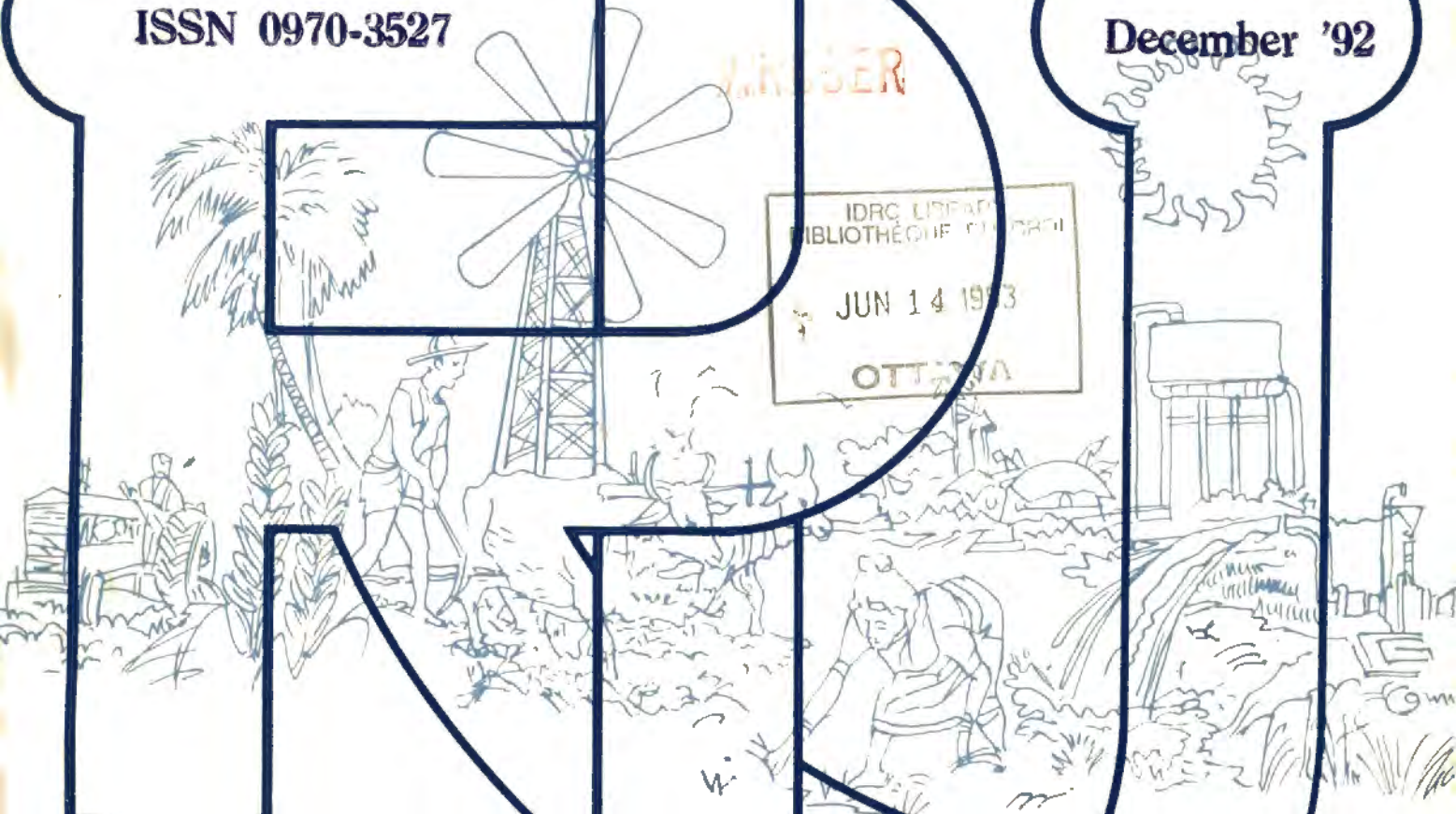
RURAL TECHNOLOGY

ISSN 0970-3527

December '92



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SOLAR ENERGY FOR GARLIC DEHYDRATION

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Peeled garlic cloves were dehydrated in open sun, direct type and indirect type solar dryers. Equations were developed to express the relationship of moisture content versus time and drying rate versus time. About 160 to 280 percent reduction in drying time was observed with direct type solar dryer over other methods, thereby resulting in low operational cost and high out turn. Direct type solar dryer was found suitable for dehydration of garlic considering various quality parameters viz. volumetric shrinkage, rehydration ratio, coefficient of restoration, colour and flavour score.

INTRODUCTION

Garlic (Allium sativa L.) is grown as one of the most important commercial crop for the aromatic characteristics and is extensively used both as spice and medicine. The annual production of garlic in India during the year 1987-88 was 286.70 thousand tonnes, almost 50% more than the production in 1985-86 (5). India being a leading garlic producer has better scope towards its processing and export. Garlic is usually available in plenty during harvesting months April to June, thus leading to heavy losses to the grower due to downfall in prices and resulting in spoilage due to glut in the market, proper preservation and processing of garlic can save about 20% of fresh crop which is wasted due to respiration, transpiration and microbiological spoilage and make it available in the off-season at remunerative prices (3).

Dehydrated products are being increasingly used as they retain culinary quality and palatability and bring about economy in packaging, handling, storing and transporting cost. Sun drying is the oldest, easiest and cheapest method of preservation based on reducing the moisture content of any produce to a very low level.

Garlic has 60-68% (wb) moisture at harvest and it should be reduced to 5% for safe storage. Dehydrated garlic should be free from any preservatives, artificial colouring matter, bleaching substances and flavouring agents (1).

Pruthi et. al. (4) have concluded that during dehydration of garlic. the product temperature should preferably be less than 60°C for better retention of colour, flavour and antibacterial activity.

Dash (2) has conducted experiments on multi-stage dehydration of garlic using a mechanical dryer and found that process involving garlic dehydration at 80°C upto 50% moisture content and then at 60°C up to safe storage moisture level gives good quality product and maximum energy savings.

In this study, solar drying was attempted because of revival of interest in solar energy and considering difficulties in adoption of mechanical drying equipment for dehydration of garlic by the rural enterpreneurs due to large capital requirement for its purchase. Moreover glut season for garlic coincides with the high solar radiation months. Therefore harnessing the natural source of thermal energy i. e. sun for drying of garlic is a wise and timely proposition. Little scientific information on dehydration of garlic is available in literature. Hence, the present investigation was taken up with a view to study the feasibility of solar energy for dehydration of garlic.

MATERIALS AND METHODS

The garlic bulbs were procured from the vegetable market. Udaipur and graded on the basis size. The medium grade bulbs having diameter of about 25 mm were taken for experiments. Open sun drying, direct and indirect type solar dryers were used for dehydration of garlic cloves. The drying experiments under this study were conducted during May, 1991.

A direct type solar dryer having a common collector-cum drying section with myler reflector and transparent glass cover (Fig. 1) and an indirect type solar dryer having separate collector and drying sections with myler reflector and transparent glass cover (Fig. 2) were used for the study.

Experiments were performed on peeled garlic cloves for which the cloves were peeled off by hand. The initial moisture content of peeled garlic cloves was determined by oven dry method by keeping the samples at 70°C for 72 hours (4).

Peeled garlic cloves samples weighing 1000 gm each were spreaded in single layer on trays of dryers for drying in solar dryers and on cement concrete floor for drying in open sun in three replications. Weight of samples at an interval of two hours was taken starting from 8 a. m. to 6 p. m. and moisture loss was determined. The samples were collected daily after 6 p. m. and kept in polythelene bag and then spreaded at 8 a.m. in the next morning. The experiments were terminated when the dehydrated garlic cloves attained the desired moisture i. e. 5% (db). The temperature inside solar dryers, and temperature and relative humidity of ambient air were observed during the period of experiments.

The drying equations were developed expressing the relationship of moisture content versus time and drying rate versus time by fitting a polynomial of 4th order for the observed data using a plot software package with the help of PC-XT computer. Equation (1) presents the general form of the polynomial.

$$Y = A + Bx^1 + Cx^3 + Dx^4 + Ex^5$$

where,

Y = Moisture content (%db) or drying rate (gm of moisture removed/hr/100 gm of dry matter)

X = drying time (minutes)

A, B, C, D, E = Polynomial constants.

Rehydration/reconstitution quality was determined by soaking 8 gm of dehydrated cloves from each sample for 4 hours in distilled water at room temperature, as reported by Ranganna (6).

A domestic mixer was used for making powder of dehydrated cloves, then its colour and flavour was compared with garlic powder obtained by multistage dehydration as suggested by Dash (2). A five member consumer panel was used for this purpose.

RESULTS AND DISCUSSIONS

The moisture loss data obtained from the experiments for open sun drying, direct and indirect type solar dryers were used to calculate the moisture content and drying rate of garlic.

It was observed that a total drying time of 19 days was required for dehydration of garlic cloves (reducing moisture from initial level of 170.5% (db) to desired level i. e. 5%) under open sun, where as 48 sunshine hours (5 days) and 130 sunshine hours (13 days) were required for dehydration under direct and indirect type solar dryers, respectively.

The experiments revealed that about 45 to 280% of drying time could be saved using indirect type and direct type solar dryers over open sun drying, respectively. The difference in total drying time may be attributed to the higher average temperature observed inside direct type dryer (64°C) in comparison with the indirect type solar dryer (48°C) and open sun drying (35.6°C) The range of ambient temperature and relative humidity during the experimental period was observed as 34 to 39°C and 26 to 12% respectively. The corresponding range of temperature inside direct type solar dryer and indirect solar dryer was recorded as 45 to 73°C and 40 to 56°C.

The polynomial constants (A, B, C, D and E) and the statistical parameters (goodness of fit and coefficient of corelation) for the observed data are presented in Table 1. The statistical parameters viz. co-relation coefficient and goodness of fit show that the 4th order polynomial equation fitted to the observed data can be used for accurate prediction of the moisture content and drying rate of garlic at any time.

The shrinkage and reconstitution data for dehydrated cloves are presented in Table 2. It was revealed that dehydrated cloves obtained from direct type solar dryer have the least shrinkage, maximum rehydration ratio and restoration coefficient among cloves obtained from other drying methods. Therefore, cloves from direct type solar dryer could also be served as fresh for salad and other preparations after rehydration.

Table 3 shows the average scores for colour and flavour of garlic powder. Very poor score for colour and flavour of garlic powder obtained from open sun drying renders it unacceptable. However slightly more score was observed for powder obtained from indirect solar dryer over direct solar dryer. The indirect type dryer required about 160% more time over direct type for garlic dehydration. The cost of dehydration per kg of peeled cloves was worked out as Rs. 4.75 and Rs. 14.5, considering the present cost of direct and indirect solar dryer as Rs. 8000 and Rs. 12000 respectively. Therefore direct solar dryer is the right proposition for low cost garlic dehydration with reasonable quality.

CONCLUSIONS

Direct type solar dryer could be used to serve a large capacity dehydration of garlic with reasonable quality (colour, flavour and reconstitution) and low operational cost.

ACKNOWLEDGEMENTS

The authors are thankful to the Indian Council of Agricultural Research for financing the study through AICRP on Post Harvest Technology.

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Table—1 : Polynomial constants and statistical parameter for the observed dehydration data.

S. No.	Type of Solar dryer used	Relation-ship between	Polynomial constants A	B	C	D	E	Coeff. of Core-lation	Good-ness of fit
1.	Direct	Moisture content versus time	170.350	-9.7954	0.15348	-0.000453	0.00001870	0.9998	0.9997
2.	Indirect	—do—	166.888	-5.2365	0.08209	-0.000644	0.00000192	0.9984	0.9969
3.	Direct	Drying rate versus time	15.642	-1.4173	0.06444	-0.001528	0.00001390	0.9997	0.9995
4.	Indirect	—do—	6.155	-0.2436	0.00428	-.00003400	0.00000010	0.9973	0.9946

Table—2 : Shrinkage and reconstitution data for dehydrated garlic.

