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Solar Energy to Indian Farming (Se-2-If) (A case study of solar energy initiative for agriculture in Bokaro district of Jharkhand)

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ABSTRACT: This study was conducted to investigate use of solar energy and materials in smallholder farming system of the Bokaro District of Jharkhand state in India. The study has to conduct in the Bokaro district of Jharkhand to investigate application of renewable solar energy in the smallholder farming systems. It is located amidst high mountains; 222 kilometer southwest of Ranchi. It has two distinct districts, i.e. the farming systems located in Bokaro district of Jharkhand are mostly small-scale. The basic source of income of the people living in this area is agriculture and related jobs. The population of the study consisted of 2,500 small farmers working in the smallholder farming systems of the area, in which 150 people were selected as sample using sample survey formula and simple random sampling technique. In order to gather the information, a questionnaire was developed for the study and validated by the self assessment. The findings revealed that the majority of the respondents use renewable energy and materials directly in its traditional forms without enabling technologies and they lack the access to renewable technologies to improve the efficiency of energy use. They preferred fossil energy for many activities due to its lower cost and ease of access. The overall conclusion is that there are potentials and capacities for using renewable energies and materials in the farming systems of the Bokaro District of Jharkhand state in India. The government has to support and encourage the adoption of renewable technologies and abandon fossil fuels wherever possible.

Keywords: Solar Energy(SE), Sustainable Agriculture, Solar Energy to Indian Farming(SE-2-IF), small holder farming, Respondents, Renewable Technologies

I. INTRODUCTION:

India's arable land area of 159.7 million hectares (394.6 million acres) is the second largest in the world, after the United States. Its gross irrigated crop area of 82.6 million hectares (215.6 million acres) is the largest in the world. The agricultural sector is one of the major contributors to Indian's economy. India is located between 8–38° N latitudes and 66–100° E longitudes, covering a geographical area of approximately 328 million ha. There are four distinct seasons in India including: winter (December–February), summer (March–June), south-west monsoon season (June–September), and post-monsoon season (October–November). A four month period of south-west monsoon season accounts for approximately 80% annual rainfall in the country. However, there is a large spatial variability in the south-west monsoon rainfall that gives rise to different kinds of vegetation across India. Natural vegetation ranges from tropical evergreen in the south to the alpine meadows in the north and from the deserts in the west to the evergreen forests in the north-east of India. The topic is focused on the five dominant types of land i.e. cropland, forest, grasslands/shrub lands, wastelands, and built-up or settlement areas. Cropland category is defined as the land cultivated for crops including single season, double or triple crops, shifting cultivation, horticultural plantations, and orchards. The Food and Agricultural Organization of the United Nations (FAO) has also included temporary fallow lands into the Agricultural Area category. However, we did not include fallow lands in cropland category since fallow lands have a significantly different influence on the biogeochemical and hydrological cycles. Forest category includes the area evergreen

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and deciduous trees with > 10% canopy cover as well as degraded forest types that has < 10% of the canopy cover. This definition is similar to the forest cover definition used by the National Remote Sensing Center. The built-up or settlement area is defined as the land occupied by buildings, roads and railways. Due to its climatic diversity, India produces a wide range of agricultural products, from cereals , rice, wheat and pulses to citrus fruits and sugar cane etc. Moreover, both irrigation and rain fed farming are used in India. Although land cultivation is still done in traditional ways in some little portion of the smallholder farming systems, new technologies such as tractor and related implements have been introduced to the majority of smallholder farming systems throughout the country. For example, land tillage is done by using both old-fashioned instruments and technology, i.e., wooden plows drawn by donkeys, mules, oxen as well as tractor. The Tractor is becoming a popular technology in seeding, threshing and winnowing as well. Rearing livestock along with land cultivation is another major feature of smallholder farming system in India. In many villages one can witness sheep, goats and cattle using the stubble fields close to the farmer's residential areas. During the winter they are kept in (sometimes subsurface) stables. However, a common feature in small holder farming systems is their dependence on renewable technology and resources in their agricultural production processes. Nowadays, agriculture sector in developing countries such as India needs to be reformed because its trends worldwide lead to monoculture, specialization and increasing dependence on inputs of distance origins which are mostly non-renewable. One of the challenges faced by sustainable agriculture is that the majority of farms still rely on fossil energy for traction and electricity and energy self-reliance does not seem to be a major concern in practice. Fossil energy for mechanized agriculture has been an important driver of the Green Revolution of increasing farm productivity. As on date, there are three energy inputs (diesel fuel, fertilizer and electricity) account for more than three-quarters of farm energy use.

