A Movement towards Solar Energy: Potential and its Actual Usagein India

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Abstract

Today Solar energy has become the most attractive renewable source of energy. First Millennium development goals and now sustainable development goals mainly aim at the promotion of clean energy. Achieving this goal has been the appealing to eye of every country whether talking about developed or developing countries, every effort is being taken to harness the renewable sources of energy in orders to reap the benefits from the same. Solar energy is the most attractive among all the renewable sources of energy as being easily available. The paper aims to bring forth the reason why solar energy is the best source of energy for future, potential, need to exploit this source and the level up to which India has been harnessing it.

KEYWORDS: Renewable sources of energy, MDG, SDG, solar energy, exploit etc.

Introduction

Solar energy is the radiant heat or light coming from sun that can be harnessed for a wide range of ever evolving technologies like solar heater, solar cooker, solar architecture,Solar air conditioning, Solar chimney, Solar calculator, Solar cooker, Solar dryer, Solar-powered fan, Solar furnace, Solar inverter, Solar keyboard, Solar balloon, Solar charger, Solar backpack, Solar cell phone charger, Solar-powered waste compacting bin, Solar lamp etc.So in nutshell, solar energy is directly attributed to the use of light and heat of the sun that sunlight generates(Bradford, 2006, Chiras, 2002, Prasad, Singh, & Nagar, 2017)

It is the most abundant energy source available on Earth. The solar energy received for just an hour is able to generate energy for one year for the entire world.Till today the solar energy that we are using is around 10,000 times greater than actually used on the Earth ever.The most important fact of energy from the sun is renewable which means thatthis source can be replenished and renewed over time. In comparison to fossil fuels like coal and crude oil of which reserves are diminishing overtime, but the energy from sunstays and this energy is an ever existing resource which can be utilized all around the world reaping the long term benefits.Solar Energy can be transformed into solar power which can be used for heating or electricity in two ways.

Use of solar energy can be divided into two categories

Photovoltaic (PV) – It involve the conversion via solar panels and the allied power is used for electricity.

Indirect or solar thermal – It involve the conversion via solar thermal collectors and the generated power is used for heating purpose.

The use of solar energy is an the most important component of renewable energy sector through both the thermal and photovoltaic routes as it provide a wide variety of applications like water heating, cooking, water pumping, drying of farm produce, home and street lighting, power generation for meeting decentralized requirements in villages, schools, hospitals, etc.

In the world still there are around one billion people living in areas which have no access to electricity. In the far remote areas where households do not have an access to an energy grid, solar systems could be the solution, installing it will improve the lives of a great amount of people. In addition to it, installing solar systems will be helpful in generation of new employment opportunities in rural regions around the globe, while supplying electricity, creating local jobs, and promoting economic development along with clean energy resources. PV projects in developing nations have brought positive change in the lives of the rural people(Steinmann, M. 2005). The Use of solar energy can reduce the use of wood and dung cakes by rural household (Singh & Singh, 2016)

Thissource need less maintenance and running costs as there are no running parts in the solar panels, there is very little depreciation. This is the main reason that why the maintenance is requirements for solar energy systems are very low with long life of up to 35 years. Once the solar system has been installed with longer life, the generation of power is free.

The use of solar Energy is Safe as there are very little hazard linked to it like explosion, fire or chemical leaks, are non- existent in this case. PV panels which are mainly made up from silicon, which means that there is no danger from any leakage of toxins or fumes. This is the quality that makes solar energy the safest source for the generation of power.One of the biggest merits of solar energy is that it does not contribute to carbon dioxide or other harmful emissions that contribute to global warming in the atmosphere. The installation of solar systems and their productions are not associated with some emission. While using the same there are no toxins released into the atmosphere for meeting our energy needs.So, it leaves no carbon footprint.

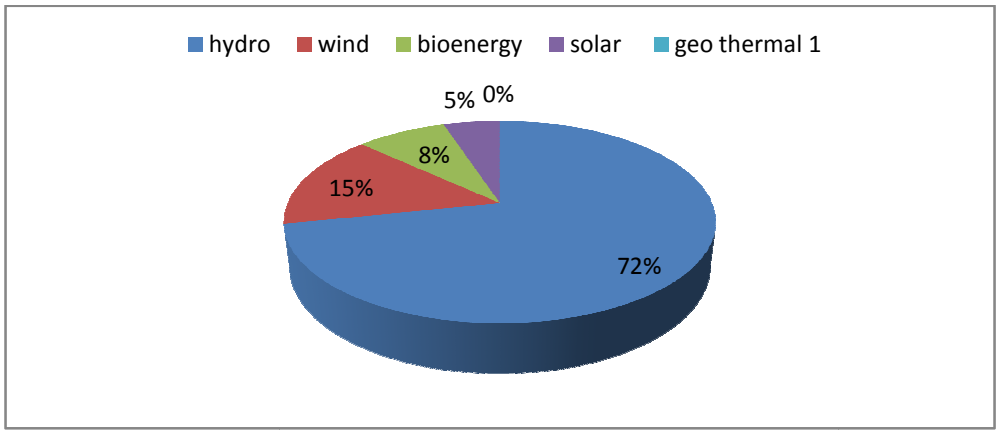
Global status of solar energy utilization

