WINDMILL INSTALLATIONS IN TANZANIA

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Parkes (Ref.1) reports in 1974 just over thirty windmills in mainland Tanzania, the majority of these located either in Shinyanga or Dodoma regions. He also reports that less than one third of these installations are in use and that they have apparently been installed at least fifteen years ago. Comments obtained from different regions are quite mixed, and most machines failed after operating satisfactory for fifteen years or so due to a variety of reasons such as saline water, lack of spare parts or other reasons. In one region local people claimed that none of the machines had ever been reliable. In other regions such as Shinyanga, several machines were in operation in 1974 providing water supply to rural communities. Beurskens (Ref. 2) visited late 1977 several windmills in Shinyanga Region. He reports that one "climax" type, installed in 1967 broke down in 1977, three "Coment" types were installed in 1968 and 1973 and worked still satisfactory, one "Comet" installation is since 1973 uncompleted, and one locally made windmill operated from 1968 till 1975 when it broke down and is not repaired since. Reported pumping heights were 15 to 22 m and pumping capacity were between 18 and 30 m^3 per day which was sufficient for village water supply systems. Windmill diameters were 4.88 m or 5.5 m (16' or 18').

Parkes (Ref. 1) also reports that Van de Laak, who installed most of the industrial made and locally produced windmills in Shinyanga region, experienced some problems with the simple Savonius Rotor, described in a leaflet of the Brace Research Institute (Ref.3). Van de Laak suggests that the pump and crank system are not satisfactory due to rapid wear of the crank, problems with the connection rod and poor performance of the pump. It is believed that van de Laak was the first to install and evaluate quite a number of windmills in Tanzania, either industrial made types or locally produced ones.

The Faculty of Agriculture in Morogoro had built and tested low cost wind-turbines for use in Tanzania. One of their earlier models was a 10 square meter Savonius Rotor, built as a student's project. It was tested, and power outputs up to about one hp were measured. A Darrieus Rotor built at the same time collapsed when starting was tried with the help of a pulley and a tractor. The Savonius rotor was later destroyed as well in a high wind, and local people picked up the remaining metal sheets to cover their roofs. Work has continued recently in the Faculty of Agriculture with conventional multi-bladed windmills and a cretan-type sail windmill (Ref.4).

The Ministry of Water, Power and Minerals (MAJI) started several wind-power programmes, some of them with imported equipment. It was decided to import ten rather large Comet windmills of 8 m diameter for pumping water to villages in Dodoma region. Most of them are erected, but some commissioning problems are reported. A similar type, of 6 m diameter but using a truck rear axle and a rotating shaft operating a mono-pump was built in the MAJI workshop in Ubungo/Dar es Salaam and erected in Kurasini (Fig.2). It operated for some time quite satisfactory before it was knocked down accidentaly by a crane operating nearby. Hopefully the windmill will be erected at another location for further evaluation.

Another design sponsored by MAJI is the so-called Arusha windmill of which some were built during the past two years or so (Fig.3). The first models were built in MAJI workshops in Arusha while later the designer started the "Arusha Apropriate Technology Project". The windmill is believed to be in

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production now by cooperative company (UJUZI LEO INDUSTRIES, P.O. Box 764, Arusha). The six-bladed windmill has 5 m diameter and costs inclusive tower Shs. 15,000/= + Shs. 1,600 for the pump ex factory. The yield pumped by the windmill is given a 243 gallons per hour for a total head of 50 ft and an average windspeed of 7 miles per hour (3.13 m/s average windspeed, 15 m totoal head, approximately 850 l per hour). These data are claimed to have been measured at an installation at Arusha airport. The company produces a simple handpump as well which is sold for Shs. 1,500/= as an ex factory kit. There are also quite ambitious plans to train village technicians in the construction and operation of windmills. Additionally a Savonius Rotor was built for pumping water from shallow wells, and an attempt was made to let a local carver make a wind-turbine blad for a fast running electricity generating system (ref. 5). Plans for the older and revised version of the Arusha windmill are available worldwide through VITA/USA.

MAJI in Dar es Salaam decided some time ago to have a windmill constructed for local production, and two foreign technicians worked for some time on this project. The outcome so far, after the technicians have left, is one prototype erected at the MAJI workshop in Ubungo. The machine is of 5 - 6 m in diameter and a conventional multi-bladed type. Recently, some experiments were made with a vertical axis machine as well, similar to the Savonius Rotor. Apparently the machine was disassembled due to poor performance.

