

Solar Energy: Power Engine for Indian Agriculture Development

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Abstract: Sustainable development in Indian agriculture will be done with the help of proper management of energy. So, India needs to focus on developing its energy as there is increasing in demand for irrigation due to the need for higher food production for rising population and decreasing fresh water supply in changing climate. Our major energy sources like oil and coal are imported in large quantities. High diesel and electricity cost and unreliability of electric power supply affect the pumping requirement for irrigation for farmers. To sustain economic growth to come out of the energy deficit situation and ensure that energy is available in every town and village.

So, India must utilize its immense potential in renewable energy sources like wind, sun, tidal, biomass. In India the sun is the source most of the energy on the earth. Solar energy also useful for generating electricity on earth. Solar energy is vast resource, but it has some limitations on availability that can be affect is deployment around the world but in many parts of India sun is available throughout the year using solar energy for irrigation water pumping and domestic use for farming and at household is a promising alternative to conventional electricity and diesel pumping set solar energy is genesis for all forms of energy, Government of India is focusing more on renewable energy in every sector. Moreover, many schemes have been developed under Ministry of New Renewable Energy and provide subsidies to the farmer. The Indian government has launched Jawaharlal Nehru National Solar Mission with target of achieving 20,000 MW by 2022 with giving 90% subsidy for solar lighting system to cover about 10,000 villages under village electrification programme of Ministry of New Renewable Energy (MNRE), KUSUM Scheme, Saur Sujala Yojana, Solar Pump Subsidy Scheme, Solar Rooftop Scheme etc.

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I. Introduction

Agriculture is the backbone of the Indian economy as India is an agriculture-based country. India rank second in farm output in the world. The agricultural sector provides a livelihood to over 50% of India's population. With growing global population, the demand of agricultural products is increasing at a wholesale rate. In fact, the share of agriculture sector in the country's GDP is 17 % to 18 %. However, the agriculture sector needs proper irrigation facilities and other facilities to reap the benefits. Climate change along with the century rising global temperatures is the major concern of the century. Therefore, it is important to focus on the number of greenhouse gases released by cash and entry region and the amount of fossil fuels they consume hot temperature such as drought, floods. With rising concern, the major problem in this sector is farmers' dependence on pumps for irrigation. Among renewable energy sources Solar is the most important as it is available in all part of India. The main reason is that using sunlight represents a virtuous circle when the sun shines it feeds the irrigation system. Well we know that crop needs more water when sun shines more. Therefore, a large amount of energy available when it is actually needed. Most of the farmers use pumps some of which are connected to the grid, while other pumps run on diesel and other fossil fuels. In many parts of India there are 60-70 days in a year when weather conditions (clouds) prevent solar water pump from working. But it rains a lot of those days, so irrigation may not be necessary at that time, still there are few days' technology leaves a few days where you might not see the sun, leaving about a 90% reliability factor for solar water pumping but adding energy or water storage could offset that issue. Also, small land holding reduces the applicability of large solar pumps unless water brought up by using solar pump can be shared among group of farmers. While the cost investment for solar power irrigation systems are decreasing and subsidy schemes increasing day by day. Furthermore, in rural area where diesel fuel is expensive or when reliable access to the electricity grid is lacking, they can provide a relatively flexible and climate friendly energy source. India uses nearly 30 million diesel or electricity powered pump used more than 4 billion litres of diesel (13% of total diesel consumption in India) and around 85 million tons of coal per annum (19% of total diesel consumption in India) to support water pumping for irrigation. In this situation solar energy is providing to be a boom to mankind. Each and every sector trying to adopt the renewable source of energy. Agriculture is an area that can benefit by adopting solar energy. If 50% of these diesel pumps were replaced with solar PV pump set by three horse power solar pumps diesel consumption could be reduced by about 225 million litres /year (7.5% of the total diesel consumption in India) and the country could generate 66.8 renewable power, as per August 2018 study by the institute for Energy economics and Financial Analysis, a think-tank. This is enough to electrify about 700,000 Indian houses for an hour. More ever one day fossil fuels will end a need arises to find alternative fuels. Renewable energy is considered as alternative to fossil fuel and now days attract a lot of attention. Use of energy is an important input for agricultural production. Solar energy can be used in agriculture in many ways a large amount of input can be saved. These important sectors of economy use energy directly as a fuel to

