Significance of Renewable Energy for Empowering Cooperative-Farming Sector in Majuli Island of India

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Abstract: Agriculture is the backbone of the Indian economy and plays a vital role in the overall development of the country. Many studies and practices have proved the importance and benefits of electricity in agriculture throughout the world. However, the fossil fuel-based conventional energy supply to agriculture is always associated with environmental issues. In an attempt to study the significance of renewable energy in the cooperative farming sector particularly in the biodiversity regions, Majuli Island of Assam, India has been selected for the case study. Even though the major income source in the said locality is agricultural farming, they are deprived of getting the optimum benefit from this indigenous income source due to lack of technological intervention. Technological intervention in this sector in the biodiversity region is not imaginable without exploring the feasible intervention of renewable energy at an affordable energy cost. Therefore, in this paper, the significance of renewable energy in agriculture considering the environmental issues has been highlighted in general and in cooperative farming in particular.

Key Words: Renewable Energy, Cooperative Farming, Environmental Issues, Sustainable Livelihood.

1. Introduction

The World's biggest waterway island, Majuli, situated in the Brahmaputra stream of Assam state, is recently declared as first island district of India [1-3]. It covers a zone of 352 sq. km and a populace of around 1, 67, 304 (approx.) [2], [4]. The beautiful excellence and uniqueness of the Island make it a vacationer location for people groups, all around the globe [4]. Both abroad and homegrown sightseers visit here on a regular stretch and along these lines makes a road for the job of the Island [4-5]. Aside from Tourism, small scale cottage industries are also providing employment opportunities in this area[2]. From the primer examination by the creators, it has been discovered that the essential type of revenue here is principally from horticulture, around 75% of the all out populace totally relies on farming for their vocation. [1-2], [4].
1.1 Cooperative-Farming

“Cooperative” in different sectors is coexisting from the last few decades, farming, is one among them. However, cooperative-farming is a novel concept conceptualized appropriately in various studies [4]. Cooperative farming is a type of farming system where each farmer remains as the proprietor of their land but the farming activities are carried out collectively by a group of farmers through cooperative activities and technological intervention [4], [6], [6]. The profit and loss from these farms are distributed among the farmers based on the ratio of the land they have own [4]. With the help of certain agencies formed by the farmers and for the farmers, individual farmers performed their farming activities jointly in their holding [4], [6-8]. These agencies also help in purchasing and sending of farm inputs and outputs. The basic idea behind agricultural cooperative is to pool the resources for getting the benefit of ‘Teamwork’ and thereby reducing risk rate. Cooperative farming in different forms has already tried and still practicing in different countries such as the UK, Germany, France, etc. for the last few decades [8-11].

1.2 Cooperative Farming and Renewable Energy

Many studies have proved that the highest efficiency in farming can be achieved only by the means of electrical energy and hence technological intervention. Technological intervention in the area of agriculture will increase the competence of certain farming activities. Usually, farming activities are carried out by manual labor and with conventional tools such as sickle, ploughing, etc. but renewable energy-based mechanized farming will reduce the manual work and automats the farming activities thereby saving time and energy. Renewable energy can play a major role in agriculture and particularly in cooperative farming for sustainable growth. Moreover, the intervention of renewable energy in farming will not only help in rural development missions but also creates a sustainable environment for the entire world in terms of reduced carbon-cost [12]. Based on the case-study conducted at the “Borgayan” village of Majuli district, the following points are the contributions of this manuscript.

1. The significance of the renewable sources of energy in the corporative farming sector for the said location and its feasibility study has been discussed systematically.
2. The analysis of the existing agricultural practices and socio-economic scenario of the proposed case-study location has been detailed.
3. The benefits of cooperative farming, the intervention of technology, and the introduction of renewable energy in the cooperative farming structure have been discussed.