S. No	Method used for dehydration	Volumetric shrinkage (%)	Rehydra-tion ratio	Coefficient of restoration
1.	Direct type solar dryer	11	2.25	0.89
2.	Indirect type solar dryer	48	1.95	0.75
3.	Open sun drying	58	1.67	0.62

Table 3 : Average flavour and colour scores for garlic powder*.

S. No.	Item of analysis	Garlic powder obtained from Multy-stage dehydra-tion	Direct type dryer	Indirect type solar dryes	Open sun drying
1.	Mean flavour score	10	8.2	8.7	5.2
2.	Mean colour score	10	8.6	8.8	6.1

*Means of scores of 5 judges. Maximum score of 10 was taken for garlic powder made from multi stage dehydration process.

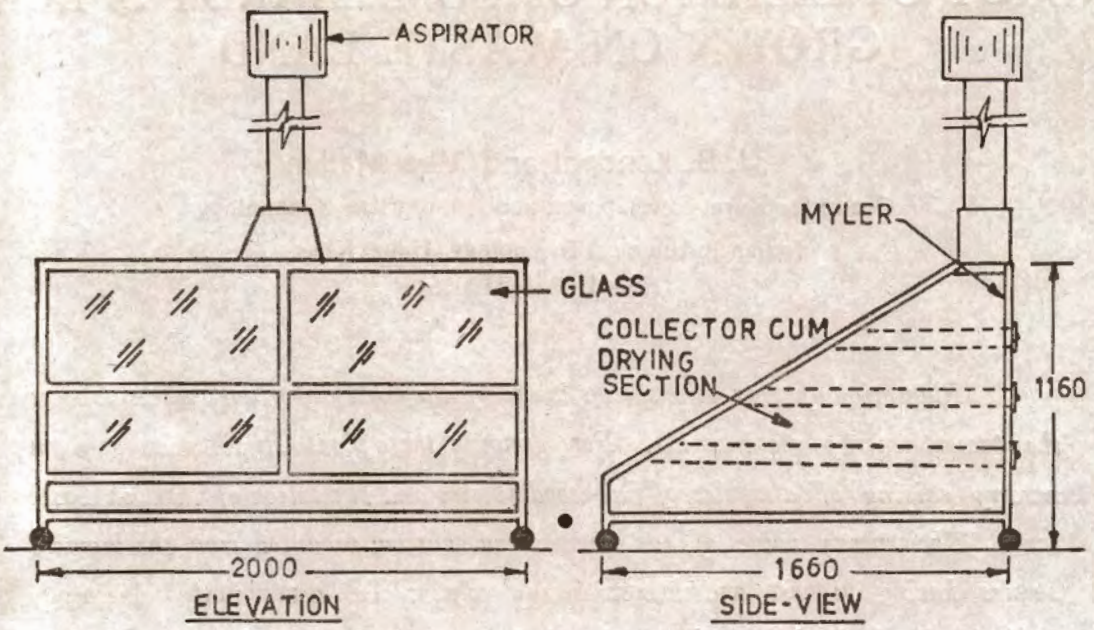

FIG. 1 : DIRECT TYPE SOLAR DRYER

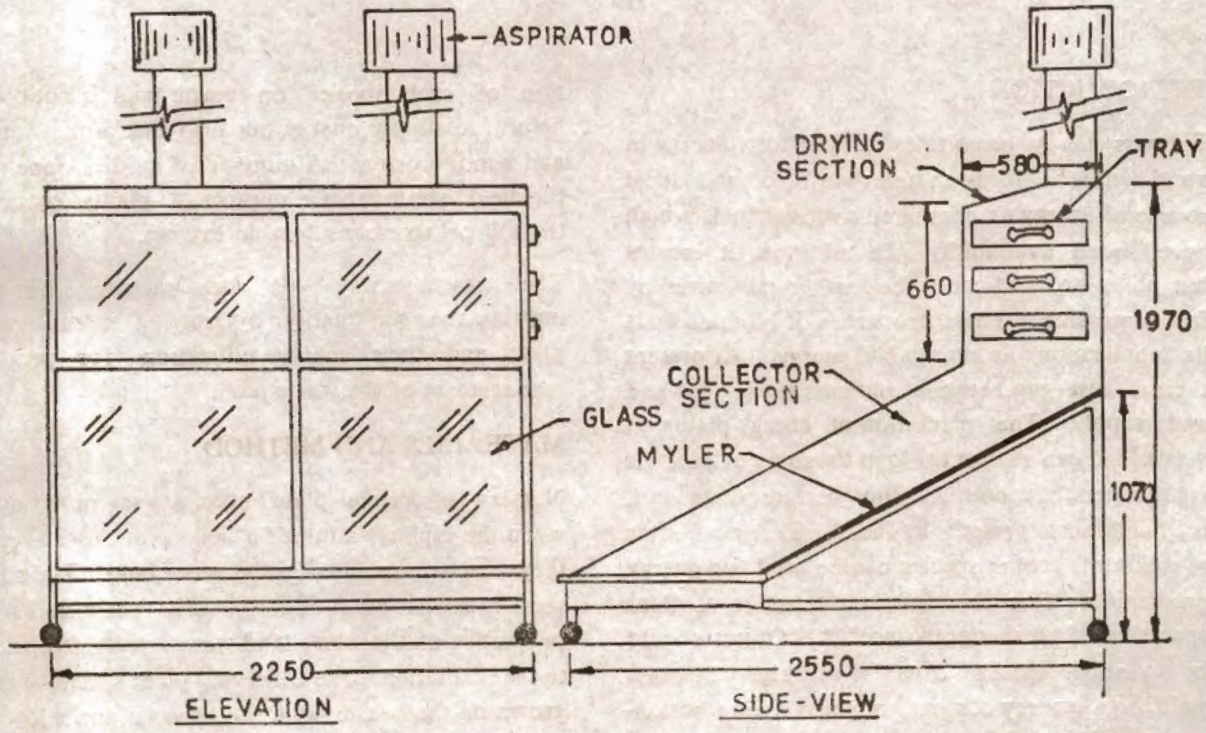

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FIG. 2 : INDIRECT TYPE SOLAR DRYER

ENERGY UTILIZATION OF SOME HARDY SPECIES GROWN ON WASTE LAND

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Plantation of energetic species is one of the most important sources to meet the present energy requirements. For growing these plants studies were done on nursery raising of a number of fuel-wood species and plantation of them on waste land. The energy value of the biomass and charcoal produced from the biomass species having highest and lowest energy content was determined. An energy analysis of both the fuel i.e. fuelwood and charcoal was done which favour strongly charcoal production for better energy utilization and least indoor air pollution during energy use.

INTRODUCTION

Biomass energy constitutes 80% of total energy in rural India[1]. It is an unexhaustible and local source of energy as compared to fossil fuels which have limited availability. In addition, it creates less pollution, and could be further minimized by fuel processing. These properties of biomass finds its application as renewable energy. At present their is vast gap between biomass energy demand and supply. The plantation of energy plants on waste land can reduce this gap to some extent. It is estimated that about 7 million hectare waste land, is available at present in India. This land after selection of proper species can be used for energy production. It is therefore, the selection of plant species is of great significance[2-4]. Object should be to select species capable of high biomass yield, high energy content, nitrogen fixing behaviour, good coppicing and pollariding behaviour, ease of establishment and little after care. Plantation of such species on waste land is not only helpful to supply energy but also checks the water and wind erosion. A number of studies done on this field show that a number of plants reduces the soil pH to a considerable extent[5].

The present study deals with such an effort to improve the soil quality. by growing salt tolerant plant and their energy utilization for proper management of the waste land.

MATERIALS AND METHOD

Nursery of certain plant species was raised and when the saplings attained a height of 20-30 cm, they were transplanted in the waste land. The survival rate was found 50-80%. The water and soil properties of the waste land were determined prior to the plantation. The following plant species were grown on the waste land i. e. Acacia auriculoformis, A. farcaena, A. nilotica, A. semia, A, tortalis, Azardichta indica, casurina equisetifolia, Jatropha

curcus, Leucaena leucocephala, Emblica officinalis, Morus alba and Saujana.

The energy content of the 4-5 year old plant biomass was determined with a bomb calorimeter. The wood sample was powdered and energy content was determined as per (ASTM 1975). The bomb calorimetric value is designated as higher heating value or gross heating value. The following formula was used to calculate the gross heating value.

$$\frac{(2000 + 448 \times \text{sp. heat of water})(t_2 - t_1) - (W_1 - W_2 \times 335) + (15 \times 0.410)}{\text{Wt. of biomass sample}}$$

Where t_1 = Initial temperature of water

t_2 = final temperature of water after combustion of biomass

W_1 = Weight of nichrome wire before combustion

W_2 = Weight of nichrome wire after combustion

335 = heating value nichrome wire, Cal/gm

0.410 = heating value of cotton thread, Cal/cm.

For determination of moisture content the wood sample was kept in an oven at 105±5°C for 2-3 h or till the constant weight is obtained.

The net heating value was calculated by substracting the amount of energy required to remove moisture and water formed from hydrogen in the wood.

The biomass having highest and lowest energy content was converted to the charcoal at a temperature of 400°C. The energy content of charcoal was determined with bomb calorimeter in similar fashion as for biomass. The energy analysis was done taking unit weight of the fuel i. e. biomass.

RESULTS AND DISCUSSION

Table 2 shows the water and soil characteristics of the waste land. The water and soil pH was high 7.3 and 7.9 respectively.

The energy content of biomass is shown in table 3.

The table 3 shows that the energy value of different biomass species ranges from *14700-16876 kJ/kg*. The energy content of *Acacia nilotica* was highest i. e. 16876 kJ/kg while energy content of *Morus alba* and *Azardichta indica* was lowest i. e. 14700 and 15506 kJ/kg respectively.

The results of yield and energy content of charcoal produced from biomass at a temperature of 400°C is shown in table 4.

It was observed that charcoal yield from the four species varied from 38-39% with slight variation in energy content i. e. 23800-24850 kJ/kg. The results indicate that the charcoal yield produced from biomass having higher energy content was more as compared to biomass having lower energy content. Similar fashion was obtained for the energy content of charcoal.

As in most of the third world countries the biomass is used for cooking purposes, an energy analysis of unit mass of biomass was done to see the feasibility of biomass conversion to charcoal. The raw biomass was burnt in a improved mud stove having efficiency 22% while charcoal was burnt in a charcoal Angithi having energy efficiency of 40%. The results of energy and economic analysis are shown in the table 5.

The amount of carbon monoxide, carbon dioxide and suspended particulate matter produced from biomass and charcoal stove were calculated. The results are shown in table 6.

Table 5 shows that use of 1 kg wood in a wood stove extracts 3710 KJ as useful energy. However for the same amount of wood after conversion to charcoal and its utilization in charcoal stove the energy recovery was 3880 KJ. In economic terms utilization of biomass directly in wood stove only recovers Rs. 0.22 while the charcoal route recovers Rs. 0.43 only.

The results shown in table 6 shows the amount of carbon monoxide and suspended particulate matter

are on higher side for wood as compared to charcoal. The above results as shown by a number of other researchers [6-7] shows that charcoal production from waste biomass can extract higher energy and minimizes the air pollutant in the kitchen environment.

CONCLUSION

The energy plantation on waste land for soil reclamation can fulfil the present energy requirement if used in an integrated way. The above study shows the superiority of charcoal over raw biomass due to its less pollutant generation and higher energy efficiency.