Another MAJI windmill programme, according to a statement of the Minister of Water, Power and Minerals (ref. 6) includes the eventual installation of more than hundred windmills and pumps in the Singida Region (Fig.4). The project is assisted by Australia, and according to the engineer working in Sindida, 10 windmills are already installed (August 1978), 20 more are in stock and additional 10 are on its way to Tanzania from Australia. The manufacturer is Southern Cross, and the actual performance in Singida is: the 5.2 m diameter type resting on a 12 m tower is pumping 3.2 m^3 per hour against 100 m head, and the 6.4 diameter model resting on a 18 m tower pumps approximately 3.8 m^3 per hour against 100 m head as well. Due to consistent winds in Singida Region for almost 20 hours a day they pump approximately double of what they would normally do in Australia (ref. 7). There are three Australians and about 50 to 60 Tanzanians working on the project which involves drilling water holes, installing the machinery and tanks etc. Included in the project is extensive on the job training of Tanzanian technicians in drilling water holes, erecting and maintaining windmills for water pumping. Two more windmills of the same type are currently being installed in Tanga region as well for village water supplies.

In a mission project of the "Precious Blood Fathers" in Manyoni district, there are seven windmills installed of up to 5 m in diameter and of Italian make (Tozzi and Bardi, Grossetto). Finance came from Canada, and Canadian students erected the windmills. Seven more machines are ordered for the project, and the manufacturer trained some local craftsmen in installation and maintenance. The yield is reported with 20 to 30 m^3 per day against 60 m pumping height.

Another remarkable individual attempt to construct a windmill from locally available material was made by three Dutch students and an ex-missionary living in the vilaage Kiguru Kiro, about 70 km north of Morogoro at the foot of the Nguru Mountains. The windmill has 3.2 m diameter and rests on a 7.5 m wooden tower. Material and transportation costs were about Shs. 5,200/= and the diaphragm pump was donated by the TH Eidhoven (Netherlands) (ref. 8).

Local efforts are also reported from the Musoma area, where namely due to the initiative of a mission a windmill developing and testing programme seems to be well underway. The objective is to use Tanzanian made windmills for pumping of water from the Lake Victoria, mainly for irrigation. The TH Eindhoven assisted this project and published recently an excellent and quite detailed feasibility study of windmills for water supply in Mara Region (ref. 2).

The Faculty of Engineering is working on several windmill projects. Completed in the Mechanical Department is the so-called Pedersen windmill for pumping water, which has 3.66 m diameter. The windmill performs satisfactory after some modifications, but problems with the pump are still not completely solved. The windmill is installed in an agricultural project in Manzese, quite near to the Faculty of Engineering.

In the Mechanical Engineering Department as well, the remarkable Protzen-Sumai rotor was constructed (Fig.5). The 4 m diameter rotor has 12 curved blades of 5 mm thick aluminium which are simply cut out of a rolled cylinder. The hub is completed as well and the tower construction awaits assembling. Various hub constructions, either for an up and down movement or for a rotating shaft, are under consideration. Very lightweight blades for another windmill prototype made from sisal-reinforced polyester are planned as well.

In the Electrical Engineering Department, the author produced two Savonius Rotor windmills, which are vertical axis types. Both are for water pumping. One is made from three oil-drums and has 2.7 m^2 swept area (Fig.6) while the other is made from aluminium sheet metal with a swept area of 4 m^2 (Fig.7). The latter one is delivered to Dodoma region for field testing and evaluation. Expected outputs are in the range of 50 to 100 l/min (3 - 6 m^3 per hour) of water pumped against 5 m head. Total material and manufacturing cost including pump was in the range of Shs. 6,500/= only.

There are very few windmill for generation of electricity used so far in Tanzania. There are some unconfirmed reports about wind-driven generators from USA powering a house near the Olduvai Gorge, and another imported machine (from Germany) is believed to operate somewhere in Mbeya region. Two rather large wind-driven generators, of 5 kW output each, are expected for installation in Dodoma region for powering houses and water-pumping systems (lighting and deep well pumps). Intermediate energy storage is provided by conventional lead acid batteries. One Dutch wind-driven generator, of 400 Watt output arrived already in March, 1978 and will be erected soon for field tests and to power a one-family house in Ubungo/Dar es Salaam. This is a project undertaken by the Electric Power Laboratory of the Faculty of Engineering in cooperation with the Royal Netherlands Embassy and the Tanzanian National Scientific Research Council. Other projects undertaken in the Electrical Engineering Department include the following projects:

1. Development of a simple plate type wind-speed indicator (see also Fig.6).
2. Development of a microprocessor system for classification of wind-data connected directly to an anemometer. The so-called bakuli-type anemometer was built at the Faculty of Engineering as well.
3. Development of small wind-driven generators, using local hard wood for the blades.
4. Feasibilitx study for a rural elctrification power station using a 45 kW wind-driven generator.

