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FABRICATION OF SOLAR DRYER TOWARDS PRESERVING SEASONAL CROPS AMONG RURAL WOMEN FARMERS IN GOMBE STATE, NIGERIA BY

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Abstract

This paper examined the fabrication of solar dryers towards preserving seasonal crops among rural women farmers in Gombe State, Nigeria. A solar dryer is a device that utilizes solar energy to remove moisture from various agricultural products, such as fruits, and vegetables, thereby preserving their quality and extending their shelf life. The study had three objectives, and three research questions and utilized the qualitative research design. A sample of thirty (30) rural women farmers participated in the study from Billiri LGA. Data collected was analysed qualitatively using the thematic approach. The findings of the study show that the rural women farmers desired a cost-effective fabricated solar dryer. Also, the dryer was easy to manage and was very effective in drying their seasonal crops. The study recommended that community efforts should pooled into the fabricating solar dryers in other to reduce spoilage of perishable food when in season. The Federal government should also support rural women farmers by supplying them with solar dryers needed to preserve their crops due to poor storage.

Keywords: Fabrication, Rural Women Farmers, Seasonal Crops, Solar Dryer

Introduction

Food spoilage is caused by moisture leading to the growth of mould, yeast, bacteria, and enzymes in the food. In order to control and stop this unwanted situation, human beings have practised food preservation. According to Kumar et al. (2022), food preservation has been practised in many parts of the world and it applies to a wide range of foods, including fruits, vegetables, cereals, and meat. It is also seen as any method by which food is kept from spoilage after harvest or slaughter (Desrosier et al., 2024).

Food preservation prevents, delay and also helps to reduce food spoilage (Olaide, 2022). There are many methods available for food preservation. Some of the techniques have been practised for many years worldwide. They include: curing (smoking or salting), drying, refrigeration and fermentation. Other are canning, freezing, pickling irradiation and the use of

chemicals. One of the cheapest means of preserving food is by drying especially in regions that have abundant sunshine. This is particularly helpful in preserving seasonal foodstuffs whether cereals, fruits or vegetables.

With the advent of solar technology, many farmers have taken to solar dryers which are equipment made to deliberately dry food items in order to preserve them for out-of-season use. Kumar et al. (2022) identified two types of solar drying systems for the preservation of food: Passive solar drying (those that use direct or indirect heating) and Active solar drying (those that use solar energy diversified). In addition, the authors outlined three main subcategories for every class which are seen according to the design and arrangement of the components and mode by the type of solar energy utilised. These are tagged: Distributed-type solar dryer, Integral-type solar dryer and Mixed mode-type solar dryer. Generally, the use of solar dryers for the Preservation of farm produce was a quest for sustainable and efficient methods of food preservation. Hence the solar energy dryer has emerged as a promising solution.

The traditional methods of drying agricultural produce often involve extensive exposure to sunlight, which can be unreliable and inconsistent. However, with the advent of solar dryers, farmers now have access to a reliable and efficient means of preserving their harvests while minimizing post-harvest losses (Kumar 2005; Dissa et al, 2019). Solar drying is a centuries-old technique that harnesses the sun's energy to remove moisture from various agricultural products. It provides a natural and cost-effective alternative to traditional drying methods, such as air drying or mechanical drying, which often require expensive equipment or large amounts of energy.

By utilizing the power of the sun, solar dryers offer an environmentally friendly and sustainable approach to food preservation. Solar dryers are specifically designed structures that optimize the capture and utilization of solar energy for drying farm products. These dryers consist of a transparent or translucent cover, which allows sunlight to enter and trap the heat inside, creating a greenhouse effect. The trapped heat raises the temperature within the dryer, creating a controlled environment that accelerates the drying process. Additionally, the dryer is equipped with vents or fans that facilitate airflow, aiding in the removal of moisture from the products.

According to Dissa et al (2019), the need for utilizing solar dryers for preserving farm products is numerous, because, they provide a consistent and predictable drying environment, reducing the risk of spoilage and contamination. Unlike traditional drying methods that are subject to weather conditions, solar dryers can operate even in cloudy or humid climates, ensuring a continuous supply of dried produce. Furthermore, the controlled drying environment helps maintain the nutritional value, colour, and flavour of the farm products, resulting in higher quality dried goods and the cost-effectiveness of solar drying. The utilization of solar energy eliminates the need for costly fuel sources or electricity, making it an economically viable option for small-scale farmers and rural communities.