2. Literature Review

Some of the similar reviews done by various authors in their respective journals are: Bardi, Toufic, and Lavacchi, (2013), in their study “Turning electricity into food: the role of renewable energy in the future of agriculture, says that encouraging the use of electric power in the farm is a worthy effort, even though it is not possible to replace renewable energy with fossil fuel simply, leaving everything unchanged, but it is possible only utilizing more efficient use of energy and mineral resources, as well as an approach in a more respectable way to preserve soil and local resources. R Athira, and et al(2019), in their research, “Proposed Cooperative Farming as a Catalyst to Livelihood Augmentation for the Marginal Farmers of Majuli Island, said that the cooperative system will not only increase the standard of living but also increases the feeling of friendship, cooperation and thereby achieves synergy in the agricultural sector. Keely AR(2016) in his study, “Renewable Energy in Pacific Small Island Developing States: the
role of International Aid and the Enabling Environment from Donor’s Perspective, studies that, High targets supported by well-structured action plans and effective regulator body is responsible for RE and also financial aspects of utilities hold a higher importance than technological aspects of utilities. Dhunny, Allam, Lobin, and Lollchund (2019) in their research,” Sustainable renewable energy planning and wind farming optimization from a biodiversity perspective, proves that, in an economic analysis performed for understanding energy generation of scenarios in respect of the selected site, reveals a positive result inefficiency of the model and its potential applicability to other sites, who are looking for sustainable energy planning. Elaine Forde, (2017), in his study, “The Ethics of energy provisioning: Living off-grid in rural Wales”, argues that living off-grid comprises of materially engaged ethics of usage of energy, emerges from and situated in everyday realities of off-grid energy provisioning. R, Borlase Matthews (1922), in his topic,” Electro Framing or the Application of electricity to agriculture” in his experimental study suggested that the highest efficiency in farming can be only achieved through electricity. Chetan Dwarkani, (2015) in their study, “Smart Farming System Using Sensor for Agricultural Task Automation”, developed a user-friendly smart farming system and suggest that it liberates agricultural productivity and mode of production can be changed. Fabio Riva and Emanuela Colombo (2020). In their research, scientific reports only show controversial results regarding the impact of electrification programs and most of the time provide attributable to inappropriate planning of off-grid capacities of the system. Bikash Das (2017) in his study on, “An overview of the economic condition of Majuli, the largest inhabited river island of the world”, says that most people of River Island depend upon agriculture, but, the traditional agricultural system o Majuli results in low productivity.” V.J.P.D. Martinho (2020), in his study,” Relationship between agriculture energy and farming indicators”, says that reviews concerning agriculture energy and pollution highlight that there is a relevant relationship between energy consumption, economic development, and environmental impacts. Kurunathilake H (2016), in this research,” Renewable energy integration into community energy system: a case study of new urban residential development”, reveals that the Renewable energy system depends upon local situations energy availability, etc.

3. Research Methodology Area

3.1. Case Study Area

The research was carried out in a village named Borgayan Village, situated in Majuli District, Assam. The literacy rate of the village, compared to Assam, is very low and no modernization has happened yet. People groups here totally relies on horticulture for their occupation just as for their every day needs. Rice is the principle cultivation here. Aside from this, many are additionally into kitchen cultivating. [4].

3.2. Data Collection

The research was done using both primary and secondary data. Primary data was collected using survey method, a field visit was done and directly interacted with the farmers at work, thereby first-hand data were used for the study. Other primary sources includes interview method, random sampling, personal observation method, etc. The Secondary data collection was made based on different sources such as census, various related journals, other publications, articles, e-journals, books, recent reports, etc.

An isolated island, no connected examination has been done in Majuli, till this date. Accordingly, the "Theory Building" idea has been utilized for proposing the model, of this paper. Theory building, is a broadly utilized idea in research territories, as it gives an examination structure to the investigation, additionally a proficient field improvement should be possible utilizing this idea and also it helps in further applicability for solving the problems and issues related to the practical real world. Theory, however a dreary artistic expression, practical, without theory, can be hazardous and dull. In explanatory
reasonable examination, a subcategory of "theory building" idea, adds new bits of knowledge into conventional issues through logical relationship building. So in this paper, we utilized the "theory Building" concept, along with primary and secondary data, for the study [13].

4. The Present Agricultural Scenario of Majuli Island

Majuli Island is situated in the Brahmaputra River of Assam. It was one of those three subdivisions of Jorhat District, but recently in September 2016, the river island Majuli is declared as one of the districts of Assam [1]. In spite of the fact that a confined island, the picturesque excellence improved with greenery makes it a traveler center point for people groups from various pieces of the world. Farming is the essential kind of revenue here, around 75% of the absolute populace relies on horticulture for their occupation. The climatic condition and soil of Majuli are very appropriate for development. Primary cultivating here is rice, mustard, vegetables, and so on from the complete region of Majuli around 41.43 percent of the zone is utilized for development. Ranchers here are generally negligible ranchers, having little landholdings of 0.95 hectares [4]. Modernly, Majuli is a little in a backward spot in the entire of Assam. Absence of modernization, innovative headway, absence of legitimate transportation facility, geological disconnection, and so forth can be the explanation behind this. Despite the fact that, couple of cottage and small scale industries are existing in Majuli, for example, ceramics industry, boat making industry, handloom, stick bamboo, and so on [2]. Aside from this sericulture is additionally a significant agro-based industry of Majuli. Majuli is additionally famous for its fishing area, around 10%-20% of clans here, fundamentally ST and SC, are occupied with fishing [4].

