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Implementation of Solar Dryer for Using Betel-nut drying at Boke Pyin Township, Myanmar

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Abstract: The farmers who cultivate the Betel nut plants typically dry the betel nuts on the ground, in the open air, a process that takes about 45 days and the quality is not so good. Therefore, the decreasing the price obtained by the producers. This solar dryer house decrease the drying time by 10-15d days, thereby yielding a higher quality product. The dryer builds a parabolic roof structure covered with polycarbonate sheets on a concrete floor. The dimension of dryer is 10fts in width, 20fts in length and 8fts in height. Two 20-W DC fans powered by two 100-W PV modules were used to ventilate the dryer. The dryer house was built at U Aung's Betel nut plant field in Boke Pyin Township, Tanintharye region, southern part of Myanmar. Therefore, greenhouse type solar dryers are recommended for natural betel nut drying from farmers. According to the performance test, the results also showed that drying air temperatures in the dryer varied from 35°C to 60°C. The betel nuts dried in this dryer were completely protected from animals, insects and rain. Moreover, good quality of betel nuts was obtained. The estimated payback period of this greenhouse solar dryer for drying betel nuts is about one year.
Keywords: solar dryer house, DC fans, PV module, betel nut drying, air temperature

1. INTRODUCTION

In Myanmar, it enjoys abundant sunshine all year round, especially in the Central Myanmar Dry Zone Area. Potential available solar energy of Myanmar is around 51973.8 TWh/year in accordance with NEDO surveying data in 2003.On average; daily global solar radiation in Myanmar varies from the value of 15 MJ/m2-day in the north and the east to 20 MJ/m2-day in the west as shown in Figure 2. High solar radiation (>20 MJ/m2-day) is observed mostly in the fertile plains including the areas of Magway, Mandalay and Sagaing Regions. In the north, low solar radiation (14 MJ/m2-day) is observed as a result of cloudy skies generated from the cold front system. On the other hand, the pattern of low solar radiation (16-18 MJ/m2-day) is also seen in the east and the south regions. This is because of the monsoons, which bring heavy rains and clouds. In contrast, high solar radiation (20-22 MJ/m2-day) is seen over the areas of Mandalay, Magway and Sagaing Regions. The year average solar radiation of Myanmar is found to be 18.3 MJ/m2-day, when averaged over the country. The annual maximum solar irradiation is in February and the minimum in July-August.[1]

Most farmers in the developing countries still use the direct sun drying for the preservation of foods. This traditional method although cheap they are susceptible to dirt, foreign materials and are accessible to animals and require larger open space. As alternative to this traditional method many have suggested to use mechanical solar drying system in which temperature, RH and air flow rate can be controlled to produce even and good quality of the final product.[2]When the betel nut drops from the tree, its moisture content is very high. High moisture contents will lead to fungal growth, reduction in shelf life, increased germination and increased brown centering, all contributing to higher reject levels, reduced product quality and lower prices to the grower. The damaging effects of high moisture content begin as soon as the nut falls, so harvesting and drying should commence as soon after nut-fall as possible. The mathematical model developed for solar dryer on the basis of energy balance of solar radiations falling on transparent cover, to give air temperature at the outlet of the collector. The collector is a most important part of the solar dryer. An absorber plate and top enclosure cover forms the entire collector. The performance of collector is the key factor in deciding total efficiency of solar dryer.[3]

2. BUSINESS MODEL AND IMPLEMENTATION PROGRAMME OF SOLAR DRYER PROJECT

The main objectives of this research are to develop the solar dryer technology, to increase the utilizing the renewable energy technology and to develop the socio-economic of people who live in rural area.

