# Analysis and survey of the application of solar dryers in eastern Nigeria

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**Abstract:** A survey on the use of solar dryers for drying purposes was carried out in some communities in eastern Nigeria. The objective of the study was to ascertain the extent uses of solar dryers by local farmers and the rural populace. The survey method included oral interview and questionnaire administration. The results of the study revealed that the practical use of solar dryers is absent domestically and industrially. However, great enthusiasm was shown by the farmers in the use of solar crop dryers if their performance is satisfactory with respect to quality and quantity of products dried at a given time interval. Most farmers rejected the idea of establishing communally maintained and operated systems but preferred commercialized systems where payments are made per unit quantity of products dried. The study therefore recommends the development of affordable solar crop dryers with auxiliary heat sources to mitigate the effects of daily and seasonal fluctuation in solar radiation in order to cope with the demands of a profit oriented commercial drying system. Such a system holds a lot of promises for entrepreneurs.

**Keywords:** crop drying, solar crop dryers, auxiliary heat sources, entrepreneurs, Nigeria
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## 1 Introduction

Solar dryers are specialized devices utilizing solar radiant energy as part or the full heat source for controlled drying and simultaneously protecting the goods being dried from rain, insects, birds and rodents. This is the main advantage of solar crop dryers over open-to-air drying method where the products to be dried are left at the mercy of birds, rodents and intermittent rains. In areas where sunlight is abundant, the use of solar dryers reduces energy cost from conventional sources such as coal, firewood and grid fed electricity. Drying has long been used as a technique for preserving products especially food substances. The basic essence of drying is to reduce the moisture content of the product to a level that prevents deterioration within a certain period of time regarded as the "safe storage period"[1]. The principal reasons for this are that the microorganisms which cause spoilage and decay are unable to grow and multiply in the absence of sufficient water and many of the enzymes which promote undesirable changes in the chemical composition of the product cannot function without water[2]. At the National Centre for Energy Research and Development, University of Nigeria,

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Nsukka, solar dryers for food crops, fish and poultry manure have been developed. Solar dryers for drying timber and laundry have also been reported[1]. Solar dryers can generally be classified as active (forced convection of air) and passive (natural convection of air). Of these two, the passive types show promise since their operations do not depend on electricity which is more or less unreliable in Nigeria.

Reports on performance evaluation of newly developed solar dryers in Nigeria, abound in literature especially that of Nigerian Journal of Solar Energy. However, the day to day use of these driers by local farmers is seldom reported. Therefore, this study was carried out to ascertain: the degree of awareness on the use of solar crop dryers for crop drying, extent use of solar crop dryers by local farmers, factors 'for' or 'against' their use and the general opinion of users and potential users of solar driers in south eastern Nigeria.

The southeast geopolitical zone of Nigeria is made up of the following States: Abia, Anambra, Ebonyi, Enugu and Imo. The furthest points in the north-south axis are located the boundaries of Enugu with Kogi State in the north at approximately 7˚N and Abia with Rivers and Akwa Ibom States in the south at approximately 5˚N. Similar points in the east-west axis are located at the banks of River Niger in Anambra and the boundaries of Ebonyi with Cross Rivers State at approximately latitudes 6°46'E and 8°30'E respectively. The mean monthly global solar radiation in the region is in the range of 10-20 $MJ \cdot m^{-2}day^{-1}$[3,4]. The vegetation in the region is predominantly humid forest except for the northern part of the region which is moist savannah.

## 2 Methodology

Communities known for either cash or food crop production were selected from the five states of the region for the study. The communities are: Bende in Bende Local Government Area (LGA) of Abia State, Achalla in Awka South L.G.A. of Anambra State, Amaujiagu-Ezillo in Izza L.G.A. of Ebonyi State, Adani in Isi-Uzo L.G.A of Enugu State and Umuikoro in Ngor-Okpala L.G.A. of Imo State. Questionnaires and oral interview were used to obtain information. This study was done in the months between March and April, 2010. In each community, seventy questionnaires were randomly administered. Questionnaires were designed to capture information on the following of the respondent: Sex, Age, Occupation, Level of Education, Primary occupation. Other queries bothered on the crops the respondents produced, whether the crops are dried at any stage in the processing operations, method(s) used for the drying operation, awareness on the use of solar dryers for drying and whether the respondent has seen or used a solar dryer. Information on the respondents feeling of a group (cooperative) owned solar drying system was also captured in the questionnaire.

## 3 Results and discussion

Out of the 350 questionnaires administered, 336 were recovered representing 96% of the sample population. The primary occupation revolved around being farmers, artisans, traders and civil servants. As shown in Figure 1, percentage of the respondents with respect to their primary occupation is as follows: Farmers-63.8%, Artisans-17.4%, Traders-15.9% and Civil Servants-2.9%. It was also gathered that the major food crops produced in the region are cassava, yam, maize and rice. Cocoa is also produced in commercial quantity in Bende, Abia State.

With respect to formal education, 7% of the respondents had no formal education, 38% had completed primary education, 47% had secondary school education while 8% had tertiary level education. This result is shown in Figure 2.

