as it is less costly and also requires less maintenance. The analysis of the paper helps the investors, Ministry of New and Renewable Energy (MNRE), Electricity Authority and Planning Commission to know which locations in India are environmentally ideal for installation of PV power plant.

Keywords- Meteorological parameter, Photovoltaic power, STC, Solar radiation, Location selection.

1. Introduction

Technological dependency of the modern world on fossil fuels and the ways in which these fuels have gradually degrading the earth's environment is pretty alarming [1, 2]. In this present generation, climate is receiving extraordinary awareness because, human activity on earth for the last hundred years is considerably diverse which resulted rapid changes in the environmental conditions [3].

Energy demand of India is increasing day by day to supplement its ambitious economic growth. Affordable and sustainable energy is one of the key to improve the quality of life [4]. Currently, India suffers from a major shortage of electrical power generation [5]. Technology is a key factor of future energy policy for the country. Suitable technological choices are vital for both supply and demand sides.

To meet this huge energy demand and to provide a clean environment for the future generation renewable energy should be given preference in India [6].Among the various renewable energy resources, India is enriched with ample potential of solar energy generation due to its geographical location near Tropic of Cancer [7]. In India nearly 58% areas are receiving annual average Global insolation more than 5 kWh/m^2/day [8]. Considering the long run effect of pollutants from fossil fuels on human health and environment [9], electricity generation from PV module is an alternative cost effective solution [10-12].

A lot of work has been done on analysis of the environmental factors that influence the performance of PV module [13-16]. Solar insolation and ambient temperature are the two main factors that affect the performance of PV module. On the other hand, the performance of PV module is circuitously prejudiced by other several parameters such as solar radiation incident angle, sunshine duration, humidity, dust [17] etc.

In SWERA project, Martins et al. prepared solar energy resource map of Brazil utilising satellite irradiation model and NREL irradiation data [18]. The prospect of solar radiation in various regions of Iran was studied by Besarati et al. and solar radiation maps were also generated [19]. Polo et al. estimated daily global horizontal and direct normal irradiation for six locations in India from the year 2000 to 2007 [20]. For feasibility study of PV power plants in Egypt long-term meteorological parameters for 29 considered sites were analyzed by Shimy [21]. Four meteorological parameters are analyzed in viability study of Solar PV plants in Egypt but insolation clearness index and solar insolation in equator pointed surface that is tilted at latitude angle were not considered in this paper [21]. Sharma and Tiwari evaluated the technical performance of 2.32 kW_p stand-alone PV array systems in New Delhi considering insolation, temperature and sunshine hours [22]. Other meteorological parameters except solar radiation were not analyzed in [18, 19, 21] and only six locations of India were considered in [20]. Precise information on the performance of unlike Photovoltaic technologies in practical field is essential for estimation of energy generation [23].

For India these meteorological parameter analysis is very important for successful implementation of solar PV plants. These parameters analysis is a bridge between the resource available in India and the actual power output from installed PV plants.

2. Meteorological Parameters Effecting The Output of Pv Module

Power output of PV modules is rated at standard test condition (STC), i.e., incident solar irradiance: 1 kW/m^2; module temperature: 25˚C and solar spectrum distribution: Air Mass (AM) 1.5G. The performance of PV modules are mainly dependent on these three environmental factors [24]. Electricity is supplied or consumed in the unit of energy. So, appropriate energy rating of PV modules is necessary. But, energy rating is extra problematical than power rating because energy rating requires meteorological parameters associated with the location of PV installation.

2.1. Effect of Irradiance

The power outputs of PV modules are mainly influenced by two factors: solar irradiance [25] and module temperature. PV current is directly proportional to irradiance and voltage has a logarithmic dependence on irradiance. A direct linear relationship has been observed in the study between solar flux and efficiency [26]. When all other parameters are not taken into account, then short-circuit current of the PV module is directly proportional to solar insolation, as a result power output is also directly proportional to the solar insolation [27]. Solar insolation is dependent on the duration of day-time, weather, ambient temperature, tilted angle with sun and the latitude of the region. Higher insolation is observed in low latitude regions than the high latitude regions [28].