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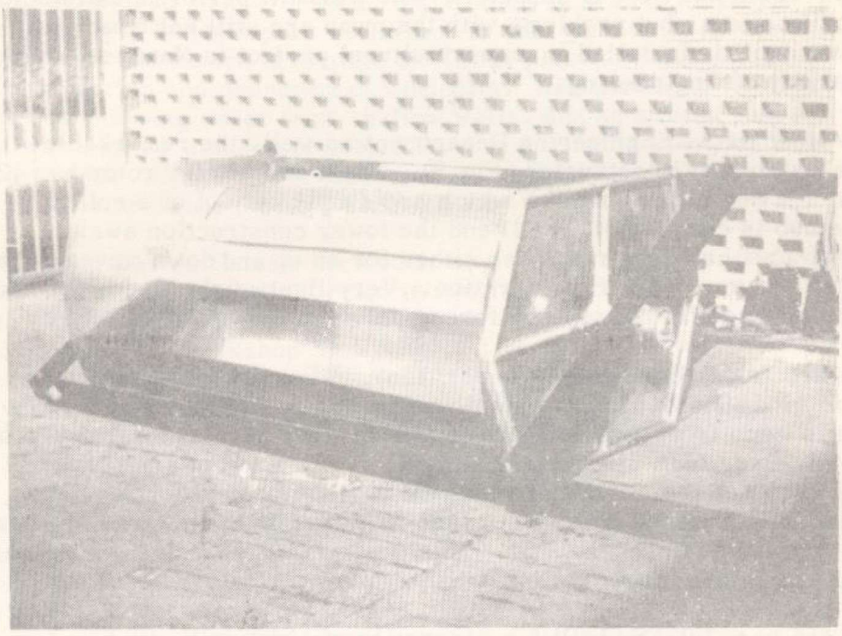

