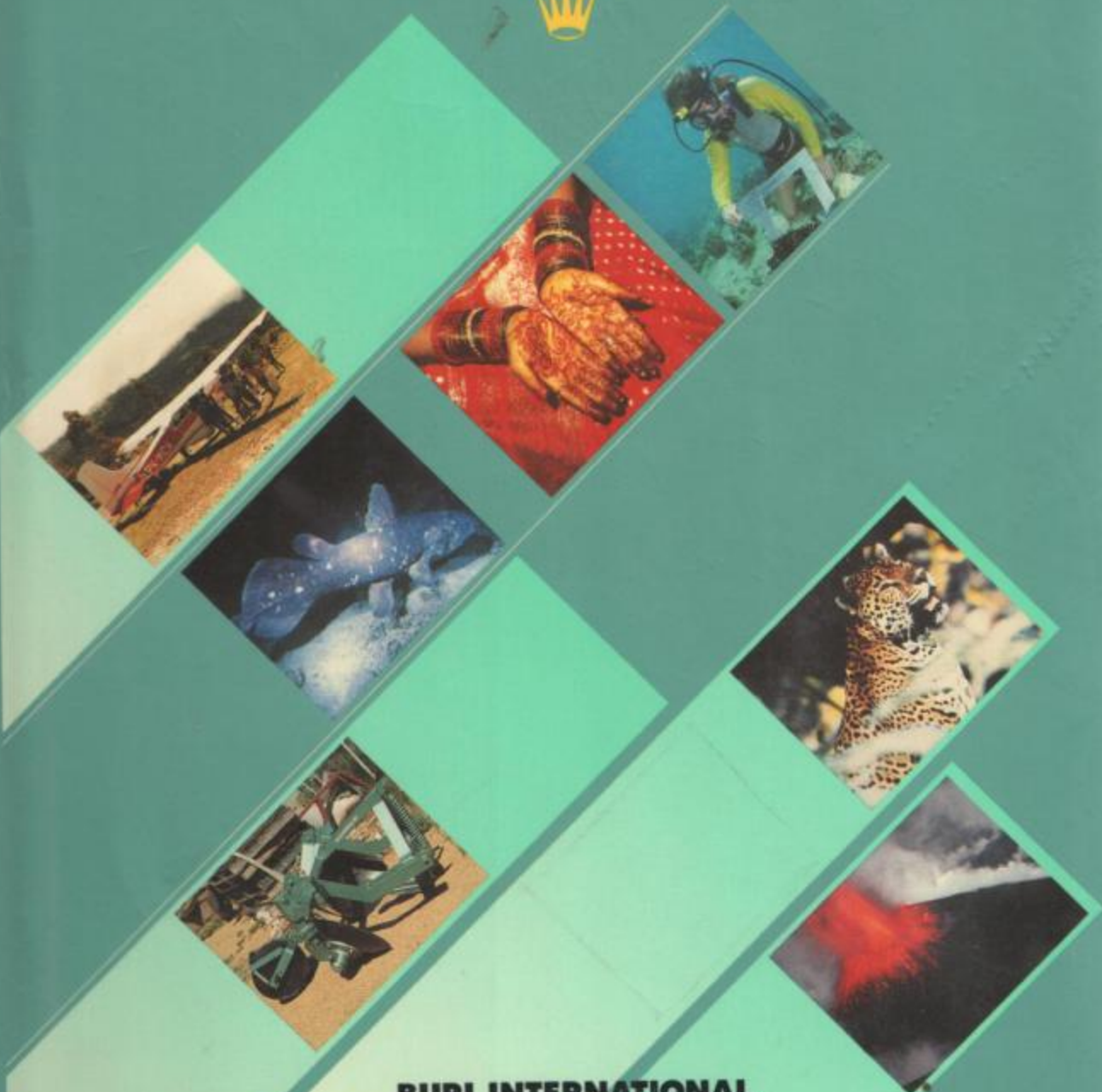


SPIRIT OF ENTERPRISE

THE 1990 ROLEX AWARDS

Spirit of Enterprise



BURI

BURI INTERNATIONAL

Spirit of Enterprise

The 1990 Rolex Awards

Foreword by

Jean Dorst

*Director, Laboratory of Zoology, French National Museum of Natural History
Member of the Institut de France*

Preface by

André J. Heiniger

Chief Executive Officer and Managing Director, Montres Rolex S. A.