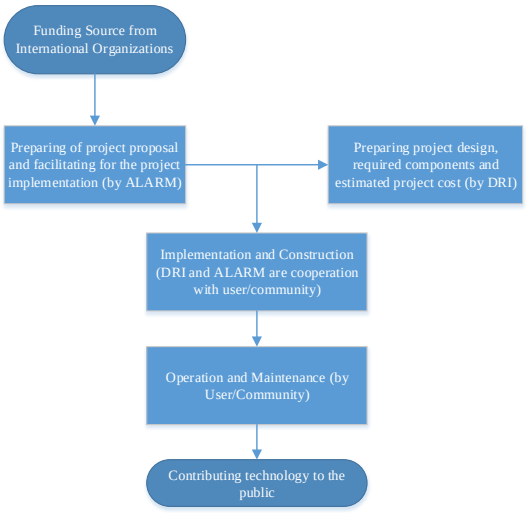

Figure 1.The implementation Structure of Demonstration Project

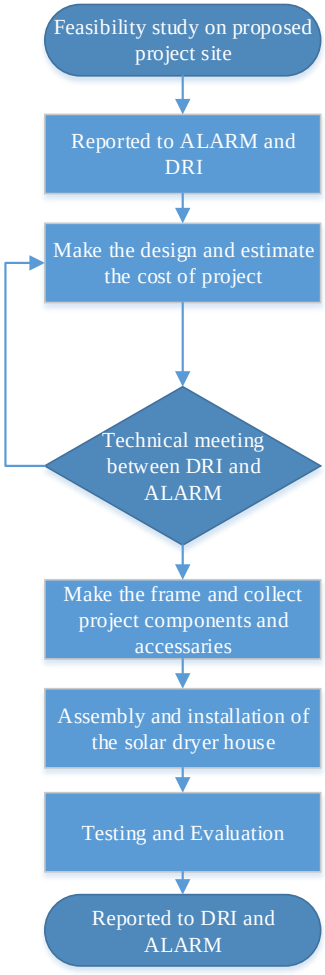

Figure 2.Implementation Programme for Solar Dryer Project

3. PROJECT SITE LOCATION

Myanmar is basically a agriculture country and it is needed to dry the agriculture products after harvesting in country, such as paddy, rubber, beta nut, chili, vegetable and other crops. Currently Myanmar haven't developed for the systematically drying the crops which produced by agriculture work. Therefore, the farmers who cultivate the crops have the losses for their income from exported to other countries. In addition, They are facing such kinds of difficulties; utilize the labors, take more time, decrease the quality of crops, etc. therefore, advanced technology like this Solar dryer technology is essential for farmers in country.

The project is located in latitudes 11.5 N and longitudes 98. 46 E in which lies in the solar intensity zone of moderate favorable belt. The weather data for solar dryer project is shown in Table 1 and Figure 4.

The site surveying of solar dryer research project is implemented at Htatkama village in Boke Pyin Township, Tanintharyee region, Myanmar. There are a lot of betel nut plant field in that area as shown in Figure 3.

In accordance with feasibility study on project area, most of the farmers are willingness to construct the solar dryer house and can effort to invest for installation of the solar dryer house.

Figure 3. The Cultivation of Betel-nut Plants in Htatkama village

Table 1. the annual weather data for the proposed site area

Month	Air Temperature	Daily solar radiation (horizontal)	Wind speed	Earth Temperature
	ºC	kWh/m2/d	m/s	ºC
January	25.9	5.74	3.1	26.3
February	26.5	6.39	2.6	27.4
March	27.1	6.68	2.7	28.4
April	27.2	6.67	2.7	28.5
May	26.8	4.6	3.2	27.8
June	26.3	3.55	4.6	27.1
July	26	3.55	4.2	26.8
August	25.9	3.31	4.7	26.6
September	25.7	4.06	3.4	26.5
October	25.6	4.99	3.3	26.4
November	25.3	5.33	4.7	25.6
December	25.1	5.54	4.8	25.4
Annual	**26.1**	**5.02**	**3.7**	**26.9**

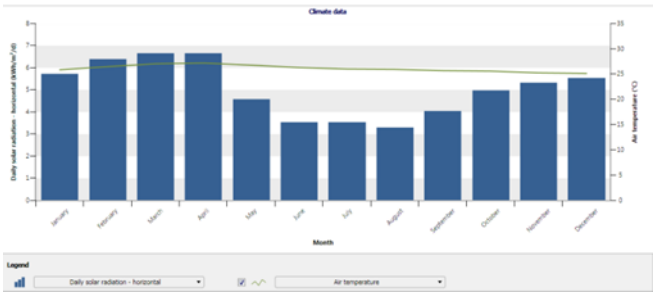

Figure 4. Daily Solar Radiation and Air Temperature in BokePyin Township, Myanmar [4]

The surveyed data for the project location are described in Table 2. The people in that area mainly focus on the cultivation of betel nut plant for their business. In future, this solar dryer house will be widely used because the betel nut from this township have being exported to India though the Tamu township, Myanmar.