Each year, agriculture emits 12 to 15 percent of the global total of estimated greenhouse gas (GHG) emissions. It seems that a basic solution to cope with the problem is to substitute renewable energy with the fossil fuels in agriculture. Renewable energy can address many concerns related to fossil energy use. It produces little or no environmental emissions and does not rely on imported fuels. Renewable resources are not finite (whereas fossil fuels are) and many are available throughout the country[1]. Therefore, application of renewable energy and related technologies has a great potential to contribute to the objectives of sustainable agriculture and are being used in a variety of applications on farms and ranches, and there are many opportunities to expand their use in the future. This study was conducted to identify the areas in which they use renewable energy and where they need modern technologies to facilitate and improve the use of renewable energy.

Objectives Of The Study:

The study has to conduct in the Bokaro district of Jharkhand state in India to investigate application of new renewable solar energy in the smallholder agricultural practices. It is located amidst high mountains; 222 kilometer southwest of Ranchi (Capital city of Jharkhand). It has two distinct districts, i.e. the farming systems located in Bokaro district of Jharkhand are mostly small-scale. The basic source of income of the people living in this area is agriculture and related associated jobs.

01. To measure the attitude & behaviors of people towards application of new renewable solar energy and their equipments.
02. To study & measure the new renewable solar energy conservation habits & techniques by the people in Bokaro district of Jharkhand state.
03. To identify the awareness of availing the different Government schemes including PM-KUSUM & other Yojana.
04. To assess the farmer's & other consumers willingness to switch over to renewable energies systems.
05. To identify & analyze the health, safety and environmental risks associated with solar power generation and to devise remedial measures.

II. METHODOLOGY:

The study was conducted in the Bokaro district of Jharkhand state to investigate application of renewable energy and materials in the smallholder farming systems. It is located amidst high mountains; 222 kilometer southwest of Ranchi (Capital city of Jharkhand). It has two distinct districts, i.e. the farming systems located in Bokaro district of Jharkhand are mostly small-scale. The majority of the farmers carry out crop farming, animal husbandry and horticulture in their agro forestry farms. The farmers use both indigenous and modern technologies. An initial investigation showed that they have a good record of renewable energy and material use in their farming systems,

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despite their lack of appropriate access to new modern renewable technologies to enhance the efficiency of renewable energies in agriculture.

However, this area needs to adopt an effective model of using renewable energies in agricultural operations. This study was an attempt to analyze the area with respect to this issue. Therefore this study was conducted in Bokaro district of Jharkhand state to investigate how renewable agriculture can be infused into this type of farming system. This was a co-relational-descriptive research conducted recently. Appropriate statistical procedures such as frequency, percentage, mean, standard deviation and correlation coefficient were applied to analyze the data. In order to measure the extent of renewable energy use by the farmers, different appropriate scales were developed and included in the final format of the questionnaire. The responses to each item of the scales were obtained on a five-point continuum viz., not at all, low, medium, high and very high with the scores of zero, one, two, three, four and five, respectively[2]. Then a total score was calculated for different scales by summing up the item's assigned scores, which indicated overall score for renewable energy use by each subject of study. Along with, the overall score of renewable material use was calculated by summing up the items included in a scale which had been developed for this purpose. These two overall scores of different new renewable solar energy and material use by the farmers were applied in correlation analysis[3].

ACHIEVED THE OUTCOME:

The majority of the respondent was male farmers around 65%, while only around 10-12 percent of the farms were headed by women. The mean of the farmer's age was equal to about ranging 38 to 39 years old with a standard deviation of about 22 years old.