Moreover, solar dryers require minimal maintenance and have a long lifespan, reducing operational costs in the long run. The utilization of solar dryers holds great potential for improving food security and reducing post-harvest losses. By preserving farm products through solar drying, farmers can extend the shelf life of their products and access markets during off-seasons, thereby increasing their income and contributing to local economies. Additionally, solar drying enables farmers to process surplus produce into value-added products such as dried fruits, vegetables, or herbs, expanding their product range and market opportunities (Sarviya & Saha, 2011; Katiyar et al, 2017). In addition, solar dryer improves the product quality of crops in terms of taste and colour and does not have any harmful effects on the environment (Nukulwar, 2020).

Solar drying shields food material from rain, moisture, dust, insects, birds, roaming pests, and microbial contamination. This is due to the closed system design which prevents or minimises the contamination of food. Food items that can be solar-dried by the rural women farmers include Moringa leaves, chilli pepper, tomatoes, Okra, Ugu leaves, Melon, Thyme, Coriander, Stevia, Tea, Curry, Basil, Lemongrass, Garlic, Ginger, Turmeric, Herbs, Spices, Crayfish, Melon, Cassava Chips, Yam Chips, bitter leaves, Hibicus flowers (Zobo), Utazi, Melon, Mango Slices, Black pepper, Coffee, Cocao beans, Maize, Fish, meats, livestock feed, etc.

Studies such as Udomkun et al. (2020), Matavell et al. (2022) and Ndukwu et al. (2022) opined that solar drying is one of the most efficient and cost-effective, renewable, and sustainable technologies for conserving agricultural products. Implementation of solar dryers as a sustainable and cost-effective solution for drying agricultural produce will hopefully promote eco-friendly practices, reduce energy consumption, and preservation of arable crops. This study is concerned with the fabrication of solar dryers towards preserving seasonal crops among rural women farmers in Gombe state, Nigeria.

Statement of the Problem

Farmers often experience significant post-harvest losses due to inadequate drying methods. Without proper drying, crops such as fruits, vegetables, grains, and herbs can spoil quickly, leading to reduced quality and market value. The traditional sun drying methods relied on by farmers are highly dependable on favourable weather conditions, such as sunlight and low humidity. Adverse weather conditions, such as rain or high humidity, can prolong the drying process or make it impossible altogether. Many farmers resort to using conventional drying methods that require fuel, such as firewood or electricity. These methods can be costly, especially for small-scale farmers, and contribute to deforestation and environmental degradation.

Without proper drying facilities, farmers often lack the means to add value to their produce. For instance, drying fruits can extend their shelf life, create new market opportunities (such as dried fruit snacks), and increase their value. Farmers often face challenges accessing

distant markets due to the perishable nature of their produce. Rural areas where many small-scale farmers are located, often lack proper infrastructure and storage facilities for drying and storing agricultural produce.

By addressing these challenges, the invention and adoption of solar dryers can significantly be of benefit to local farmers, empowering them to improve their productivity, reduce post-harvest losses, add value to their produce, access better markets, and contribute to sustainable agricultural practices**.** This research work is aimed at solving the rising issue of loss in farm products with an innovation that could address the problem steering at farmers face using solar dryers.

Objectives of the Study

The specific objectives of the study are to:

1. design and fabricate a cost-effective solar dryer for rural women's use.
2. **determine the workability of a fabricated solar dryer for** rural women farmers.
3. determine the effect of the fabricated solar dryer on rural women farmers.

Research Questions

The following research questions guided the study:

1. What type of fabricated cost-effective solar dryer can the rural women farmers use?
2. **What is the workability of the fabricated solar dryer for** rural women farmers?
3. What is the effect of the fabricated solar dryer on rural women farmers?