2.2. Effect of Temperature Variation on PV

Performances of solar cells are temperature dependent. Temperature is one of the most important parameters for predicting the long term performance of PV cell [29]. The efficiency of the solar cell decreases with increase in temperature and depends linearly on the operating temperature. Therefore, the low temperature performance is required [30]. It is clear from previous literatures that the increasing temperature reduces the efficiency of the PV module [31]. Kesler et al. evaluated that thin-film PV panels can be used in high ambient temperature regions like Manavgat, Turkey, due to less effects of high ambient temperature on the efficiency of thin-film PV panel with respect to the mono-crystalline type [32]. From the case study of Chigueru and Ricardo in Recife and Araripina, it is seen that the temperature of the C-Si module is lower in Araripina than other two locations. So, the energy yield was higher there [33]. The results showed that the effect of the local climate conditions on the temperature of the module is considerable, as it causes reduction in generated electrical energy. Superior module temperatures in addition lead to ruin of cell-wires, encapsulant as well as reduces the module life in the field. So, temperature analysis for a particular location in India is important to know if the installation of PV power plant is profitable or not.

2.3. Degradation of PV Module

The gradual drop of the characteristics of a element or system caused by the working environment is degradation [34]. Temperature, humidity and dust are the main environmental factors which cause degradation of PV module [35-37].

All these effects are functions of meteorological conditions which depend on geographical location. Performance of PV modules can be enhanced by choosing suitable locations that have high solar irradiation, sunshine duration, mild temperature, moderate humidity, high clearness index that indicates low level of air pollution and dust concentration. Thus the same module will perform in a different way if moved from one place to another with a dissimilar climate, as performance of module is not in linear relation with irradiation. So, Meteorological parameter analysis for a particular location is important to know the feasibility of the PV power plant. In this paper an attempt has been made to analyze all aforesaid meteorological parameters to select suitable location in India for installation of PV power plant.

3. Methodology

NASA Surface Meteorology and Solar Energy database [38] is the key source of solar energy and meteorological data used in this paper. The global availability of these data on a 1°×1° grid with the same temporal, spatial resolution and same definition across all geographical regions makes this method globally applicable.

The mainland of India extends between 8°4' to 37°6' (N) North Latitude and 68°7' to 97°25' (E) East Longitudes. India is divided into 6 zones i.e. Northern, Eastern, North-Eastern, Southern, Western and Middle zone. Total 70 locations are selected from these zones. Insolation on horizontal surface, insolation incident on an equator-pointed surface that is tilted at latitude angle, insolation clearness index, daylight hours, air temperature and relative humidity data are collected for the analysis. The long-term values and the long-term monthly averaged values of the above mentioned parameters are obtained using the long-term site averages and monthly mean values for all the considered sites. Insolation on horizontal surface is the amount of electromagnetic energy (solar radiation) incident on the surface of the earth and expressed in kWh/m^2/day. Insolation clearness index is a dimensionless parameter and is defined as portion of insolation at the top of the ambiance which reaches the surface of the earth. Insolation on tilted surfaces is calculated from the monthly average insolation on a horizontal surface and expressed in kWh/m^2/day. In this paper the tilt angle of the surface is equal to the latitude angle of the considered location. Relative humidity is the ratio of real partial pressure of water vapour to the partial pressure at saturation, expressed in percent. Day light hour is the time between sunrise and sunset.

The Tropic of Cancer 23°30' N divides India almost into two halves named as Upper and Lower India. Most of the selected sites in India are shown in Fig. 1 and meteorological parameters considered are shown in Table 1. Analysis of meteorological parameters to select suitable site for installation of PV power plant in India are presented in consequent part of this paper.

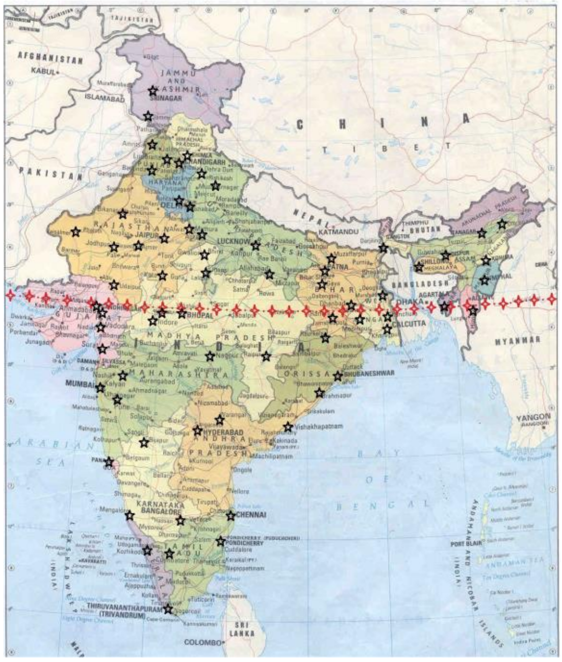

Fig. 1. Map of India locating the selected sites.

