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Small-Scale Renewable Energy Resources and
Locally-Feasible Technology in Nepal

by Andreas Bachmann and Gyani Shakya

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SMALL SCALE
RENEWABLE ENERGY RESOURCES
AND
LOCALLY - FEASIBLE TECHNOLOGY
IN NEPAL



A. BACHMANN
G.R. SHAKYA

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FOREWORD

It was in early 1979 that a first brochure of this kind was published. At the time we thought that many more years would pass before a re-print would be needed; for things move at a snail's pace in a land that has stagnated for centuries. But to our very pleasant surprise, changes and improvements have come so thick and fast in a period of barely three years, that we feel a new edition will be justified.

The processes of development once started have snowballed. Nepal has applied itself with zest and determination to a wide range of locally feasible technologies in the field of renewable energy resources. But though the acquiring of knowledge and expertise has been rapid, their actual dissemination has been somewhat slower. It requires more time.

However, the successes so far achieved have been gratifying, and the outlook is bright. We are conceited enough to think and hope that what we have been able to do may encourage and exchange with other developing countries in the efforts at self improvement. And that is why we are publishing this brochure, as an adding to the international technology exchange.

People interested in more detailed information are requested to contact the organizations or individuals concerned. Their address are given at the end of the brochure.

Rev. B. R. Saubolle, S.J.

ABSTRACT

Decentralized energy resources are of great importance for the development of rural living standards. The development and dissemination of devices for the application of renewable energy resources, such as solar, biomass, small scale hydro power, were started in Nepal several years ago, and still further developments are taking place and new applications are being proposed.

New technologies and improvements on the old are based on the already existing traditional technology and on fuller information obtained from the country itself and from abroad. The development, production and dissemination of new devices must go hand in hand with proper training and the development of skills. Using locally available materials enables enthusiastic knowledgeable private individuals to carry out their ideas without the need of foreign exchange.

More and more devices and applications are spreading to rural areas, and different new developments are being initiated. Awareness is noticeably increasing and an ever greater production of renewable energy resources devices is taking place.

Development and dissemination of renewable energy devices must start in small workshops with the assistance of information obtained from technology exchanges within the country and from abroad. The strengthening of cooperation between executing agencies and academic bodies may further improve the development of practical solutions for rural applications.

This article has been presented by the authors to the ISEC 1981
(International Solar Energy Congress / Brighton, England, 24-28 Aug)

INTRODUCTION

In Nepal more than 90 percent of the inhabitants live by agriculture. The country, being in the Himalayas, is mostly mountainous, though there is a wide strip of densely forested land in the plains along the southern border. The population of approximately 15 million lives on a surface area of some 148,000 sq.km.

The energy requirements of the rural people are very basic and are connected for the most part with food production and food processing (agriculture, cooking, grinding, storage). The mechanical power requirements are met mainly by human and animal power. There are no known indigenous fossil fuel resources in Nepal, but this lack is offset by a huge water potential. Water power makes possible the production of electricity on a large scale for supply to big towns and industries, and happily also for export to neighbouring countries. For the farmers however, living as they do quite scattered and individually in remote areas, the energy situation will not change fast, even with the advent of such big power plants.

In former times the land could supply the basic needs of the people. Today, however with increasing demands due to population growth, the load on the environment is growing heavier: people now have to leave the hills in greater numbers than before and migrate to the Plains, the Terai, and even India, in search for a living.

One single energy source will not cover the rural demands in the future (economics, time factor, availability, &c). Nowadays more emphasis is being given to new and renewable energy resources for rural areas. This will help to improve the living standard and increase self-reliance by using local skills, locally available materials, &c.

Nepal is working at present in several places on different projects:

SMALL SCALE HYDRO POWER

While huge electric power plants serve industrial centers and big towns, there is a remarkable scope for small scale hydro power application throughout the country. Until recently work was done chiefly on turbines ranging from approximately 10 to 50 H.P. These were intended mainly for mechanical production, though a few were used for small scale electricity supply. Nowadays for this purpose (mechanical power production) mainly cross-flow turbines are being manufactured. At present approximately forty of these have been installed.

Recently much attention has been given to the improvement of existing traditional water mills. These devices have been used for grinding grain almost everywhere in the country from time immemorial and have always given full satisfaction to the villagers. The numbers of mills existing in Nepal alone is not accurately known but estimates indicate probable figures from 25,000 to 50,000 or more scattered all over the hills and valleys of Nepal.

With a new approach to this tremendous water power application -until now not really taken into consideration - many improvements can be made. The mills can be improved using wood alone or wood and metal or mainly only metal. The Multi-Purpose Power-Unit (MPPU) is a new concept developed and manufactured entirely in Nepal. The unit is made in three detachable sections easy to transport into remote areas. It has a penstock (instead of an open water channel, spoon shaped blades (instead of flat paddles), bearings (instead of bushes); and the improved grinding stones are enclosed under a dust cover to prevent the flour from flying all over the room. A very important addition to the mill is a pulley on the main axle which permits a power take-off for other machinery as well.

At one site with a head of 2.5 meters only and a water flow of approx. 85 ltr/sec. 2.8 H.P. can be obtained. At another site the head is 4.5 meters and has a water flow of appr. 100 ltr/sec., 5 H.P. can be

obtained. This measurements indicate that an improvement in grinding efficiency over the traditional mill of from 4:1 to 8:1 can be obtained!

The advantages over other alternative mini scale hydro power applications are obvious: the MPPU can be carried anywhere and installed within a few days (if replacing a traditional water mill); the investment is reasonable, and the MPPU can be understood quite easily by village folk, as it is based on traditional technology. At present such units are being used for the processing of agricultural products (grinding, hulling, threshing, oil expelling) and for mini electricity production, either 12 V DC with a car generator or 220 V AC with a 1.5 kW generator. Such an installation costs approximately U.S.\$ 2000.00 only and is being found most attractive. Orders have already been received even for export to India and Bhutan.

COOKING STOVES

As most of the fuel energy requirement of the country (75 to 85 percent) is met by wood consumption for cooking and heating, more attention is now being paid to this very basic and essential problem for the rural population. The traditional village cooking stoves are being improved not only for better fuel efficiency, but they are also being made smokeless. It has been found that smoke (not necessarily or only tobacco smoke) is a constant health hazard to the eyes and lungs of both human beings and animals. Stoves should be built preferably of materials available in the neighbourhood: some are made from stone, others of brick or of mud. Fuel efficiency is much improved by the use of a grate. Still at the beginning, many problems have yet to be solved, for example the chimney whose material is always costly and whose construction is often time consuming; the adaption of different traditional designs to meet the expectations of housewives; training of people for the proper construction and maintenance of both stove and

chimney. The country now has an ambitious programme for afforestation and the introduction of 15,000 improved stoves within the next five years.

SOLAR ENERGY

Started in autumn 1974, the development of solar water heaters has gained a remarkable popularity. They are made to work mainly on the thermosyphon principle and in non-freezing areas. There are two different systems available: The Circulation System and the Flat Tank Collector; both work without electricity. These heaters are of modular design and standard measurements, so that they can be easily produced and kept in stock. This facilitates handling and maintenance. In Nepal at present over 50,000 liters are already being heated each day by the sun's energy. One manufacturer alone claims to have produced, sold and installed more than 270 heaters up to 1981.

Other applications of solar energy with improved technology are solar driers, solar stills and possibly solar kilns for wood seasoning. A lot more research and experimentation are still needed for the introduction of successful solar cookers. These could be of great help in remote areas and at high altitudes where fuel for cooking is difficult to get.

BIOGAS

Fuel for cooking is the basic demand of rural people. As firewood becomes scarcer people increasingly burn dried dung cakes, thus reducing this manure to about 1/16 of its original fertilizer value! Biogas has been introduced as an alternative for cooking and lighting, and with it a double advantage has been obtained: fuel for domestic needs (and even for running a few internal combustion engines), and improved fertilizer for field and garden.

Since the adoption of the programme in 1975, a remarkable number of over 750 plants have been installed. The floating drum design, based on Indian technology, still outnumbers other types of construction. However, with the increasing cost of imported steel (for the floating drum) other designs are fast gaining popularity. The fixed dome construction, based on Chinese technology, reduces costs by approximately 40 percent and can be built with indigenous materials.

The potential is great for a good part of the country, namely the plains and the lower hills, to which the less costly modern technology is restricted by the cold temperatures at higher altitudes. More effort is needed to lower the costs still further, to make other organic materials besides animal dung viable for digestion, and also to improve fermentation at lower temperatures.

WIND ENERGY AND ANIMAL POWER

These need further investigation for development and application. There are some places in the country with strong and regular winds. The use of this energy source has been limited so far to a few trials by private individuals, and as it is not easy to utilize it for economic and useful applications, grants-in-aid for experimentation are not available.

As for the improvement of animal power, certainly much more could be done. Beginning with the yoking of the animal, one may also improve the working capability. Animals do provide useful power especially in rural areas. Additional application of animal power for water pumping, food processing, etc., will further contribute to the improvement of life in rural areas.

APPROACHES

Development and dissemination of new and renewable energy resources in Nepal to a great extent originate in the small workshops of private individuals. It can be noted that in many places trial-and-error methods bring quick and economical results. What is needed is information and also people with enthusiasm and skill.

The educational factor is a very important one. It is only if the people on the execution level, manufacturing and installing the various devices, are properly trained and skilled and that the various forms of application will have a fair chance of successful introduction.

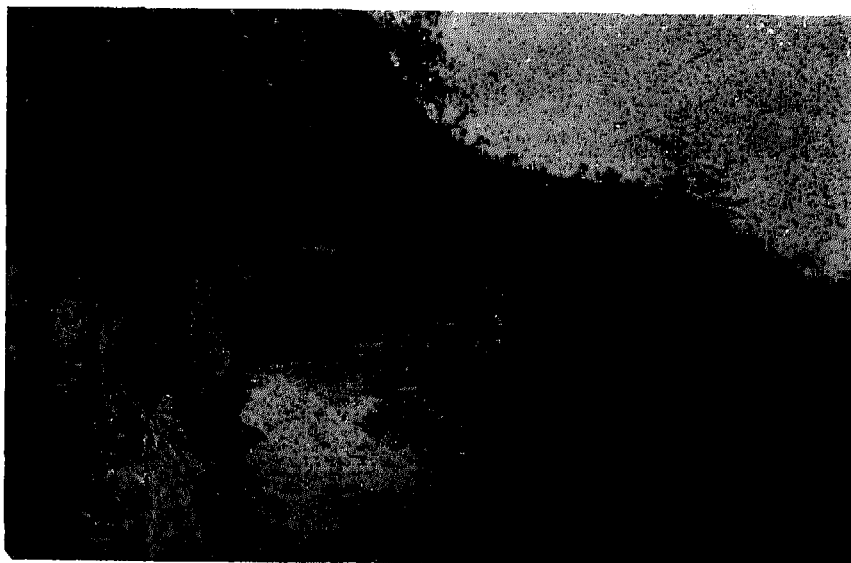
The choice of materials needed must, as far as possible, be based on local availability. Their supply and use will thus be less difficult, and the country's own currency can be invested.

CONCLUSIONS

Developing countries can at the present time develop and disseminate new and renewable energy devices. The exchange of technology undoubtedly plays an important role and enables the country to profit by the experiments made and the experience gained in other parts of the world. Development work may be carried out at many places: laboratories, factories, large industrial centers, or even only small private workshops. Dissemination depends on several factors: proper installation technology, skilled and well trained operators, capable and dedicated instructors. These are all very essential for successful introduction. And taken for granted of course the availability of information from within the country and from abroad.

The improvement of interlinks between the workshops and the scientists will broaden the scope for further development, and grants-in-aid from banks, Government and other organizations will further help the work of dissemination.

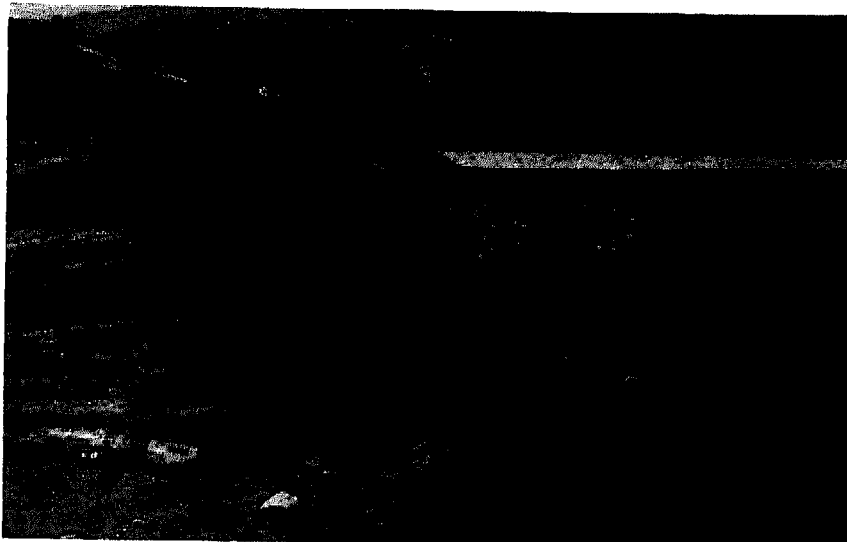
For most of the people
wood is the main fuel
for cooking and heating.