run the pump for irrigation tools, Machinery and other equipment, to heat or cool the house, lightning the house i.e. and indirectly to produce chemicals and fertilizers etc. Solar can be used for all these function of agriculture products. Agriculture is itself an energy conservation process i.e. the conservation of solar energy through Photosynthesis into food energy for human and food for animals. Tribal farming involves more work than scattering seeds on land and accepting the low yields that resulted. Modern agriculture requires an energy input at all stages of agricultural production such as direct use of energy use include energy for food processing, storage and transportation to markets. In addition there are many indirect or sequestered energy inputs used in agriculture as of mineral fertilizers and chemical pesticides. Today's rural educated youth interested in mechanical farming rather than traditional farming to increase their agriculture income. So, if solar powered machines become available, there will be real development in Indian agriculture. Solar heat collection can be used to dry crop and warm homes, Livestock buildings and greenhouses. Thus, solar energy can be highly useful for agricultural methods. Solar energy as renewable energy source is considered as an important alternative option for farmers. There are many challenges to the development of renewable energy in rural areas. Agricultural expansion by its nature has an important role in promoting the adoption of new technologies and innovations. Regular a business creates India's will lead to a huge rise energy need for agriculture alone. Irrigation is often seen as the engines that ensure food security increase income create employment and drives rural development. Another issue in agriculture sector is related to the plight of farmers. Since source of crop are seasonal most of the farmers are deprived of regular source of income moreover, there are no farmers to get anything from dry uncultivated land. Solar energy can be put to good use to address these serious issues of the agriculture sectors. Solar energy is being widely adopted in residential, commercial and industrial sectors and it likely to benefit the agriculture sector as well. With declining solar module prices (70% in last 4 years) solar pump are fast becoming a viable financial solution for irrigation. In most of Indian state electricity for agriculture related task is provided at no cost to farmers, usually at night, to ease off-peak daytime loads. This encourages the uncontrolled use of electric pump, with farmers often leaving pumps running through the night results in over irrigation farms and low ground water levels, not to mention all the wasted electricity. The current energy use system of India's agricultural sector is inefficiency suppressed. Although farmers dependent on the sun for most farming, irrigation happens late at night. This is due to practice of supplying electricity to farmers during the midnight hours. One could argue that with solar energy could exacerbate the problem. Since the availability of solar energy in abundance, the responsibility of monitoring the use of solar pump may be reduced to the farmers, which may even lower ground water level. But what if it doesn't? Savvy farmers won't take long to realize that they have the option of selling their surplus solar electricity to the grid at good rates. That means they'd think twice before pumping up groundwater unnecessarily. Therefore, in an endeavour effect to offer financial and water security to farmers, the Indian government has launched various schemes for grid-connected solar power projects and installation of solar pumps.

Objective of the study:

- To examine the various scheme of government to boost solar energy source.
- To review existing scheme of Indian government regarding the solar plant for agriculture development.
- To study the benefits of grid connected solar power project.
- To promote the use of solar energy for sustainable and economic development of Indian farmer.
- To improve the quality of life and alleviate rural areas by providing the basic need such as lights, through affordable and reliable source of solar energy.

II. Methodology:

A wealth of the report is information from various website published papers and data from wide variety of source has been used which include various reports of Indian government for solar power plant, available in standard literature. Ministry of new and Renewable energy and Indian Meteorological Department websites are important source of the paper. Several years back report is useful source system is changing rapidly the increasing efficiency and technology. Solar pumping is an attractive alternative for irrigation and drinking water applications for rural area in developing countries like India keeping in view huge solar potential and the fact that significant rural population lives in remote area which requires water for drinking and irrigation of crops.

Benefits of Solar panel and solar pump for agriculture

- It will offer a stable source of income to landowners for many years.
- In this way farmers can even earn from there uncultivable land.
- A minimum installing height will ensure that farming activity can take place along with solar plant in case of cultivable lands.
- Through the scheme, sufficient solar power can be generated to power and agriculture pump and to fulfil other power requirement of own.
- Solar pump is free from volatile fuel prices and unreliable and costly fuel supplies.
- In the long run cost of solar water pumping will reduced.
- There is huge potential for increasing agricultural productivity and income constant access to water.
- There are changes to income diversification due to multiple uses of energy (Feed into the grid, cooling, house lightning) and water.