Table 1 : Energy consumption in rural India

Source	Consumption
Non-conventional Fuelwood	68.5
Animal dung	8.3
Agro-residue	3-4
Conventional Oil	16.9
Coal	2-3
Others	3-4

Table 2 : Characteristics of waste land water and soil

	Water	Soil
pH	7.3	7.9
Ec	225.0	850.0
SAR	10.1	3.3
ESP	12.0	3.5

Table 3 : Energy content of oven dried biomass samples

Biomass	Heating value, Gross heating value KJ/Kg	KJ/Kg Net heating value KJ/Kg
Acacia auriculoformis	17984	16753
Acacia farceana	17930	16648
Acacia nilotica	17661	16876
Acacia semia	18043	16770
Acacia tortalis	17665	16363
Azardichta indica	16480	15506
Casurina equisetifolia	17493	16405
Jatropha curcus	17611	16246
Leucaena leucocephala	17383	16082
Emblica officinalis	17245	15998
Morus alba	15897	14700
Saujana	17345	16060

Table 4 : Energy content of Charcoal

Charcoal	Yield %	Energy content KJ/Kg
Acacia nilotica	39.0	24,850
Acacia semia	38.80	24,590
Morus alba	38.10	23,800
Azardichta indica	38.50	24,100

Table 5 : Energy and economic analysis of biomass and charcoal

1 Kg wood (168 6 KJ)	—	Wood stove efficiency 22%	—	3710 KJ			
1 Kg wood (16176 KJ)	—	Charcoal yield, 39%	9692 KJ	—	Charcoal stove 40% efficiency	—	3880 KJ
1 Kg wood Rs. 1	—	Wood stove 22%	—	Rs. 0.22			
1 Kg wood Rs. 1	—	Charcoal yield, 39%	— 0.390 KJ Rs. 1.07	—	Charcoal stove 40% efficiency	—	Rs. 0.43

Table 6 : Pollutants generated from wood and charcoal

	Efficiency %	Carbon di-oxide %	Carbon monoxide %	Suspended particulate matter $\mu g/m^3$
Wood stove	22	11 4	0.79	3300
Charcoal stove	40	10.2	0.61	950

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TECHNOLOGY FOR RURAL DEVELOPMENT IN JAISALMER DISTRICT OF WESTERN RAJASTHAN

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The authors has discussed about the various problems of Jaisalmer district of Western Rajasthan like wind errosion, grassland improvement and utilisation and their control, soil water conservation measures. They have also specified the various species, fruit crops and suggested economic plants which are helpful in control of wind errosion, improvement of grassland. Lastly they have discussed about irrigation management and technology transfer programmes in Jaisalmer district of Rajasthan.

Jaisalmer is the largest district in India, having 38,401 sq. km. area and lies on the Indian part of the Thar desert. The physiography of Jaisalmer is hetrogenous e. g. barren rocky area, shifting sand-dunes, sandy plains, alluvial flats, buried streams and hills. The annual maximum temperature is 34°C and the highest potential evapotranspiration is 2069 mm with average rainfall of 180 mm being the lowest recorded in the country. As a result of the hostile agroclimatic conditions agriculture is at a low key, being practised is not more than 5 per cent area (Ahuja, 1977). Pasture based animal husbandry is the mainstay of the economy of the desert peasantry. For integrated development of western Rajasthan it is essential to evolve suitable technology to uplift the peasantry. Governments of India as well as Rajasthan and several institutions are doing excellent job in development of this famine prone part of our country. In this context, the central Arid Zone Research Institute (CAZRI), Jodhpur and its Regional Research Station, Jaisalmer have been engaged for last three decades in development of suitable technology for integrated rural development of this district.

SAND DUNE STABILIZATION

About 4.5 per cent of Jaisalmer is covered with sand dunes : different shape, size and orientation. The phenomena of sand movement and shifting dunes are operative over large part of the district. Wind erosion is the main problem of the district. Techniques of afforestation of shifting dunes were standardised after series of studies conducted for several years (Kaul 1968, Mann and Muthana, 1977, and Harsh *et al*, 1989). The techniques consists of (i) protection against biotic interference, (ii) erection of micro-wind breaks with parallel strips or chess-board design using local shrub material starting

from the crest down to the heel of the dune to protect the seedling from burial or exposure by the blowing of sand, and (iii) afforestations of such treated dunes by planting with nursery raised seedlings in polythelene tubes. The suitable species for erecting brush wood for micro-wing breaks are *Crotalaria burhia*, *Dipterygium glaucum*, *Leptadaenia pyrotechnica* and *Aerva persica*. Direct seeding of grass species or the rooted slips of *Lasiurus sindicus* and *Panicum turgidum* are carried out in lines, 2 to 5 cm apart on the leeward side of the micro-wind break. Direct seeding of treated seeds of creeper like *Citrullus colocynthis* has given very good results, besides economic return from its seeds.

The indigenous and exotic species which have proved very effective are : *Acacia tortilis*, *A. nilotica*, *A. jacguemontii*, *Calligonur polygonoides*, *Ziziphus rotundifolia* and *Tecomella undulata*. After a 14 years gestation period, these systems become profitable.

WIND EROSION CONTROL

The climatic endowments in this district preclude the possibility of sustained crop productivity, mainly due to strong and hot winds coupled with low rains. One of the important techniques of combating the spread of desertic conditions is possible through forestry, including establishment of tree shelterbelts comprising predominantly of trees like *Acacia tortilis* and *Prosopis juliflora*.

The major shelterbelt effect extends to over twenty five times the belt height on leeward side. The major manifestations of shelterbelt effect include reduction in wind velocity and evaporation giving rise to effective conservation of moisture and fertility of soils (Muthana *et al*, 1989).

For transfering this technology farmers training programmes are being organised regularly through DRDA. The seedlings of recommended species are being provided free of cost and subsidy of Rs. 3/- per plant survival over a period two years is given to individual farmers. The crops like pearl millet and cluster bean and fruit crops like *ber* cv. Gola and Seb, pomegranate and daterpalm get full protection against strong wind and dust by planting three to five row shelterbelts on windward side of farms.

GRASSLAND IMPROVEMENT AND UTILIZATION

The Jaisalmer district has sprawling natural grazing lands dominated by *Lasiurus sindicus* (*Sewan*) and *Panicum turgidum* (*Murat*) grass species. They occur in most of the area by and large, and is in degraded condition primarily due to past misuse and present neglect. Carrying capacity of the rangelands of this district can be restored and improved further, if the practices perfected by CAZRI, are applied and adapted on long term basis.

Studies on primary productivity at four Centres, over a period of three decades have provided very useful information on different aspects of grazingland management with major emphasis to enhance primary productivity (Mertia, 1984; 1989 and 1991). With adequate protection and following grazing on carrying capacity basis (aiming at 70 per cent utilization) for a period of two years, forage production could be increased by 148.3, 91.9 and 116.3 per cent in poor, fair and good condition class of grasslands respectively. Productivity level of good condition class could be achieved over a period of 10-12 years in this region having average forage production above 1000 kg/ha/year. Thereafter productivity level of 1.1 to 1.7 tonnes/ha/year could be maintained under normal rainfall years (Table 1).

SOIL AND WATER CONSERVATION MEASURES

Contour furrows on grassland with shallow soils and rolling topography could increase the forage production by 638.7 per cent (from 212.7 to 1566.2 kg/ha) over a period of ten years. Reseeding of grassland with pelleted seeds at the rate of 5-7 kg/ha has given encouring results for increasing the plant population.

SILVI-PASTURE SYSTEMS

Introduction of indigenous and exotic leguminous fodder species is a viable proposition for silvi-pasture landuse system for this region. These fodder species have not only provided nutritionally better quality fodder during lean period, but have proved useful in the nitrogen buildup in the soil and will provide shelter, shade to animals and fuel and minor timber to local inhabitants. The important species mainly include *colophospermum mopane, Digrostaychis nutans, Ziziphus mauritiana. Z. nummularis, Prosopis cineraria, Acacia senegal* and *A. tortilis.*

Utilization of grasslands should be through deffered rotational grazing system which proved superior over continuous controlled grazing. Fortunately most of the livestock breeders have awareness about the merits of this system. Pasture development programmes having a unit of 100 ha have been recommended for adaption in this region.

Recent studies have also indicated that heifers are capable of producing 50-300 per cent more body weight gain during July-December as compared to unsystematic grazing by local animals. Partial conservation of grass hay and feeding it to animals during lean period has led to higher productivity as compared to continuous controlled grazing (Mertia, 1986) and it is being followed up by majority of animal breeders. Animal productivity studies have indicated sound resilience and economic viability of milk production systems on improved grassland (Kalla, *et al*, 1987).

ECONOMIC PLANTS

The indigenous plants of economic importance studied for different parameters mainly includes *Citrullus colocynthis* (*Tumba*), *Salvadora oleoides* (*Piloo*) and *Commiphora wightil* (*Gugal*)

Fruits of *C. colocynthis* are collected and cut into small pieces and given to goats/sheep as a feed. Collection of dry seeds serves as a major sources of income even during severe drought years (Mertia and Gupta, 1991). Seeds are sold in the market for extraction of oil for soap making industries. There is high variability in its germination. However, seed collection, pretreatment and related agronomic practices have been standardised, Based on its economic importance and cultivation potential it has been recognised by Government of Rajasthan as a conventional oil seed crop for this extreme arid district.

Silvicultural practices for the species of minor forest products have also been worked out *salvedora oleoides* is a sources of higher percentage of oil (fat) (40-50 per cent) in seed karnel (Gupta and Saxena, 1988) and the *Commiphora wightii* is a rource of gum for allopathic medicines. Both of these species have slow growth but have very high potential for economic returns in dry region of the part.

FRUIT CROPS

Various fruit plants adapted to this agro-climatic region has bean identified and established. A programme of budding of Gola and Seb varieties of *ber* on the root stock of common local bush viz. *Ziziphus nummularia* has been successful and has generated a interest in the farming community. Standardization of grassbased farming system with fruit plants of Gola and Seb variety has been widely demonstrated.

Promising varieties of datepalm have been screened. Now techniques for establishment of datepalm suckers has also been evolved. Jalore—Seedless an ideal soft seeded pomegranate is an introduction from the Ahore area of Jalore district of western Rajasthan and proved to be superior and promising variety for this district. Now, with the introduction of Indira Gandhi Canal, these horticultural crops have very high potential.

USE OF MULCHES

Higher positive thermal flux in summer and negative in winter are common in sandy soils. Moisture losses during summer are substantial. Pan evaporation values range from 5.4 to 19.1 mm/day. Gravel mulch was found to conserve moisture. Gravel dug out from the planting pits can be used

as much after planting. The combination of bentonite subsurface barrier and gravel mulch has showed 75 per cent higher moisture storage than control (Mertia, 1990).

JALSHAKTI

Jalshakti is a starch based water absorbing polymer developed by National Chemical Laboratory, Pune which can absorb water 100 times of its weight. Jalshakti in range of 50 to 200 g was used in pomegranate variety. Jalore Seedless and moisture regimes of IW/CPE ratio of 0.4, 0.6 and 0.8 were used. Moisture retained in these three regimes was monitored after each irrigation which indicated that frequency of irrigation can easily be reduced with Jalshakti (100 g) and 0.6 IW/CPE ratio. Better establishment of pomegranate plants and high yield of fruits have been observed in treated plants (Das *et al.* 1989).

IRRIGATION MANAGEMENT

The desert soil of this region are excessively sandy having very low moisture storage capacity (36 mm in 60 cm depth of profile). Most of the water percolates into the subsratumdue to very high infiltration rate (15-20 cm/hr). This implies that frequent irrigation is required to establish fruit crops like datepalm, pomegranate, cordia, *ber* and other fruit crops which have higher potential even under such harsh climatic conditions.

Bentonite clay is a natural resource of Jaisalmer district. As subsurface barrier bentonite can be placed at the bottom of planting pits and also laterally with a novel technique developed by Mertia and Singh (1991). The placement of bentonite with this technique has proved very effective in increasing storage of soil moisture in the 60 cm depth of profile as compared to control conditions which helps in better establishment of fruit plants in the initial stages (Table 2).

TANKA

Tanka is a local name given to under ground covered reservoir for storing runoff during monsoon period. Such structures are mainly used as a sources of drinking water in the desert regions. Improved design of such reservoir has been developed and all the rangeland experimental sites have been provided with such improved tankas of capacity of 2000,000 litres for one unit of 100 ha rangeland to fulfil requirement of 72 sheep. 20 heifers and 4-5 persons on year long basis (Vangani *et al*, 1988). The 21,000 litre capacity tanka has been recommended for a single family on year long basis to cater the need of drinking water. Thousand of tankas have been constructed under Water Technology Mission Programme in Barmer, the adjoining district. Such tankas are also under construction through DRDA funds in Jaisalmer district. The catchment area required for 21,000 litre and 100.000 litre capacity tankas are 750 M^2 and 1.5 ha respectively. In sandy catchment, there is need to spread the gravelly sand locally called (*Murram*) to improve the runoff.