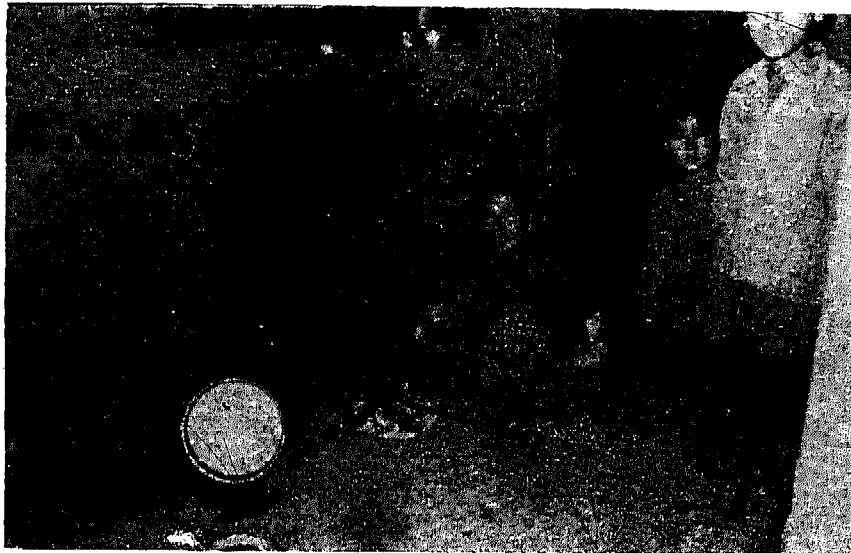
To get firewood is more
troublesome near urban
settlements, where for-
ests sometimes are even
protected with walls.

π

Nowadays even dungcakes
are being burnt; and
less fertilizer remains
for the fields.



A traditional cooking stove, made of clay.



Such cooking stoves provide heat for cooking, warmth in cold seasons, light in dark rooms and impregnate the roof and the rafters.

The same stoves consume more wood than necessary and the produced smoke is hazardous to health.

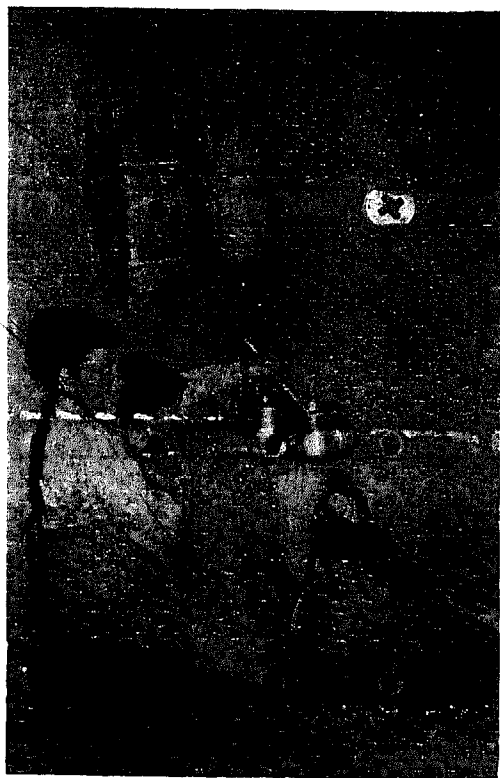




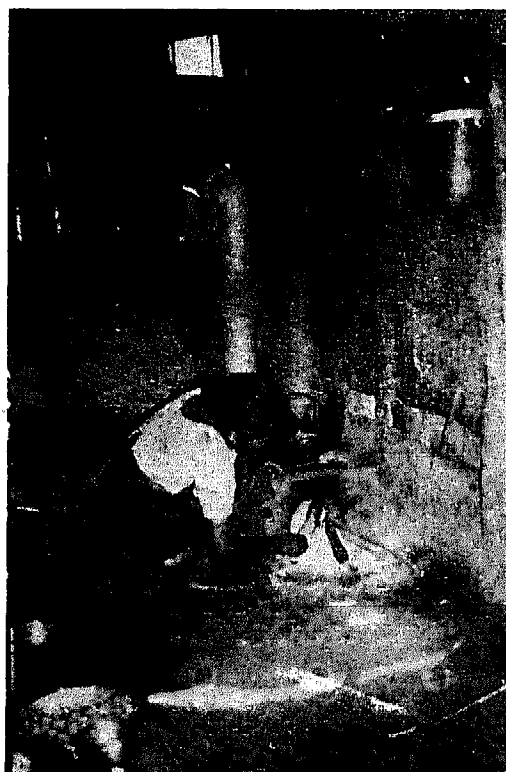
The different efforts over the last two decades to improve cooking facilities..



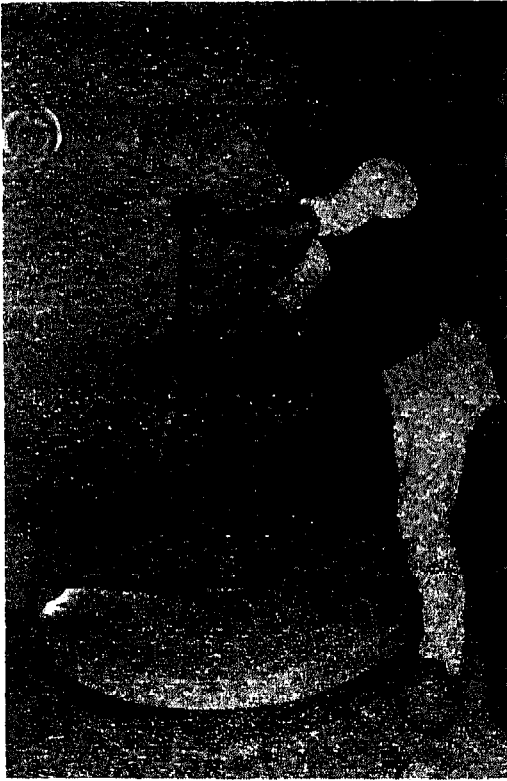
.. resulted in stoves which are being assembled at site of prefabricated materials, made of fired clay.



New stoves have to look preferably the same as the traditional ones.



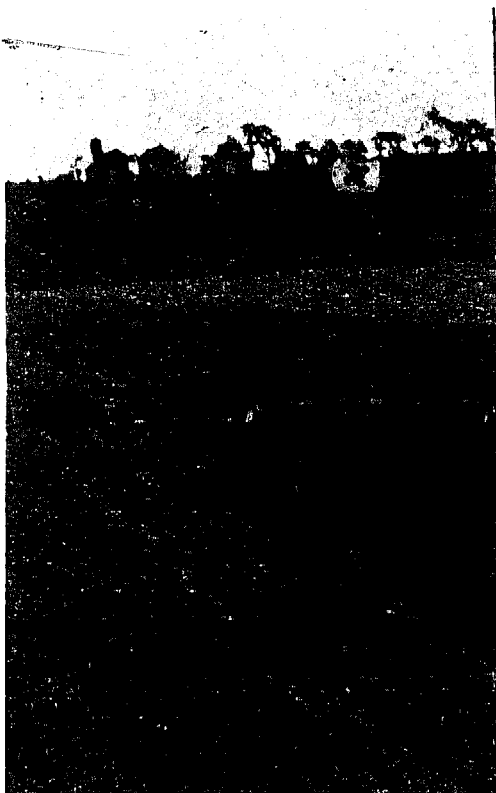
Such stoves consume less wood (30 to 50 percent) and provide smokeless kitchens



A potter and his wheel in Sano Thimi near Bhaktapur..



.. produces a chimney pipe for the improved cooking stoves.



A lot of hard labour is still done by man.



Small machines provide valuable assistance; here for rice threshing.

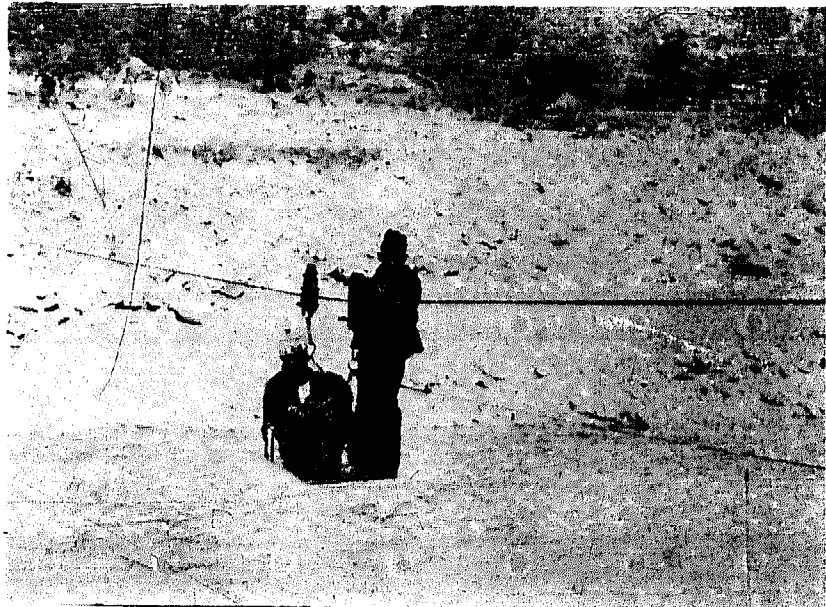
A blacksmith's field workshop. The smith blows air in to the charcoal fire.

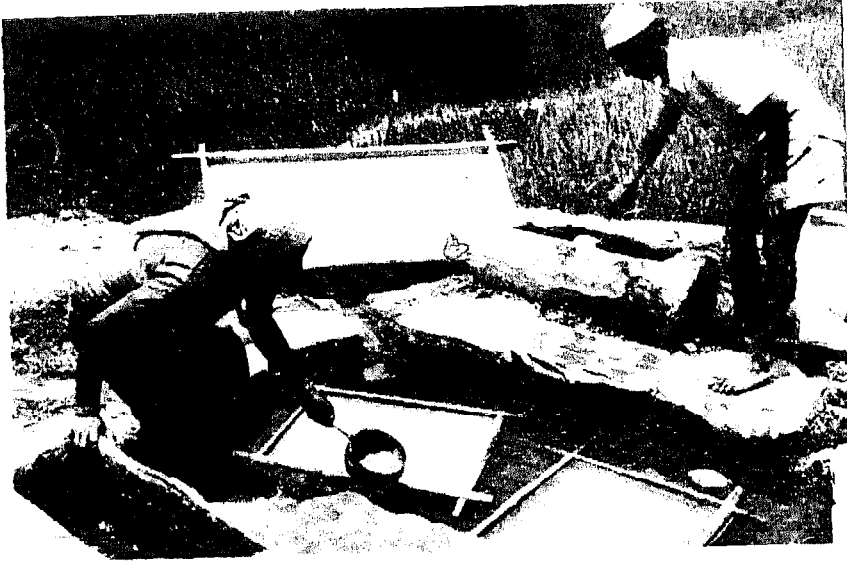


A traditional oil press. The preboiled seeds are squeezed in the center and the oil drops down through the hole. This is hard labour!

(Photo: David Sassoon)

Simple devices are locally produced to cross the rivers, for places where there are no nearby bridges.





The making of paper in the hills and drying in the sun.

Cutting of wood with a log saw is a welcome improvement over traditional methods still using axes.



Simple and effective devices are often locally made: a log holding device, beam ready for cutting.

