Solar Technology and Food Security in remote regions of Nepal

Seona Candy (PhD Student); Email: candys@unimelb.edu.au
Supervisors: Dr Lu Aye and Dr Robert J Fuller

Abstract

This poster presents the process of design selection, construction and testing of solar greenhouses and dryers in Humla, a remote mountainous region of Nepal. It forms part of an ongoing research project investigating the potential of these solar technologies to improve food production and preservation in this impoverished area. Initial results show that greenhouse conditions are suitable for the growing of fresh vegetables over the winter period, but are too warm in the shoulder seasons. The solar dryer performance was found to be marginally better than traditional sun drying. Performance improvements for both technologies will be investigated using modeling and simulation in future stages of the project.

Introduction

Hunger is the most extreme effect of poverty and arises in circumstances where individuals or families cannot meet their most basic need for food. This is more commonly known as food insecurity. A lack of food and inadequate nutrition will result in poor health, reduced ability to work, impaired mental development and further entrench the poverty cycle. This poster describes the initial stages of a project to improve food security in Humla, a remote mountain region of Nepal, using two solar technologies. Due to the severe weather of this region fresh food cannot be harvested for eight months of the year. In similar areas, increased food production and preservation has been achieved using solar greenhouses and dryers. However, a systematic approach, where these technologies are used in a complementary way to supply the shortfall in food and address nutritional deficiencies, has not been attempted.

Aim

The overall project aim is to investigate the potential for fresh and dried produce from the solar greenhouse and dryer respectively to address nutritional deficiencies in Humla. The food and nutrition review, crop selection, design selection, construction and experimental test results are presented here.

Methodology

Food Availability & Nutrition Review
↓
Crop Selection
↓
Design Selection and Construction
↓
Testing of Experimental Models
↓
Model Development in TRNSYS
↓
Validation of Simulation Models
↓
Parametric Study

Food & Nutrition Review

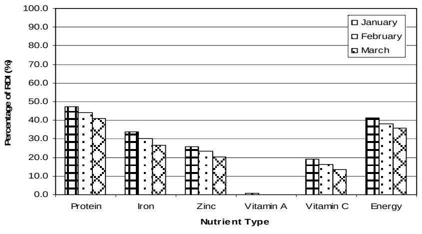
To explore the potential nutritional benefits of the two solar technologies in the Humla context, it was first necessary to quantify the existing deficits for a typical Humla family.

Daily food consumption of a typical Humla family - January to March (source: RIDS-Nepal nutritional survey)

Month	Rice (g/day)	Roti (g/day)	Daal (g/day)	Fruit & Veg (g/day)
January	420	550	235	0
February	405	505	200	0
March	410	450	167	0

The main nutritional deficiencies were found to be vitamin A and C, iron, zinc, protein and energy, all of which were at levels less than 50% of the recommended daily intake (RDI).

Daily nutritional intake for a Humla family in winter



Crop Selection

Based on the results of the food and nutrition review, it was decided to grow green leafy vegetables in the greenhouse and dry apples in the solar dryer. These crops are locally grown and have complementary nutrients that are lacking in the local diet.

Design Selection and Construction

The design requirements for the solar greenhouse and dryer are similar in that they both must be constructed from local or easily transportable materials, be simple to operate and not require any auxiliary energy.

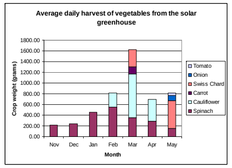
The greenhouse was based on a design developed by Stauffer et al. (2004), which is presented as a generic design for remote mountain areas.

It has a south face glazed with polyethylene sheets and double stone walls on three sides to provide thermal mass for passive temperature regulation. Roof and side ventilators allow for additional climate control.

The solar dryer selected was a direct cabinet dryer, similar to the basic design developed by the Brace Institute (1973) but with two levels. It is constructed from wood with polyethylene sheet glazing.

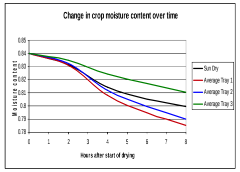
Testing of Experimental Models

Problems unfortunately occurred with data recording during the first winter testing period, so no greenhouse temperature data is available. But the crop data gives a good indication that the temperature were within acceptable limits.



These results show that vegetables can grow in sufficient quantities throughout the winter, particularly in March the most severe hunger period.

The results from the solar dryer tests show that on two of the three trays inside, the drying rate is higher than that of the sun-drying control sample.



Conclusion

The test results show that both the greenhouse and solar dryer design selected can be constructed and operated adequately in Humla. There is, however, potential for improvement, which will be explored during the modelling and simulation stage of the project.

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