Fig. 1: Savonius Rotor of 4 m^2 for DODEP

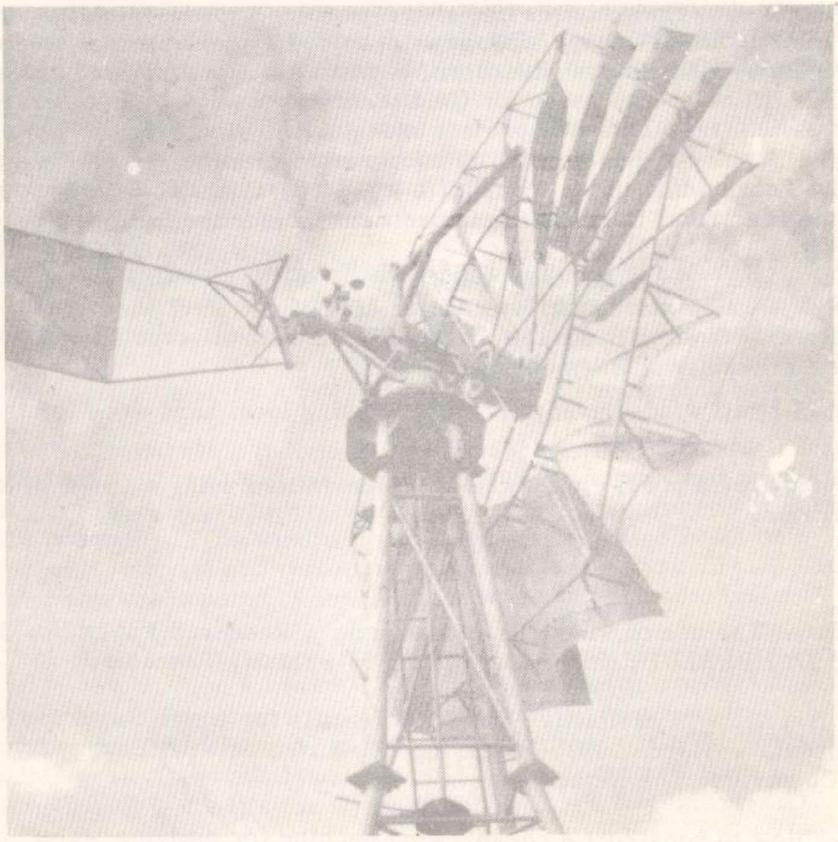

Fig. 2: MAJI Windmill at Kurasini / DSM

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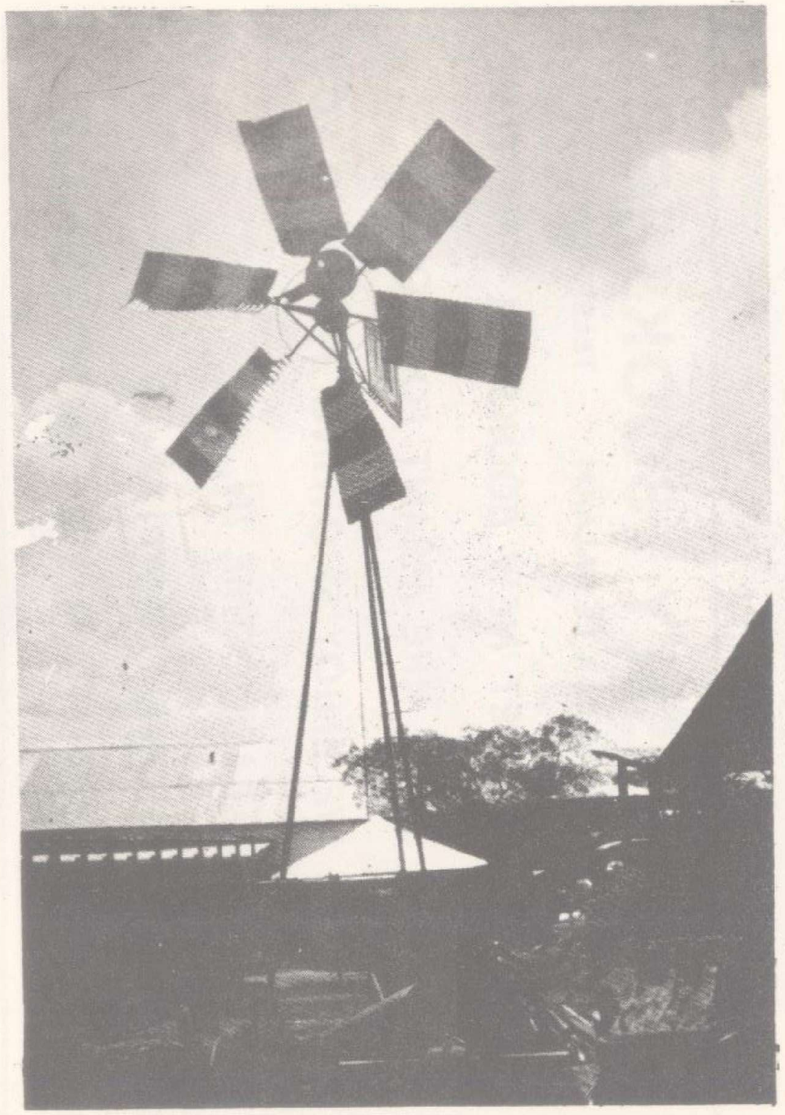