Table 1. The long-term average values of some meteorological parameters for various sites in India

Region	Location	Latitude(N)	Longitude (E)	GHI[a]	TI[b]	K_t[c]	S[d]	T[e]	RH[f]
Northern	Srinagar	34.09	74.79	1.69	5.09	0.55	12.15	5.39	61.4
	Jammu	32.73	74.87	1.94	5.92	0.62	12.13	19.8	47.9
	Shimla	31.1	77.17	1.92	5.9	0.61	12.13	7.9	58.9
	Rohtak	28.89	76.58	1.83	5.42	0.56	12.12	23.6	51
	Amritsar	31.64	74.86	1.94	5.84	0.61	12.13	22.7	47.1
	Bathinda	30.23	74.95	1.85	5.52	0.58	12.12	23.4	47.5
	Ludhiana	30.91	75.85	1.91	5.77	0.6	12.13	22.5	49.6
	Chandigarh	30.75	76.78	1.98	6	0.62	12.14	20.9	51.3
	Dehradun	30.31	78.36	1.94	5.92	0.61	12.12	11.3	58.4
	Haridwar	29.96	78.17	1.97	5.95	0.61	12.12	20	54

	Mathura	27.49	77.67	1.78	5.25	0.55	12.13	24.5	51
	Agra	27.18	78.02	1.79	5.26	0.55	12.14	24.5	52.4
	Jhansi	25.45	78.57	1.81	5.29	0.55	12.12	25.6	49.5
	Allahabad	25.45	81.85	1.82	5.32	0.55	12.12	25.3	54.4
	Varanasi	25.28	82.96	1.82	5.31	0.55	12.12	25.1	56.2
	Kanpur	26.46	80.33	1.81	5.3	0.55	12.12	25.1	54
	New Delhi	28.61	77.21	1.84	5.5	0.57	12.12	23.8	52.2
Eastern	Muzaffarpur	26.07	85.45	1.92	5.69	0.59	12.13	22.5	61.7
	Patna	25.61	85.14	1.90	5.6	0.58	12.12	24.7	61.2
	Gaya	24.75	85.01	1.78	5.19	0.54	12.12	24.6	61.6
	Ranchi	23.35	85.33	1.74	5.06	0.52	12.12	24.3	62.3
	Bokaro	23.67	86.15	1.75	5.07	0.52	12.12	24.9	64.2
	Dhanbad	22.8	86.45	1.74	5.07	0.52	12.12	25	65.9
	Siliguri	26.71	88.43	1.77	5.27	0.55	12.13	19.4	69.3
	Malda	25	88.15	1.82	5.4	0.56	12.12	24	68.3
	Krishnanagar	23.4	88.5	1.75	5.07	0.52	12.11	25.4	69.9
	Bardhaman	23.24	87.86	1.76	5.09	0.53	12.12	25.3	67.3
	Kolkata	22.57	88.37	1.70	4.94	0.51	12.12	25.6	71
	Berhampur	19.32	84.78	1.75	5.05	0.51	12.09	25.8	68.2
	Rourkela	22.25	84.88	1.78	5.2	0.53	12.12	24.3	61.1
	Bhubaneswar	20.27	85.84	1.75	5.06	0.51	12.11	25.9	67.4
North-East	Itanagar	27.1	93.62	1.44	4.21	0.45	12.13	14.6	78.3
	Kohima	25.67	94.1	1.66	4.91	0.51	12.12	20.4	72
	Imphal	24.82	93.95	1.68	4.95	0.51	12.12	21	72.1