Methodology

The research design for the study is the qualitative research design which utilized interviews and a focus group (Creswell & Creswell, 2018). The population for the study comprised women rural farmers from Tal Community, Billiri Local Government Area of Gombe State. Billiri LGA is blessed with abundant sunshine and fertile soil which the women rural farmers cultivate for some seasonal crops such as vegetables (Tomatoes, spinach, moringa etc) and fruits. These vegetables and fruits are perishables which are in abundance during their season. Thirty (30) women were selected systematically in the community to participate in the study. The women were placed in three (3) focus groups (10 each) for easy interaction. A phone recorder was used to record the interviews and all interviews were fully transcribed verbatim.

The interview schedule was structured into the following five sections:

i. participant's demographics
ii. types of crops cultivated
iii. experience with drying crops

iv. Knowledge of dryers/solar or sun drying

Fabrication of Solar dryer

The design for the fabricated solar dryer was very simple and cost-effective using local materials that are affordable by a group of women who are willing to collaborate on a solar dryer project. The following materials were used: Food Grade stainless material, Pr module (200W x 3), GEL Battery (100AH x 2), fans (6), heaters (6), Solar charge controller (30AH) and Inverter (3.5 KVA/12). The fabrication of cost-effective solar dryers is very essential to rural farmers worldwide (Ndukwu et al., 2022). The design is presented in figure 1.

Solar Dryer Design

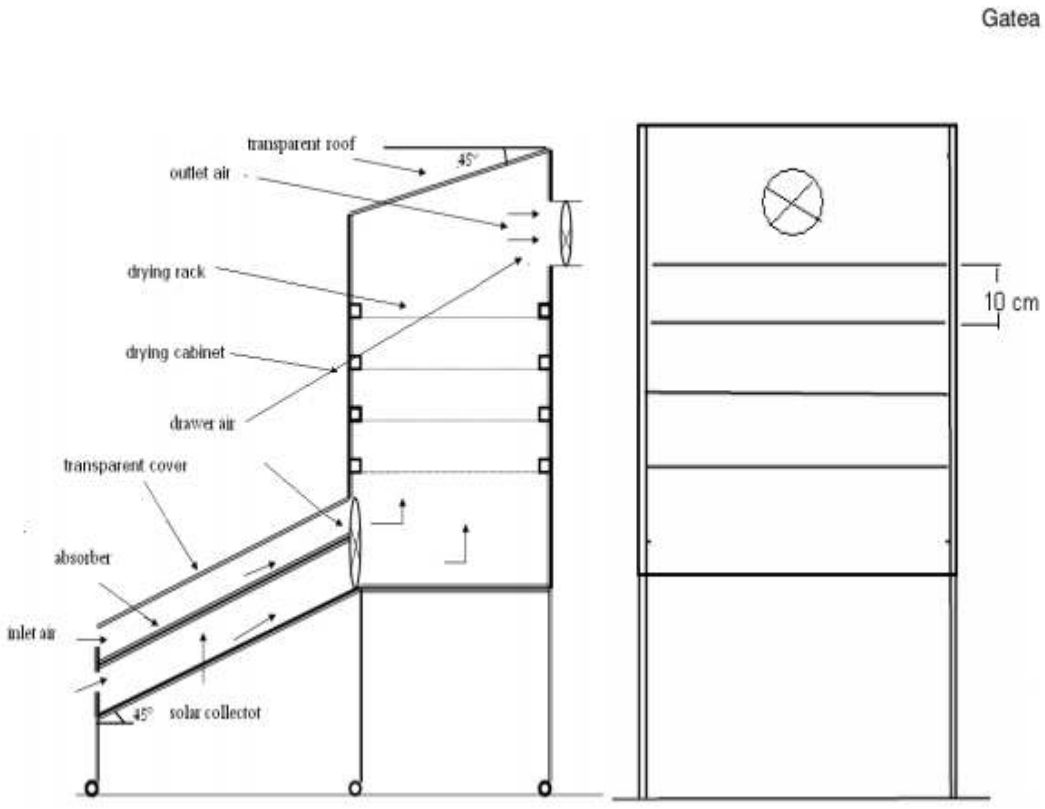

Figure 1. Shows section of the mixed-mode solar dryer.