Table 1. Average dry forage yield (kg/ha) on rangelands of Jaisalmer region during 1972 to 1981.

Range management areas	Soil type	Grass cover	Average forage yield (kg/ha/yr)
Jaisalmer	Sandy-rocky	Lasiurus sindicus Eleusine compressa	927
Chandan	Sandy	L. sindicus	1754
Khetolai	Gravelly-sandy	L. sindicus E. compressa Cenchrus biflorus	1500
Lawan	Gravelly-sandy	L. sindicus E. comprssa Cenchrus biflorus	1163

Table 2. Effect of bentonite barrier on soil moisture storage and growth of datepalm suckers.

Treatment	*Moisture storage in 60 cm soil profile (m^3/m^3)		Growth in height (cm)	
	27.10 87	2.11 87	4.11.87 to	10.12,88
Control	0.080	0.080	43.00	64.00
Bentonite barrier	0.142	0.145	62.00	96.00

*Observations on moisture storage were taken 3 days following each irrigation.

TRANSFER OF TECHNOLOGY

At present the transfer of technology programme involves :

* Publicity of technology through mass media, journals.
* Conducting regular training programme on specific areas by Division of Out Research Programme of CAZRI.
* Through Operational Research Projects and demonstrations at farmers field.
* Farmers training programmes, Kisan Mela and interactions of scientist with farmers.
* Providing S and T inputs to the office of Desert Development Commissioner and RDA's at district level.
* Interactions at Secretary level for incorporation of S and T inputs in State Plans.

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SCOPE OF DECENTRALISED ENERGY OPTIONS AND ENERGY CONSERVATION IN RURAL SECTOR

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This paper deals about the various options for the rural sector in the perspective of decentralised energy. The author has given the present energy scenario in various sector, future availability of energy and demand have also been elaborated. He has also suggested energy conservation methods in different sectors

INTRODUCTION

Energy is necessary for daily survival. Future development crucially depends on its long-term availability in increasing quantities from sources that are dependable, safe and environmentally sound. At present, the energy to provide services comes from fuels-oil, gas, coal, nuclear, wood and other primary sources (solar, wind or water power) that are all useless until they are converted into the energy services needed by machines. A lot of primary energy is wasted because of the inefficient design or running of the equipment used to convert it into the services required, though there is an encouraging growth in awareness of energy conservation and efficiency.

The energy scene in India today is a complex mixture of variety of energy sources. The use of conventional energy sources is expected to continue increasing steadily in India, There are several constraining factors like quantum of proven reserve, quality of product, logistics of transportation and environmental pollution. It has been realised that for a country like India, use of renewable energy sources would be of increasing importance. India is very well endowed with renewable energy sources such as Solar, Wind, Biomass, Ocean etc Being a tropical country, it receives sunshine of about 1648-2108 kwh/m^2 per year in nearly 250-300 days.

The daily solar energy incidence is between 5 and 7 kwh/m^2 at different parts of the country. The solar energy received by the total land of India is about 19 trillion kwh per day which is about 2.2 million tonnes of coal equivalent or 1.52 million tonnes of oil equivalent. The average annual wind density of 35 kwh/m^2/ day in prevalent at a number of places in Peninsular and central India.

India's energy requirements are considerable and growing and the country's per capita commercial energy consumption is less than a tenth of the world average and within this low average figure, there is a great disparity between the urban and rural areas.

Warming of atmosphere due to the green house effect, depletion of the Ozone layer, large scale deforestation taking place in the developing countries, and destruction of forests due to acid rain in the industrialized areas are well known. Energy is intimately bound with these issues. Today, energy sector, as a whole is one of the major contributors to environmental degradation. The conven-

tional energy sources such as oil, natural gas, coal, all involve releases of warming gases to the atmosphere.

Hence on the one side new scientific and technological inputs are required to reduce the quantum of conventional fuel used while on the other hand, we have to immediately expand utilization of renewable energy resources.

RURAL ELECTRIFICATION

More than 70% villages have already been electrified leaving a balance of 30%, majority of which are predominantly inhabited by tribals, scheduled caste/tribes and are located in inaccessible and difficult terrains where the extension of grid network poses many technical and economical problems. There is a general consensus that the development of rural environment is dependent to a great extent on electrification. The modernisation of agriculture and development of agro based industries are totally depends on energy inputs in general and the adequate supply of electricity in particular.

The Rural Energy options available for meeting the energy needs of a village evolve the energy potential that can be tapped in the village itself. In India, decentralized energy systems will have a distinct role to play for the development of remote area villages. They can help in accelerating the pace of rural electrification in areas where normal centralized electrical network is difficult to extend. The unelectrified remote area villages are characterized by extremely low per capital energy consumption ranging from 28 kwh (Mizoram) to 422 kwh (Punjab). The decentralized energy generation systems based on locally available renewable sources of energy could takeup their legitimate role in building a self-reliant village system.

The advisory Board of Energy in their second set of recommendations in 1984 had observed :

"So far we have concentrated our management and Investment concern only in centralized energy systems. This has now to be complemented by a commitment of equal magnitude and seriousness to the development of decentralized energy systems. The greatest attractiveness of decentralized energy systems lies in the opportunity they provide for involving local communities in the planning, implementation and management of projects".

There are about 10,000 villages which are at considerable distance from the power grids and it will be economical to provide electrical energy to many such places through alternate sources of energy. It may be observed from Table 1 and that out of 2,05,794 villages remaining unelectrified as on 31.3.85, the number of villages below 500 population group are 73.95% and 500-999 population group 16.43%. These left-over small population villages are mostly located in hilly, backward, desert, tribal and forest areas of the relatively backward states. The statewise number of villages in population group (i) below 500 and (ii) 500-999 are shown in Table 2 while Table 3 presents statewise no. of unelectrified villages There are few villages with population more than 10,000 which are unelectrified.

POWER AVAILABILITY SCENARIO

The total installed generating capacity in the country is about 50258 MW-32776 MW thermal, 16212 MW Hydel and 1270 MW nuclear. During the Eighth Plan, the country is likely to add 38000MW out of which 22.000 MW will come from new Projects for which Rs. 1100 crores have now been allocated in advance by Planning Commission for Planning, Design, Acquisition of land and ordering machinery and Equipment, and 16000 MW from the on going Project. On conservative estimates of economic growth between now and 2000 AD the Advisory Board of Energy has estimated that about 1,64000 MW generation capacity would be required. The present installed generating capacity call an erection of about 10,000 MW per year. Keeping in view the past performance, the resource constraints and record of slippages since 1950, while, it is expected that the new technologies would help in creating the capabilities to implement such a massive programme, it would be

prudent to follow a National Policy which encourages the development of new and renewable energy sources.

An ideal development programme would be to develop the hydro Power potential to the maximum. The total potential is estimated at more than 89530 MW. The installed capa ity at the end of 7th Plan has been estimated as 20,000 MW Hydro, 42900 MW thermal and 1800 MW of Nuclear aggregating to 64700 MW. A Hydel capacity of 47,800 MW, by 2000 AD is achievable as per present indications. While emphasizing on a good Hydro-Thermal mix, India should plan for the new and emerging options like Solar thermal, Solar Photovoltaic, Biomass, Wind electric generator, besides tapping 100% of small hydel potential in the country. A rough power scenario upto 2000 AD is given in Table 4. The non-conventional generation systems would come to the aid of the country in an increasing manner with a possible 15000 MW capacity.

ELECTRICITY GENERATION FROM RENEWABLE ENERGY SYSTEMS

Wind turbine generators, mini and micro hydel, gasifier based dual fuel systems, biogas, photovoltaic systems urban wastes power plant and solar thermal power plants are being installed in various parts of India for decentralised generation of electricity. Several studies already carried out show that power generation from renewable energy technologies is economical in several locations.

WIND TURBINE GENERATOR

In India significant potential exists for electricity generation from wind in certain windy areas of the country. According to Gupta (1987) during the period March and August, the winds are uniformly strong over the whole of Indian peninsula except the eastern peninsular coast. The months of May, June and July account for nearly half of the annual energy availability Wind speed during November to March are relatively weaker though higher wind speeds are available during this period in Tamil Nadu Coastline. The number of hours in year when rated wind speeds for most of the wind turbine generators would be available at a given place would preferably be between 1000–2000 hours, though not equally distributed throughout the year. Wind sites having an annual mean wind speeds of 22 km/hr exist on coastal areas in Gujrat (Kandla/Mandvi) and in the range of 17-20 km/hr in the Saurastra (Veraval, Okha, Dwarka, Rajkot, Bhavnagar) Orissa (Puri) Tamil Nadu (Tuticorin) and Maharastra (Deogarh) coastlines. According to a rough estimate, there exists a potential of atleast 20,000 MW in the country for wind generated electricity.

The generation of electricity from wind farm is found to be economical mainly in suitable wind regions (e. g. Okha, Mandvi, Tuticorin) when compared with coal thermal power plant and diesel generator system. The cost of generation is estimated taking units of 55 KW size. For higher unit sizes and higher installed capacity wind farms (2-10 MW) the economics will be more favourable. Thus, the investment in wind farms is already justifiable from the view point of society in the areas where wind regime is favourable.

SOLAR THERMAL POWER PLANT

The cost of electricity generation of solar thermal power plant (30 MW) was higher in 1986 than the cost of generation from coal-based thermal power plant. However, if costs are compared over 20 years for both the solar and thermal power plants, the average cost of power from the solar plant is competitive, even at today's capital costs, with the average cost of power from the thermal plant. Moreover, the solar plant can be set up within 2 years as against 5 to 6 years for thermal plant. The economic value of production in the time difference (3 to 4 years) is more than the higher initial cost of the solar plant. Moreover, if it is anticipated that the power shortages would continue till 1992 and beyond (upto 1996), then the correct comperison will be with the cost of captive diesel generation. According to information available from the studies carried out by TERI on

captive diesel generation in some industrial units in north India, the cost is above Rs. 2 per kwh at present rates of utilization. On the basis of this, it is clear that the investment in a solar thermal power plant of 30 MW is economical from the viewpoint of society.

MINI AND MICRO HYDEL

The cost of electricity generation in mini and micro hydel (capacity 300 KW) is found to be cheaper than conventional thermal power generation if the plant load factor is 50 percent or more and the capital cost is in the range of Rs. 15000/kw to 25000/kw. In fact these mini and micro hydel plants are even more economical when compared with diesel generation.

PHOTOVOLTAIC STREET LIGHTING :

Photovoltaic (PV) street lighting, and other power needs of 1 KW to 3 KW when compared with grid extension is found to be economical from the view point of society for low loads for distances around 4 km to 12 km from the substation-even at the current high capital costs of PV arrays. For villages 10 kms away with a load of 10 km (including street lighting, agricultural and industrial use) solar photovoltaic is relatively costlier than grid extension. However, even for this load if the village is 40 Km or more from the grid, photovoltaic systems are more economical. Further more the grid, photovoltaic systems are more economical. Further more the economics of PV system will improve further with expansion in volume of production and improvements in the technology of cell manufacture including amorphous silicon development. Since solar PV offers a technology where remote areas as well as regions with power shortages can receive benefits of electricity, and of several social services like health and literacy, in a very short time, investment in PV system installations in hill areas, desert regions and other inaccessible parts, as well as unelectrified villages in the plains which are more than about 8 km from the grid, would be economically justified.

WATER PUMPING :

In water pumping, several renewable energy systems alongwith the conventional energy sources are compared . The wind mill is economical at its own level of output when compared with diesel and electric pumpsets. However, it should be noted that the application of the windmill for water pumping is site-specific and should be installed in small plots matching the water requirements of crops with the output of the windmill, preferably high-value commercial crops. Another important aspect is the reliability of the technology in the sense that the windmill chosen for the particular application should withstand the varying wind speeds. Such windmills are now available for large areas of country.

