

Solar Cookers for Rural Development in Fiji Islands

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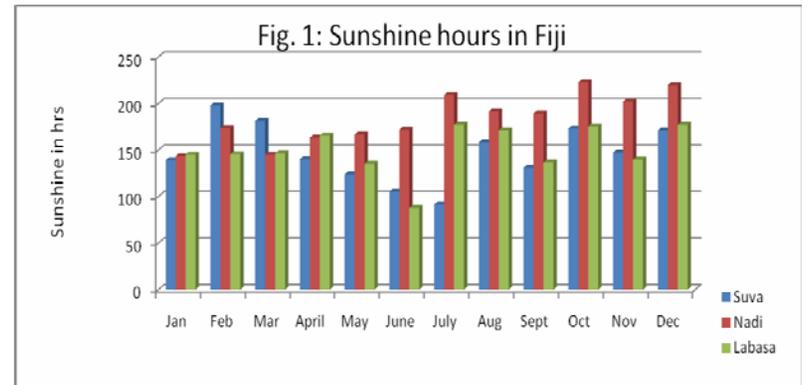
Abstract

The rural population and sections of urban population in Fiji are generally depending on wood and kerosene for cooking fuel. Fuelwood, agricultural residues, human power and draught animals continue to be the primary energy resources for rural families in Fiji. Energy resources play a crucial role in the development of rural areas. Fiji imports 26.6m litres of residual fuel to fulfil the needs of 827,900 people. Finding alternative sources of energy that are both economical and environmentally friendly is crucial for increasing agricultural productivity and improving the quality of life in rural communities. This paper attempts to bring into focus the importance and use of solar energy in cooking, through various types of solar cookers.

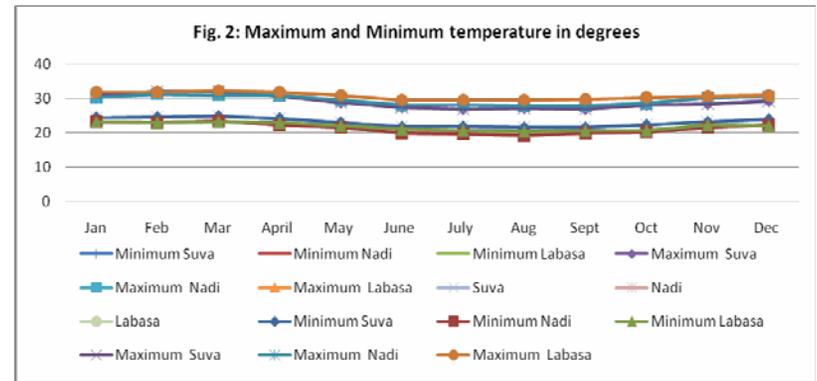
able energy alternative, people will not need to cut down trees to cook with, and reforestation efforts can be allowed to take root.

Solar Radiation in Fiji

Fiji lies in the heart of the Pacific Ocean, midway between the equator and the South Pole, and between longitudes 174⁰ East and 178⁰ West of Greenwich and latitudes 12⁰ S and 22⁰ South. It enjoys a tropical south sea maritime climate. The following graphs are of sunshine hours and temperature at three metrological stations in Fiji for 2009, respectively:



Source: Fiji Islands Bureau of Statistics



Source: Fiji Island Bureau of Statistics

Introduction

Energy, Economy & Environment (3E's) are the inter-related areas that have direct correlation for the development of any nation. Fiji risks facing huge environmental problems due to the depletion of its forests, caused by mining, increasing rural/urban populations, increased farming on previously forested land and increasing demands of their needs. If current trends are not reversed, Fiji will have no remaining forests within the next twenty years (FAO,2005). Another looming crisis is the cooking fuel wood crisis. This may lead to increased poverty levels as firewood becomes scarce and expensive, forcing families to switch to other fuels. This will lead to an increase in the demand and price of cooking fuel (kerosene, LPG, wood etc). The alternative to this crisis/problem is renewable energy; solar energy in particular. If reforestation plans are combined with solar cooker programmes that provide an affordable, renew-

The Fiji Meteorological Services has six pyranometer stations in Viti Levu (Nadi, Vaturu, Monasavu, Nacocolevu, Koronivia, Laucala Bay); one in the Lau Group (Vanuabalavu); and, two in Vanua Levu (Dreketi, Seaqaqa). There are also ongoing data recordings at the Nabouwalu Hybrid Power Station (since 1996) with an annual daily average insolation of 4.5 kWh/m²-day.

The annual average insolation for Vunatovau location is 4.8 kWh/m²-day. Highest values (5.1 kWh/m²) of insolation are found at Nadi Airport station. At Vanuabalavu (the Lau Group), the long-term average is also relatively high at 5 kWh/m². Around Bua Province (Vanua Levu), the value is ~4.5 kWh/m². The lowest value is found in Monasavu Dam (808 m elevation) with long-term annual average of daily insolation at 3.7 kWh/m².

The population of Fiji in 2007 was 827,900; there was an increase of 52,823 from the 1996 count. Failure to improve the living standards and household incomes in rural areas would only serve to accelerate the rural to urban drift, increasing pressures for basic services in urban areas while further worsening rural poverty (Narsey et al. 2010). The rural population of Fiji (comprising 49% of total population) is mostly dependent of fuel-wood for its cooking requirements.

The above indicates that there is a large potential for the usage of solar energy for cooking. Use of solar cookers has several advantages over other fuels. Areas where an immediate impact of solar energy can be felt are in agriculture, health and education.