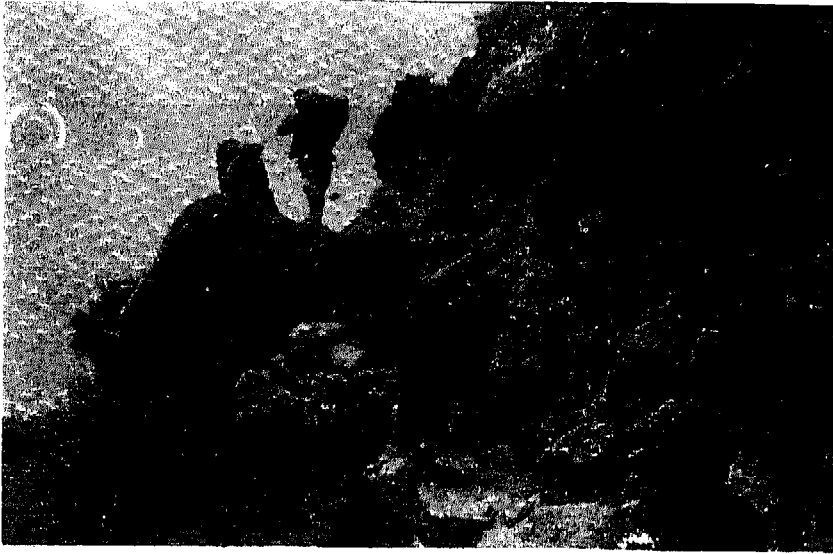
Animals do help farmers,
to do the field works,



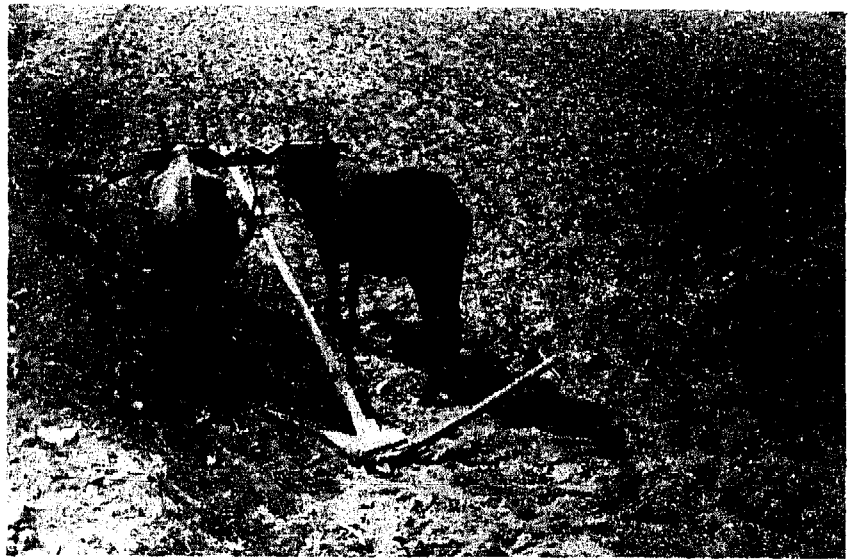
.. to pump water,
(Photo: Luzi Hugentobler)

... to squeeze the sugar
cane.

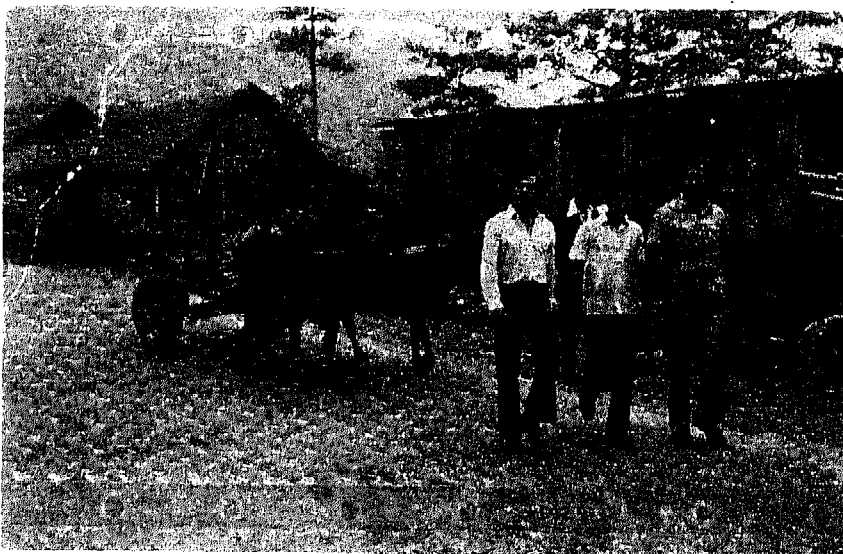




Animals are valuable porters,

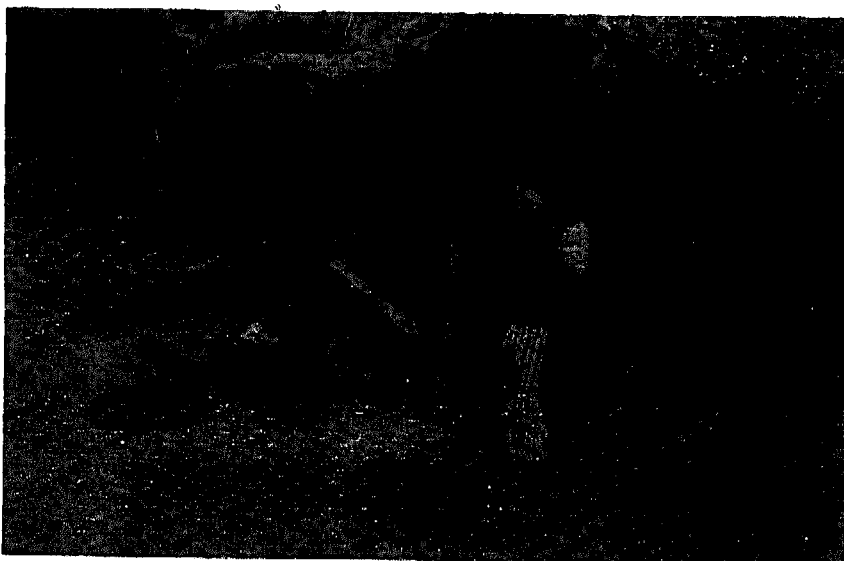


... hard labourers in the field,



.. and also useful for transportation on roads.

The famous *dheki*, the food operated pestle hammer, for dehulling of rice and beating of various foods.



A workshop in the field, people working with a grinding stone.

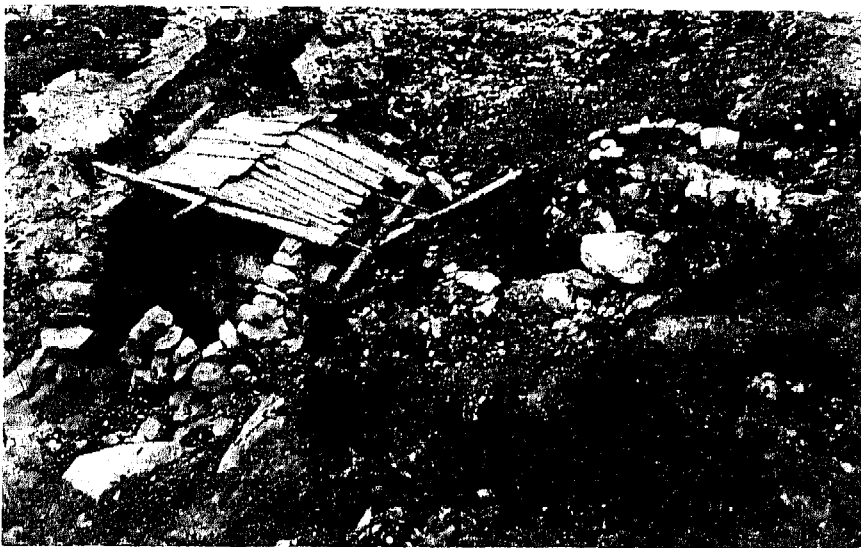
Not all machines are easily available yet - no reason not to meet the requirements anyhow!





In hilly areas many thousands of traditional horizontal water mills are still in daily use. Such traditional mills work with three to five meters of head.

Where the height is available such mills are often operating in line.



Traditional water mills are well spread in the Himalaya's. There is an estimated number of 30,000 to 50,000 working in Nepal alone.



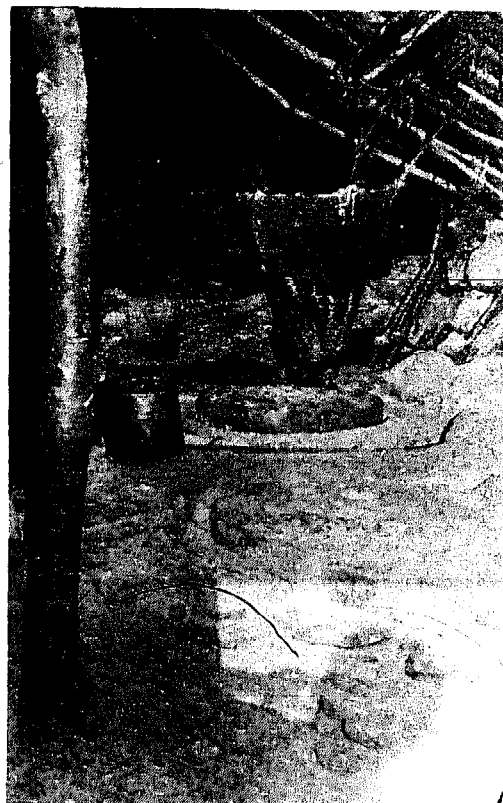
The grinding stones need to be adjusted regularly.



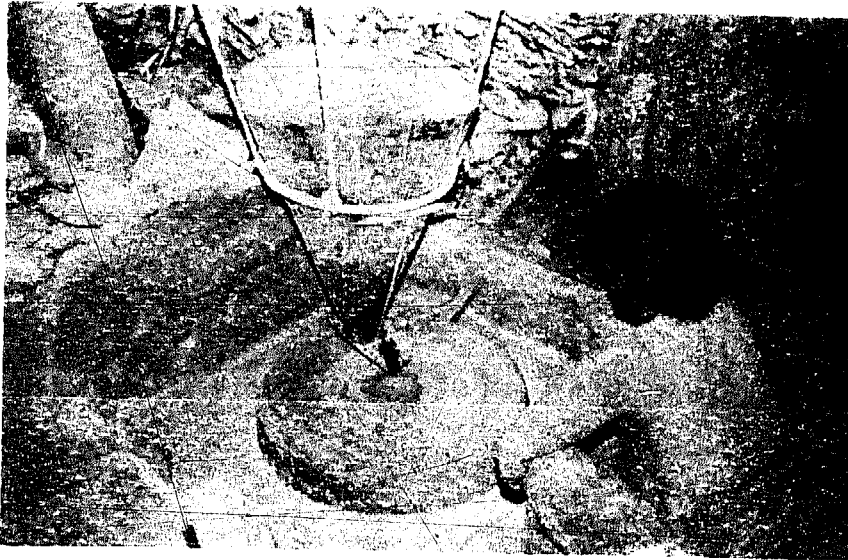
Front view of a typical traditional mill house.



A new construction of a traditional horizontal water mill in the hills.



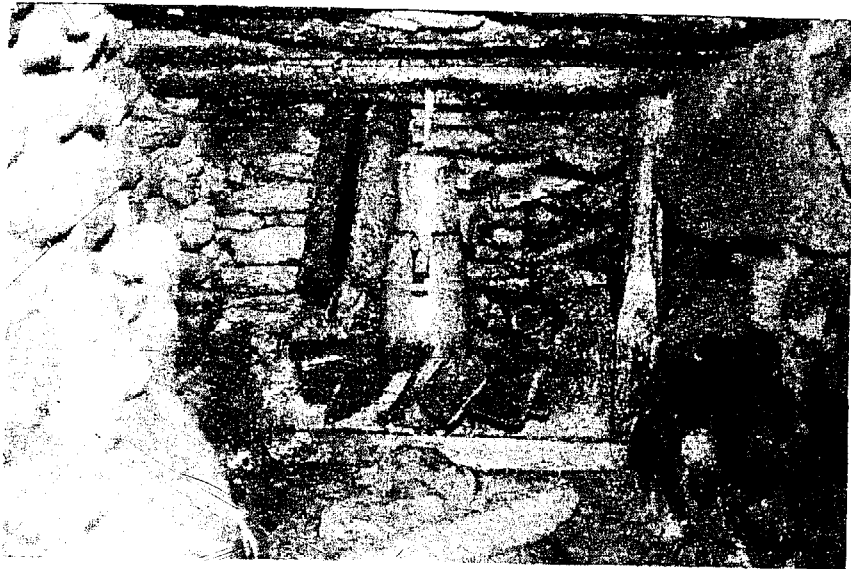
The inside of a traditional mill house.



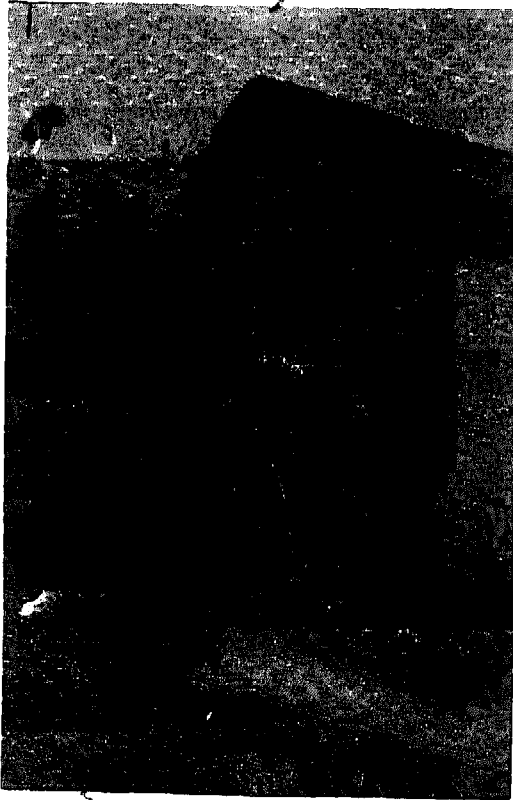
A customer watches the grinding.