	Aizawl	23.73	92.72	1.71	5	0.52	12.11	23	70.6
	Agartala	23.83	91.27	1.69	4.93	0.51	12.11	24.5	71.4
	Shillong	25.56	91.88	1.61	4.78	0.5	12.12	22.4	71.7
	Dibrugarh	27.48	94.9	1.43	4.23	0.45	12.13	17.1	75.3
	Guwahati	26.18	91.73	1.71	5.12	0.53	12.13	18.4	73.8
Southern	Warangal	18	79.58	1.88	5.43	0.54	12.09	27.2	55.2
	Hyderabad	17.36	78.47	1.89	5.43	0.54	12.11	26.9	55.1
	Visakhapatnam	17.69	83.22	1.85	5.3	0.53	12.1	26.6	72.4
	Coimbatore	11.02	76.97	1.81	5.07	0.5	12.08	24.4	72.4
	Chennai	13.08	80.27	1.90	5.34	0.53	12.09	27.7	68.4
	Bijapur	16.83	75.71	1.96	5.62	0.56	12.11	26.3	54.1
	Mangalore	12.87	74.88	2.04	5.76	0.57	12.09	26.5	72.9
	Bangalore	12.97	77.57	1.92	5.38	0.53	12.09	24.6	64.9
	Trivandrum	8.49	76.95	2.04	5.66	0.56	12.08	26.8	76.9
	Kozhikode (Calicut)	11.25	75.77	2.01	5.66	0.56	12.07	25.8	73.7
	Puducherry	11.93	79.78	1.88	5.21	0.52	12.08	27.1	70.8
	Goa	15.5	73.83	2.11	6.04	0.6	12.1	26.5	67.5
Western	Nagpur	21.15	79.09	1.85	5.39	0.55	12.1	26.4	50.1
	Navi Mumbai	19.02	73.02	1.85	5.35	0.54	12.1	25.2	61.4
	Mumbai	18.97	72.82	2.16	6.27	0.62	12.1	26.6	69.6
	Pune	18.52	73.86	1.86	5.41	0.54	12.1	25.2	62.6
	Gandhidham	23.08	70.13	1.89	5.45	0.56	12.12	27.7	45.8
	Ahmedabad	23.03	72.58	1.90	5.54	0.57	12.12	27.3	44.5
	Vadodara	22.3	73.20	1.93	5.61	0.57	12.12	27.5	46.2

	Surat	21.17	72.83	1.90	5.52	0.56	12.1	28.2	47.5
	Bikaner	28.02	73.31	1.80	5.24	0.55	12.12	24.5	43.5
	Jodhpur	26.28	73.02	1.90	5.5	0.57	12.11	25	44.4
	Ajmer	26.45	74.64	1.88	5.46	0.57	12.11	24.6	46.1
	Jaipur	26.93	75.82	1.84	5.37	0.56	12.11	24.6	47.3
	Kota	25.18	75.83	1.85	5.39	0.56	12.12	25.3	46.6
	Udaipur	24.58	73.68	1.88	5.48	0.57	12.12	25.6	46.1
Middle	Ujjain	23.18	75.78	1.88	5.46	0.56	12.12	26.1	46.6
	Bhopal	23.25	77.42	1.85	5.4	0.55	12.11	26	47.2
	Gwalior	26.22	78.18	1.79	5.26	0.55	12.11	25.2	50.9
	Indore	22.72	75.86	1.89	5.49	0.56	12.12	26.6	47
	Raipur	21.14	81.38	1.85	5.37	0.55	12.1	25.6	54.7

[a]GHI: Averaged insolation on horizontal surface (MWh/m^2/Year).
[b]TI: Annual averaged insolation on equator pointed surface i.e. tilted at latitude angle (KWh/m^2/Day).
[c]K_t: Annual averaged insolation clearness index.
[d]S: Annual averaged daylight hours(h).
[e]T: Annual averaged air temperature (°C).
[f]RH: Annual averaged relative humidity (%).

4. Methodology

The long-term monthly average of insolation incident on a horizontal surface (MWh/m^2/year) and insolation incident on an equator-pointed surface that is tilted at latitude angle over India are shown in Figs. 2 and 3, respectively. The long-term averaged monthly variations of global solar radiation over India as shown in Fig. 2 are obtained using monthly average values for all the considered 70 sites.