Table 2. The Collected Information data of Project Site

No	Description	Quantities
1	Project Location	Htaukkama Village, Bokpyin Township, Tanintharye Region
2	The area of Beta nut, rubber and coffee	28 acre
3	chickens	6000 nos
4	Pigs	9 nos
5	Start to harvest for beta nut	October (in annually)
6	Rubber	In the whole year
7	The size of beta nut (max)	2 inch x 2inch
8	Take the time for one batch (Beta nut)	Totally 50 days
9	The price of Belta nut	5000 to 5800 Myanmar kyats

In addition, this township hasn't accessed the electricity from the national grid yet. They depend on the diesel generator from private sector for electricity. For that case, The price of electricity is very expensive for them, about 450 MMK/kWh.

4. DESIGN SPECIFICATIONS OF SOLAR DRYER

The heat received by the collector was calculated using Eq. (4.1)

$$Q_c = I \times 0.86 \times A_c \qquad (4.1)$$

Where,

I = Solar insolation, (18MJ/m2/day)

A_c =Area of collector. (18.5m2)[3]

Table 3. Technical data for Solar Dryer Project

No	Description	Material /quantity
1	Type	Green House type
2	The size of solar dryer	6.096m x 3.048m
3	The type of material for roofing	Poly carbonate sheet (3 sheets)
4	The area of Concrete Foundation	7.315m x 4.267m
5	Frame of Solar dryer	Angle Iron and iron pipes
6	Exhaust Fan (12 inches Dia)	2 nos
7	Solar panel (100watts)	2 nos
8	Battery (65Ah)	2 nos
9	UPS (500Watts)	2 nos
10	Charger controller (10A)	2 nos

The technical data for solar dryer project are as described in Table 3.

In accordance with Eq (4.1), the calculation result of the heat received by the solar dryer is 286.38 MJ per day.

Figure 5. The Whole System of the Constructed Solar Dryer

5. RESULT AND DISCUSSION

The solar dryer dried using sunlight to the test when the best available measure of the maximum temperature of 70 ° C minimum, received up to 43 ° C. The average temperature is receiving up to 53 ° C temperature for a day was found to be able to maintain. According to the measure, when the outside temperature is 35 ° C Indoor temperature 53 ° C, the difference between internal and external temperature of about 18 ° C according to the test. The inside temperature testing result data are as shown in Figure 6.

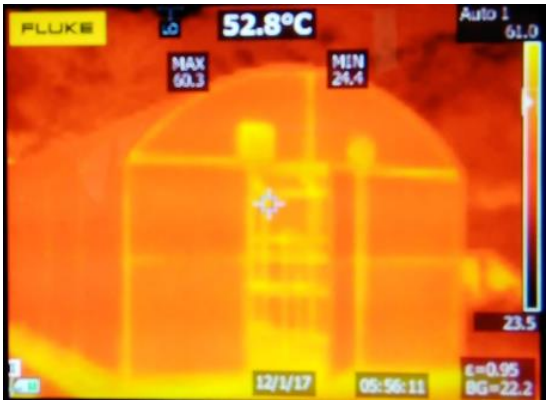

Figure 6. The measurement of Temperature inside Solar Dryer House


Figure 7. Drying on Betel-nut by using Solar Dryer

Table 4. The Survey records data for Betel-nut Drying Process

Date	Temperature (C)			
	8:00	11:00	2:00	5:00
15-May,2018	37.7	55.3	43.9	34.0
16-May,2018	34.0	44.7	44.7	41.9
17-May,2018	42.1	35.0	44.3	36.8
18-May,2018	34.0	49.9	41.4	29.6
19-May,2018	35.9	35.0	40.6	39.8
20-May,2018	31.8	33.0	43.9	37.0
21-May,2018	30.8	37.2	37.0	28.1
22-May,2018	32.0	30.8	31.7	32.4
23-May,2018	34.0	40.0	32.7	32.2
24-May,2018	29.3	36.8	41.6	27.6
25-May,2018	39.1	39.8	37.5	37.2
26-May,2018	27.7	29.1	36.6	29.3
27-May,2018	29.4	37.5	27.6	27.6

Previously, the traditional drying takes the 45 days for drying these betel nuts, but if dried in the solar dryer house, it is found that lasted only 10 days for drying them. According to measurements, over 30000 numbers of betel nuts are dried in the dryer house for each batch. Other crops are found to be able to dry the amount equivalent to the size.

6. CONCLUSION

The solar drying system used to dry the crops and keep the original quality of the Holy export has increased the income of farmers in rural area in our country. Therefore, this technology can support the people who live in rural area in Myanmar in order to develop the socio-economic. We will carry on the testing and measuring the quality of other fruits and crops by using this solar dryer house.

7. ACKNOWLEDGMENTS

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