2

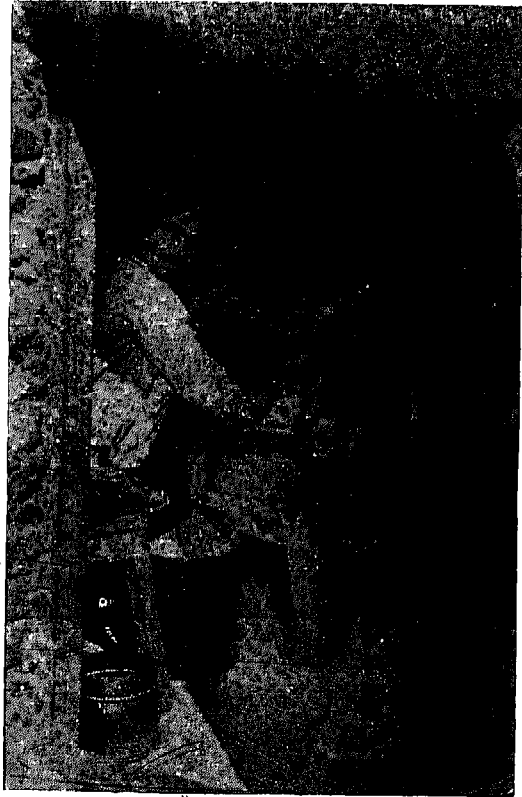
A typical horizontal water wheel. On the left side is the open chute for water delivery.



A clever miller improved his water wheel efficient with a simple metal water wheel.



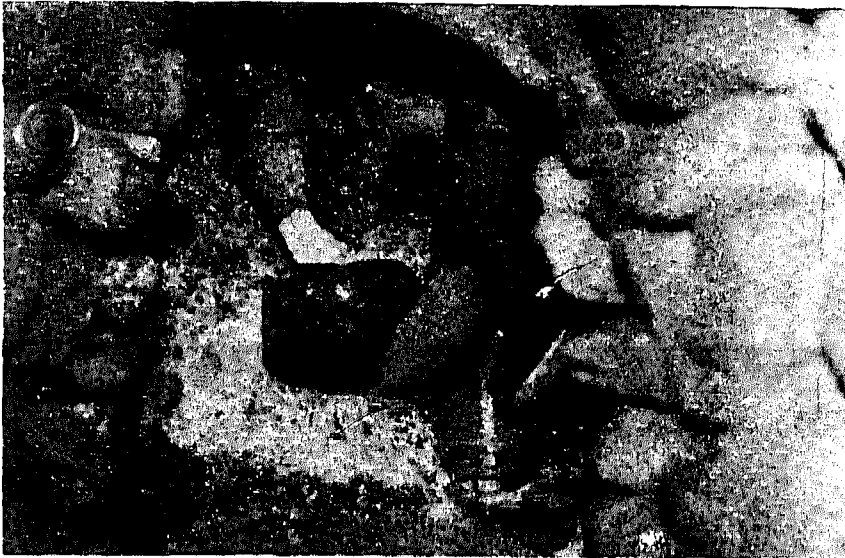
Undershot water wheel
made of wood, the symbol
of Naubise in 1974,



The miller running a rice
huller,



The wrecked device in 1982.



Improvement of traditional water mills with spoon shaped blades made of wood. (Ref. 3)

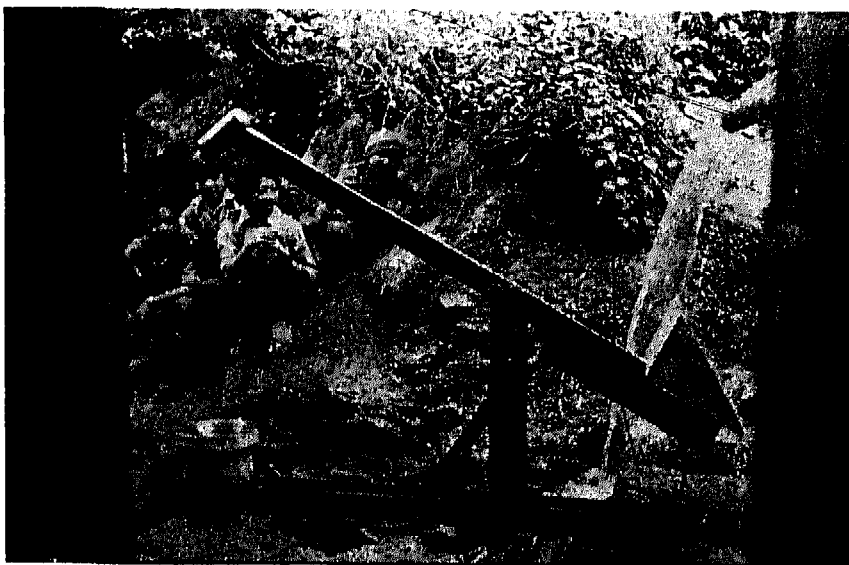


The same site. The grinding stones are covered and a small dynamo fitted (Ref.3)



Small scale irrigation, a trial run of a locally made Plata Pump (Ref.3)

Trials with a water
powered pestle hammer.

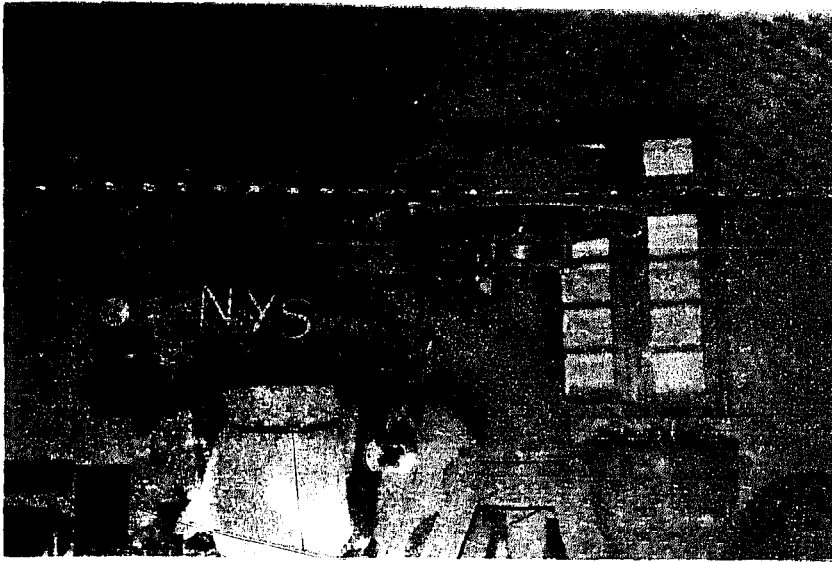
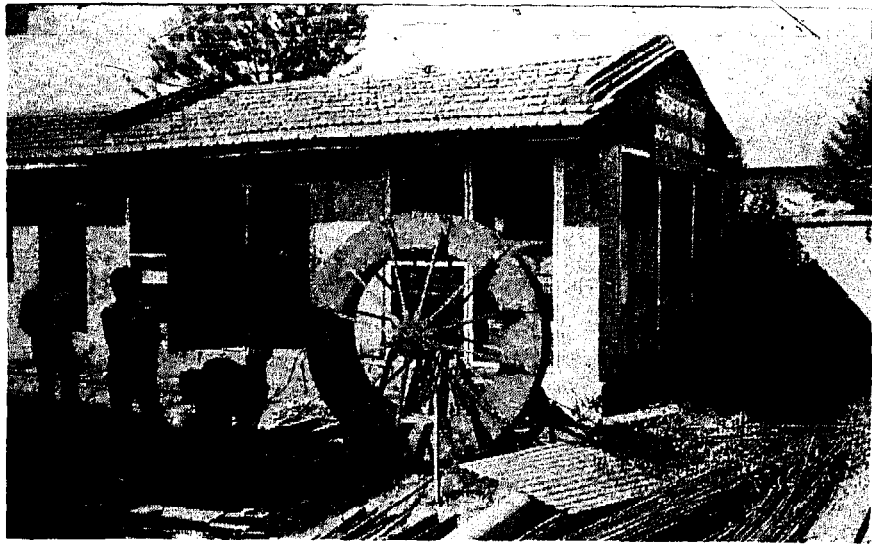


It takes five to seven
seconds for one stroke.

The hammering is quite
powerful and many
applications are thought
for practical use.



Prototype construction
of a metallic Overshot
water wheel (Ref.22)

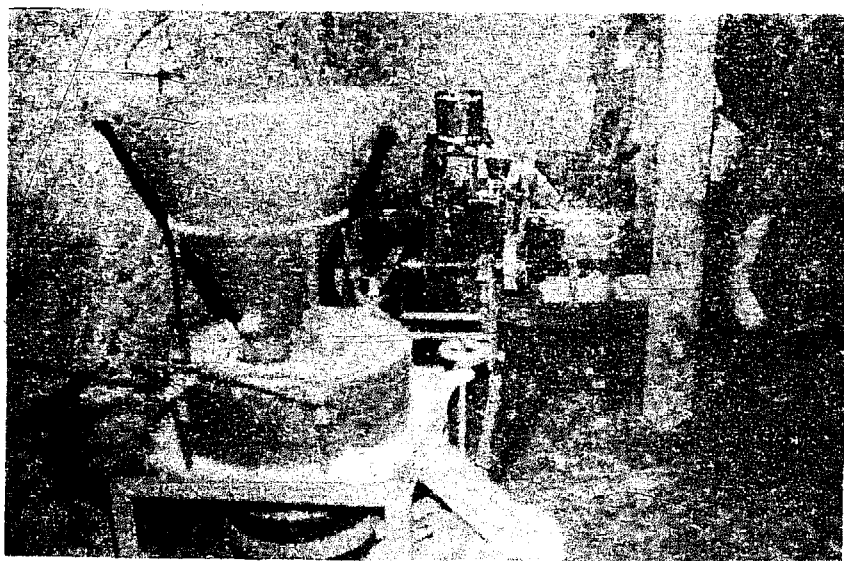
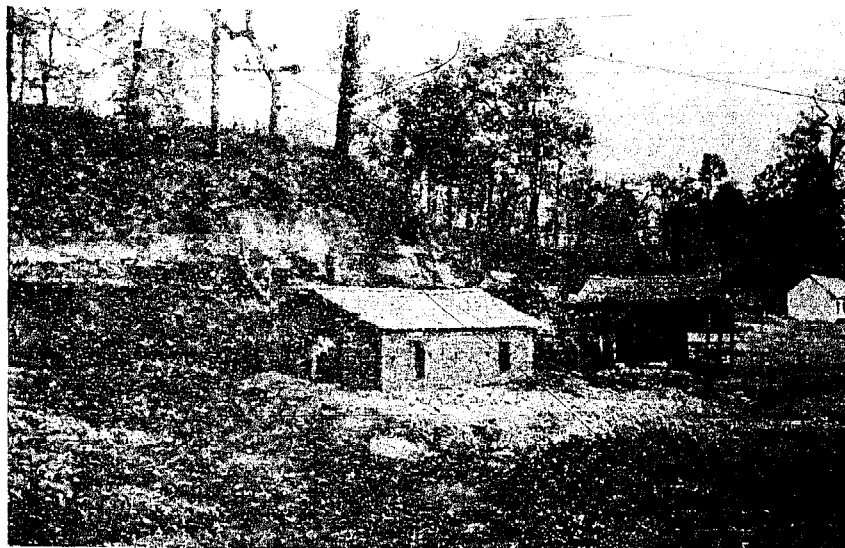


Prototype construction
of a vertical axis pro-
peller turbine (Ref.22)

Prototype construction
of a Turgo turbine wheel
(Ref. 18 & 19)

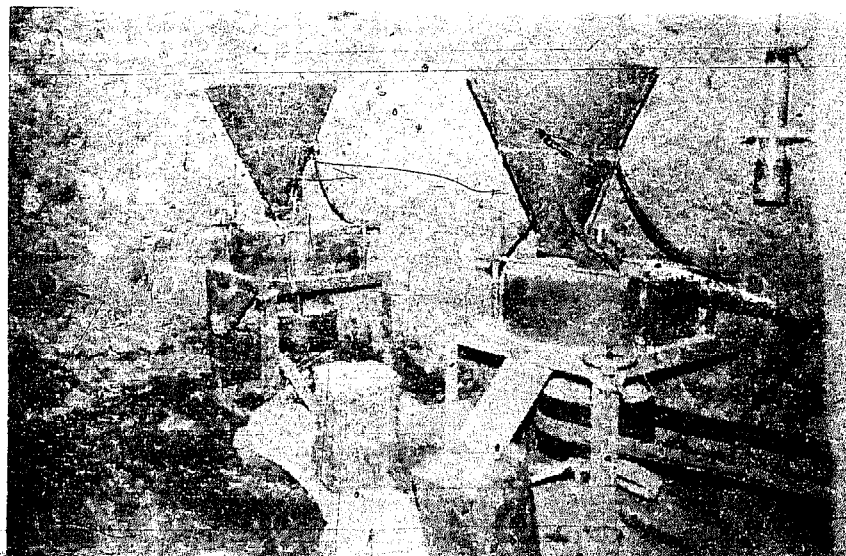


A new mill house, replacing the old, traditional water mill (the chute can be seen) Ref.18