4.1. Current Scenario of Borgayan Village

The town we chose for the research was Borgayan. As per statistics 2011, the all out populace of the town is 1320. Rice and mustard are the fundamental development here in the town, around 90% of the populace are into horticulture. Three primary sorts of rice crops are developed here. The yield development graph is given in Table 1. Ahu-Dhan and Mustard are the fundamental harvests here. This town is additionally well known for the black gram and curd [2]. Peoples here additionally insignificantly do kitchen cultivating, just to meet their every day needs. Apart from this, the other sources of revenue are from livestock, fish ponds, and so forth some are also workings labors at nearby small-scale industries.

| Crops         | Harvesting         |
|---------------|--------------------|
| Ahu-Dhan (rice) | Jan-July           |
| Baw (rice)    | April-Dec          |
| Mustard       | Sep-March          |
| Chana Dal     | Nov-May            |

It is found that farming here is done using the traditional system of agriculture. Due to a lack of modernization and technology availability, peoples here get a minimum profit. For irrigation peoples here depends upon “rain”. Only 5% of farmers use pumps for irrigating their land and that too a diesel one. Based on land availability, some also do multi-cropping. Mustard is the only crop, used for trade purposes. Harvested mustards are collected by brokers directly from the farm and sell it to the mill, thereby brokers are more benefited and farmers get less benefit. For rice, farmers here, after harvesting, store the grains in a “bhari”, a small room made up of bamboo and dried grains. Based on the need, these grains are taken to the mill and processed into rice, the rice husk is used as cattle feed and rice for their daily needs. Here, a conventional method of farming system is used. As every farmer, having land, does their farming on that particular lad itself. Here, the profit and loss is beard by the individual farmer himself. As a being an isolated island, Majuli is facing issues like soil erosion, flood, etc, when such calamities affect farming the farmers have to face the entire loss, and sometimes the loss can be too high.
for a marginal farmer to bear [1]. The other issue of this system is that the small farmlands divided with boundaries create a problem for proper irrigation as well as for proper drainage related issue. Since there was no other option available, farmers were facing the entire struggles.

5. Renewable Energy and Cooperative Farming Correlation

5.1. “Cooperative” in detail

Many studies have proved that “cooperative farming” or “collective farming” can resolve many issues of individual farming [14-15]. The basic concept of these farming is to pool together the land and resources. In this system, each farmer will remain as the owner of their respective land but farming will be carried out jointly. Here the profit and loss incurred from agriculture will be divided based on the ratio of land, the farmer holds [6]. Based on the number of days/ hour, they work, wages can be decided and distributed accordingly. In this system, the land earlier used for dividing boundaries can be used for cultivation, hence, wastage can be reduced. As working together, the feeling of brotherhood and spirit of synergy can be achieved [4], [6], [8]. It is found that in many developed countries, a large proportion of farmers rely on a cooperative system of agriculture to govern both forward and backward market transactions [6], [8]. Many producers are joining the force in agriculture cooperative by becoming its member and using the services, the collective organization provides. Existing cooperative farming can be divided into two: a) agriculture production cooperative, which helps in land pooling and using resources jointly b) agricultural service cooperative, which provides basic services required for farming such as warehousing, storing, etc. mainly the agricultural inputs are purchased from the market at a reasonable price, but when the market fails to do so, cooperatives form [4].