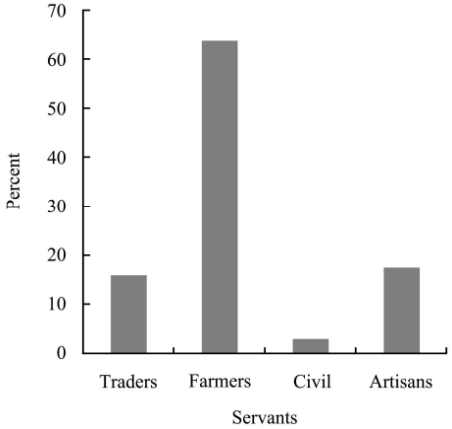


Figure 1 Chart of primary occupation

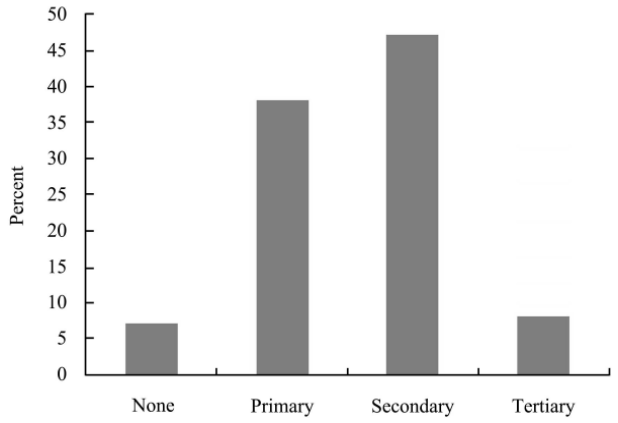


Figure 2 Chart of formal education

Information gathered on awareness of the use of solar crop dryers was very low. Only 2% of the sampled population reported being aware of solar crop dryers. While 98% reported complete ignorance of solar crop dryers. However, the 2% that reported awareness on the use of solar dryers have never seen or used a solar crop dryer but got the awareness from literature. This shows that none of the respondents has used a solar crop dryer. All the respondents showed great willingness on acquiring and using a solar crop dryer provided that the dryers are efficient and affordable.

Farmer cooperative groups have always been used in making capital intensive services affordable for individual farmers. In this study, about 88% of the sampled population shunned the idea of a communally/cooperative owned solar drying system but preferred a commercialized system where charges are paid per unit weight of products dried although sole ownership is preferred if possible. The respondents applauded the use of cooperative groups in obtaining certain services from government like fertilizers at affordable rates but feared that a communally owned solar drying system may not be operationally sustainable since periodic maintenance services will be required. The respondents also raised concern on controlling drying schedule since some farmers may be drying more products than others.

The result also showed that the prevalent methods of crop drying in this region are open-to-air sun drying and smoke drying. The respondents were quite satisfied with open-to-air sun drying method in the dry season but complained about drudgery and poor quality of dried produce in rainy months of the year. While open-to-air sun drying may be environmentally friendly, it is not so friendly on the quality of crops dried especially during the rainy season. Insect infestation, accumulation of dust on the products, intrusion from animals and drudgery associated with intermittent rain are well known as short comings of this method. High crop loss is also associated with this method. Smoke drying on the other hand uses fuel wood more often than not and hence contributes to deforestation and depletion of carbon sinks. Energy efficient and environmentally friendly methods are therefore necessary for drying food and cash crops in this region.

A properly designed and constructed solar crop drying system could be solution to this agricultural drying challenge. While passive solar drying systems could be used by households and farmers involved in subsistence farming, active systems with supplementary heat sources would be suited for commercialized systems. However, common and practically use of these systems will not match the volume of literature on this subject if awareness is not created in these agrarian communities by practical demonstration.

## 4 Conclusions and Recommendations

Awareness on the use of solar dryers in the south-eastern states of Nigeria is very low. The practical use of these dryers is completely absent domestically and industrially. This is partly because solar dryers are not available in the open market. Developed prototypes are only on display at government funded research centres and dissemination of these technologies is usually done at workshops and seminars where the potential users who are rural dwellers are absent.

The prevalent methods of drying are open-to-air sun drying and smoke drying. Enthusiasm shown by the respondents in this study towards using solar dryers indicates that great prospects abound in research, development and entrepreneurial endeavour in this field.

Extra efforts should be made by researchers in this area of study to demonstrate durable, affordable and functional solar crop to stake holders with a view to making this technology common place amongst potential users.

## [References]

[1] Ekechukwu O V, Norton B. Review of solar energy systems: An overview of solar drying technology. Energy Conversion and Management, 1999; 40: 615-655.

[2] Earle R L, Earle M D. Unit operations in food processing-Web edition. 2004. Available at http://www.nzifst.org.nz/unitoperations.

[3] Louis E A, Sunday E E. Relationship between global solar radiation and sunshine duration for Onne, Nigeria. Turk J Phys, 2003; 27: 161- 167. Available at http://journals.tubitak.gov.tr/physics/issues/fiz-03-27-2/fiz-27-2-9-0207-1.pdf.

[4] Agbo S N, Ezema F I. Estimation of the monthly average daily global solar radiation in Nsukka, Nigeria. Nigerian Journal of Solar Energy, 2008; 19(1): 40-47.