Solar energy utilization has a long history as man since he learnt the art of living on this earth; it has been utilized for drying up of clothes, warming during winters, etc. In between 1860's to First World War, a number of technologies were developed to generate steam involving the capture of the sun's heat, to run engines and irrigation of pumps and soon after some time solar PV cells were invented at Bell Labs in 1954 (USA), and these have been used in space satellites for the generation of electricity generation since 1950s (Smith, 1995&Hoogwijk, 2004).Solar energy has a huge potential utilization of which exceeds the entire global energy demand (Kurokawa et al. 2007; EPIA, 2007).

The main focus towards the renewable sources of energy has been made since the world has realized the need to shift attention towards renewable energyfor the growing concern of green house effect and climatic change, Brundtlandreport which focuses on the sustainable development where the need of shifting the attention from conventional to

non conventional sources of energy was felt. Goal 7 related to the environmental sustainability of MDG 2000focused on the need to look forwards to renewable sources of energy like solar, wind energy etc. which were extended further in Goal 7 of the SDGs aiming to correct this enormous imbalance by ensuring everyone must have an access to affordable, reliable, and modern energy services by the year 2030. To achievethe goal, governments of different counties have stated to invest in renewable energy. Asia has been the main driver of progress in this area which has been expanding access at the twice the rate of demographic growth. About 72% of an increase in energy consumption has been from modern renewable sources between2010 - 2012 in these developingregions as energy obtained from these renewable resources – solar, wind, water biomass and geothermal energy – is inexhaustible and clean. In 2015, International solar alliance was formed with 122 member countries and in January 2016, NarendraModi, and the then French President François Hollande both jointly laid the foundation stone of the ISA Headquarters and inaugurated the interim Secretariat at the National Institute of Solar Energy (NISE) in GwalPahari, Gurugram, India (Wikipedia)

Figure 1: Electricity generation from renewable energy



Source: IRENA, Renewable energy 2015.

In 2015, of the total amount of electricity generated from renewable was 5512 TWh in which Hydro accounted for about 3 893 TWh, followed by wind with 826 TWh, bioenergy 456 TWh, solar energy with 256 TWh, geothermal energy with 81 TWh and marine energy comprising of 1 TWh. (IRENA, 2015)

Table 1 gives the PV installed capacity top ten ranks achieved by the countries

Top 7 Countries In 2016 For Annual Installed Capacity			Top 7 Countries In 2016 For Cumulative Installed Capacity	
S. NO.				
1	China	34,5 GW	China	78,1 GW
2	USA	14,7 GW	Japan	42,8 GW
3	Japan	8,6 GW	Germany	41,2 GW
4	India	4 GW	USA	40,3 GW
5	UK	2 GW	Italy	19,3 GW
6	Germany	1,5 GW	UK	11,6 GW
7	Korea	0,9 GW	India	9 GW

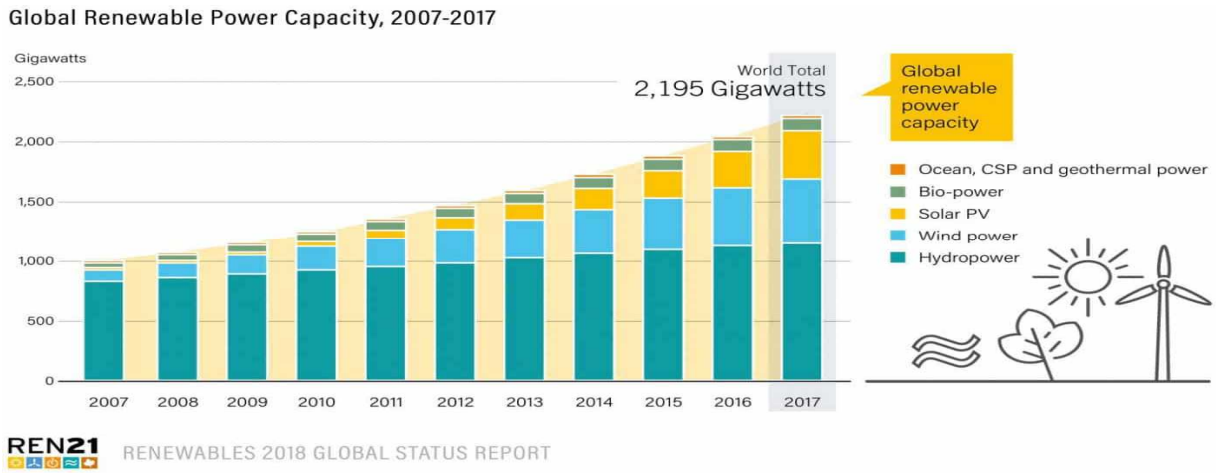
Source: Snapshot of Global Photovoltaic Markets - IEA PVPS