The Table-1 shows the education levels of the farmers. The results indicated that 23.33(approx.) percent of the farmers were illiterate, while only 10 percent(approx.) had a higher education degree. The average numbers of girls and boys in the families of farmers were 3% and 3.5% respectively. The average experience of farmers in crop farming and animal husbandry were 35% and 30 years. About 70 percent of the farmers had no knowledge of computer, Android phone operations etc and the rest was a little aware of these technologies[4].

TABLE-1 Educational Level among 150nos. of frequency

Sl.No	Educational Level	Survey done for 150 nos. of Village people in Bokaro District of JH	% (Approx.)
01	Illiterate	35	23.33
02	Primary school	30	20.00
03	Junior high school	20	13.33
04	Senior high school	15	10.00
05	ITI Course	24	16.00
06	Diploma	10	06.60
07	Bachelor of science	07	04.66
08	Post Level	08	05.33
09	PhD Level	01	00.66
	Total	150	100

TABLE-2 Educational Level among 100nos. of People Survey[5].

Sl.No	Respondent Parameters Level	Survey done for 100 nos. of Village people in Bokaro District of JH	% (Approx.)
01	Male awareness about New renewable solar energy applications	100	03
02	Female awareness about New renewable solar	100	01

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	energy applications		
03	Education Level in the village	100	65
04	Male on Organized Job	100	20
05	Female Un- Organized Jobs	100	03
06	Male on Agriculture	100	35
07	Female on Agriculture	100	10
08	People in outside of Village	100	08
09	House Wife	100	30
10	Unemployment	100	55
11	Computer Knowledge among the people	100	02

USE OF SOLAR ENERGY:

The amount of energy from the sun that reaches earth each day is enormous. All the energy stored in Earth's reserves of coal, oil, and natural gas is equal to the energy from only 20-22 days of sunshine. In order to efficiently use this energy, solar technologies have been developed to produce electrical or thermal energy. In agriculture, photovoltaic applications can economically

provide electricity where the distance is too great to justify new power lines. Solar electric systems are also used to provide electricity for ICTs, lighting, Solar Cookers, Water Heaters, battery charging, small motors, water pumping, electric fences, steady supply of fresh air for confinement operations, drying crops and heating homes, livestock buildings and greenhouses, poultry firms etc. It can also provide hot water for dairy operations, pen cleaning, and homes. Regardless of the specific solar energy application (drying crops, heating buildings or powering a water pump), it makes the farm more economical and efficient[6]. For example, heating water and cooling milk can account for up to 35-40 percent of the energy used on a dairy farm. Using the sun to dry crops and grain is one of the oldest and most widely used applications of solar energy. The simplest and least expensive technique is to allow crops to dry naturally in the field, or to spread the grain and fruit out in the sun after harvesting. The Solar energy has been one of the basic sources of energy available to the farmers in Bokaro district of Jharkhand state of India to operate some agricultural practices[7].

Significance:

- There were positive significant relationships between some random variables viz., farmer's age, age of farmer's wife, working experience and family size with the use of renewable energy and materials by farmers[8].
- The smallholder farming households, farmers and their wives who have higher age, more experience and larger family size are more dependent on renewable energy and materials.
- This is because they are mostly resource-poor and unable to pay the cost of non-renewable energy and materials[9].

BARRIERS:

- The crops and grain are subject to damage by birds, rodents, wind, rain, and contamination by windblown dust and dirt. More sophisticated solar dryers protect grain and fruit, reduce losses, dry faster and more uniformly, and produce a better quality product than open-air methods[10].
- There were negative significant relationships between educational level as well as farmer's knowledge in computer with their use of renewable energy and material use.
- The negative correlation coefficients indicate that farmers with higher level of education level and computer literacy use less renewable energy and materials.
- It might be due to lack of sufficient financial and information resources of peasant farmers to cope with the cost and complexity of non-renewable energy sources.
- Lack of access to many of non-renewable energy technologies at the farm and even at house might be another reason for the higher use of renewable energy and material use by small peasant farmers[11].
- They cannot use recent modern machines, tools and devices to perform their farming operations due to traditional structure of their

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farming systems. Some of the new technologies such as tractors are not applicable for solving peasant farming problems. They sometimes use animals for transportation of inputs and outputs as well as for plowing in small plots of lands[12].