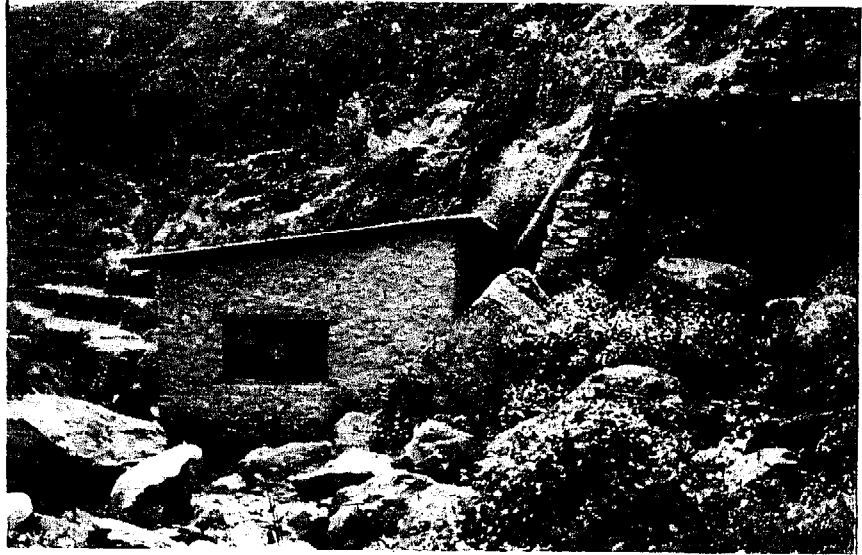


This building houses one Multi-Purpose Power-Unit (MPPU) with the turbine fixed below the grinding unit, 1 baby oil expeller and 1 small rice huller. (Ref. 19)

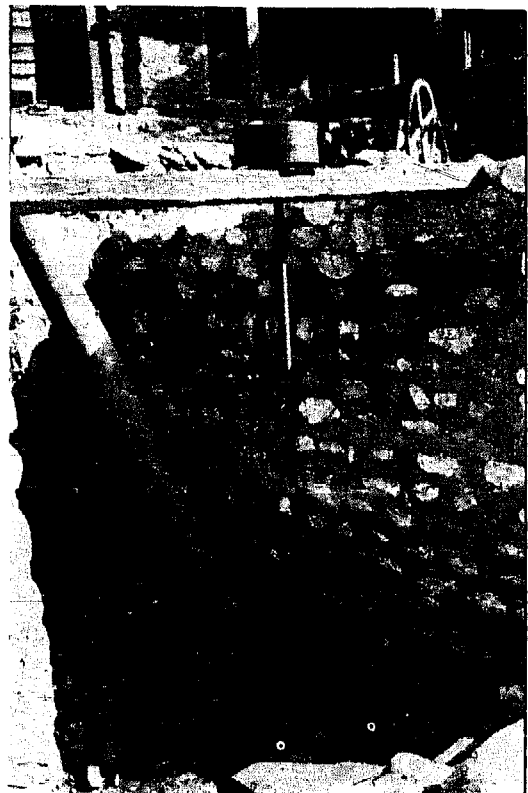
There is also a second milling device fixed. (Ref. 19)



The new mill house in
Tupchhe, a community
owned mill enterprise,
established under the
Small Farm Family
Programme (of the
Agricultural Development
Bank/Nepal and Unicef)
(Ref. 18).

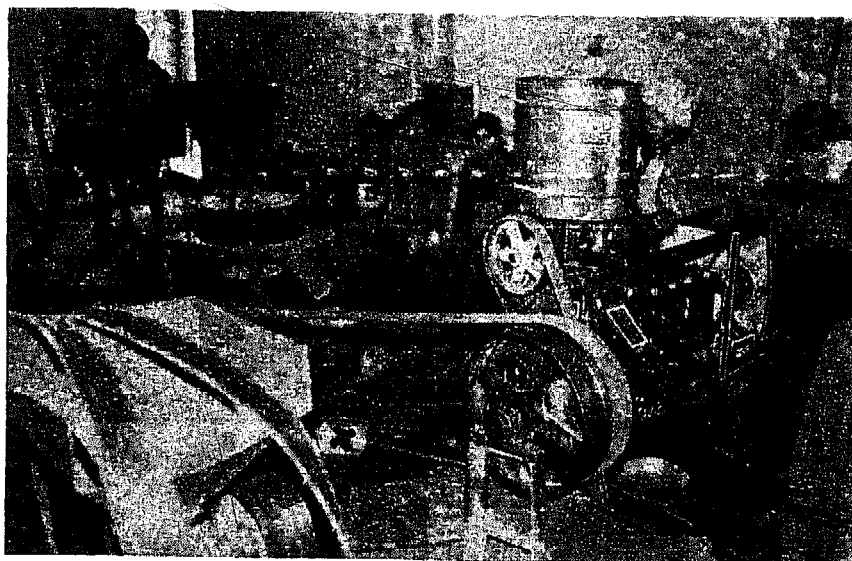
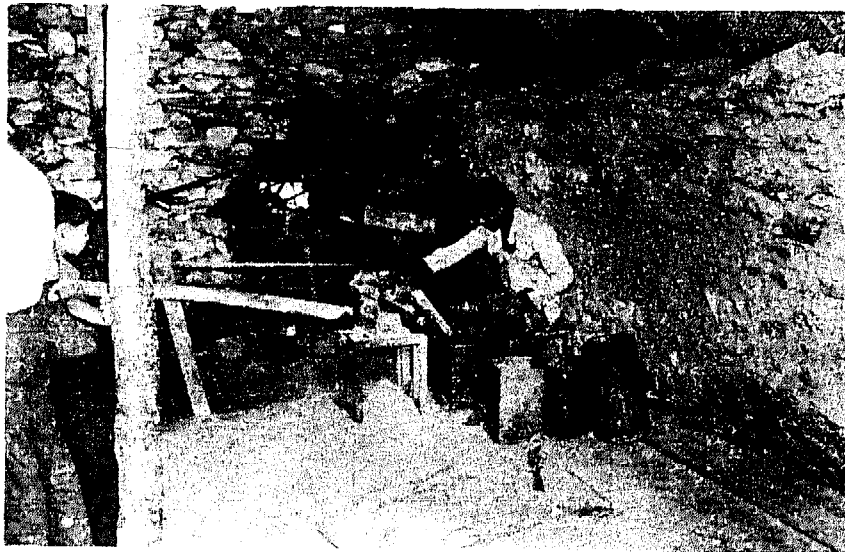


Customers are waiting
for the water powered
grinding of their grain.
(Ref. 19)



The MPPU-Turbine part
can quite easily be
used to run various
machines; here it is
installed to run a
1 kW Alternator.

Water power drives effectively many small machines, here a rice huller. (Ref. 22)

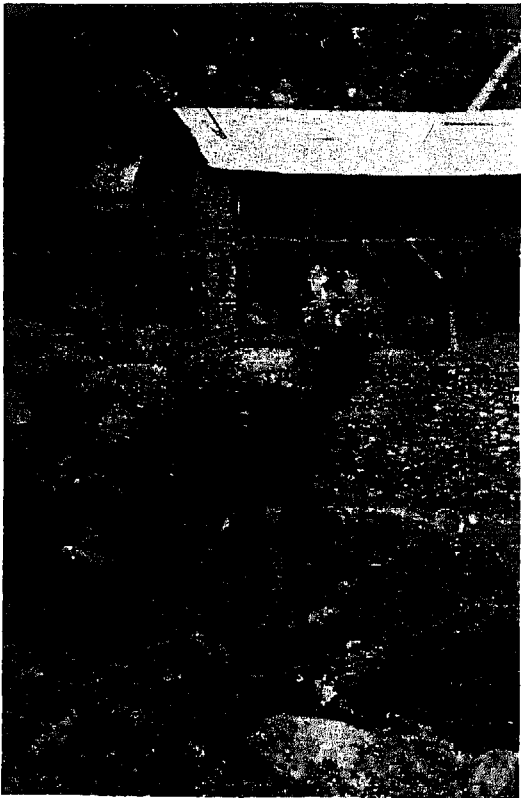
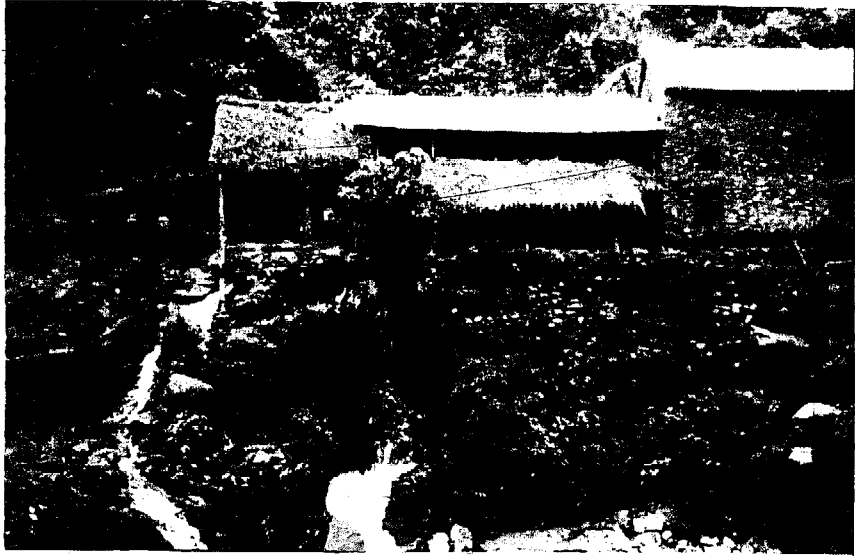


Modern milling sites with improved grinding facilities can also run oil expellers (Ref. 19)

The production of MPPU's in Kathmandu (Ref. 19) and a pilot assembly of a lowest-head "Pelton" turbine (Ref. 18 & 19)



The pilot installation of a Barker's Turbine (or Segner's Turbine). This mill house has a cross flow turbine. The tailrace water can again be used to produce power. (Ref.21)



The vertical pipe is the penstock and the turning axis. The turbine turns quite slow (at about 150 rpm) and at a quite stable speed. (Ref. 21)



The four nozzles permit an easy adjustment to the variation of water flow by closing one by one. (Ref. 21)



The assembly of an Open Cross Flow Turbine (Ref.19)



An Open Cross Flow Turbine under construction. (Ref.18)



Mahadev Besi, the site of the installation of an Open Cross Flow Turbine (Ref. 18 & 19).



The installed Open Cross Flow Turbine (Ref. 18 & 19)



The well-known Hydraulic Ram, made in Nepal (Ref.21)

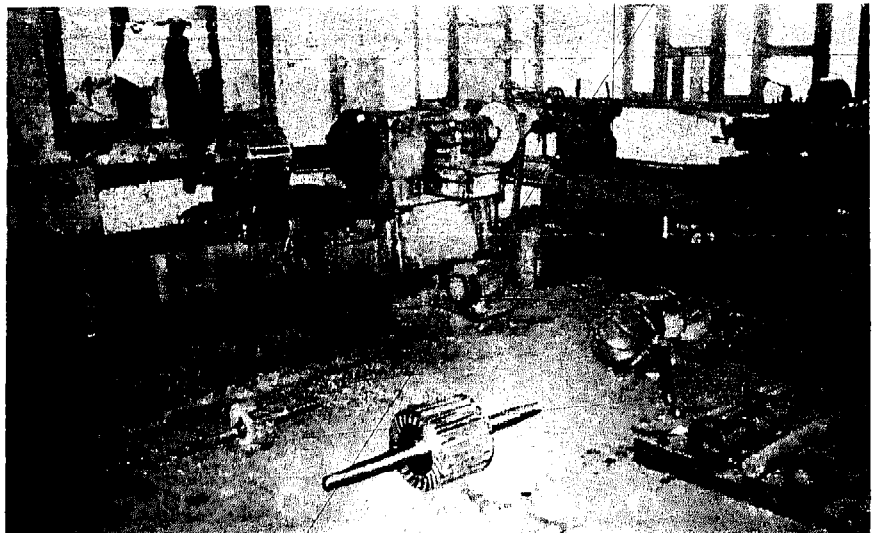


Assembly of a Cross Flow Turbine Wheel (Ref. 21)



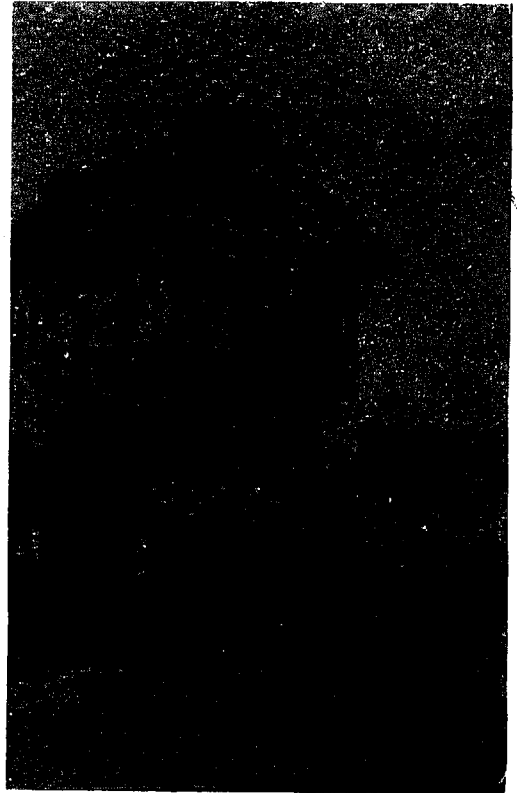
A Cross Flow Turbine turning an oil expeller (Ref.21)

Local manufacturing of different turbines, Cross Flow and MPPU, for export (Ref. 19)





Solar powered field station:
a small solar cell panel
(left side, top of the house)
provides electric light.
A solar collector on the
small house gives hot water.



