

Investigation of the Potential of Solar Roof Collectors for Preheating of Air at Drying Facilities in Northern Thailand

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Introduction

- Longan is an important fruit grown in northern Thailand. A substantial amount is dried as a whole fruit and exported as a commodity that heavily supports the local economy.
- The drying is conventionally done using liquefied petroleum gas (LPG) as the thermal energy source.
- The rising prices of petroleum products may threaten the competitiveness of dried longan in international markets.
- Alternative energy sources should be used to partially or completely replace fossil fuels and reduce costs.

Objectives

- To simulate the potential air temperature rise using roof-integrated solar air heaters.
- To estimate possible economic savings resulting from the use of solar energy.



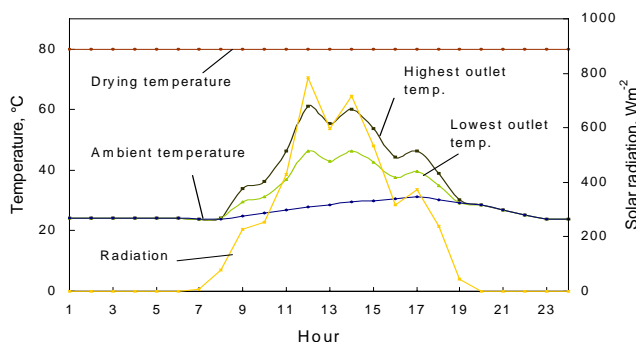
Materials and methods

- A survey was done to collect data about roof characteristics and process parameters for 8 longan drying facilities using flat-bed convection dryers.
- Suitable local materials to construct solar air collectors were identified and investigated.
- A mathematical model for a single-glazed air collector programmed in Fortran, together with the software for solar processes TRNSYS, were used to simulate the thermal performance of a solar collector system.

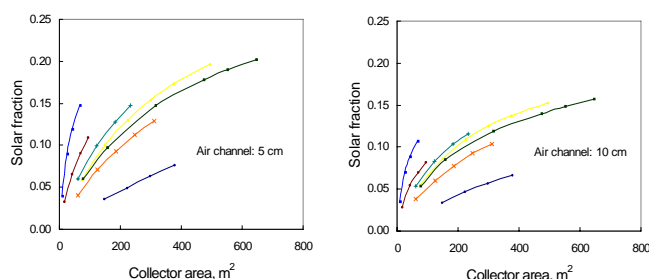
Results

- Assume:** entire roofs are used as solar collectors and the facilities work at an average of 48% of their full capacity.
- The temperature rise for an average day reaches 33° C.
 - Solar collectors can provide up to 20% of the energy demand for longan drying during the harvest season.
 - The collector efficiency ranges from 13 to 61%, mainly depending on air flow rate and air channel height.
 - For a middle size drying facility, annual monetary savings can reach THB 56,000 (US\$ 1,800; US\$ 1 = THB 31).

Highest and lowest outlet temperatures achievable by the various collector configurations with respective radiation and temperatures (ambient and drying)



Solar fraction achievable for the drying facilities with an air channel height of 5 and 10 cm



Conclusions

- Longan drying is performed day and night. Solar energy cannot cover the entire energy demand by itself.
- The price of materials and labor to build collectors can be excessive for big roofs. In some cases, smaller collector areas greatly reduce construction costs while the solar fraction only slightly decreases.
- Small channels show the best performance but pressure drop through the collector might increase the electric consumption if the fan is kept at the same flow rate.
- The longan drying season lasts about 2 months. The dryers are usually not used the rest of the year. For the investment in solar collectors to be worthwhile, it might be necessary to use the equipment all the year. This would be possible if the dryers were used for rice.
- Monetary savings must be calculated for a particular facility, depending on its size and used capacity.

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