- Operating cost is low
- Easy to transport and relocate.
- Operation of solar pump does not produce any greenhouse gas emissions.
- Easy to install on your own.
- Solar water pumps are ecofriendly and saving money.
- Solar pumps systems are extremely efficient.
- Solar water pumps are easier to maintain than other pump power sources.
- These systems are not affected by power cutting, low voltage, single phase problems or the motor burning.

Recently, India has achieved 5th rank in the world in solar power deployment. In solar energy the capacity has increased 11-fold in last five years from 2.6 GW in March 2014 to 28.18 GW in March 2019. The target of installing 100 GW of grid connected solar power by 2022 has been kept to achieve the above goals. Government of India has launched various schemes to encourage generation of solar power in the country like Solar Park schemes, VGF schemes, CPSU scheme, Canal Bank & canal top scheme, Building scheme, Grid connected solar roof top scheme, etc. Various policy measures are also undertaken to promote the grid connected solar power plants.

Development of Solar Park Scheme: The development plan for solar parks and ultra-mega solar power project was launched by Ministry of New & Renewable Energy on 12 December, 2014 with a target of setting up at 25 solar parks with aggregate capacity of 20,000 MW within a span of 5 years starting from 2014-15. These parks are proposed to be set up by 2021-22. The scheme facilitates the installation of grid-connected solar power projects for large scale power generation. All the states and Union Territories are eligible for getting benefit under the scheme. The scheme proposes to offer financial support by the government to establish and facilitate infrastructure necessary for setting up solar power plants. Under the scheme, the Ministry provides Central Financial Assistance (CFA) of up to Rs.25 lakh per solar park for preparation of Detailed Project Report (DPR). Beside this, CFA of up to Rs.20.00 lakh per MW or 30% of the project, along with grid-connectivity cost, whichever is less, is provided to achieve the prescribed steps in the scheme.

Ujjwal Discom Assurance Yojana (UDAY) : UDAY was launched in November 2015 by the Government of India with the idea of finding a permanent solution to the financial dilemma between power distribution companies. The aim is to improve the power sector, operational improvement, development in renewable energy, reduction of cost of generation of power, energy efficiency and conservation. UDAY Scheme was launched by Union Power Ministry for financial turn around and revival package for state electricity distribution companies (DISCOM). It aimed to help to make DISCOM financially and operationally healthy so they can supply adequate power at affordable rates.

Kisan Urja Suraksha evam Utthaan Mahaabhiyan (KUSUM) Scheme 2015: Kusum Scheme was launched under the ministry of power and new & renewable energy. With the help of Kusum Scheme government is planning to update the irrigation system of India and as well as promoting solar power production. The implementation of Kusum Scheme will give the boost to the production of solar energy. Kusum Scheme is a multiple Benefit Scheme of Central Government. The farmers save the cost of petroleum fuels by installing solar irrigation pumps. The second benefits of the schemes are that farmers can sell the extra power directly to the government. And thirdly make use of barren land in order to generate solar energy. The electricity company who will install solar panel on farmer land will pay the paise per unit to the land owner, which is roughly Rs 6600 per month. Central Government has allocated Rs.48,000 crore for the Kusum Scheme for the 10-year period. This scheme will start with building 10,000 MW solar plants on barren land and providing 1.75 million off-grid agricultural solar pumps. It will promote decentralized solar power production reduce of transmission losses of DISCOMS as well as provide support to improve the financial health of DISCOMS by reducing subsidy burden to the agriculture sectors.

Jawaharlal Nehru National Solar Mission (JNNSM): The Jawaharlal Nehru National Solar Mission is one of the right most national mission in India, included the NAPCC. The objective of this solar scheme is to establish India in the world ranking in the field of solar by creating policy conditions. The mission has set an ambitious target of deploying 20,000 MW of grid connected solar power by 2022 and aim at reducing the cost of solar power generation in the country through long term policy, large scale deployment targets, aggressive R&D and domestic production of critical raw materials, components and products. The Mission has set the ambitious target of deploying 20,000 MW of grid-connected solar power by 2022, which was revised to 1,00,000 MW by 2022 during June 2015. The total investment in setting up 100 GW will be around Rs 6,00,000 cr. In the first phase the Government of India is providing Rs 15,050 crore as capital subsidy to promote solar capacity addition in the country. This capital subsidy will be provided for Rooftop Solar projects in various cities and towns, for Viability Gap Funding (VGF) based projects to be developed through the Solar Energy Corporation of India (SECI) and for decentralized generation through small projects. The Ministry of New and Renewable Energy (MNRE) intends to achieve the target of 1,00,000 MW with targets under the three schemes of 19,200 MW.