Figure 2 and 3 is the finished cross section of the solar dryer

Figure 2: Cross section of the fabricated solar dryer with some vegetables being dried.

Monitoring and Evaluation

After fabrication, the solar dryer was tested by using it to dry some vegetables. The rural women farmers were trained on how to use the solar dryer to dry vegetables for three days. Thereafter they were allowed to use the dryer for a week.

The researcher interviewed the women and discussed with the focus group during every stage of the study from fabrication to utilization of the solar dryer in order to determine the objectives of the study which are: **the workability of a fabricated solar dryer for** rural women farmers use and the effect of the fabricated solar dryer on rural women farmers.

Results

What type of fabricated cost-effective solar dryer can the rural women farmers use?

This question was posed to select participants and the focus group to respond to. Many answers were given. From the coded data a popular theme of low-cost, affordable, easy-to-manage solar dryers, made from local materials was extracted. Hence, from the themes, it is clear that the rural women farmers desire a solar dryer that is low cost, made from local materials and easy to manage.

What is the workability of the fabricated solar dryer for rural women farmers?

From the interview conducted and the focus group discussion, data was collected and coded. Themes such as 'it is good', 'I like the way the dries the crop', 'this is amazing' 'it is working very well', the fabricated solar dryer worked well' evolved.

What is the effect of the fabricated solar dryer on rural women farmers?

The themes identified from the code are: 'it has made drying faster and better', 'the solar dryer makes life easy', 'it is hygienic', 'better than sun drying', 'the solar has made drying crops a fun chaos', 'it helps to dry large quantity at a go'. In addition, to **the interview conducted and the focus group discussion, data was collected and coded. Themes such as 'it is good', 'I like the way the dries the crop', 'this is amazing' 'it is working very well', the fabricated solar dryer worked well' evolved.**

Discussion

From the first question which was on a type of fabricated cost-effective solar dryer the rural women farmers can use, the findings from the interviews and focus group discussion revealed that the participants desire a low-cost, easy-to-manage solar dryer made from local materials within their reach. This amplifies the study of Udomkun et al. (2020), Matavell et al. (2022) who reported similarly on farmers' quest for solar dryers.

The discussion with participants on the **workability of the fabricated solar dryer among rural** women farmers indicated that: the fabricated solar dryer was good works well. The rural women farmers are optimistic that it will serve the purpose for which it was made evidenced by the trials carried out on some of their crops for which the results were astonishing. This finding supports the assertion of Dissa et al (2019), Nukulwar (2020), Udomkun et al. (2020) and Matavell et al. (2022) whose study puts a case for the utilization and workability of solar dryers among farmers and people living in remote places.

On the effect of the fabricated solar dryers, the rural women farmers generally agreed that it was effective for drying their crops and added that the fabricated solar dryer was more automated, produced faster results, more hygienic when compared to the conventional sun dryers they have been using. This corroborates with Sarviya & Saha (2011), Katiyar et al. (2017), Udomkun et al. (2020), Matavell et al. (2022) who reported that solar dryer use has produced similar outputs. Also, the participants attested that the solar dryer improves the product quality of their crops, the taste and colour were retained and it does not have any harmful effect on their environment. This finding aligns with Nukulwar (2020) report.

Conclusion

The study concludes that the fabrication of cost-effective solar dryers for rural women farmers is a very important venture that should be pursued. In addition, it was observed that the fabricated solar dryer was found to be workable and appreciated by the rural women farmers who used it in drying some of their seasonal crops. The solar dryer helped in the preservation of the crops, improved their taste and retained their colour in a hygienic environment. Moreover, the fabricated solar dryer was found to be very effective in the drying of crops because it is automated, produces faster results, more hygienic when compared to the conventional sun dryers they have been using.

Recommendation

Based on the findings of the paper the following recommendations were made:

The study recommended that community efforts should pooled into fabricating solar dryers in other to reduce spoilage of perishable food when in season.

The Federal, State and Local governments should also support rural women farmers by supplying them with solar dryers needed to preserve their crops due to poor storage.

The Government should also give credits to rural women farmers to acquire cost-effective solar dryers. This will help save perishable crops and improve food retention and supply in the economy.

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