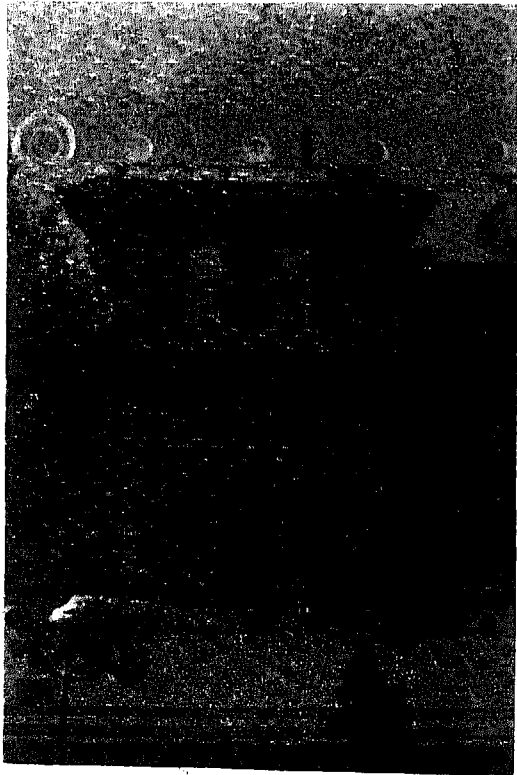
A trial with a Solar Trombe
Wall for room heating in
Bhaktapur.



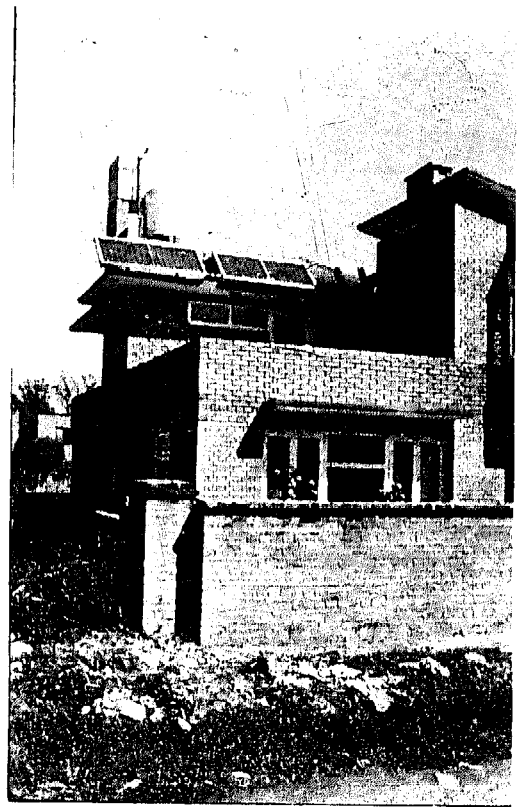
Solar food warmer: still
not successful.



The novelty under solar
cooking devices: the
Spiral Cooker; with the
promising spiral design.
Still to be improved .

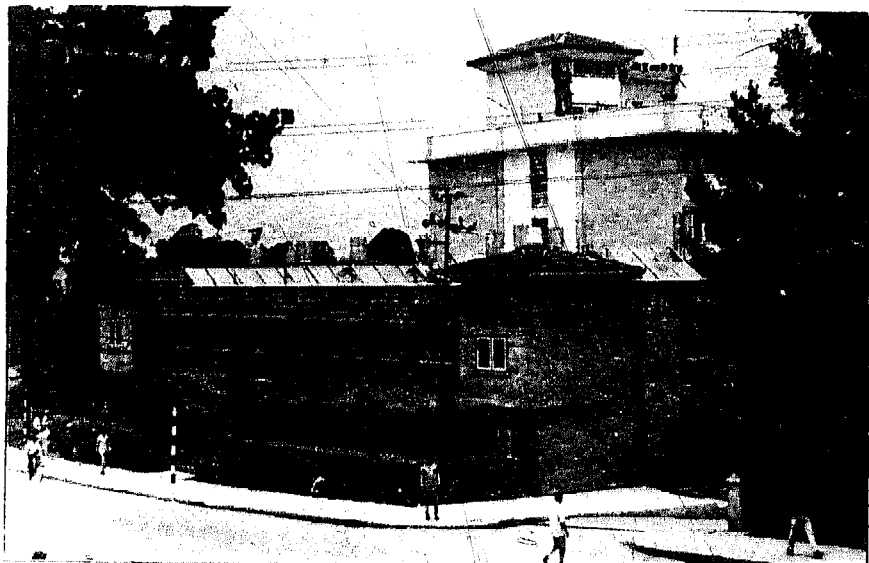


Solar Water Heaters have often become integrated parts of architecture. (Ref. 20)

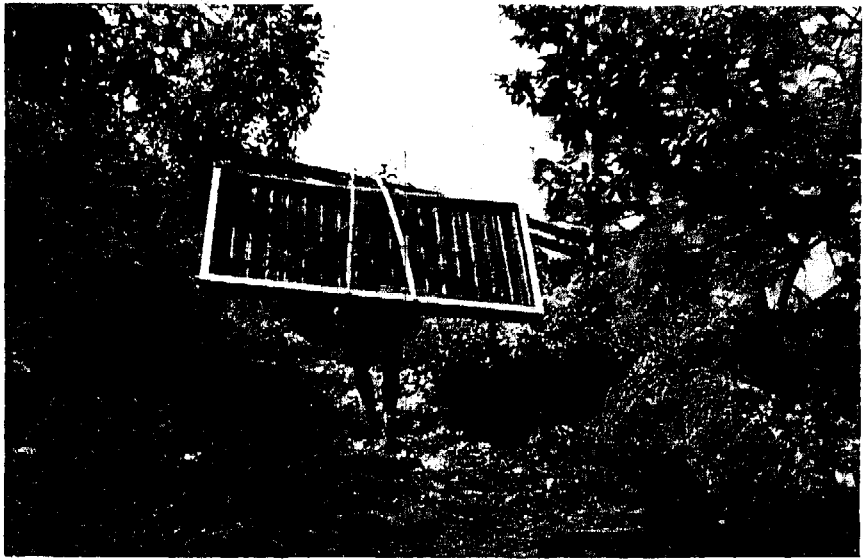


Double solar collector installation in Kathmandu. (Ref. 20)

Hijal Narmyani in Kathmandu: solar water heater installations.

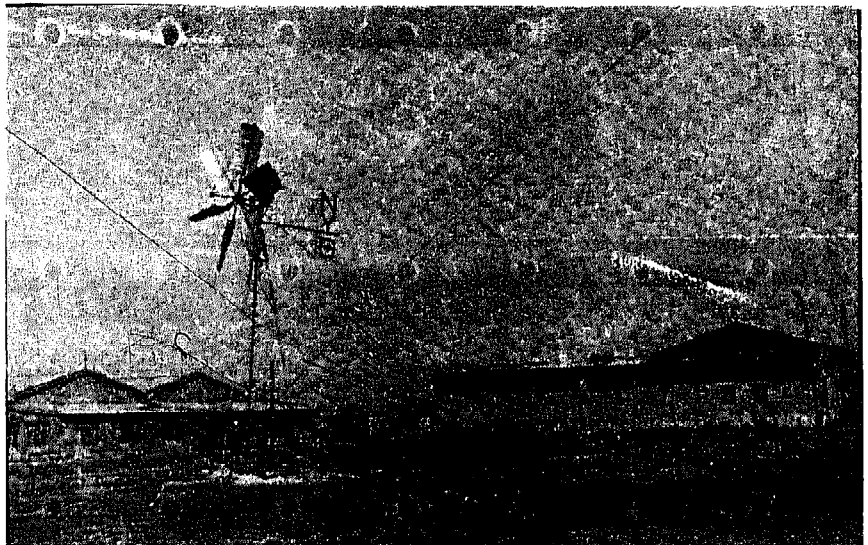


Devices for renewable energy resources have preferably to be made in porterable loads, to reach remote places. (Ref. 20)



Solar water heater installation in Chialsa, in the remote hills.

Windmills may have a future - which still needs to be proven.

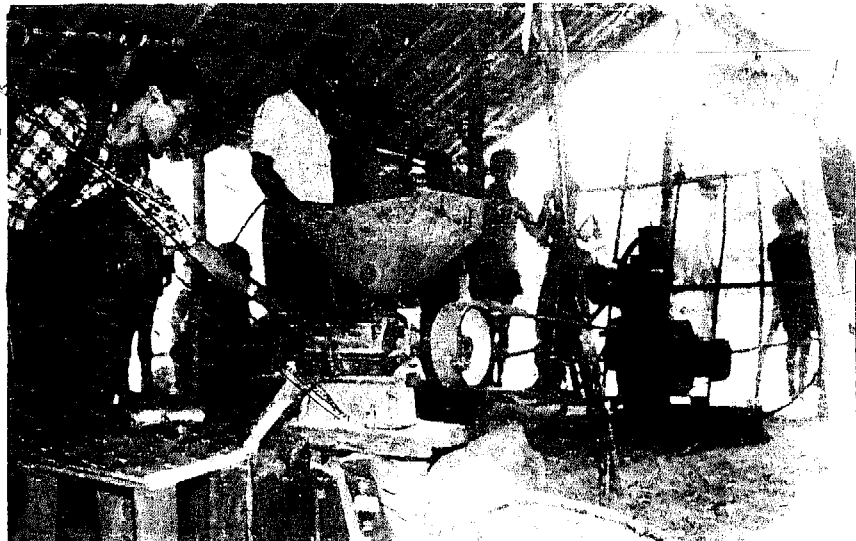


Late Rev. B.R. Saubolle
with Nepal's first ever
built biogas digester.
Initiated in early 60's.



A floating drum design
biogas plant (Ref. 20,21)

Biogas can successfully
run motors, providing
80 percent of the fuel;
the remaining percentage
is conventional diesel.
(Ref. 36)

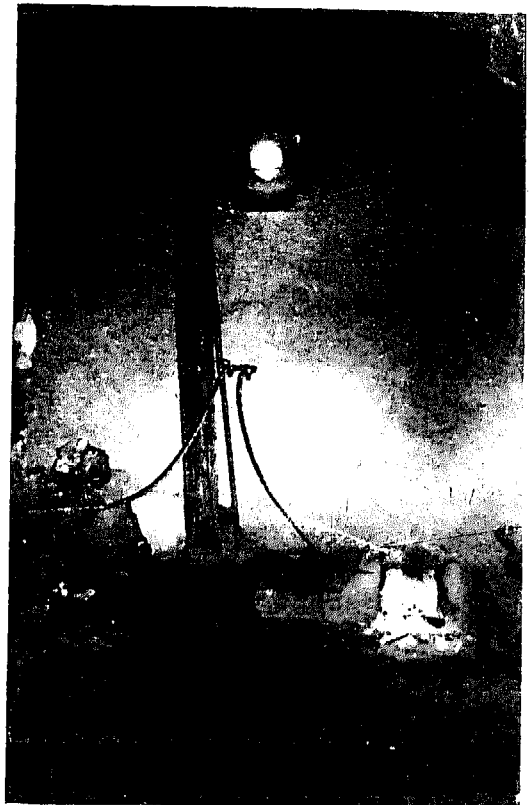


The construction of a
fixed dome biogas plant,
Chinese design (Ref. 36).
(Photo: Kunda Dixit)

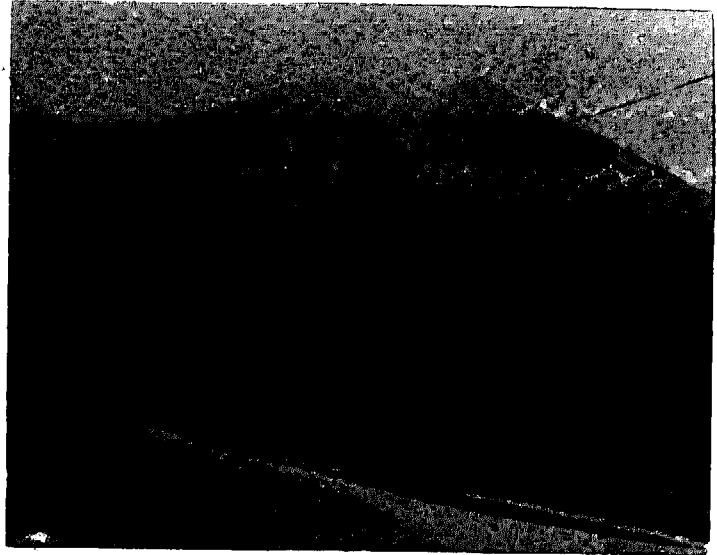


A completed underground
digester, here in
combination with a
latrine. (Ref. 36)

Biogas provides fuel for
cooking, lighting and
to run motors,
and an improved, odour-
less fertilizer!