Jawaharlal Nehru National Solar Mission with Viability Gap Funding (VGF) Schemes: The Scheme is solar energy Corporation of India, New Delhi connected to the grid will be implemented Viability Gap Funding support will be provided Built-Own-Operation basis & the power generated from the projects shall be purchased Solar Energy Corporation of India (SECI) at a fixed tariff of Rs.5.43/KWH from 25 years and shall be sold by SECI to willing State Utilities /DISCOM/Other bulk consumers at fixed tariff of Rs 5.50/KWH for 25 years.

Rooftop Scheme: 200MW projects have been allotted under rooftop scheme implemented by SECI out of which 45MW projects have been started. Special schemes have been launched with 75 MW for warehouses and 50MW for the Central Public Works Department (CPWD) have been launched. SECI recently issued a tender which is the largest global type of tender in the world. It has 132 bidders who bid for a total capacity of 602MW. This tender is a part of the MNRE's initiative to achieve the target of 40 GW rooftop solar capacities by 2022.

Year wise achievement of Grid connected Solar Power Project details

SR. No	Year	Capacity added during F.Y. (MW)	Cumulative capacity (MW)
1	2009-10	8.54	11.35
2	2010-11	24.58	35.93
3	2011-12	896.37	932.30
4	2012-13	752.16	1684.46
5	2013-14	947.46	2631.93
6	2014-15	1112.07	3743.97
7	2015-16	3018.88	6762.87
8	2016-17	5525.98	12288.85
9	2017-18	9362.63	21651.48
10	2018-19	6529.20	28180.68

Source : <https://mnre.gov.in>

SouraGruha Yojana(SGY) 2019-20: Ministry of New and Renewable Energy (MNRE), Government of India under phase – II schemes has launched grid connected solar rooftop scheme for Residential and Group Housing Societies (GHS)/Residential Welfare Scheme (RWA) categories of consumers with Central Finance Assistance (CFA). The consumer investment in the project excluding CFA/ subsidy from MNRE is to be borne by consumer owned fund/borrowed fund.

Central Public Sector Undertaking (CPSU)scheme: The CPSU scheme, meant to promote domestic solar manufacturing, was being run by the Solar Energy Corporation of India (SECI), the CPSU scheme phase – II is aimed at setting up 12,000 MW grid-connected solar PV power projects under the government producers with VGF support for self-use or by government entities either directly or through DISCOM.

Defence scheme : Under Defence scheme against a target of 300 MW, 357.50MW, MW has been sanctioned, under Central Public Sector Undertakings (CPSUs) scheme against a target of 1000 MW, entire capacity sanctioned, under 3000MW Bundling scheme, Tranche- I 3000MW has been tendered under 100 MW Canal Top scheme all capacity sanctioned under 2000 MW & 5000 MW VGF Scheme and under 20,000 MW : The Indian government has started to make strides towards solar energy.

Solar Energy Subsidy Scheme: The Government Scheme clarifies that a person is eligible for a subsidy if the installs solar panels on the rooftop. The subsidy is determined according to a capacity of the solar power plant but the good part is that people are moving forward with installation of the solar panels. Another advantage is the people can reduce their electricity bills and the load on power Plant will reduce increasing power generation.

Solar Energy Corporation of India (SECI) Scheme: The main objective is to engage in the development of large scale and rooftop solar projects channelized the investment in the government Sector and implement MNRE and VGF schemes, project management consultancy and trading of Solar power. SECI has also played a major part in installing rooftop solar power plant. Till date it has released tender for 4307 MW of large scale solar project of which 675 MW have been commissioned. In the rooftop part, It has released tenders for around 200MW of Projects of which 46.5 have been commissioned. Solar power irrigation have environment and socio economic benefit at village and national level. At village level solar technology is reliable source of energy for irrigation of land in remote area particularly in the area that are not connected with electricity or an area where no regular supply diesel.