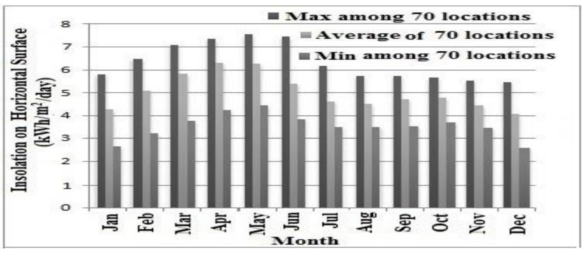

Fig. 2. The long-term monthly averaged, maximum and minimum insolation incident on a horizontal surface over India

-Based on Table 1 and Fig. 2, the global solar radiation is geographically dependent such that it varies from a minimum value of 1.43 MWh/m^2/year at Dibrugarh (Assam) to a maximum value of 2.16 MWh/m^2/year at Mumbai (Maharashtra).

-It is clear from Table 1, the amount of solar radiation is higher in west and south part and lower in north – eastern part of India with an average global solar radiation of 5.03kW/m^2/day over the whole region (only 70 locations are considered). India can be considered as one of the best regions for solar energy related projects.

-In Mumbai, Jammu and Haridwar average daily global insolation varies respectively from 5.09-7.37kWh/m^2/day, 3.15-7.47kWh/m^2/day and 3.64-7.59kWh/m^2/day. Among these 70 locations maximum and minimum annual average insolation on horizontal surface is found in Mumbai and Itanagar as 5.93kWh/m^2/day and 3.92kWh/m^2/day respectively.

-According to Fig. 2, it is understandable that superior solar radiation were observed during summer months and inferior in the winter months. A maximum value of 6.32 kWh/m^2/day is found in April while the minimum of 4.10 kWh/m^2/day in December. The seasonal blueprint of the solar radiations matches with the electrical load pattern in India.

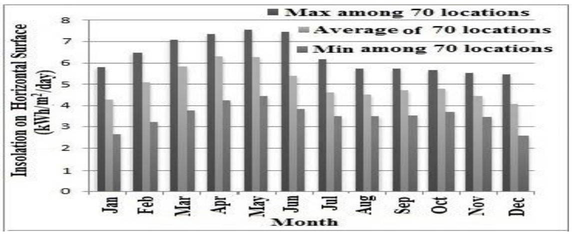

Fig. 3. The long-term monthly averaged, max and min insolation incident on an equator-pointed latitude angle tilted Surface over India

The long-term monthly averaged, maximum, minimum insolation (kWh/m^2/day) incident on an equator-pointed surface that is tilted at latitude angle over India (for selected 70 locations) are shown in Fig.3.

-Maximum annual averaged titled insolation is 6.27kWh/m^2/day in Mumbai, where as minimum is 4.21kWh/m^2/day in Itanagar.

-Maximum value of insolation incident on equator facing surface that is tilted at latitude angle is found 7.46kWh/m^2/day in the month of March at Mumbai and minimum 3.34kWh/m^2/day in the month of August at Navi Mumbai.

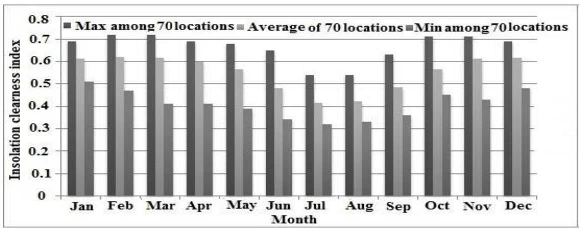

Fig. 4. Long-term monthly averaged, maximum and minimum Insolation Clearness Index (0 to 1.0) over various sites in India

Insolation clearness index is a dimensionless parameter. The long-term monthly averaged, maximum, minimum insolation clearness index for 70 locations are shown in Fig. 4. Higher clearness index indicates good quantity of solar radiation reaches to the earth.

-Annual average insolation clearness index is maximum 0.62 at Mumbai, Jammu and Chandigarh and minimum 0.45 at Itanagar and Dibrugarh of Assam.

-Considering monthly insolation clearness index for 70 locations maximum 0.73 is found in the month of November at Shimla and minimum (0.32) is in Shilong during the month of July. It indicates during the month of November at Shimla most of the radiation from the outer atmosphere reaches to the earth.