From the table 1 China occupying top position in both PV installed capacity in both installed and cumulative installed capacity while India which also has enough potential stands 4th in the installed capacity and 7th in the cumulative installed capacity in comparison

Global renewable capacity trends over years

Over years the share of renewable sources of energy has been increasing Figure 2 Global renewable capacity trends over years.

Figure 2: Global renewable energy 2007-17



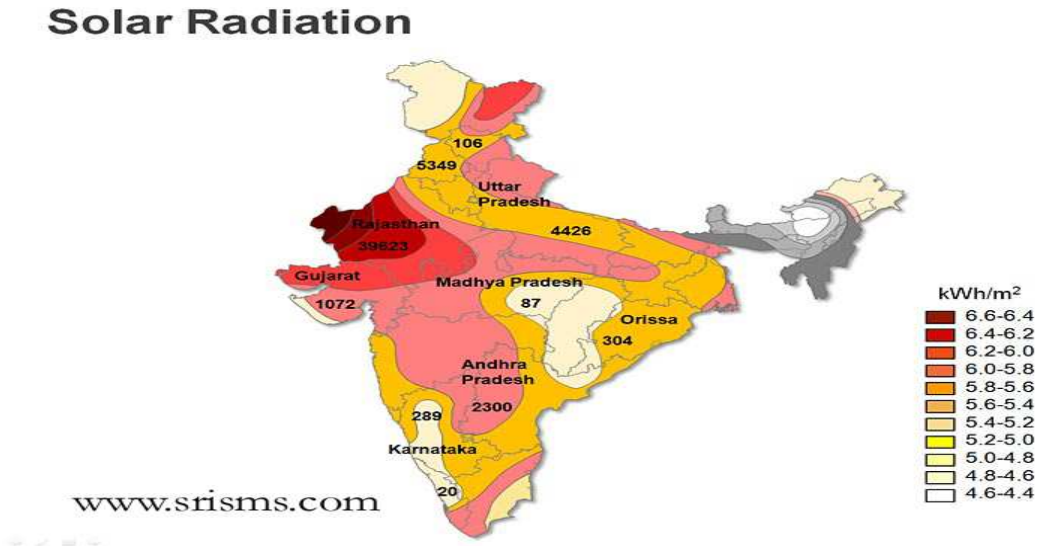
Source: Renewable 2018, Global status report

From figure 2 it is clear that the share of renewable sources of energy is continuously increasing. Before 2010 its role was not too much but with the passage of time the share has been increasing

Solar energy scenario in India

India is large country in comparison to all countries with lively characteristics like deserts, lakes and rivers for the installation of solar plants (AmnonEinav., 2004).India receives about 300 clear and sunny days every year, the calculated solar energy incidence on India's land area is about 5000 trillion kilowatt-hours (kWh) per year (or 5 EWh/yr).Itreceives a solar energy equivalent to more than 5000 trillion kW/h per year, which is far more than its total annual consumption (Muneer et. Al 2005; MNRE, 2014).

Figure 3: solar radiations map



Source: Solar radiations map India.

“India is a tropical country, where sunshine is available for longer hours per day and in great intensity. Solar energy, therefore, has great potential as future energy source. It also has the advantage of permitting the decentralized distribution of energy, thereby empowering people at the grassroots level”……The National Action Plan on Climate Change (NAPCC)

India has enough solar potential as the temperature ranging from 25 1C - 27.5 1C. The sunniest parts are located in the south or east coast, from Calcutta to Madras. The potential output of solar energy in India in a single year exceeds the possible energy output from all of the exhaustible sources of energy like fossil fuel energy reserves in India. The average solar-power-plant generation capacity in India is around 0.20 kWh per m^2 of used land area which is equivalent to 1400–1800 peak (rated) capacity operating hours of a year with available, commercially-proven technology(Wikipedia).

Historical background of solar utilization in India

Solar energy has been widely used in India as being inexhaustible source of renewable energy. It is used in various forms of solar lamps, solar water pumps, solar water heaters and cooking purpose etc. (Prasad A. &Jagadish D. 2013). In India, after the Second World War and the oil crises in the world there has been a shift towards the solar energy. Under GOI, the department of non conventional sources of energy (DNES) was formed in 1982, in 1987 Indian Renewable Energy Development Agency (IREDA) was set up. In 1992, Department of non conventional sources was converted into Ministry of Non-conventional Energy Sources (MNES) which till today has taken several steps to create a sound atmosphere for harnessing non-conventional sources of energy.