Dezentralized rural electrification from a small water wheel provides light to the nearby bazaar in Naubise.

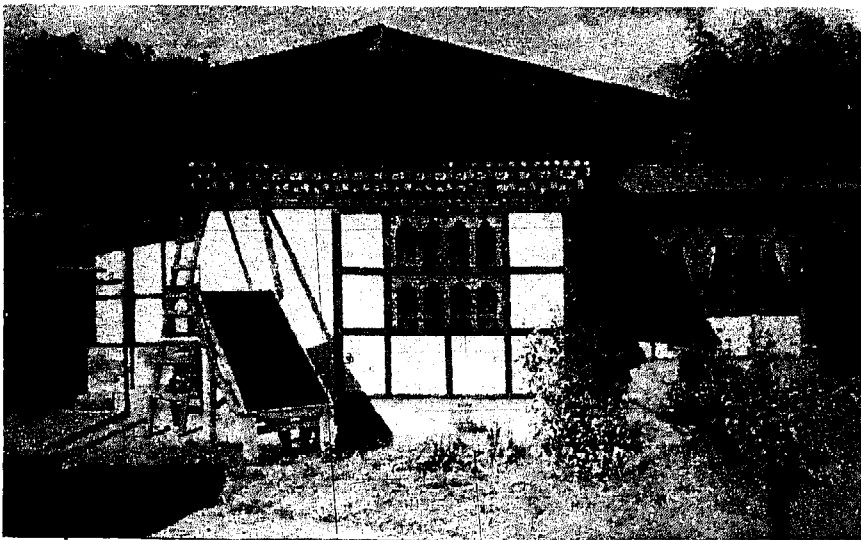


Rural electrification can provide very effective secondary energy for cottage industry: light source!

Warmth for chicken raising through little electricity.



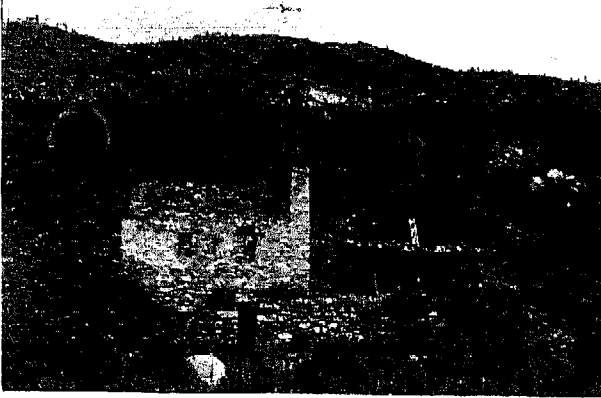
Improved cooking stoves
in Bumthang/Bhutan,...



A solar water heater in-
stallation in Thimphu,
Bhutan, ...

A Cross Flow Turbine for
the saw mill in Gheza,
Bhutan, ... (Ref.21)
are results of success-
ful regional technology
exchange!



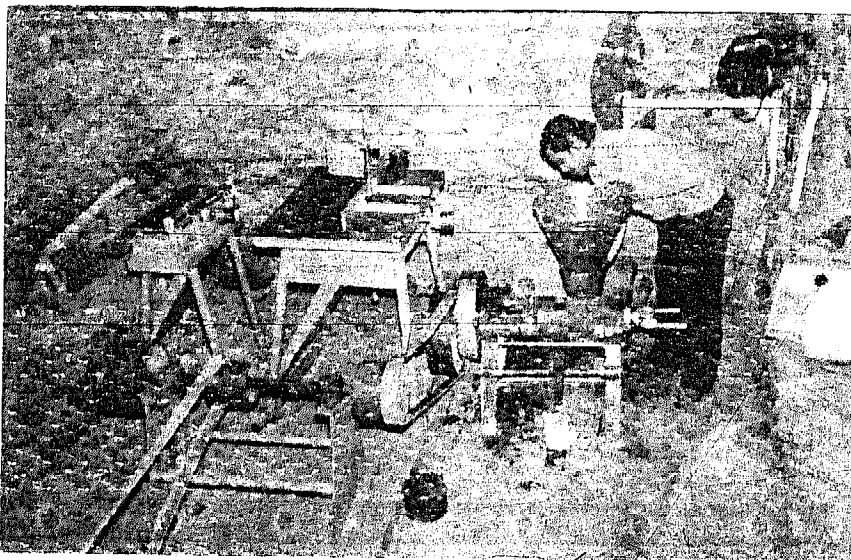
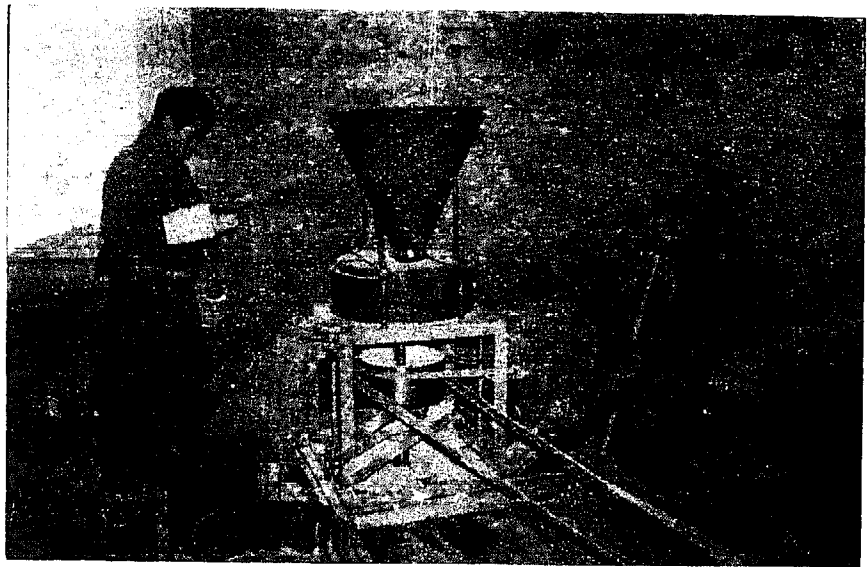


Reviving traditional technology in Bhutan, old mill house in Namseling, near Thimphu.



The newly renovated mill house ready to house an improved water mill.

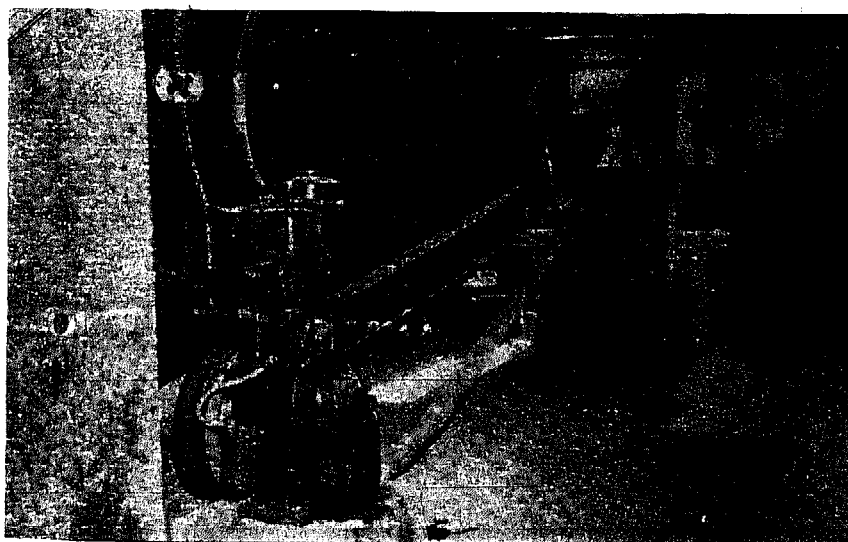
Testrun of the newly installed Multi-Purpose Power-Unit (MPPU) Ref. 18



Testrun and adjustment of the newly installed machines, which can be run from the MPPU, from left to right: wood planer, a circular saw and an oil expeller.



Decentralized, small scale water power utilization has a good future: the electricity supply of large generating plants will not soon be available to all people. (Note the electricity tower near the mill house).



It is surely reasonable to use first of all the own and renewable energy resources wherever feasible. Here a diesel motor drives a rice huller; nearby are also water resources available.

SMALL SCALE HYDRO POWER BIBLIOGRAPHY		
S.No.	Information available	Address to apply for
1	SMALL HYDRO POWER PLANTS Gate Modul 1/12	GtZ, German Agency for Technical Cooperation
2	SMALL WATER TURBINE Gate Modul 1/13 (with valuable details for manu- facturers)	Project Coordination Office 3-70 Pulchowk P.O. Box 1457 / Kathmandu (office is opposite of the Ministry for Local Development)
3	SMALL MITCHELL (BANKI) TURBINE VITA, 11045 BK	V I T A Volunteers in Technical Assistance 1815 North Lynn Street
4	LOW COST DEVELOPMENT OF SMALL WATER POWER SITES, VITA 1967	Suite 200 Arlington / Virginia 22209 U S A
5	MICRO-HYDRO POWER PROJECTS VITA, Energy Fact Sheet, No. 4	
6	CHINESE HYDROPOWER (2 Papers) UNIDO / ESCAP Conference Extracts Micro-Hydro Power	AID Resources Report Room 509, SA-14 Office of Development Information and Utilization Bureau for Science and Technology U.S. Agency for International Dev. Washington, D.C. 20523 / USA
7	SMALL SCALE WATER POWER by Dermont McGuigan, 1978	Prism Press, Stable Court Chalmington, Dorchester, Dorset, U.K.
8	MICRO HYDRO POWER Reviewing an old Concept, 1979 by Ron Alward et. al.	NCAT, The National Center for Appropriate Technology P.O. Box 3838 Butte, Montana 59701 / USA
9	SMALL DECENTRALIZED HYDROPOWER (SDH) PROGRAMME, A Case Study Micro-Hydropower in Pakistan by Allen R. Inversin	NRECA, National Rural Electric Cooperative Association 1800 Massachusetts Avenue, N.W. Washington, D.C. 20036 / USA
10	DESIGN OF SMALL WATER TURBINES FOR FARMS AND SMALL COMMUNITIES by Mohammad Durali, 1976, TAP Report 76-1	Technology Adaptation Program Massachusetts Institute of Technology Cambridge, Massachusetts 02139 USA
11	Technical Digest, -RCTT Special Issue on Mini-Micro Hydro Power, March/April 1981	R C T T, Manickvelu Mansions P.O. Box 115, /49, Palace Road Bangalore -560 052 / India

SMALL SCALE HYDRO POWER BIBLIOGRAPHY		
S.No.	Information available	Address to apply for
12	MULTI-PURPOSE POWER-UNIT (MPPU) WITH HORIZONTAL WATER TURBINE Volume I / Basic Information, 1982	SAHAYOGI PRESS, Tripureshwar or: UNICEF, P.O. Box 1187 Kathmandu / Nepal
13	PROCEEDINGS OF THE WORKSHOP ON BIOGAS AND OTHER RURAL ENERGY RESOURCES, Series No. 19 / ESCAP	ESCAP, United Nations Building Rajadamnern Avenue Bangkok -2 / Thailand
14	A PELTON MICRO-HYDRO PROTOTYPE DESIGN	A T D U Appropriate Technology Development Unit, P.O. Box 793 L a e Papua New Guinea
15	TECHNICAL NOTES ON THE BAINDOANG MICRO-HYDRO & WATER SUPPLY SCHEME	L a e Papua New Guinea
16	LOCAL EXPERIENCE WITH MICRO-HYDRO TECHNOLOGY, HARNESSING WATER POWER ON A SMALL SCALE, 1981	S K A T, Varnbuelstrasse 14 CH- 9000 St. Gallen Switzerland
17	TRADITIONAL WATER WHEELS AND SMALL WATER TURBINES IN NEPAL Sample Survey	RECAST, Research Center for Applied Science and Technology Tribhuvan University Kathmandu / Nepal
18	REPORT ON STUDY TOUR ON WATER RESOURCES IN CHINA, 1980 SATA / UMN	S A T A, P.O. Box 113 Kathmandu Nepal
19	RENEWABLE ENERGY RESOURCES IN NEPAL, Proceedings of the Workshop-Seminar 1-4 April 1981 SAHAYOGI / RECAST	SAHAYOGI PRESS or: SATA, P.O. Box 113 Kathmandu Nepal
20	PUBLICATIONS ON SMALL SCALE WATER POWER DEVELOPMENT	ITDG, 9 King Street, London WC2E 8HN
21	a) ENERGY FOR RURAL DEVELOPMENT Renewable Energy Resources and Alternative Technology for Developing Countries, 1976	Commission on International Relations (SH 215) NATIONAL ACADEMY OF SCIENCES 2101 Constitutional Avenue, N.W. Washington, D.C. 20418 / USA
	b) SUPPLEMENT ENERGY FOR RURAL DEVELOPMENT, 1981	