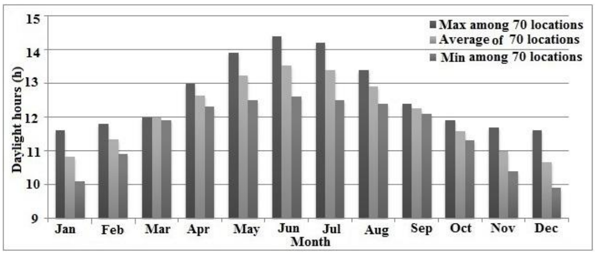

Fig. 5. Long-term monthly averaged, maximum and minimum daylight hours over various sites in India

Time between sunrise and sunset is considered as daylight hours. The long-term monthly averaged daylight (hours) over India (70 locations are considered) are shown in Fig. 5.

-It is clear from Fig. 5 and Table 1 that the daylight hours are insignificantly dependent on the geographical locations and at least 10 hrs of daylight hours exist over India.

-Fig. 5 shows that, the daylight hours are longer in summer months (maximum in June) and shorter in winter months (minimum in December) for all the considered locations.

-Maximum daylight hours of 14.4hrs occur at June and a minimum of 9.9hrs occurs at December. But unexpectedly both the maximum and minimum daylight hours among 70 locations is observed in Srinagar during different months of the year.

-Annual average value of daylight hours is maximum 12.15hrs in Srinagar and minimum 12.07hrs in Kozhikode (Calicut) of Kerala.

To ensure the green settlement in India with the essential criterion of working conditions for PV modules a revision of the long-term monthly averaged air temperature and the long-term monthly averaged relative humidity is conceded out with significant data obtained from NASA renewable energy resource website (Surface Meteorology and Solar Energy)[28]. The long-term annual averaged air temperature at 10 m above the surface of the earth (°C) and relative humidity (%) are shown in Figs. 6 and 7, respectively.

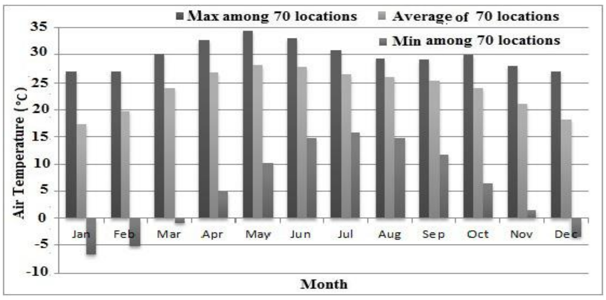

Fig. 6. Long-term monthly averaged, maximum and minimum air temperature at 10 m above the surface of the earth (°C) over various sites in India

Temperature is an important parameter that affects the output of PV modules. The average air temperature over India increases from north to south. Average air temperature over the entire region (only 70 locations are considered) is

23.77°C which is within the range of standard operating condition of PV modules.

- A maximum air temperature of 34.4°C occurs in May at Nagpur and a minimum of -6.74°C occurs in December at Srinagar among 70 locations. Annual average value of air temperature at 10m above the surface is maximum 28.2°C in Surat and minimum 5.39°C in Srinagar.

-Fig. 6 shows the air temperature is higher in summer months (maximum in May) and lesser in winter months (minimum in January) for all the considered locations.

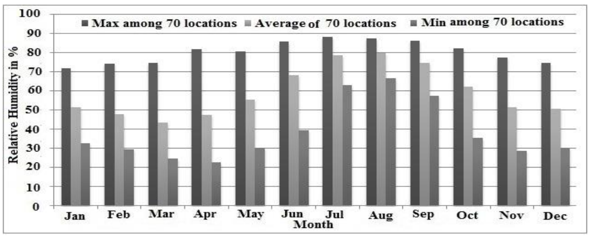

Fig. 7. Long-term monthly averaged, maximum and minimum relative humidity over various sites in India

-Humidity is a parameter that causes degradation of PV module. It is clear from Fig. 7 and Table 1, the long-term humidity for diverse locations in India matches with the standard operating condition range of PV modules.

-Maximum annual average relative humidity among 70 locations is 78.3% occurs in Itanagar and minimum is 43.5% in Bikaner.

-According to Fig. 7 the relative humidity is more in monsoon with average value of 79.9% in August than in spring with average value of 43.42% in March. A maximum relative humidity of 88.1% occurs during July in Siliguri and a minimum of 22.4% occurs during April in Bhopal among 70 locations.

-Relative humidity is higher in North-eastern and southern part of India than other locations.