Fig. 3: Arusha Windmill

Fig. 4: Australian Windmills in Singida Region

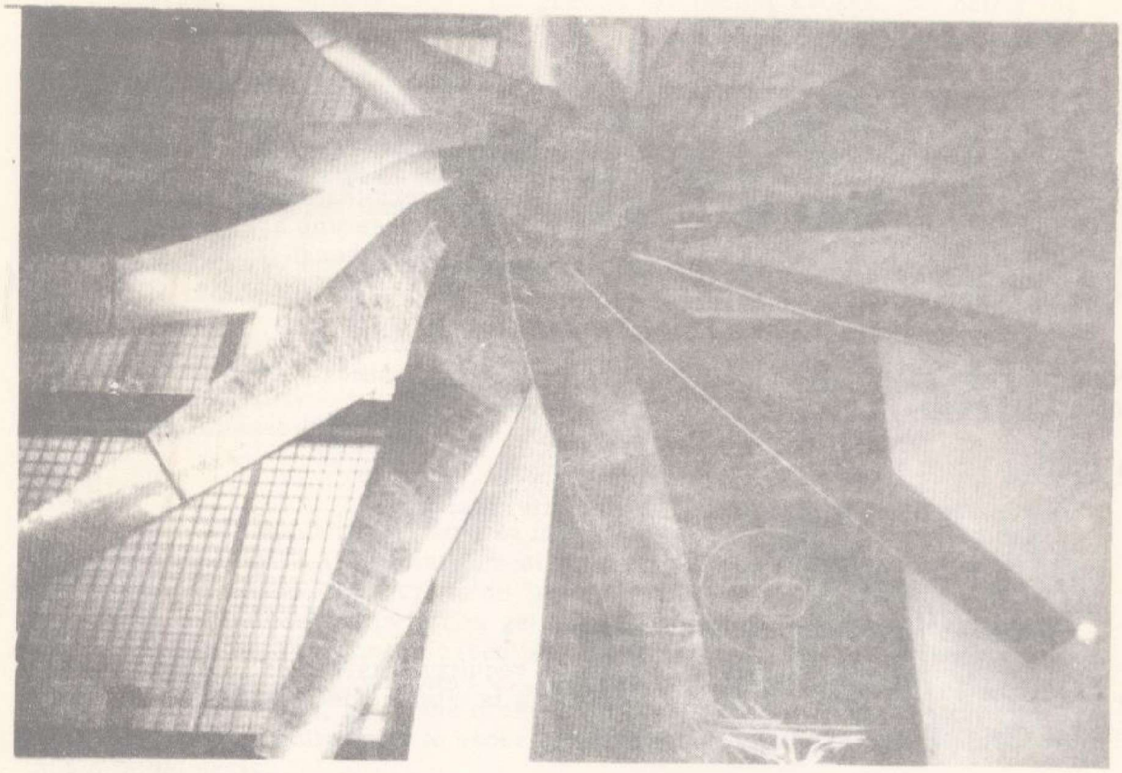

Fig. 6: Savonius Rotor made from 3 drums

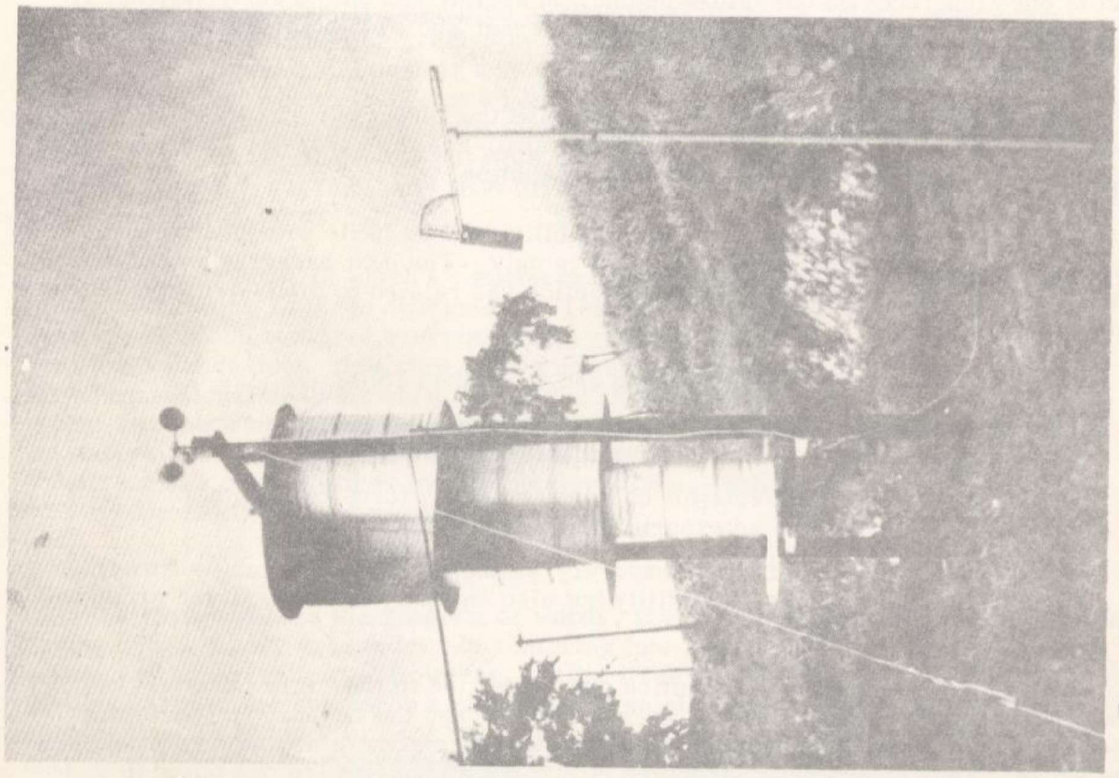

Fig. 5: Protsen-Sumai Rotor at the FoE