SMALL SCALE HYDRO POWER BIBLIOGRAPHY		
S.No.	Information available	Address to apply for
22	CLOUDBURST, 1973 (Vol. I) A Handbook of Rural Skills and Technology	Cloudburst Press Ltd. Box 79 Brakendale, B.C. V0N 2J0 Canada
23	ENERGY PRIMER Solar, Water, Wind and Biofuels	Energy Primer, Portola Institute 558, Santa Cruz Avenue Menlo Park / CA 94536 / USA
24	THE BANKI TURBINE, 1949, Bulletin No. 25 by C.A. Mockmore & F. Merryfield	Oregon State University Engineering Experiment Station Corvallis / ORE 97331 / USA
25	SOCIO-ECONOMIC EVALUATION STUDY OF SMALL TURBINES AND MILL INSTALLATIONS -Summary, Final Report (Vol. I) May 1982 -Case Studies, Final Report (Vol.II) May 1982 by East Consult (P) Ltd. P.O. Box 1192 / Kathmandu	United Missions to Nepal Development and Consulting Services P.O. Box 126 Kathmandu / Nepal

APPROPRIATE TECHNOLOGY IN NEPAL			
S.No.	Address	Activities	Information available
1	DEPT. OF COTTAGE AND VILLAGE INDUSTRIES (DCVI) Tripureswar Kathmandu	Development of small scale devices - semi automatic looms - hand made paper - beekeeping - etc.	Leaflets on different devices - improved water mills - furnaces - etc.
2	COMMUNITY FORESTRY DEVELOPMENT PROJECT HMG / UNDP / FAO Hattisar, Naxal P.O. Box 107 Kathmandu	Aforestation Programmes Improved cooking stoves	Seed collection and sowing time calendar Nepali calendar Seed collection booklet
3	R E C A S T Research Center for Applied Science and Technology Tribhuvan University Kirtipur Multicampus Kathmandu	Research and Development: - solar energy - water power (plata pump, improvement of water mills) - cooking stoves - building materials (lime) - etc.	Booklets: - New Nepali Chulo - Improvement of traditional water mills (in Nepali) - Reports
4	Agricultural Development Bank ADB/N	Banking - loans to individuals - loan/subsidy scheme under "Small Farm Family Programme"	Booklets: - Small Farmers Development Program Folders: - Domestic Energy Components - Improved water mill - Cooking Stoves - Biogas (in English and Nepali)

APPROPRIATE TECHNOLOGY IN NEPAL			
S.No.	Address	Activities	Information available
5	UNITED MISSION TO NEPAL Development and Consultancy services P.O. Box 126 Kathmandu	- Biogas Development - Water Power Development - Solar Energy -	Biogas: Construction and Maintenance
6	WORLD NEIGHBORS Hadigaon P.O. Box 916 Kathmandu	- Cooking stove development and dissemination - Aforestation	Improved cooking stove (Nepali) Ipil-IPil tree plantation (Nepali)
7	RAPTI INTEGRATED RURAL DEVELOPMENT PROJECT Dhobighat, Jawalakhel P.O. Box 2978 Kathmandu	Domestic Energy Components - stoves - water mills - biogas - etc	
8	RESOURCES CONSERVATION AND UTILIZATION PROJECT (RCUP) Dhobighat P.O. Box 861 Kathmandu	Domestic Energy Components - stoves - water mills - biogas - solar driers, water heaters - windmill (prototype)	
9	U.S. PEACE CORPS Lal Durbar P.O. Box 613 Kathmandu	Rural life improvement	different prints

APPROPRIATE TECHNOLOGY IN NEPAL

S.No.	Address	Activities	Information available
10	S A T A Swiss Association for Technical Assistance Jawalakhel P.O. Box 113 Kathmandu	<ul style="list-style-type: none"> -Community Water Supply and Sanitation (Pokhara) -Suspension Bridges (HMG, Suspension Bridge Division) -Water Power Development (BYS, Mechanic) -Solar Water Heaters, Driers (BYS, Sanitary Engineering) -Cooking stove trials (Tinao Khola Watershed Project) 	Manuals on rural water supplies, Manual on Sanitation Drinking Water Installation and Drainage Requirements in Buildings Pipe Work Manual Suspension Bridge, Standardized Programme and Field Manual Water Power: Brochures Seminar/ Report Copies: - Mountain Environment (1976) - Renewable Energy Resources in Nepal (1981) - Study Tour on Water Resources in China (1980) -
11	GERMAN AGENCY FOR TECHNICAL COOPERATION (GtZ, Ltd.) Project Coordination Office 3-70 Pulchowk / Lalitpur P.O. Box 1457 Kathmandu		Information of gate: - moduls (water turbine construction (library))
12	DED, German Volunteer Service Dilli Bazar P.O. Box 442 Kathmandu	Rural life improvements	-gate module collection, files (water turbine, solar energy, etc.) in library

APPROPRIATE TECHNOLOGY IN NEPAL			
S.No.	Address	Activities	Information available
13	SOS CHILDREN VILLAGE Pokhara	Training Solar Water Heaters	
14	SOIL SCIENCE DIVISION Dept. of Agriculture Kumalthar Kathmandu	Biogas Development	
15	SHAKTI PUBLICATIONS P.O. Box 1309 Kathmandu	Collection and dissemination of information	Biogas Newsletter (English) SHAKTI, Journal on Energy (Nepali)
16	SAHAYOGI PRESS Tripureswar Kathmandu	Publisher and Printer	Books and reports on AT: - Mini Technology - Fuel Gas from Cowdung - Beekeeping - Improved water mill, MPPU - Drinking water installations and drainage requirements in buildings in Nepal - Mountain Environment Seminar 76 - Renewable Energy Resources in Nepal, Proceedings of Seminar 81

APPROPRIATE TECHNOLOGY IN NEPAL

S.No.	Address	Activities	Information available
17	UNICEF P.O. Box 1187 Kathmandu	Community Water Supply and Sanitation (CWSS) Programme with Agric. Dev. Bank: Small Farm Family Programme - paper making - beekeeping - domestic energy components: stoves, improved water mills, biogas, - etc.	Manuals on drinking water installation Sanitation - stoves - improved water mills - fuel gas from cowdung -

APPROPRIATE TECHNOLOGY IN NEPAL			
S.No.	Address	Activities	Products available
18	KATHMANDU METAL INDUSTRY 12 / 514 Quadon, Nagal Kathmandu	Manufacturer	<ul style="list-style-type: none"> - Cast iron products, also for improved cooking stoves, - Hotwater jacket for wood fired stoves - machines; grinding mills, circular saw, planer, - water power development; cross flow turbine, improved water mill (MPPU) Plata pump, petrol drum propeller device (prototype), small pelton, Turgo (prototype), overshot, open cross flow - Solar water heater
19	NATIONAL STRUCTURE & ENGINEERING COMPANY Patan Industrial Estate Lalitpur Kathmandu	Manufacturer	<ul style="list-style-type: none"> - Cast iron products, also for improved cooking stoves, - Hotwater jacket for wood fired stoves - machines; grinding mills, planer, wood turning lathe, circular saw, - turbines; cross flow, MPPU, - Suspension Bridges - Electric light bulbs, 12 VDC, 40 W
20	BALAJU YANTRA SHALA Sanitary Engineering Balaju Industrial District P.O. Box 2070 Kathmandu	Manufacturer	<ul style="list-style-type: none"> - Solar Water Heaters - Solar Driers - Natural Gas Installation in Kathmandu Valley

APPROPRIATE TECHNOLOGY IN NEPAL

S.No.	Address	Activities	Products available
21	BALAJU YANTRA SHALA Mechanical Workshops Balaju Industrial District P.O. Box 207 Kathmandu	Manufacturer	- Suspension Bridges - Hydraulic Rams - Water Turbines: Cross Flow and Barker's Turbine - Windmill Prototype -
22	NEPAL YANTRA SHALA Patan Industrial Estate Lalitpur Kathmandu	Manufacturer	- Suspension Bridges - Water Turbines: Cross Flow, Propeller, Overshot Open cross flow -
23	STRUCTO Patan Industrial Estate Lalitpur Kathmandu	Manufacturer	- Suspension Bridges - Penstock (Pipe for Turbines) - Solar Cooker
24	BUTWAL ENGINEERING WORKS Butwal	Manufacturer	- Cross Flow Turbines - Heat Generator (Prototype) - Solar Water Heaters
25	INTERTEC Butwal	Manufacturer	- Cross Flow Turbines
26	THAPA ENGINEERING COMPANY Butwal	Manufacturer	- Cross Flow Turbines

APPROPRIATE TECHNOLOGY IN NEPAL			
S.No.	Address	Activities	Products available
27	TOOLS AND AGRIC. EQUIPMENT FACTORY, Birgunji	Manufacturer	- Pedal Thresher - Showels - Crow bars, - etc.
28	Mr. Mohan Dhoj Basnet Tebahal, Sankata Kathmandu	Manufacturer	- Charcoal stoves made of cement
29	Potters in Thimi, Bhaktapur	Manufacturer	- Improved cooking stoves and pipes (fired clay)
30	NANDA SIDDHI & SONS, Pvt.,Ltd. -The Concrete Masonry Works -Kayo Fibreglass Udyog/ Kathmandu Sales: Makan Tole, Tel: 11 880 Factory: near Tribhuvan University Campus gate, Tel: 12 821	Manufacturer	- A.C. pipes and appliances - Fibreglass products; sanitary apparatus, latrine pans, etc.
31	YETI & CO. Pvt. Ltd. 6/16 New Road P.O. Box 846 (Mr.P.R.Tamrakar) Kathmandu.	Agent	- ARCO, Solar cell powered systems
32	GREYHOUND ELECTRONICS 253 Teku, P.O. Box 1410 Kathmandu	Agent	- Solar powered wireless stations

APPROPRIATE TECHNOLOGY IN NEPAL

S.No.	Address	Activities	Products available
33	BELSONS Pvt. Ltd. Mr. Prem Krishna Shrestha Super Market, New Road Kathmandu / Tel: 13 514	Manufacturer	- Automatic electronic light generator; light from batteries on load sheddings from the mains.
34	BIRA Furniture Patan Industrial Estate Lalitpur Kathmandu	Manufacturer	- Beehives
35	Mr. Promod Kumar Newa 386, Pyukha Tole Kathmandu -8	Manufacturer	- Bee Escapes, Queen Excluder - Corn Sheller, Aluminium Casting
36	GOBAR GAS TATA KRISHI YANTRA VIKAS, Co. Jyatha Tole Kathmandu	Manufacturer	- Biogas plants for cooking, lighting, running of motors, - gas cookers - seed storage bins - foot-operated water pumps - etc.
37	P E C O Pradhan Engineering Company (Pvt.) Ltd. 2/36 Narayangath Cnitwan	Manufacturer	- Grinding mills (vertical axles) - Corn Sheller - Sheller-Rice mill - etc.

APPROPRIATE TECHNOLOGY IN NEPAL			
S.No	Address	Activities	Information/Products available
38			
39			
40			

SMALL SCALE
RENEWABLE ENERGY RESOURCES AND LOGALLY-FEASIBLE TECHNOLOGY
IN NEPAL

by
A. Bachmann and G.R. Shakya

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A good pathfinder!

OTHER INFORMATION AVAILABLE ON APPROPRIATE TECHNOLOGY

MULTI-PURPOSE POWER-UNIT (MPPU) WITH HORIZONTAL WATER TURBINE

Basic Information, A. M. Nakarmi and A. Bachmann

With a few words and with many diagrams and photographs the latest development in the field of micro hydro-power in Nepal is explained. The basic technology is based on century-old experiences; which can provide two to ten and more horse power. The modular design is made in standard sizes and manufactured in porterable loads, so that even remote areas can be reached. The booklet provides valuable information for people interested in the production of alternative and renewable energy resources in rural areas. A real new concept!

FUEL GAS FROM COWDUNG, B. Saubolle and A. Bachmann, 2nd edition, -

An excellent, succinct, clear exposure in simple language of the principles of methane production from animal dung - abundant, clear diagrams with measurements in metric and British systems. This booklet has already gained world-wide distribution and has proved very practical and helpful in several developing countries. It has received much praise!

MINI TECHNOLOGY, B. Saubolle and A. Bachmann, Volume I

Contains 36 low-key projects to make life more livable: solar water heaters, biogas, saw-dust stoves, room heating and cooling, corn sheller, crow trap, fly trap, and much more. Abundantly illustrated. A real jewel!

BEEKEEPING, B. Saubolle and A. Bachmann,

An introduction to modern beekeeping in Nepal. Written expressly for the *Apis indica*, this booklet will render great service all over South-East Asia. Clear, to the point, practical. Treats also of wall and log hives and of the African Top-Bar Hive.
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