To select ideal locations for installation of PV power plant, suitable range of different meteorological parameters for proper working of PV should be known. Considered ideal range of different meteorological parameters for PV power plant installation concluded from various literatures, i.e. Global Horizontal Insolation (GHI), Tilted Insolation (TI), Insolation clearness index (K_t), Daylight hours (S), air temperature (T) greater than or equal to 1.8 MWh/m^2/Year, 5kWh/m^2/Day, 0.55, 12h, 25°C respectively and Relative Humidity (RH) is between 44% to 52%. Suggested locations for PV power plant installation depending on considered ideal range of different meteorological parameter are tabulated in Table.2.

Table 2. Suggested locations for PV power plant installation depending on different meteorological parameters.

Location	$GHI^a \geq 1.8$	$TI^b \geq 5$	$K_t^c \geq 0.55$	$S^d \geq 12$	$T^e \leq 25$	$44 \leq RH^f \geq 52$
Jammu, Rohtak, Amritsar, Bathinda, Ludhiana, Chandigarh, Mathura, Jodhpur, Ajmer, Jaipur.	√	√	√	√	√	√
Shimla, Dehradun, Haridwar, Agra, New Delhi, Muzaffarpur, Bikaner, Patna, Malda.	√	√	√	√	√	×
Kota, Udaipur, Ujjain, Bhopal, Gwalior, Indore, Gandhidham, Ahmedabad, Vadodara, Surat, Nagpur, Jhansi.	√	√	√	√	×	√
Mumbai, Goa, Trivandrum, Kozhikode (Calicut), Bijapur, Mangalore, Allahabad, Varanasi, Raipur, Kanpur.	√	√	√	√	×	×
Gaya, Rourkela, Coimbatore, Bangalore.	√	√	×	√	√	×
Warangal, Hyderabad, Visakhapatnam, Chennai,	√	√	×	√	×	×

Puducherry, Navi Mumbai, Pune, Bardhaman.						
Srinagar, Siliguri.	×	√	√	√	√	×
Ranchi, Bokaro, Dhanbad, Aizawl, Guwahati.	×	√	×	√	√	×
Krishnanagar, Berhampur, Bhubaneswar.	×	√	×	√	×	×
Itanagar, Kohima, Imphal, Agartala, Shillong, Dibrugarh.	×	×	×	√	√	×
Kolkata.	×	×	×	√	×	×

[a]GHI: Averaged insolation on horizontal surface (MWh/m^2/Year).
[b]TI: Annual averaged insolation on equator pointed surface i.e. tilted at latitude angle (KWh/m^2/Day).
[c]K_t: Annual averaged insolation clearness index.
[d]S: Annual averaged daylight hours(h).
[e]T: Annual averaged air temperature (°C).
[f]RH: Annual averaged relative humidity (%).of PV power plant.

5. Conclusion

In this paper the long-term meteorological parameters from NASA renewable energy resource website (Surface Meteorology and Solar Energy) for 70 considered locations in India are analyzed. The data taken from NASA website is a monthly average of previous 22 years. The main observations are as follows.

Study shows that India is a country with diverse environmental conditions and has sufficient amount of solar radiation all over the year.

Jammu, Rohtak, Amritsar, Bathinda, Ludhiana, Chandigarh, Mathura, Jodhpur, Ajmer, Jaipur are ideal places for installation of PV power plant considering all important meteorological parameters mentioned above.

Shimla, Dehradun, Haridwar, Agra, New Delhi, Muzaffarpur, Bikaner, Patna, Malda have good prospect in PV power generation considering all other meteorological parameters except relative humidity.

Itanagar, Kohima, Imphal, Agartala, Shillong, Dibrugarh, Kolkata are not ideally suitable for setting up big PV power plant because most of the meteorological parameters are not in the considered ideal range for installation of PV power plant.

Before setting up a PV power plant in a country like India only analysis of GHI or air temperature of that location are not sufficient but other meteorological parameters are equally important to analyse before selecting appropriate location. If the other important parameters are not within the ideal range then we can say that area is not ideally suited for installation of large PV power plant.

The study of the together meteorological factors ensures the suitability of India’s meteorological conditions with the safety operating condition range of the PV-modules.

This analysis help technologist to select appropriate PV technology environmentally best suited for a particular location.

This paper is an effective one for PV power plant installer along with different agencies like Ministry of New and Renewable Energy, Electricity Authority and Planning Commission of India to select appropriate location for installation of PV power plant considering various meteorological parameters.

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