Using biogas in dual-fuel engine for water pumping is found to be economical from the viewpoint of society while compared with diesel and electric pumps where irrigation intensities are high and there are power shortages. Further, it should be emphasised that the biogas dual-fuel engine is economically viable even when the proportion of diesel used is substantially increased during the winter months when biogas generation is relatively less. When solar thermal device is used for water pumping, it was found to be not economically viable at present as compared to electric and diesel pumps.

SOLAR WATER HEATING SYSTEM :

Solar water heating system when compared with heating energy sources like electricity, furnace oil, coal and wood is found to be financially viable for the individual when 50% subsidy is available and when the Solar water heating systems utilization rate is 300 days per year. However, it is more economical from the view point of society since electricity and furnace oil are saved as a consequence of installation of Solar Water heating systems. Hence a subsidy on solar water heating systems is justified economically since it saves capital costs as well as running costs for fuel that would otherwise have to be incurred in the case of conventional systems.

FAMILY BIOGAS UNITS :

Family size biogas plant is found to be a highly economically viable investment even for a private household if the saving of the cost of alternative fuels like firewood/agricultural wastes and kerosene are considered and the benefit of nitrogen-rich slurry machine is monetised. However, since fuelwood is mostly procured as a zero private cost, saving in fuelwood does not result in monetary savings even for the farmers who have cattle and financial resouces to install bio as plants.

On the other hand, since the public aim is to save fuelwood and aviod de orestation by providing alternative fuels for cooking, the value of biogas to the society should be taken in terms of the shadow price of wood, kerosene or softcoke. Under this situation investment in a biogas plant becomes highly economical from the viewpoint of society. It must be added that the economics of the family size biogas plants (although there is no direct cash flow) should be considered for other indirect benefits such as improved health of women, general sanitation of the surrounding homestead, increasing the life of utensils and time saved in cooking, etc. Thus public investment in family size biogas plants (i. e. subsidies) may be supported in all regions where fuelwood has high opportunity costs and rural energy needs partly responsible for deforestation. In effect, this means that this conclusion is applicable to all part of Indla.

It must be emphasized that the above studies clearly bring out the fact that many of the renewable energy systems are already economical from the viewpoint of society. However, these systems may not be financially viable from the individual's viewpoint of consumer/farmer entrepreneure because of subsidized prices of conventional electricity, diesel, oil and kerosene. Further more in the case of renewable energy systems, the consumer/farmer/entreprenure may have to incur the capital cost of installing the energy producing systems, whereas in conventional systems the public undertakes this capital investment. This dichotomy between social profitability and private financial viability has been one of the main reasons for slower diffusion of renewable energy technologies than they merit. The financial profitability of RES will be quite favourable if the real resource costs of supplying electricity and diesel/kerosene to rural areas the charged from the consumers. However, if, for socio-political reasons, subsidies on conventional fuels and electricity cannot be removed, there is an urgent need to give an equivalent subsidy or investment support to renewable energy systems even where they are installed in individual premises. Thus, these capital subsidies on renewable energy systems should be considered as investments in energy supply (apart from their environmental and social advantages) and adequate and greatly increased fund allocations should be made for such capital subsidies/investments so that more and more systems can be installed.

ENERGY CONSERVATION IN RURAL SECTOR

The total energy used in rural India (Table—5) the share of human and animal power is 23%, non-commercial sources 66% and commercial sources is 11%. The scope of meeting the rural energy demand through commercial sources is limited by their low availability and also the low purchasing power of the rural masses. About 50% of the country's villages are not connected by motorable roads and vast stretches of rural farms can only be reached by bullock carts. About 80% villages are now electrified but electricity is hardly available for more than 3 to 4 hours and that too at low voltage. Maximum energy in villages is used for domestic sector (64%) mainly from non-commercial sources of energy. Kerosene and electricity is used for lighting purpose.

As a result of concentrated efforts by the Central and States Governments, scientists, planners, administrators and above all millions of farmers, India has made remarkable progress in agriculture, transport and communication. To strengthen the economy further, a multi dimension approach to

conserve energy must be followed. A few of which may be :

1. Energy conservation in land preparation by adopting improved and efficient farm equipment.

2. Energy conservation on the farm in use of diesel engines, tractors and electric pump sets

3. Energy conservation in processing of farm produce by adopting improved method and machineries.

4. Proper utilization of farm bye products, farm wastes such as crop residues, animal wastes (dung, urine and human excreta) and social forestry for energy generation.

5. Use of non-conventional sources of energy such as Solar, Wind, Biomass, Geothermal and waves energy on farm to supplement the existing sources of energy.

ENERGY CONSERVATION IN RURAL TRANSPORT

Rural transport plays an important role in the villages. It includes animals like horse donkey, mules, camels, elephants, animal drawn bullock-carts, bi-cycles, power driven motor cycles, tractors, petrol and diesel motor vehicles. The roads are usually rough whether earthen or metalled. There are about 15 million bullock cart for improved draftability and less hazards to draft animals is required to develop. The improvements include better wheel and wheel-bearings to carry more load with comfort. A correct harnessing device at optimal lower height and provision of a braking device is necessary to avoid cruelity to the animals. India manufactures small two wheel tractors (power tillers) for rural transport and field use. There are about 50,000 power tillers in use in India in the power range of 4 to 8 kw. These have not been popular among the farmers for a variety of reasons. These may be made energy efficient if suitable modifications are made in the tillers. Bio-gas and producer gas can be used to replace and supplement the fuel in rural transport vehicles. Several such engine designs are available in the country.

In case of commercial vehicles, the fuel consumption is influenced by—

(a) Energy requirement for various operating conditions like to overcome rolling resistance, wind resistance, scope resistance and initial resistance.

(b) Energy losses at various stages. Keeping other factors constant, the energy requirement in rural roads directly depends on overcoming rolling resistance which is about 10 times more on mud roads in comparison to roads. The energy losses due to idling, frequent braking is considerably higher than better roads. A significant amount of energy upto 60%) can be saved if better road conditions are provided.

(2) RURAL TRADING

The rural industries are agricultural products based. It includes transport of farm produce like, food grains, dairy products, fruits and vegetables. Besides with better technological awareness, agro-processing based industries rice-milling, oil-milling are also being set up. Energy conservation in these areas can be initiated with the improved rural transport, use of non-conventional sources of energy like solar water heaters, Solar dryer, biomass based furnaces etc.

(3) RURAL COMMUNICATION

It includes improved facilities for post and telecommunication, radio and television facilities and provision of social awareness and education. Rural transport and electricity has played a major role in developing rural communication system.

Solar Photovoltaic technology which allows direct conversion of sunlight in electricity is emerging as one of the best options for meeting decentralized

electric power needs quickly in remote and isolated areas. Such power can be used for a variety of applications including street lighting, lighting of community centres, primary health centres. Adult education centres, drinking water supply, television, radio, night schools, radio signalling wireless rural telephone exchanges, low power T. V. transmission tower etc. The installation capacity of such systems may range from 1.5 kw to 25 kw. At present the price and energy conversion efficiency of silicon solar cells is a main problem to make this project viable. However, the efforts are being made to increase the efficiency and reduce the cost of the systems. CEL, BHEL, RELL, MEL mettur and private sector companies have started manufacturing such systems and their components in the country.

Telecommunication systems require a contineous power supply in a reliable manner. Since hill tops and mountain peaks are preferred sites for telecommunications, Solar photovoltaics offer the best option for reliable energy and low maintenance. Many types of tele-communication systems powered by solar photovoltaics are the following.

1. Two way radios including radio-telephone.
2. Radio and T. V. secondary transmitter.
3. Telephone systems including exchange, repeator stations and satellite ground stations.

Solar photovoltaic systems are equipped with batteries for operation in night or during low sunshine periods. The batteries for use in a PV system are specially selected for their long cycle life, low self discharge, high charge efficiency and low maintenance. The number and the capacity of the battery bank to meet specific needs is dependent upon system voltage and ampere hour capacity requirements. Several such systems are successfully working in the country.

ENERGY CONSERVATION IN COOKING

In India the domestic sector accounts for nearly half of the energy demand and in the rural areas 90% of the energy consumed is spent on cooking. At the household level fuels are used to serve the basic needs i. e. physical, social and psychological needs. Energy consuming items at household level include cooking, heating of water, refrigeration, air conditioning, lighting, ironing etc.

Since cookin consumes a major share of energy, the women in India can play a significant role in conserving energy. It has been rightly emphasized that energy saved is energy produce. Given below are a few useful tips for the house wives to make the most effective use of the scarce resource of energy irrespective of the type of fuel being used at home.

Plan you cooking, collect all the ingredients and utensils required for cooking. This will avoid unnecessary movements and also reduce the fuel consumption. Often it is observed that after lighting the stove, the housewife runs around to collect the ingredients or other items required for the cooking. Another way to save energy is to chop and cut the vegetables before lighting the stove so that the cooking can be carried on without any break.

Reduce the heat when water or the cooking medium starts boiling. Once the liquid comes to the boiling point it requires a very small amount of heat to maintain its boiling temperature. Studies reveal that about 35% fuel can be saved by just this simple action. Similarly when using the pressure cooker reduce the flame immediately after the first whistle. Very little heat is required to maintain this pressure. Open the lid of the pressure cooker after all the steam comes off by itself. Keeping the cooker on stove longer and then cooling it under water wastes fuel. Many a housewives count the number of whistles for cooking different foods. This involves lot of wastage of the precious fuel as with each whistle extra pressure obtained is released. It is advisable to note the time after the first whistle and reduce the flame just to maintain this pressure instead of developing extra pressure with extra fuel for getting the whistle. For the most efficient use of pressure cooker,

cook more than one food at a time. For example you can cook rice, dal and potatoes simultaneously in different containers of the cooker. The seasoning can be added either before or after cooking depending on the type of food.

Cook the food just enough, over-cooking of food especially vegetables and dals makes them mushy valuable vitamins are lost besides the wastage of fuel. The cooking time of whole pulses and dry grains can be significantly reduced by soaking these overnight prior to cooking. Sprouting of pulses increases their nutritive value by the natural synthesis of vitamin C and B complex vitamins and also improves the absorption and availability of minerals especially iron which is essential for the formation of haemoglobin in blood. The fuel consumption of pulses can be reduced to less than half with this simple process. Cook pulses and vegetables in tightly covered containers. This reduces cooking time, retains flavour and keeps the temperature in the pan even.

Use combinations of food to make one dish instead of cooking each food separately. For example you can make nutritious prathas or chapaties by combining wheat flour, gram flour and chopped green leafy vegetables and making a dough. To this dough you can add a small amount of groundnut paste or curds and add the desired amounts of salt, chopped green, chillies and make the dough with sufficient amounts of waters. The prathas or chapaties made from this dough are very nutritious, tasty and keep fresh for a longer time. They are ideally suited for packed lunches for school children and office goers and a most nourishing breakfast to begin the day. By combining all these ingredients the housewife will save lot of fuel and time and her morning cooking session cooking will end with a smile.

For efficient fuel utilization proper choice of cooking vessels is very important. Use flat bottomed cooking vessels with a wider base on hot plates, gas and kerosene stoves. Small vessels with a round bottom waste fuel as they allow the flame to creep up the sides of the vessel. For efficient fuel utilization the flame should not extend beyond the bottom of the pan. The traditional Indian frying pan (kadhai) is not all suitable for electric hot plates and open coil heaters.

Only for open type of chulhas with fire wood and other such fuels a round bottom cooking vessel is good as the bottom of the vessel in this case goes deepes into the chulha. Narrow tall cooking vessels waste more fuel. Heavy based vessels are desirable for cooking. They retain heat better and keep the food hot for a longer time. Avoid the use of pan-supporting rings as the support reduces heat transfer to the vessel and hence consumes more fuel. Keep your vessels clean. Aluminium kettles with salt deposits waste lot of fuel. A one mm. thick layer can increase energy consumption by 10%.