The Rural Electrification Program (GOI) in 2006, made first step in recognizing the importance of solar power by an implementation of off-grid solar applications. The Solar Energy Corporation of India Limited (SECI)was set up on 9 September 2011 as a non-for-profit Company for the promotion of solar energy in India under companies law 1956.

In July 2009, with $19 billion solar power plan was unveiled with projected capacity to produce 20 GW of solar power by 2020.

The National Solar Mission: The Prime Minister launched on the 11th January, 2010, with an ambitious target of deploying about 20,000 MW of grid connected solar power by 2022 with an aim to reduce the cost of solar power generation in the country through

- long term policy;
- large scale deployment goals
- aggressive R&D;
- Domestic production of crucial raw materials, components and products for the achievement of grid tariff parity by 2022.

This Mission mainly aims to create an enabling policy framework to achieve this objective and will be helpful in making India a global leader in solar energy. Government of India, recently has revised the target of Grid Connected Solar Power Projectsfrom 20,000 MW by the year 2021-22 to 100,000 MW (2021-22) under the National Solar Mission and it was approved by Cabinet on 17th June 2015 (MNRE, 2015).
Various programmes have been implementation of Solar Roof Top Scheme, Solar Park, Solar Defence Scheme, Solar scheme for CPUs Solar PV power plants on Canal Bank and Canal Tops, Solar Rooftop, Solar Pump, etc have been launched during the 2016 and 2017.

Table 2: Over years trend of solar energy in electricity generation

CAP (MW)	2010	2011	2012	2013	2014	2015	2016	2017
World	39844	70495	98423	137102	174361	224345	296873	390625
India	37	565	926	1 336	3 518	5 396	9647	19 275

Source: IRENA (2018), Renewable capacity statistic 2018

From table 3 it is clear that the generation of electricity via solar energy over years has been increasing in the world as well as in India.

Table 3: Installed solar PV (2018)

Installed solar PV on 31 March 2018	
Year	**Cumulative Capacity (in MW)**
2011	461
2012	1,205
2013	2,319
2014	2,632
2015	3,744
2016	6,763
2017	12,289
2018	21,651

Source: All India installed capacity of power stations (2018).

From table 3, it is cear that cumulative capacity of installed solar pv in 2018 the country has been more than twice as of 2011

Top five solar power generating plants in 2018 include

- Pavagada Solar Park, Karnataka with an installed capacity generate 600 MW by January 2017 at Pavagadataluk of Tumkur district.
- The world's largest solar park isKurnool Ultra Mega Solar Park which spread over a total area of 5,932.32 acres in Kurnool district of Andhra Pradesh.
- The world's largest single location solar power plant Kamuthi Solar Power Project is located at Kamuthi in Tamil Nadu with a capacity of 648 MW commissioned by Adani Power. The Kamuthi solar plant is the world's second largest solar park
- The Bhadla Solar Park which is near Jodhpur district of Rajasthan has total capacity of 2,255 MW and NTPC announced that it had commissioned 115 MW on 22 February 2017. It is the third largest solar park in India, spread over a total area of 10,000 acres.

- One of the Asia's biggest solar parks which is also the world's second largest photovoltaic power station, spreading across 5,384 acres of unused landis Charanka village solar park which is located at northern Gujarat.

States in solar energy

Indian states that have the maximum high instance of solar radiations i.e. solar insolation are Rajasthan and Gujarat and Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Maharashtra and Chattisgarh also enjoy good insolation levels.

Table 4: State wise installed capacity of grid interactive renewable power (2019)

State-wise installed capacity of Grid Interactive Renewable Power as on 31.01.2019.				
		Solar Power		
	States	**Ground Mounted**	**Roof Top**	**Total**
		(MW)	**(MW)**	**(MW)**
1	Andhra Pradesh	2840.77	48.52	2889.29
2	Arunachal Pradesh	1.27	4.12	5.39
3	Assam	10.67	7.98	18.65
4	Bihar	138.93	3.52	142.45
5	Chhatisgarh	215.83	15.52	231.35
6	Goa	0.95	0.74	1.69
7	Gujarat	1836.3	166.73	2003.03
8	Haryana	130.80	88.79	219.59
9	Himachal Pradesh	0.00	4.50	4.50
10	Jammu & Kashmir	8.49	5.89	14.38
11	Jharkhand	19.05	13.36	32.41
12	Karnataka	5175.06	153.75	5328.81
13	Kerala	100.00	38.49	138.49
14	Madhya Pradesh	1619.22	30.67	1649.89
15	Maharashtra	1447.30	172.26	1619.56
16	Manipur	0.00	3.23	3.23
17	Meghalaya	0.00	0.12	0.12
18	Mizoram	0.10	0.40	0.50
19	Nagaland	0.00	1.00	1.00
20	Odisha	383.56	6.71	390.27
21	Punjab	828.1	77.52	905.62
22	Rajasthan	3045.69	96.2	3141.89