5.2. Significance of Renewable Energy Based Electricity

In view of numerous ongoing examinations it is discovered that most extreme productivity in agriculture can be arrived at simply by the utilization of the electrical technique [16]. The utilization of power in cultivating is numerous, for example, in the poultry area, electric light, and etc, the details are shown in Table-2.

| Use in Farm Building | • Electric light for dairy, yards, milking, chaff, food preparation, dust extractor  
|                      | • Dairy- milk separation, cooler  
|                      | • Poultry- increasing egg production, egg tester, etc.  
| Use in Farming Land  | • Manure distribution by electric machines  
|                      | • Plowing  
|                      | • Irrigation purpose  
|                      | • Electric engines for farmland works  
| Treatment of Crops   | • Preparation of seed- bathing of seed, seed drying, etc.  
|                      | • Gathering groups- hay drying, pulp extraction from fruits, etc. |

Apart from this, a lot of works that ought to be substantial by electric power, is currently being done by manual labor [17]. However, these farmers are not aware that electricity can assist them to a great extent until someone shows them the possibilities. Currently, they are forced to work with all their effort with disregard of time. Though electric light is avoided or considered to be less important, bringing these
electric light will allow the safety and convenience of their work apart from agriculture, livestock farming can also be done using electricity [16]. Sufficient milk from cooperative farming can be stored and used for other purposes in the food processing section can be done easily done using cooler facilities through electro farming [16],[18]. An experiment done on a foreign farm shows that certain electric light treatment can be used for egg-laying and earlier maturity of livestock [18]. In India, around 70% of the population is into agriculture, contribution to GDP is 8%. The main reason behind this deprived performance is the lack of automation in the agriculture sector. Because of the absence of appropriate advancement, farmers are not able to update themselves. They are not even able to get to know about the benefits and programs from the government. With the help of electricity, many issues can be solved. Digitalization is also an important element along with electricity [17], [19-20]. The sector agriculture plays an important role in reducing poverty, providing food, earning foreign exchange, etc. but the main input needed to sustain the agro sector and its growth is irrigation which requires access to electricity at farms [20]. Studies have proved that electrification to the farm can increase yields and consequently income from the farm through adopting electric pumps for irrigation and also other needy applications [17], [20]. This is a labor-saving technology for farmers and also reduces the expenditure on hired labor and time consumption. Adoption of electricity can also benefit farmers from the issue of getting access to information related to getting the best practice of farming through an internet connection [4], [21].

5.3. Adopting Renewable source of Energy

In many different parts of the world, electricity is being used in the agriculture sector and are getting maximum benefit too [22]. But it is found that modern technology-based agro farming is depending upon energy supply obtained from fossil fuels or we can say the conventional source of electricity. Fossil hydrocarbon is a limited source to rely on completely and also its harmful effect on the environment creating an urgent need for reducing their use [19], [23]. By this agriculture, which meant to be the highest livelihood provider, ultimately resulting in one of the major emitters of greenhouse gas [24]. This question is about the sustainability of the environment. The continued use of fossil fuel may lead to a slowdown of production in near future causing serious issues to the agricultural sector [19], [25-26]. Many researchers on their different studies have proved that a renewable source of energy is the best to rely on to avoid a negative impact on the environment created by the conventional source of energy supply. So, it is important to resolve this issue, so that we can aim towards the conservation of precious resources such as the fertility of soil and water [26-27]. Renewable energy provides a wide variety of energy production in different forms, at different cost with different efficiencies, which reduces the dependency on the conventional source of energy and ensures long term energy security for the country as well [9]. RE plays a vital role in achieving primary and secondary energy supply goals such as improved diversity, energy supply security, reducing local pollutants, etc. studies have observed that there are ample amount of opportunities available with favorable geology and geographical conditions with a huge customer base and widening gap between demand and supply. Sustainable renewable energy can be of vital link for the development of the nation [28-31].

5.4. Feasibility Study on Solar PV based Renewable Energy in the Case-Study Site

The Majuli biodiversity region is situated in the global positioning of 27.0016° N, 94.2243° E. The average solar radiation (kWh/m²/day) data has been collected for the year 2019 with a sample size of 7 samples/day basis using the Solar Radiation (Silicon Pyrometer) Smart Sensor - S-LIB-M003. The collected data has been shown in Fig.1.
It has been observed that the average solar radiation at the test site is well above the standard 0.2 (kWh/m²/day). This is the minimum radiation level above which it is suitable for solar PV power generation site economically [32-35]. Therefore, the site is suitable for solar PV based on renewable power generation technologies. Based on a proposed 5kW solar power plant, the cost analysis has been performed in an attempt to compute the cost of energy as shown in Table 3. The estimated cost is found to be $0.1756/ which is significantly less than the present cost of energy from conventional sources at the same location.