For utensils which conduct heat slowly such as stainless steel, caste iron, enamel, glass and glass ceramic, cook foods with a liquid. The liquid helps to conduct heat and keep the temperature of the pan even.

Use small burners for smaller vessels. Small burners use less gas than large burners. The cooking on smaller burners may take a longer out the total consumption of fuel is much less. Keep the burners clean. Trim the wicks of the kerosene stove regularly. Clogged gas burners and charred wicks increase fuel consumption considerably. The yellow flame with also blackens the cooking vessels and the kitchen involving more wastage of human energy for their cleaning. A clean stove gives a blue flame which has the maximum heat.

Use minimum quantity of water required for cooking. Surplus water consumes extra fuel and also the cooking water when discarded leaches away precious nutrients. When cooking rice is boiled in double the required amount of water it increases the fuel consumption by 65%.

The use of Solar cooker can save a lot of fuel. In fact in households which has a terrace or back-yard or front open where they get sum for 4-6 hours at a stretch can use solar cooker for preparing all vegetables, pulses rice, meat and baked products. Studies conducted on the acceptance of dishes prepared in the solar cooker reveal that all preparation are highly acceptable.

For saving electricity consumption at home use tube lights in place of bulbs. Tube lights give more light than bulbs at half the cost and last much longer. The tube lights and bulbs should be kept dust free for brighter illumination. The lights and appliances must be put off when not required. Make the best use of day light for all the activities Encourage school going young children complete their home work and studies during day time. Open the door of the refrigerator for minimum of time. A little bit of planning and organising will reduce the need for opening the refrigerator too frequently. Cool the cooked foods to room temperature before keeping them in the refrigerator. Thawing of frozen foods in the refrigerator before cooking will save fuel and time.

Here is a challange for all of you, expecially the housewives. Do experiment with the above given tips and find out for yourself how much energy you can save at your end. You will feel proud to realise that the housewives can make a significant contribution in helping the nation meet the energy crisis.

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TABLE 1—Growth of rural electrification.

Population group	Total villages	% age of total	Electrified up to 3/85	% age electrified	Bal. as on 3/85	Bal as % age of total unelectrified
Below-500	3,18,868	55.35	1,66,677	52.27	152191	73.95
500-999	1,32,993	23.08	99,189	74.58	33804	16.43
1000-1999	81,930	14.22	67,587	82.49	14343	6.97
2000-4999	36,003	6.25	31,168	86.57	4835	2.35
5000-9999	4,974	0.86	4,400	88.46	574	0.28
10000 & above	1,358	0.24	1,311	96.54	47	0.02
	5,76,126	100.00	3,70,332	64.28	205794	100.00

TABLE 2—No. of electrified villages and the balance left over upto the year 1985.

S. No.	States	Below 500			500-999		
		Total	Electri-fied (3/85)	Balance	Total	Electri-fied (3/85)	Balance
1.	A. P.	9735	5841	3894	5438	5171	267
2.	Assam	12272	5976	6296	5950	3585	2365
3.	Bihar	37923	14682	23241	15232	8623	6609
4.	Gujarat	6405	4849	1556	5242	4928	314
5.	Haryana	2018	2018	....	1909	1909	....
6.	H. P.	15743	13517	2226	861	811	50
7.	J & K	3948	3353	595	1556	1451	105
8.	Karnataka	12913	10271	2642	7082	6774	303
9.	Kerala	4	4	....	2	2	....
10.	M. P.	47030	22060	24970	16516	11359	5157
11.	Maharashtra	14141	12171	1970	10529	10105	424
12.	Meghalaya	4285	1021	3264	237	190	47
13.	Manipur	1453	245	1208	237	133	104
14.	Nagaland	659	407	252	169	157	12
15.	Orissa	33771	13005	20766	8821	6873	1948
16.	Punjab	5198	5136	62	3577	3577	....
17.	Rajasthan	19781	10153	9628	7817	5290	2527
18.	Sikkim	263	91	172	117	73	44
19.	Tamil Nadu	2969	2936	33	3425	3424	1
20.	Tripura	3964	1156	2808	473	426	47
21.	U. P.	62212	30501	31711	28295	18582	9713
22.	W. Bengal	18562	5988	12573	9085	5376	3709
Total States		315248	165381	149867	132570	98819	33751
Total U. Ts.		3620	1296	2324	423	370	53
Total India		318868	166677	152191	132993	99189	33804

TABLE 3—No. of Unelectrified Villages on 31-3-85.

S. No.	State	Total	500	500–999	1000–1999	2000–4999	5000–9999	10000
1.	Assam	10189	6296	2365	1055	457	15	1
2.	Bihar	34169	23241	6609	2960	1153	195	11
3.	M. P.	30408	24870	5157	265	16	....	....
4.	Orissa	23230	20766	1948	456	60	....	....
5.	Rajasthan	13529	9628	2527	927	389	58	....
6.	U. P.	49486	31711	9713	6024	1809	205	24
7.	W. Bengal	18873	12573	3709	1822	676	83	10
	Total	179884	129185	32028	13509	4560	556	46

TABLE 4—Power Scenario 2000 A D

	Power from Sources	Installed capacity in M W		
		As on 31.3.87	As on 1.4.90	As on 1.4.2000
A.	Conventional Sources			
	Hydro	16212	20000	47800
	Thermal (Coal)	32776	42900	75700
	Nuclear	1270	1800	10000
		50258	64700	133500
B.	Renewable Sources			
	1. Power from Biomass		20	6000
	2. Power from Wind		20	5000
	3. Power from Solar (Thermal and Photovoltaic)		60	2000
	4. Power from small Hydro		20	2000
			120	15000

TABLE 5—Energy use in India for various activities

Activity	Energy use	Energy Source		Share of Total Energy %
		Commercial %	Non-Commercial %	
Domestic	7.31	2.0	98.0	64.0
Agriculture	2.52	23.0	77.0	22.0
Industry	0.76	....	100	7.0
Lighting	0.48	100.0	....	4.4
Transport	0.35	....	100	3.0

Information on Rural Technology Products/Processes

KEEPING CENTRIFUGAL PUMP TROUBLE FREE & ENERGY SAVING TIPS

1.0. INTRODUCTION

In the past few years, there has been significant achievement in the development of ground water resource involving increase in the number of irrigation pumping sets. The increase in pumping sets has like-wise been affected throughout the country. However, comparable facilities for proper repair and maintenance have so far been lacking. It may not be possible for the users to take up major repairs by themselves but usual maintenance, proper handling and minor repairs can be performed by them knowing schedule of maintenance, possible trouble and their remedies. A properly maintained pumping set gives trouble free operation and low operating cost.

The pumping sets commonly used are centrifugal pumps driven by diesel engine or electric motor. A break down of the pump during the irrigation season could mean a great reduction in yield and farm income. Therefore, it is necessary to ensure proper care and maintenance of centrifugal pumps for their efficient and prolonged service.

2 0. ABOUT THE CENTRIFUGAL PUMPS

A centrifugal pump is a rotary machine consisting of two basic parts, the rotary element or impeller and the stationary element or casting (Fig. 1). The impeller is a wheel or disc mounted on a shaft and provided with a number of vanes or blades usually curved. The vanes are arranged in a circular array around an inlet opening at the centre. The impeller is secured on a shaft mounted on suitable bearing. The shaft usually has a stuffing box or seal where it passes through the casing wall. Stuffing box packings are generally made of basic materials such as asbestos or organic fibre.

3.0. CARE PRIOR TO STARTING PUMP

Prior to starting the pump for the first time special attention should be paid to the following points :

1. Check the alignment of the pump. (See fig. 2). The pump and prime mover (driver) must be carefully aligned. The correct method of aligning couplings is shown in fig. 2. Parallel alignment can be checked by placing a straight edge across the coupling halves. They must raise evenly on both halves at four positions placed at approximately 90° intervals around the coupling. Angular alignment can be checked with a feeler gauge placed between the coupling halves at 4 points around the coupling.

2. Make sure that the engine/motor will drive the pump in the direction indicated on the pump body (Follow Fig. 3).

3. Make sure that the gland is lightly and evenly adjusted and the pump shaft revolves freely when turned by hand. (Follow Fig. 4).

4. Fill the suction line and pump with water and removes the air from casting (Fig. 5).

5. Check the air tightness of the suction pipe and any leakage in the foot valve. (Fig. 6).

After fitting the airtight flanges and foot valve in the suction line as shown in Fig. 6, fill the pump body and its suction pipe completely with water and leave the system for few minutes. If there is any air leakage in flanges and foot valve joints the filled water will flow in drops. Dismantle all the joints, clean the surfaces, place the rubber packing in between flanges joint, coat the white lead over threaded portion and then tighten all the joints carefully. For foot valve check seat and packing and repair it. Insert the foot valve properly in

the suction line and tighten the pipe and make a coat of white lead over the joint.

6. Lubricate parts wherever necessary.

4.0. PUMP OPERATION

On account of its simple construction, the centrifugal Pump requires practically no attention while running. Proper lubrication of the bearing and adjustment of the glands are usually the only things which need attention from the operator. The centrifugal pump must be stopped promptly if no liquid is being pumped.

5.0. PUMP MAINTENANCE

Operating conditions of pumps vary widely and so do the maintenance requirements. There are some tips, that should be kept in mind for the successful operation and maintenance of a centrifugal pump. The following maintenance schedules apply to most pumps under average operating conditions ;

5.1. GENERAL

(i) The pump and engine/motor flanges should be in alignment.

(ii) The entire suction and discharge line should be self-supporting. No weight from the piping should be put on the pumps otherwise the casting is likely to be cracked or damaged.

(iii) Use a suitable foot valve at the entrance of the suction pipe when it is planned to pump from an open pit.

(iv) Gland packing should be replaced periodically Never put a new packing on the old one.

(v) Never tighten a gland more than necessary. After the required number of rings have been inserted, they should first be tightened until there is no leakage. (Fig--4).

(vi) Replace the worn out rubber flap of the foot valve.

(vii) Never run pump dry. If pump runs dry, the rotating parts will wear out quickly. In case the prime mover is to be started, it should be disconnected from the pump,

(viii) Coat all the piping joints with white lead.

(ix) Lubricate the bearings with grease of proper grade. Clean the nipple and the connector before lubrication. It should be done while the pump is running.

5.2. EVERY MONTH

Check bearing temperature. Bearings may run hot due to lack of lubrication or excess lubricants.

5.3. EVERY THREE MONTHS

Drain lubricants in ring oil bearings and wash out oil wells and bearings with kerosene. In case of sleeve bearings, check to see that oil rings are free to turn with the shaft. Refil with the lubricant recommended by the manufacturer. Check the wear in the bearings and replace, if excessive,

5.4. EVERY SIX MONTH

Replace gland packing. Check alignment of pump and driver and add shims if required.

5.5. EVERY YEAR

Thoroughly inspect the unit once a year. Remove bearings, clean and examine for flaws. Clean bearing housings. Remove packing and examine the wear in the shaft sleeve or shaft. Disconnect coupling and check alignment. Inspect foot valve and check valves.

6.0. SPARE PARTS

It is advisable that following spares be maintained by the owner for quick replacement and smooth operation of pump.

(i) Set of ball bearings.
(ii) Coupling bolts with washer.
(iii) Rubber packing.
(iv) Gland packings.