- They do not have access to portable gas stove for cooking at farm and have to use firewood for this purpose. In addition, electricity is accessible only in the farms located nearby the city. Therefore, they inevitably use renewable energy and material in considerable extent due to both the lack of availability of non-renewable energy, technology and materials as well as the farmer's poverty to bear the costs.

HOW TO APPLY ONLINE FOR SOLAR PUMP YOJANA 2020:

- Visit the official website of PM KUSUM 2020
- Click Here
- https://kusum-yojana.co.in/
- OrClickHere https://www.onlinekusumyojana.co.in/
- Then fill all necessary information on the website including the address and email id.
- Select solar power megawatt, state and district.
- After successful submission of all information, you will receive a message from the department.

Subsidy Structure Of Solar Scheme:

Under the scheme, the farmer will get subsidy on new and improved solar-powered pumps. The farmers will have to spend only 10% of the total expenditure to acquire an install a solar pump and 60% cost will be handled by govt. and the remaining 30% will be taken care of by the bank as credit.

Name of Subsidy Institution	% of Subsidy
Central Government	60% of the total cost as Subsidy
Banks	60% of the total cost as Subsidy
Farmers	10% of the Total Cost

The Eligibility for PM Kusum Yojana 2020:

- Applicants should be a farmer and should have a valid Aadhaar Card on his name.
- Farmers must also hold a valid bank account.

Important Documents for Solar Pump PMKUSUM Yojana 2020 :

- Adhaar Card
- Bank Account

III. CONCLUSIONS:

The smallholder farming systems of bokaro district of Jharkhand state of India is use renewable energies and materials at the great extent. The results showed that they lack access to intermediate renewable energy technologies to benefit from the renewable energies and reduce the cost of the non-renewable option. In fact they have lost some of their traditional technologies being used to transform renewable energy into mechanical energy, e.g., watermills. Using the sun to dry crops and grains is one of the oldest applications of solar energy. Solar drying equipment can dry crops faster and more evenly than leaving them in the field after harvest, with the added advantage of avoiding damage by birds, pests, and weather etc. The study shows that the farmers use solar energy directly; the ground is ready to promote and introduce solar drying technologies to the farmers. If a farm has a crop dryer already in place, it may make sense to install a low cost solar heater to supplement a propane or oil heater. The farmer would save on fuel costs while still being able to dry crops even in cloudy weather etc. Some of the farms are dispersed in vast areas and cannot have easy access to electricity. Some resource-poor farmers ignored to adopt new technologies as they are dependent to electricity unavailable to them. It seems that solar electric is a very good alternative to provide the energy needed in a cost-effective and feasible manner. It will reduce the dependence of rural and farming areas on costly remote electricity supply. Solar electric, or photovoltaic (PV), systems convert sunlight directly to electricity. They can power an electrical appliance directly, or store solar energy in a battery. PV systems may be much cheaper than installing power lines and step down transformers in applications such as electrical fencing, lighting, and water pumping . At the same time a strong and growing private market for renewable energy technologies in the agricultural sector should be developed. In addition, the places with enough wind resources for small turbine use should be identified.

Agricultural extensions have to receive training in the appropriate use of renewable energy technologies for ranching and farming and empowering local people to make decisions related

to their own energy and water use at a community level. The universities and extension offices have to pay due attention at each block and grama panchayat level to this issue to guide, support & coordinate the renewable solar energy agriculture programs by educating the actors of agricultural development. The Government has been encouraging farmers towards Solar Energy by initiating different schemes. The registration process for the central government's ambitious Pradhan Mantri Kisan Urja Suraksha evem Utthan Mahabhiyan (PM-KUSUM) has already started in many states which aims to provide agricultural solar pumps with 90% subsidy. The official website of PM KUSUM is finally opened and the government has requested the farmers to apply through online mode. PM KUSUM 2020 aims to provide around 20 Lakhs solar pumps across the nation to eradicate all the water problems of farmers. As per the reports, the Solar Pump Yojana has been gearing up with full swing in the state of Rajasthan and Uttar Pradesh. Moreover, the Solar Pump Yojana which promises to fulfill the irrigation and water problems by providing a 90% subsidy to the farmer for setting up pump sets has been expanded to cover 20 Lakh farmers across the nation this year.

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