Edited by

David W. Reed

Ethanol from sweet sorghum for use as cooking and lighting fuel

Anil Kumar Rajvanshi

Nimbkar Agricultural Research Institute, P. O. Box 23, Phaltan-Lonand Road, Phaltan 415523, Satara-Maharashtra, India

Indian, born 1 September 1950. Director of Nimbkar Agricultural Research Institute. Educated in India and United States; Ph. D. (Mechanical Engineering) from University of Florida, Gainesville, in 1979.

Cooking and lighting in rural India accounts for about 57% of the country's total energy consumption. There is already a major cooking energy crisis in certain rural areas, and reports talk of women in some parts of the country having to walk as much as 5–10 km every day to collect firewood. At the same time, sudden shortages of kerosene in rural areas darken the houses of thousands of people. The major fuel used for cooking in rural areas is wood. However, studies have shown that with the increased income level of the rural population, there is a perceptible shift towards liquid fuels like kerosene which has to be imported. Forecasts indicate that liquid cooking and lighting fuel consumption will continue to increase and, consequently, there is an urgent need to find a replacement for kerosene.

Ethanol as a kerosene substitute

Ethanol (ethyl alcohol) is one such alternative fuel since studies have shown that it can easily be used for cooking and lighting in new stoves and lamps, and can be produced from locally available renewable sources like biomass. Traditionally, alcohol has been produced from sugar cane, molasses, etc. However, the search for a multipurpose biomass source for alcohol production has highlighted the attractions of sweet sorghum (*Sorghum bicolor* (L.) Moench). It provides grain from its ear head, sugar from its stalk, and the bagasse is an excellent fodder for animals. Besides being a multipurpose crop, sweet sorghum has a great tolerance to a wide range of climatic and soil conditions. It is a short-duration crop, is cheaper to grow than sugar cane and requires less water.

Exploiting sweet sorghum for fuel production

Our institute, the Nimbkar Agricultural Research Institute (NARI), has launched an integrated programme to develop the cultivation of sweet sorghum and its use for production of cooking and lighting fuel. The programme entails: the breeding of high-yielding sweet sorghum varieties for alcohol production;



Alcohol distillation plant running on solar energy capable of producing 30–150 litres/day 95% (v/v) ethanol. On the right is shown the solar hot-water storage tank.

studies on sorghum distillation and fermentation, in particular using solar energy; and the development of stoves and lanterns running on alcohol.

Breeding work at NARI since the 1970s has resulted in sweet sorghum varieties which yield in one year, from one hectare, about 2–4 tonnes of excellent quality grain, 2,000–4,000 litres of 95% (v/v) alcohol, and sufficient bagasse for all the yearly fodder requirements for 3–5 cattle.

Fermentation studies have been conducted on the juice of our sweet sorghum varieties using strains of *Saccharomyces cerevisiae*, and the strain best suited for fermentation has a fermentation efficiency of 90%; fermentation was completed in 48–72 hours.

Distillation accounts for about 70–85% of the total energy consumed in alcohol production and the existing alcohol distillation facilities in India and other developing countries are usually fuelled by biomass such as bagasse, wood, etc., or by steam from sugar factories (which again is bagasse based). However, bagasse is an excellent raw material for paper and its use as boiler fuel wastes a precious resource. We have therefore installed a pilot solar distillation plant at NARI campus.

To date, the system has logged about 4,000 hours of operation and 70% of total yearly distillation load comes from solar energy while the rest is provided by fossil fuels (presently electric heaters) but fossil fuels can be replaced by bagasse. Development of devices like stoves and improved lanterns running on alcohol was essential as a part of an overall rural alcohol economy.

A wickless alcohol stove has been developed which runs on alcohol and has a thermal efficiency of 30–35%. Efforts are also under way to modify the existing wick stoves to run on alcohol. Two types of lanterns have been developed –

pressurized and non-pressurized. Efforts are under way to raise funding for the manufacture of a few hundred lamps for field trials.

Plans for the future

Much work needs to be done to spread this technology widely. Sweet sorghum is a relatively new crop in India and hence efforts are required to popularize it. We therefore propose to: breed better sweet sorghum varieties to increase the yields of alcohol per hectare; improve the effluent treatment of distillery waste; set up one mini-distillery producing 5,000 litres/day based on the above technology, hopefully in the next 2–3 years; and manufacture 100–200 lanterns and make them available to a small section of local population for field trials.

A major administrative problem is the reticence of the Government, which levies a heavy duty on alcohol for human consumption, to accept the usefulness of sweet sorghum alcohol for cooking and lighting and considerable public pressure will be required to change this attitude.



Alcohol lanterns which produce light equivalent to that from a 100-W electric bulb.