NABARD Solar Scheme: Sponsored schemes farm sectors. Dairy Entrepreneurship development scheme. Capital investment subsidy Scheme for Commercial Production units for organic/ biological input, Agri clinic and Agribusiness Centre Schemes; National Livestock Mission; GSS/ Ensuring End use of subsidy Released; Interest Subvention Scheme for the below Solar home lightning System has been discontinued since March 2017. All loans sanctioned by NABARD before 15th March 2017 will be eligible for the subsidy. MNE (GOI) has signed an MOU with NABARD to promote solar home lightning system in rural areas. This program is to be implemented under the Jawaharlal Nehru National Solar Mission (JNNSSM) JNNSSM aims to achieve 20000mw of solar power production by the year 2022.

Suggestions:

1. If farmers are planning on installing solar panel in their field or approach power supply Grid Company hoping to developing their dry land / uncultivated land into solar farm, they should do it in such a way that they can keep agriculture going on the land. They can continue to earn an income from farming in addition to the revenue earn from solar energy.
2. There are different opportunities for dual farming.
3. Besides earning and income through the sale of electricity farmer may able to sale their crops for value added price because they are grown in shade of solar panel.
4. Energy earning from the solar panel sized to meet the energy needs of the home, irrigation and balance energy will be sale to grid provider.

5. Tapping the energy from the sun has always had great potential but large scale utilization has face many bottlenecks.

6. Solar roofs installed in homes, industrial, institutional and commercial buildings can be used to meet the energy needs of other occupants of the buildings. To give more emphasis to Solar Rooftop System government should launch a scheme those who share or supply solar power to other occupants of the building called Solar Rooftop Sharing Subsidy Scheme.

7. Additional / priority funding should be given through Deendayal Upadhyay Gram Jyoti Yojana (DDUGJY), Integrated Power Development Scheme (IPDS), Power Sector Development Fund (PSDF) or other such schemes of Ministry of Power and Ministry of new and Renewable Energy to boost the use of solar power.

III. Conclusion

As demand of electricity is increase day by day and resources are not enough to compare the usages. It was difficult to for common man to pay heavy electricity bills for their domestic use.

- To solve this problem, government suggests solar energy as a good alternative to electrical energy. Solar energy is less expensive than electrical energy. This energy solves all of our motives that electrical does. This solar energy can be used for domestic purpose as well as for commercial purpose.
- Now a days solar system is very popular in urban areas. And more and more people are trying to use this system to save electricity and keep away from heavy electrical bills.
- Solar rooftops installed in households, manufacturing, institutional and commercial buildings can be used to partly fulfill the energy requirements in other occupants in the building.
- If usages of solar energy increase for agriculture purposes which are the largest sources of energy in India so solar power technology would be reasonable source for agriculture equipment. The most important renewable source of solar energy that can be utilized for various purposes.
- Solar energy can increase self-reliance, reduce pollution and electricity bills and ultimately reduce in production costs.
- Solar energy makes easy as consumer need not depend on grid power where solar decrease the usages of diesel generator and save the environment.
- Solar energy scheme most suitable for commercial organization can do max generation for the period of peak usage time.
- Solar energy has less costly then the grid power which is not costly than electrical generatorsystem.
- Solar energy technology is onetime investment which saves lot of way from paying as electric bills also after installation of this solar system it needs no other expenses.
- Through this Solar energy technology people can save lot of their cash by using this scheme.
- Government get up to 70% discount on the Solar energy technology system setup and very less and monthly cost is also less.
- Thus, Solar energy technology scheme is the source of give their contribution in growth of country. And source of income of Indian farmers whereas farmer suicides will be stopped. And their debts will also be forgiven.
- Agricultural trade will be facilitated and rural economic development will take place.
- Through the solar energy system, the farmer's financial support small scale, cottage industries will grow in rural areas, which will increase the per capita income and GDP which contribute to sustain economic growth of rural development.
- Solar energy technology scheme will create employment which will be source of farmer's income so that the farmer's reinvestment will enable the farmer to repay the loan on time.
- Solar technology scheme promoting export growth by increasing agricultural income and it will become easy to get foreign currency too.
- Indian farmer's spareed time can be used for Solar technology to reduce costs and produce commercial crops and adequate use of dry land and timely crop on arable land which contributed sustain economic growth of country.

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