7.0. PUMP TROUBLES, CAUSES AND THEIR REMEDIES

When the centrifugal pump fails to operate or there is reduction in discharge or pressure drops, the cause of trouble should be investigated and steps taken to eliminate it. A list of the most common troubles, causes and their remedies are given below :—

S. No.	Troubles & Causes	Remedies
A.	**DISCHARGING NO WATER FROM PUMP IN BEGINING**	
	(i) Lack of Priming	(i) Fill the pump and its suction pipe completely with water. Leave the vents open until clear bubbles free liquid flows from them. Close the vents and start the pump.
	(ii) Speed of pump driver too low.	(ii) Adjust the driver speed to its proper speed.
	(iii) Discharge head too high.	(iii) Check vertical head (particularly friction loss).
	(iv) Suction lift too high.	(iv) (a) Total lift including friction loss in suction pipe should not exceed 7.5 meters. (b) Check the foot valve strainer chocking.
	(v) Wrong direction of rotation.	(v) Check up the pump turns in the direction of arrow.
	(vi) Air leaks in gland,	(vi) Tighten the gland.
	(vii) Air leaks in suction pipe.	(vii) Tighten the suction pipe.
	(viii) Water leaks through foot valve.	(viii) Check up the foot valve.
B.	**NOT ENOUGH WATER DELIVERED**	
	(i) Speed too low.	(i) Adjust to its proper speed.
	(ii) Impeller eye too small.	(ii) Install the pump having a suitable capacity for the job.
	(iii) Discharge head higher than anticipated.	(iii) Check particularly friction loss.
	(iv) Air pocket in suction line.	(iii) Remove air pocket by filling the pump and suction pipe completely by water.
	(v) Impeller or suction pipe plugged up.	(v) Remove the foreign matter causing plugging.
	(vi) Air leakage.	(vi) Check the pump stuffiing boxes and adjust the gland.
	(vii) Foot valve too small.	(vii) Replace with the suitable foot valve.
	(viii) Mechanical defects :	(viii) Remove mechanical defects.
	(a) Wearing rings worn cut.	(a) Replace all worn out parts during the pump overhaul.
	(b) Impeller damaged	(b) Repair or replace the damaged impeller.
	(c) Casing packing defective.	(c) Make the casing packing properly effective.
C.	**DISCHARGE PRESSURE LOW**	
	(i) Speed too low.	(i) Adjust suitable speed.
	(ii) Worn wearing rings, packing, gasket etc.	(ii) Replace the wornout parts.
	(iii) Damaged Impeller.	(iii) Repair or replace the damaged impeller.
	(iv) Pump water passage obstructed.	(iv) Remove any obstructions in the passage.
	(v) Excessive amount of air or gas in liquid.	(v) Remove if possible or wait till the air or gas exhausted.
	(vi) Impeller diameter too small.	(vi) Check with the pump manufacturer.

D. PUMP STOPS DELIVERING WATER WHILE WORKING

(i) Air leaks through the gland.	(i) Tighten the gland.
(ii) Air leaks through the flange or some joint in the suction line.	(ii) Locate the leak and remove the cause of leak.
(iii) Impeller is choked up with foreign matter.	(iii) Remove the foreign matter.
(iv) Foot valve strainer choked up with rubbish.	(iv) Clean the foot valve.
(v) Water level gone down below practical suction lift.	(v) Wait till the water rises or lower pump within the practical suction lift.
(vi) Engine is running slow.	(vi) Adjust the engine to its proper speed.
(vii) Belt is slipping, if driven by belt.	(vii) Tighten the belt.

E. PUMP IS NOISY

(i) Bearing worn out	(i) Check and replace.
(ii) Pump and driving units misaligned.	(ii) Make the proper alignment of pumps and driving unit.
(iii) Rotating parts out of balance, loose or broken.	(iii) Check and repair.
(iv) Foundation is not rigid.	(iv) Use correct foundation for rigidity.
(v) Lack of lubrication	(v) Lubricate the moving parts.

F. PUMP TAKES TOO MUCH POWER

(i) The bearings are running hot.	(i) (a) Check the lubrication is properly given. (b) Check that the belt is not over tight.
(ii) Speed too high	(ii) Adjust the speed suitably.
(iii) Vibration in pump	(iii) (a) Use correct foundation for rigidity. (b) Check for pump misalignment. (c) Check for bent shaft.
(iv) Stuffiing box too tight	(iv) Adjust the tightness.
(v) Rotating element rubbing.	(v) Check and repair the rubbing parts.

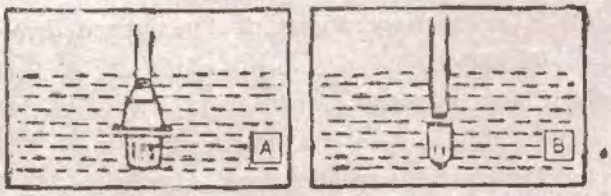
G. PUMP DOES NOT START

(i) Impeller locked	(i) Remove the sand or any other cause of locking.
(ii) Trash in casing	(ii) Remove the obstruction and fit the suction with strainer to keep trash out of the pump.
(iii) Corrosion in case of pumps out of service for long period.	(iii) Remove the corroded matter from the pump by using acid or other recommended chemicals.
(iv) Too much bearing friction	(v) Use the right lubricating oil and check the shaft bent, replace if necessary.
(v) Wiring faulty, if driven by electric motor.	(v) Check the circuit breaker of fuses for an open line.

ENERGY SAVING TIPS FOR FARMERS

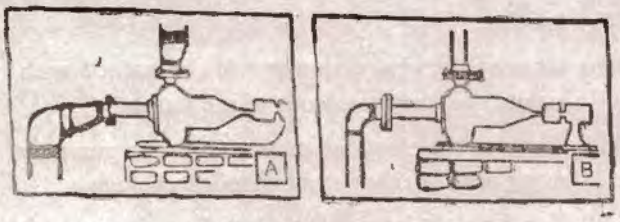
Which foot-valve saves more energy ?

The foot-valve in the diagram A has a wider mouth and larger area of openings. This helps to save about 10 percent energy (diesel/electricity) because less fuel or less power is needed to draw water from the well (A good foot-valve, though slightly costlier, pays back fast for the extra cost by saving a lot of energy). The recommended foot valve should have K valve which is less than 0.8 mm.



Which pipeline requires lesser quantity of diesel ?

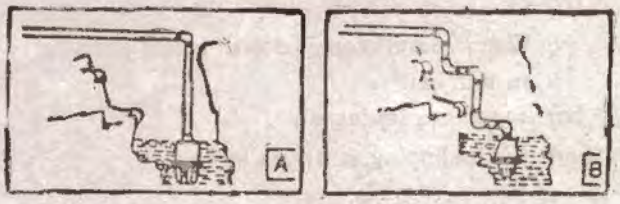
The pipeline, with bigger diameter figure B requires less energy. More energy is required to pump water through small diameter pipes because they offer higher friction. If the pipe is bigger than the pump flange size, a reducer (see the figure) must be used. A 20 mm decrease in diameter increases the friction 3 times. If, in place of a 100 mm (4") pipe, you use 80 mm (3") pipe, the loss due to friction for drawing the same quantity of water will be three times more, and your energy consumption greater.



Which pipeline arrangement needs less energy ?

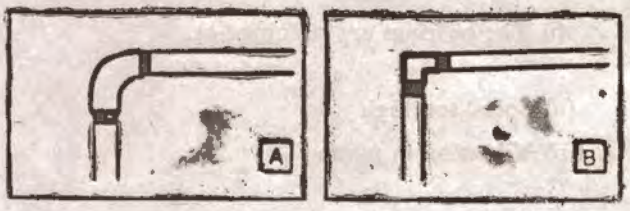
The pipeline arrangement Figure B with may bends and unnecessary fitting, increase energy consumption. Do you know that each bend in a 80 mm (3") diameter pipeline leads to as much friction loss as with 3 metres of additional pipe length ?

Just remember, the lesser the number of bends and fittings in a pipe, the more energy it saves.



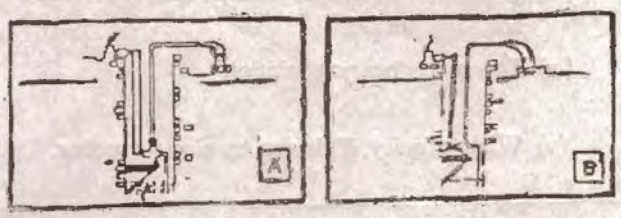
Which bend would you use in the pipeline ?

The right bend is Curved. Sharp bends and L-joints in the pipe lead to 70 percent more frictional losses than standard bends And this results in a greater energy consumption. Recommended RPVC pipes/HDPE material with minimum 5 kgf/cm^2 strength (grade 6 of I. S.) should be used.



Which installation is better ?

Your pump works most efficiently when it is not more than 10 feet above the water level, Figure A. Some farmers install their pumps even upto 25 feet above the water level. This results in a wastage of energy. If the well is deep, the pump should be installed on a platform at the right height.

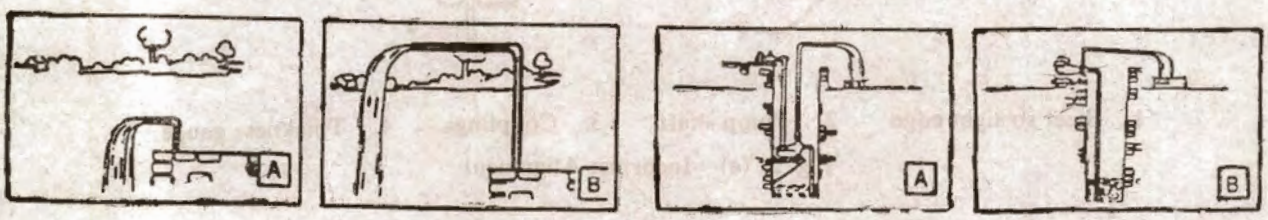


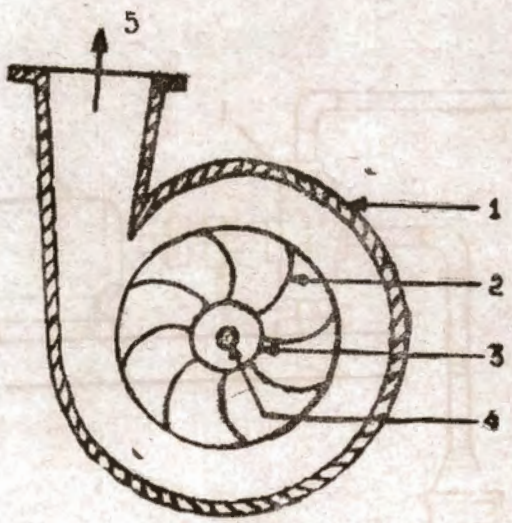
Which pipe will you choose for pumping water ?

The short-length pipe Figure A. The pipe that is unnecessarily high and this would require more energy for pumping water.

Which transmission is better ?

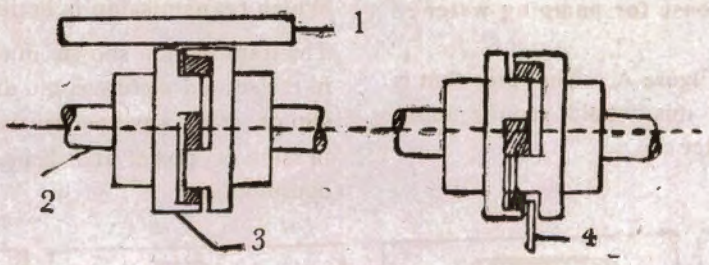
The transmission shown in the figure A. The belt in the second picture is old and worn out. It can slip or snap anytime, causing a loss in the transmission of power and hence an increased energy consumption.