23	Sikkim	0.00	0.01	0.01
24	Tamil Nadu	2098.27	135.07	2233.34
25	Telangana	3519.27	64.34	3583.61
26	Tripura	5.00	0.09	5.09
27	Uttar Pradesh	834.00	68.33	902.33
28	Uttarakhand	239.78	64.49	304.27
29	West Bengal	50.00	19.56	69.56
30	Andaman & Nicobar	5.10	1.46	6.56
31	Chandigarh	6.34	26.06	32.40
32	Dadar& Nagar Haveli	2.49	2.97	5.46
33	Daman & Diu	10.15	4.32	14.47
34	Delhi	8.96	115.25	124.21
35	Lakshwadeep	0.75	0.00	0.75
36	Pondicherry	0.03	1.77	1.80
37	Others			
	Total (MW)	**24582.23**	**1443.74**	**26025.97**

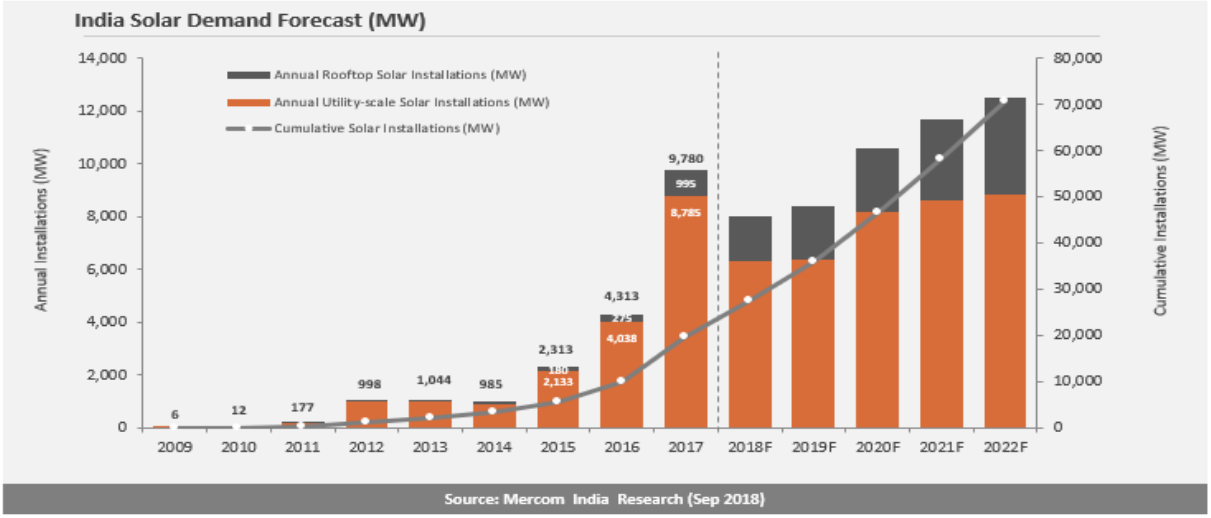
Source: MNRE 2019

From table,over years there has been increase in the utilization of solar energy. The installed solar PV has shown the increasing trend as table shows

Steps taken by government for the promotion of solar energy

Various steps have been taken by GOI to promote solar energy in India: A complete Exemption from excise duties and various concessions on import duties on components and equipments required to set up a solar plant. For Solar Power Projects complete 10-year tax holiday. Wheeling, banking and third party sales buy back facilities by state and guaranteed market through solar power purchase obligation to states. The GBI schemes for small projects in India that are connected to grid below 33 kV.Reduced wheeling charges for non conventional in comparison to those for conventional energy. A payment security mechanism which will cover the risk of default by state utilities/discoms. 30% subsidy of the project cost for off-grid solar thermal projects, subject to availability of funds. Special incentives for the exports from India in renewable Energy technology under renewable energy sector- specific SEZ. Historic Low Tariffs has been made for Solar (Rs. 2.44/ unit) achieved through transparent bidding and facilitation (MNRE, 2017).For training personals, Surya Mitra Scheme has been launched with a target for creating 50,000 trained solar photovoltaic technicians by March 2020 and until 31st March 2017, a total number of 7500 Surya Mitra'shave been trained by 31.03.2017.

Figure 4: Solar demand forecaste



Source: Mercom India Research, 2018

The Government has also made a target of installing 40 GW of grid connected rooftop solar capacity in the country which will include Delhi and National Capital Region (NCR) by year 2022. The Delhi Solar Policy, 2016 as notified by Government of National Capital Territory of Delhi, has made target of 1 GW to be achieved by 2020 of solar power and 2 GW of solar power to be achieved by year 2025 in Delhi.The Government has also set a target of installing about 100 GW from solar, 60 GW from wind, 10 GW from bio-power and 5 GW from small hydro-power(MNRE, 2017).