Traditional Cooking Methods

Firewood is used in almost all rural areas for cooking. Smoke from traditional cooking endangers the health of women and children. This leads to consequences such as loss of forest area, loss of fertile soil caused by erosion, desertification, increase of poverty and conflicts. Smoke exposure from firewood seriously affects the children's growth and the health of women, leading to an increase in burden and poverty. UNDP (9) survey found that the 'most common method of cooking throughout rural areas in the developing world is the open hearth or three stone fires, which typically transfers only 5-15 percent of the fuel's energy into the cooking pot'. This is one of the greatest challenges of humanity.

According to UNIDO, many families are said to spend nearly a quarter of their income on firewood in some locations. In Fiji, especially for the 54 percent of its population in rural areas, as firewood becomes scarce, dependence on fossil fuels such as kerosene and gas increases.

And as the expense of fossil fuels increases, so does the poverty levels. Therefore, the potential health benefits of using solar cookers are literally lifesaving. Many governments import and subsidize fossil fuels like kerosene (Fiji is having the lowest price for this in the Pacific region). With solar cookers, families often reduce their fuel wood needs by nearly half (Verma, 2012).

Solar Cooker- Alternative form of Cooking

Solar cookers have high potential of reducing poverty, increasing health benefits, increasing productivity and reducing environmental degradation and pollution, with as little as a foil-lined cardboard box (Solar Cookers International, 2004). It is a device that allows cooking food using the sun's energy as fuel.

Types of Solar Cooker

There are many types of solar cookers, such as heat-trap boxes, curved concentrators and combinations of both.

Curved concentrator cookers: Curved concentrators (often called parabolic cookers) cook fast at very high temperatures but requires frequent adjustment and supervision for safe operation. They are especially useful for large-scale institutional cooking.

Box cookers:

Box cookers are the most widely used in households all over the globe. This box-type solar oven is both easy-to-build and very inexpensive (SCI, 2006c).

Figure 3: Box Solar Cooker



like endocrine, nutritional and metabolic diseases, certain infectious and parasitic diseases, diseases of digestive system etc.

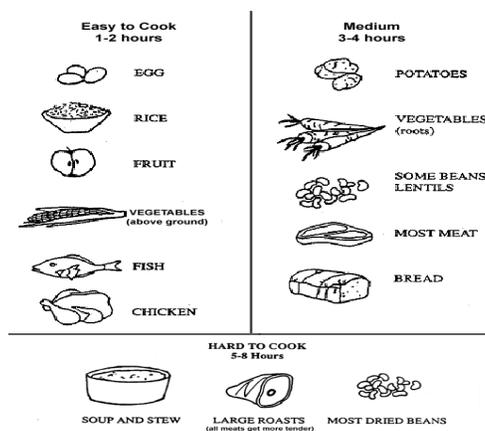
There is great potential in the health aspect of solar cookers. Disease-causing organisms in water are killed by exposure to heat in a process called pasteurization (Table 2). All bacteria and microbes (*Escherichia coli*, *Rotaviruses*, *Giardia* and the *Hepatitis A virus*) harmful to humans are killed when water reaches 150 degree Fahrenheit. The solar ovens can obtain 350 degrees within 45 minutes. At around 71°C (160°F), milk and food are pasteurized. Boiling is not required.

Table 2: Pasteurization of Water

Microbe	Killed rapidly at
Worms, Protozoa cysts (<i>Giardia</i> , <i>Cryptosporidium</i> , <i>Entamoeba</i>)	55°C (131°F)
Bacteria (<i>V. cholerae</i> , <i>E. coli</i> , <i>Shigella</i> , <i>Salmonella typhi</i>), Rotavirus	60°C (140°F)
<i>Hepatitis A virus</i>	65°C (149°F)

Generally, it takes about twice as long to cook food with a solar oven than in a conventional oven. The time taken for cooking various types of food in a solar cooker is stated in Figure 7.

Figure 7: Time Taken for Cooking Various Items in a Solar Cooking



Source: <http://solarcooking.org/images/cooking-times.gif>

In the rural areas of Fiji, disease-causing organisms in dry medical supplies are killed by exposure to heat. When these medical supplies, such as instruments, bandages and other cloth materials are heated to 149°C (300°F) for a short period of time, they are free from nearly all organisms. So, solar cookers are having good potential to be used in the rural areas of Fiji especially for medical purposes.

Conclusion

People on earth are over-utilizing and depleting natural resources. Overutilization and exploitation of natural resources in the South Pacific Countries particularly leads to climate change that causes natural disasters, draught, epidemics etc. The resounding acceptance of solar energy as an alternative fuel provides numerous benefits, including statistically significant savings in fuel expenditure, a reduction in the inhalation of toxic smoke and a reduction of the environmental degradation from the consumption of fuel wood.

Solar energy in all its diverse forms can play a significant role in the development of rural areas of Fiji. Positive changes can be anticipated in agriculture (food processing and preservation, drying of Copra etc), health (clean and warm water, solar refrigeration) and in small/ household industries through the use of solar cooker. Assembling, spreading, promoting and using/ repairing of solar cookers create jobs. It is very easy for a common man to construct and can be made from locally available materials.

There is huge potential for private sector led joint ventures with local entrepreneurs to play their role in solar cookers and renewable energy, which will lead to agriculture, sustainable tourism and marine resources development. Sustainable development of the rural Fiji can be achievable through the people participation in promoting the use of solar cookers in the rural and urban communities.

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