| Cost Factors                  | Value  |
|------------------------------|--------|
| Initial Capital Investment ($) | 6600/- |
| Cost of Energy ($/kWh)        | 0.1756/- |
| Net Present Cost ($)          | 1220/- |
| Operating Cost ($/year)       | 675/-  |

6. Proposed Electro Based Cooperative Farming Model

Based on certain studies we designed a model, a model based on electricity and technology. The main idea of this proposed model is to lessen human labor and getting a clearer idea of responsibilities and thereby obtaining a productive environment through the activities of agriculture using a cooperative farming system based on electricity and technological advancement for the betterment of livelihood.
Electricity influenced Capacity Building

Now, we all know that modernization is the basic concept behind this model. Smartly achieving maximum benefit is the concept here. To reduce those manpower labor work and optimal utilization of time can only be achieved using electricity. As it plays a very important role in all of this. Each part of the model, need electricity. We cannot deny the fact that nothing in this cooperate model can be performed without the use of electricity. We need electricity in farm machinery, food processing, use of information and technology, to get an update about all the marketing and financial stuff. The main purpose of this electricity influenced capacity building is to support the other elements of the cooperative section, through electricity, to make the working more productive in less time and also in a smart way.

a) ICT Infrastructure

This section will carry out activities related to technology and information. New farming techniques, ideas, updated information regarding the outside world, the subsidy is given by the government, and other initiatives by the government can only be acquired using this unit. Since Majuli is an isolated island, the village in which the study was carried out, found that peoples there are completely unaware of the subsidy and benefits providing by the government. The main motive behind the introduction of this unit is to build a platform for communication with the outer world using information communication technology and being updated with the technological world.

b) Mechanized Farming

This unit will be dealing with the mechanical part. The usage of various farm machinery such as tractors, irrigators, other farm machines used for plowing, harvesting, etc. can be done here. This area will give training to peoples and will be carrying out the mechanical parts. Not only in the farming area but also food processing section. Plants, machinery, etc. will be dealt with by this unit. Under this unit, an idea will be given regarding the farming pattern, current technology, farming culture related to climatic condition, soil pattern, etc. this stuff can be very familiar to peoples who are into farming there. But the newcomers or new generations who are new to this field will not have many ideas about the land and soil. The main purpose of this unit is to give needy ideas and knowledge to upcoming people about the fertilizer, its amount to be used, its impact on soil, making them aware how to deal with manure, identification of soil fertility, cropping pattern, smart irrigation of land using modern technologies, etc.

c) Post-Harvest Treatment

The agricultural output, need to be processed in mills and products like grains which are usually taken to mill to separate the husk, can be done here in a cooperative unit. Apart from this, the excess products that can be processed into new brands for trade purposes can also be done here. Hence, all the activities related to food, food processing, agricultural output, etc. can be carried out in this “post-harvest treatment” unit. The processed food which needs to be sent for trade purpose can be done by this section. Also, the decisions regarding linkage with the outside market such as purchasing agricultural inputs like seed, fertilizers, etc. can be made by this unit. The overall marketing, advertising, selling related kinds of stuff can be performed by this group. Therefore, these three renewable energy-based sections
will ultimately contribute to cooperative farming. Where peoples will be carrying out their farming activities in a cooperative way as discussed earlier in this article, and finally contributing to sustainable livelihood development. As studies have declared that sustainable development is a paramount issue that requires urgent action and changes from the side of government and society as a whole [36]. In this model, we focused on renewable sources of energy which will switch from the demand need for fossil fuel in a farming area and thereby enjoying a sustainable cooperative development of the area.

7. Conclusion

Hence, the basic need for electricity and its importance in the agricultural sector is discussed. As many actives, of machine nature, are currently being done manually. This leads to high cost, time-consuming and resulting in low productivity, therefore, the paper focus on achieving a cooperative sustainable farming system by replacing green energy sources with conventional one. An electro based cooperative model was developed and proposed in the paper, the technical based cooperative model, if implement properly can result in various benefits such as providing a platform for communication with the outer world, systematic and structured working pattern where each one gets a clear idea about the work, increased production, economic development of farmers, market linkage, optimal utilization of land, organized source of employment, bulk surplus, being a cooperative, high valued machinery can be purchased, etc. the benefits are enormous. With this cooperative model, since people working jointly will bring the synergy and love of brotherhood can also be achieved. If implemented properly can also provide employment opportunities within the village as well.

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