Level of awareness at the grass root level about solar energy

In order to know the level of awareness and the use of solar energy at the grass root level four villages from two blocks of doda distric have been selected from J&K. The study is mainly based on primary data collected from the respondent households by using questionnaire designed for the present study. A questionaire was developed, projected and administed in the selected households in the sample villages inorder to get relevant data and informationabout the level of awareness about the solar energy. In addition to it other information has als been collected. The detailed questionnaires included information regarding the family size, socio economic conditions of family, education level, fuel using pattern, fuel mix constituents, housing characteristics like whether pacca or kaccha, electrified or not etc. For the paper only main data related to has been presented in order to have a comprehensive focus on the solar aspect the other data has not been tabulated. Dat been collected from the sample size of 120 households from two blocks i.e. Ghat and Bhaderwah (60 from two villages of Ghat block and 60 from two villages of Bhaderwah block). Total population of the sample households is 669 of which 368 are males and 301 are females. Majority of the sample households are having joint family (68.3 percent) while 32 percent are having nuclear family. The family type has been found to be the important factor influencing the fuel-mix in the study area. The large-sized families are found using more traditional fuel, whereas the nuclear families

use more modern fuel. This phenomenon is due to the fact that large families have enough surplus labour which can be used to collect the firewood even if there is seasonality in the firewood.

The dependency ratio in the study is 51.7 percent which reflects burden on the working members in the households for fulfillment of their basic needs. Less family planning programmes, less awareness among people, low change in the thinking of the people due to less education and other factors results in a high dependency ratio in the study area. Dependency Ratio has influenced the fuel consumption in the study area because higher the dependency ratio has its implications on the income level of the family.

More than half of the sample households are belonging to labour class with non- farm wage as their source of livelihood and income less than or equal to 10000 rupees per month. This low income of the respondent households is the most crucial determinant which influences the type of fuel to be used by the households because of the reason if the earners have low income and large family to support, they first want to fulfill the basic needs of the family then think of buying modern fuel. The level of education of the households also influence the fuel-mix used for meeting energy needs of the people. The illiterate people generally do not the side effects of using firewood in less efficient thermal chullahs, where as educated families have their level of understanding higher and thus tend to avoid using firewood. This however, has to be accompanied by other factors influencing fuel-mix. In the study area, it has been found true. Out of 669 the total populations of the respondent households 248 were illiterate, 240 have studied up to primary level, 103 respondent households have studied middle level, 64 have studied hr. secondary and 12 have studied higher education which include graduation and post graduation. Education level of the households in the study area is found to be important factor influencing the fuel mix, with villages having more illiterate people are found using firewood as the main sources of energy whereas level of fuel switching is higher among the educated families.

While choosing fuel maximum gives importance to fuel price in the study area i.e. 87.5 percent. The fuel use pattern is much influenced by the houses being electrified and in the study area it has been found that 99.8 percent are electrified. Of the four villages electricity availability is found erratic, two villages by Thanala and HanchMalana with frequent power cuts. So we can conclude that the use of fuel is much influenced by type of family, occupation, economic conditions of the households and power availability in the area.

Our findings reveal that 52.5 percent are using single fuel, 30 percent are using two type fuel-mix strategy and 30 percent are using three fuel-mix strategy. The most common fuel-mix used in the study area is a combination of two fuels i.e. wood + LPG (34.6 percent), followed by three fuel mixes i.e. wood+ LPG+ kerosene (19.3 percent) and a combination of wood + Kerosene (15.5 percent).

Firewood is main source of energy as far as the study area is concerned and its contribution in the fuel consumption per month is 292.2 million BTU of the total 300.3 million BTU which is maximum in comparison to other fuels available.

A majority of the people (96.0 percent), in the study area are aware of the clean and renewable sources of energy like solar lights. This level of awareness is much influenced by using appliances like television, radio, mobile etc. Table 5 gives

Present Status of Use of Clean Renewable Source of Energy in the study area by respondent Households

Different fuels are used by the sample households involving the renewable which either are clean like solar lights or unclean like firewood, cow dung and biomass. From the sample households question has been asked whether they use any clean renewable source of energy. The response of the respondents is given in the table .

Table6: Present Status of Use of Clean Renewable Source of Energy (solar energy) by Respondent Households

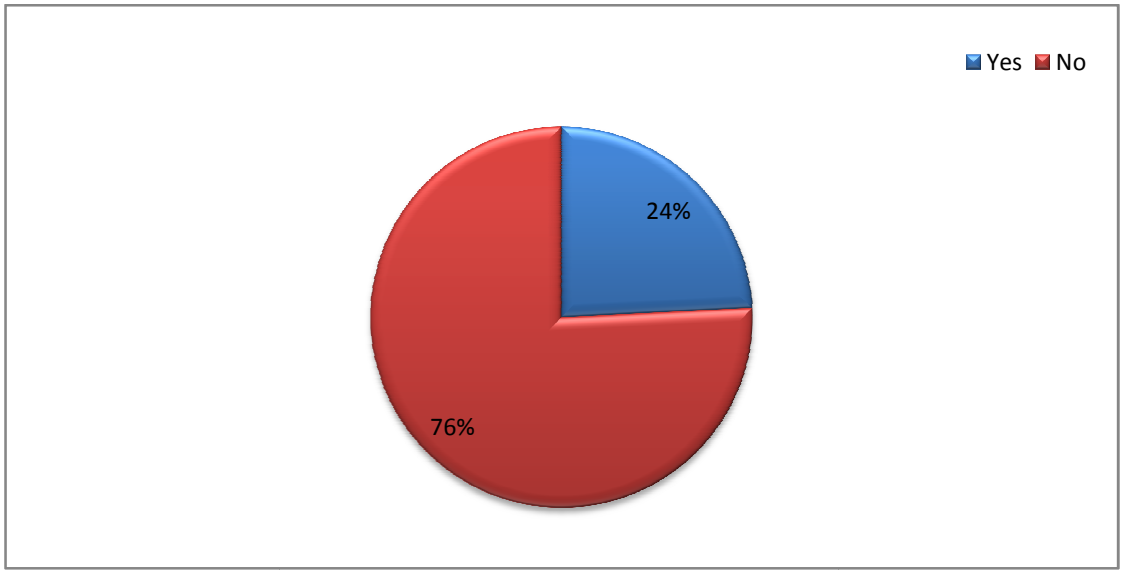
S. No.	Block	Village	Yes	No	Total
1	Doda	Birshalla	8	22	30
			(26.7)a	(73.3)a	(100)a
			(27.6)b	(24.2)b	(25)b
		HanchMalna	6	24	30
			(20.0)a	(80.0)a	(100)
			(20.7)b	(26.4)b	(25)
2	Bhaderwah	Thanala	5	25	30
			(16.7)a	(83.3)a	(100)
			(17.2)	(27.5)	(25)
		Sertangle	10	20	30
			(33.3)	(66.7)	(100)
			(34.5)	(21.9)	(25)
3	Total		29	91	120
			(24.2)	(75.8)	(100)
			(100)	(100)	(100)

Source: Field survey

Subscript a-shows the percentage of family type with respect to row total
b-shows the percentage of family type with respect to column total

Table 6 shows whether the households are using the any renewable source of energy. Out of the total 120 households 91 sample households (75.8 percent) are not using any renewable source of energy and 29 sample households (24.2 percent) are using renewable source of energy which comprises mainly solar lights. In comparison to other villages in Sartangle has the maximum number of solar lights users.

Figure 5: Present Status of Use of Clean Renewable Source of Energy (Solar Lights)



Source: Calculated from the table 6

From the figure 5, it can be seen that 76 percent are not using any clean renewable source of energy which comprise mainly solar lights. 24 percent are using clean renewable source of energy which mainly comprise solar lights.

Potential of Scaling up Subsidized Solar Lights in the Study Area

Government at present is providing a lot of incentives to make the people to switch to clean renewable source of energy like solar lights. Solar lights are very advantageous as being clean, easy to handle and rechargeable. Many schemes have been launched to promote the use of such fuel. Many advertisement campaigns have been launched for the promotion of the same. In order to know the scaling up of solar lights, the respondents are asked if such incentive will make them to switch to these sources.

Table 7Potential of Scaling up Subsidized Solar Lights in the Study Area.

S. No.	Block		Yes	No	Total
1	**Doda**	**Birshalla**	21	9	30
			(70.0)a	(30.0)a	(100)a
			(23.6)b	(29.0)b	(25)b
		HanchMalna	24	6	30
			(80.0)a	(20.0)a	(100)a
			(26.9)b	(19.4)b	(25)b
2	**Bhaderwah**	**Thanala**	16	14	30
			(53.3)a	(46.7)a	(100)a
			(17.9)b	(45.2)b	(25)b
		Sertangle	28	2	30

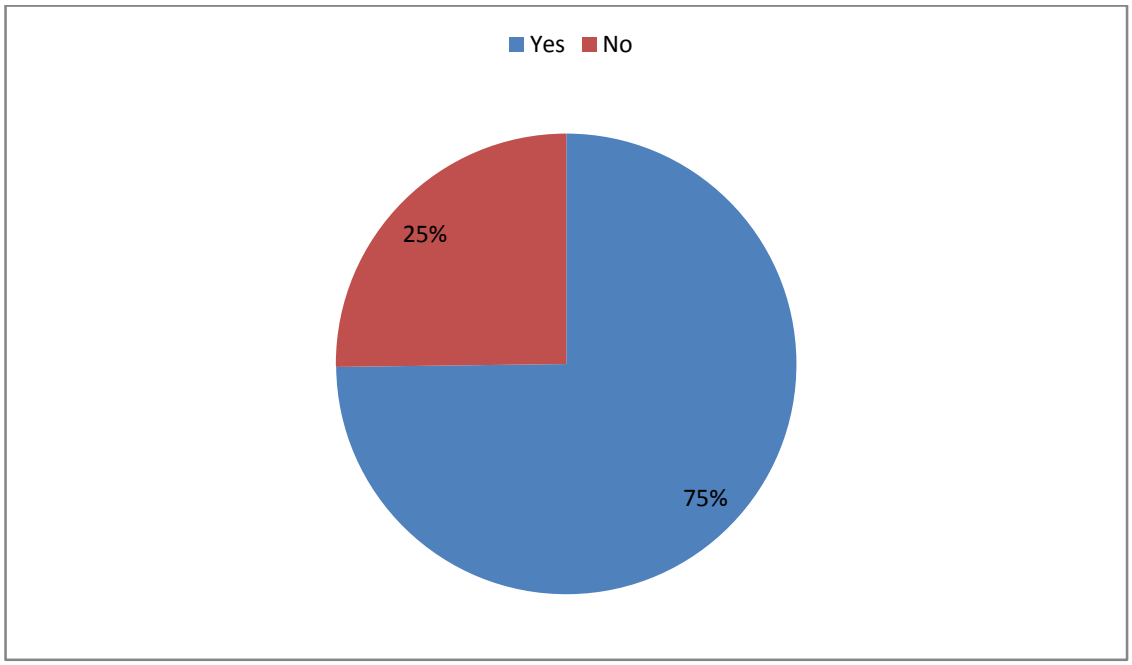
			(93.3)a	(6.7)a	(100)a
			(31.5)b	(6.4)b	(25)b
			89	31	120
3	**Total**		(74.2)a	(25.8)a	(100)a
			(100)b	(100)b	(100)b

Source: Field survey

Subscript a-shows the percentage of family type with respect to row total
b-shows the percentage of family type with respect to column total

Table 6 shows that out of 120 households 89 households (74.2 percent) want to switch to solar rights if it is subsidized by the government and 31 households (25.8 percent) do not want to switch to solar lights even if it is subsidized. Maximum negative response come from Thatnala, the main reason behind it is that people of this region are suffering from immense poverty for whom subsidy don't matter but they first want to meet their basic need.

Figure 6: Potential of Scaling up Subsidized Solar Lights in the Study Area.



Source: Calculated from the field survey table 7

From the figure 6, it can be seen that 75 percent are willing if they get renewable source of energy which comprise mainly solar lights at subsidized rate while the remaining 25 percent are not willing to switch to it.

However, only 24 percent of the total respondent households are found using clean renewable sources of energy i.e. solar lights. The other households who although are willing to switch but do not use the same because of its non availability, high price and no repairing facilities. The level of awareness about the clean sources of energy as can be concluded from the study is less in the remote and backward areas with less

infrastructural facilities like roads, transport, education, etc. in comparison to the areas that are much developed with proper road connectivity, facilities of educational institutes and marketing facilities. The important findings of the present study are in conformity with the existing body of knowledge on the subject.

Conclusion

Solar energy has enough potential to reduce the dependence on the exhaustible sources of energy. A complete shift to this source for getting energy is the main focus of all the countries of the world because in comparison to other non-conventional sources it is mostly available almost everywhere.. Efforts are being made to switch the reliance on this source. India has no doubt enormous scope in solar field as being a tropical country but still the potential has not being fully exploited. People of the country are mostly aware about this energy source but still majority of the population are not completely switching to it. The main problem of making this source at the grassroot level is the people suffering from poverty, which is creating hurdle and there is a need of poverty eradication in these rural areas via addressing basic needs to be addressed; social

Apart from above, there is need of improving the access to affordable and reliable energy services including clean renewable and alternative sources of energy for rural households. More and more subsidized LPG and solar lights facilities should be made for rural households. Repairing facilities in case of damage of the solar lights and other new modern devices should be made so that in case of damage these equipments should be repaired. Awareness about the clean renewable sources of energy requires most attention. Training programmes are needed to be developed in the local languages so that information about benefits of solar energy and its proper use and the maintenance plants being installed in the villages. Awareness about the clean renewable sources of energy should be also be telecasted on national television and radio in the regional or Hindi language for these people. Involvement of women is very important as women are the chief end users of electricity in the households as they spend most of their time indoors doing most of the household work. Empowering them is related to empowering whole society. So, special training programmes need to be generated for women and be delivered from time to time.

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