1, Casing 2. Vane 3. Eye of Impeller 4. Impeller Shaft 5. Discharge

Fig. 1



1. Steel straight edge 2. Pump shaft 3. Couplings 4. Thickness gauge.

Fig. 2 (a)—Incorrect Alignment

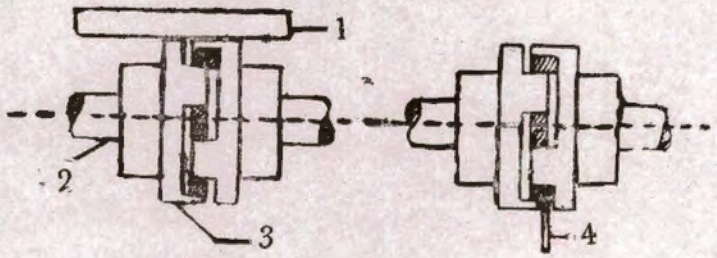
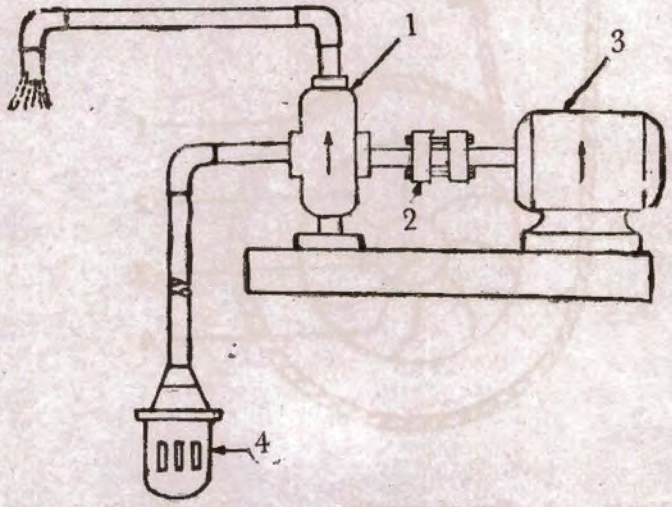


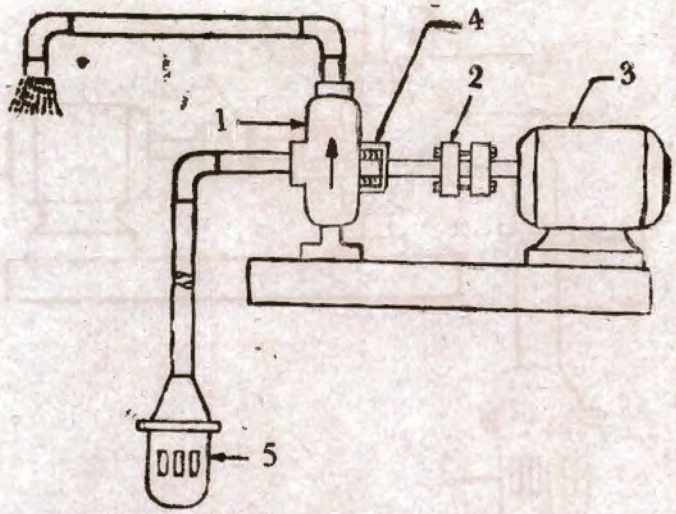
Fig. 2 (b)—Correct Alignment

Fig. 2 (a & b) checking of pump alignment



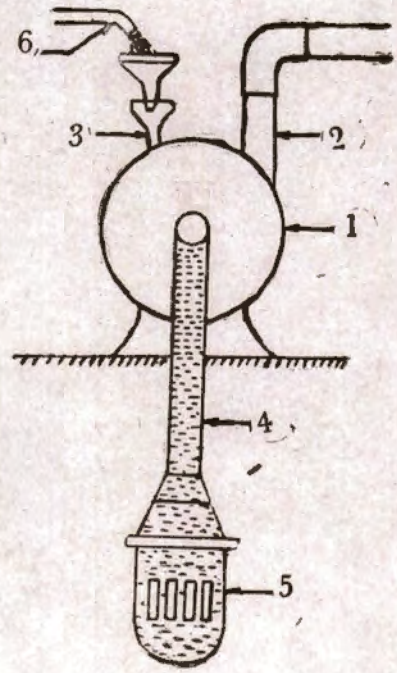
1. Pump 2. Coupling 3. Primemover 4. Foot Valve.

Fig. 3—Correct direction of Rotation



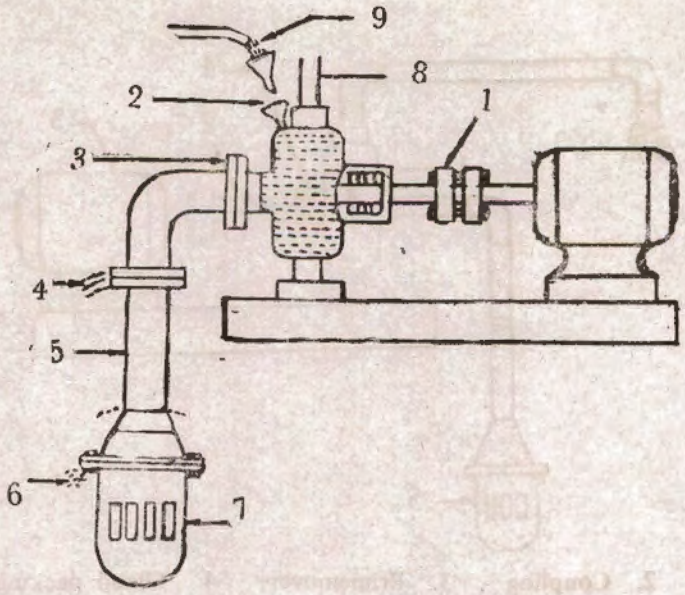
1. Pump 2. Coupling 3. Primemover 4. Gland packing lightly and evenly adjusted tighted 5. Foot Valve

Fig. 4



1. Pump casing 2. Delivery pipe 3. Air Bleeder or Vent 4. Suction pipe 5. Foot Valve
6. Priming of pump by fillling water.

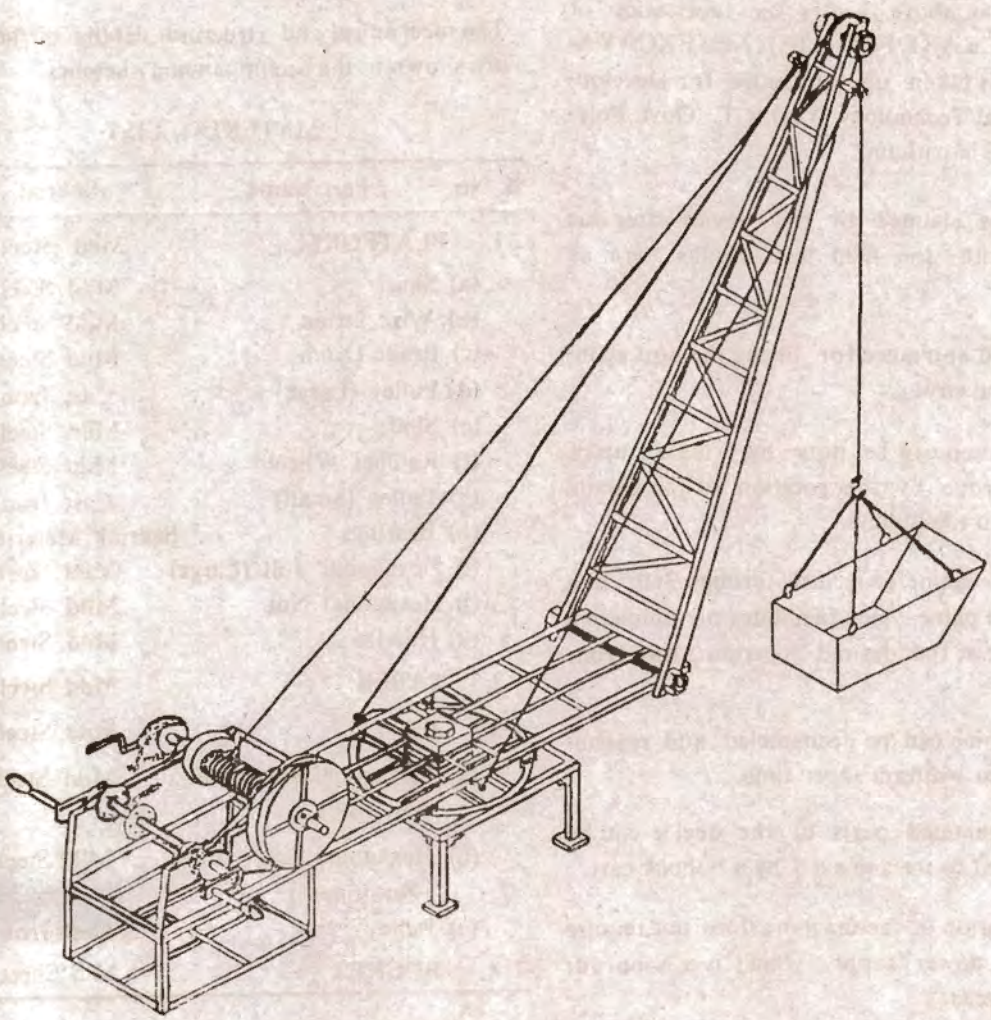
Fig. 5—Removing of Air from Pump casing and suction line by Priming



1. Coupling 2. Vent 3. Airtight flanges 4. Water leakage 5. Suction pipe
6. Water leakage 7. Foot valve 8. Delivery pipe 9. Water.

Fig. 6

RURAL CRANE FOR LIFTING EXCAVATED SOIL



GENERAL ARRANGEMENT OF RURAL CRANE

Lifting of excavated soil from wells, irrigation channels. drainage courses etc., poses a difficult problem in general with particular stress in rural areas where availability of electrical power in the vicinity, adequate funds and apt facilities for the maintenance of the devices deployed in the operation are the major constraints.

The wells are excavated for augmenting drinking water supplies as well as for agricultural purposes. The lifting of excavated soil from the wells by the conventional method requires wooden posts, beams, pulleys, coir ropes etc. The wooden posts are frequently effected by white ants and in many cases are not fit for use even a second time. The coir

ropes are susceptible for immense wear and tear resulting in breakages at frequent intervals. The The number of persons required for the operation is excessive making the expenditure exhorbitant.

Considering the above factors the fabrication of a "RURAL CRANE FOR LIFTING EXCAVATED SOIL" is taken up by Centre for Development of Rural Technology (C.D.R.T, Govt. Polytechnic, Vishakhapatnam.

The advantages claimed by this device after due verification with the field test results are as follows :—

1, Mechanical appliance for lifting the soil reduces physical strain.

2. Lifting of soil can be done by winding up of the wire rope by the rotation of the handle attached to the pulleys.

3. The crane can be swivelled through 360° in a horizontal plane which facilitates the unloading of the soil at the desired location away from the wall.

4. The machine can be dismanteled and reassmbled at situ within a short time.

5. The dismanteled parts of the device can be transported to the site even by a bullock cart.

6. The operation of the machine does not require electrical power supply which is a boon for remote areas.

7. This requires only two people for the operation thus affecting a saving of about 30% in man power.

8. The device can be fabricated with varying structural elements to suit the depth of excavation.

9. Skilled workman are not necessary for the operation, as there is no complicated mechanism.

DETAILS OF THE CRANE FABRICATED :—

(i) Weight of the Crane	....	145 Kg
(ii) Lifting Capacity	....	50 Kg
(iii) Cost of the Crane	....	Rs. 4,500/-

The mechanical and structural details of the crane are shown in the accompanying sketches.

MATERIAL LIST

S. No.	Part Name	Material	No. off
1.	PLATFORM	Mild Steel	01
	(a) Shaft	Mild Steel	01
	(b) Wire Drum	Mild Steel	01
	(c) Brake Drum	Mild Steel	01
	(d) Pulley (Large)	Cast Iron	01
	(e) Shaft	Mild Steel	01
	(f) Ratchet Wheel	Mild Steel	01
	(g) Pulley (Small)	Cast Iron	01
	(h) Bearings	Bearing Material	04
	(i) Hexagonal Bolt (Large)	Mild Steel	01
	(j) Hexagonal Nut	Mild Steel	01
	(k) Handle	Mild Steel	01
2.	TABLE	Mild Steel	01
3.	JIB	Mild Steel	01
	(a) Hexagonal Bolt with Nut (Big)	Mild Steel	01
	(b) Hexagonal Bolt with Nut (Small)	Mild Steel	01
	(c) Pulley	Cast Iron	01
4.	BUCKET	M S Sheet	01

NOTE—Cranes of lifting capacities upto 100 Kg and 150 Kg can also be fabricated to suit the depth of excavation in each case.

For further details please contact :—

Principal and Chief Co-ordinator,
Centre for Development of Rural Technology,
(C. D. R. T.)

Government Polytechnic,
VISHAKHAPATNAM—530 007.
(Andhra Pradesh)

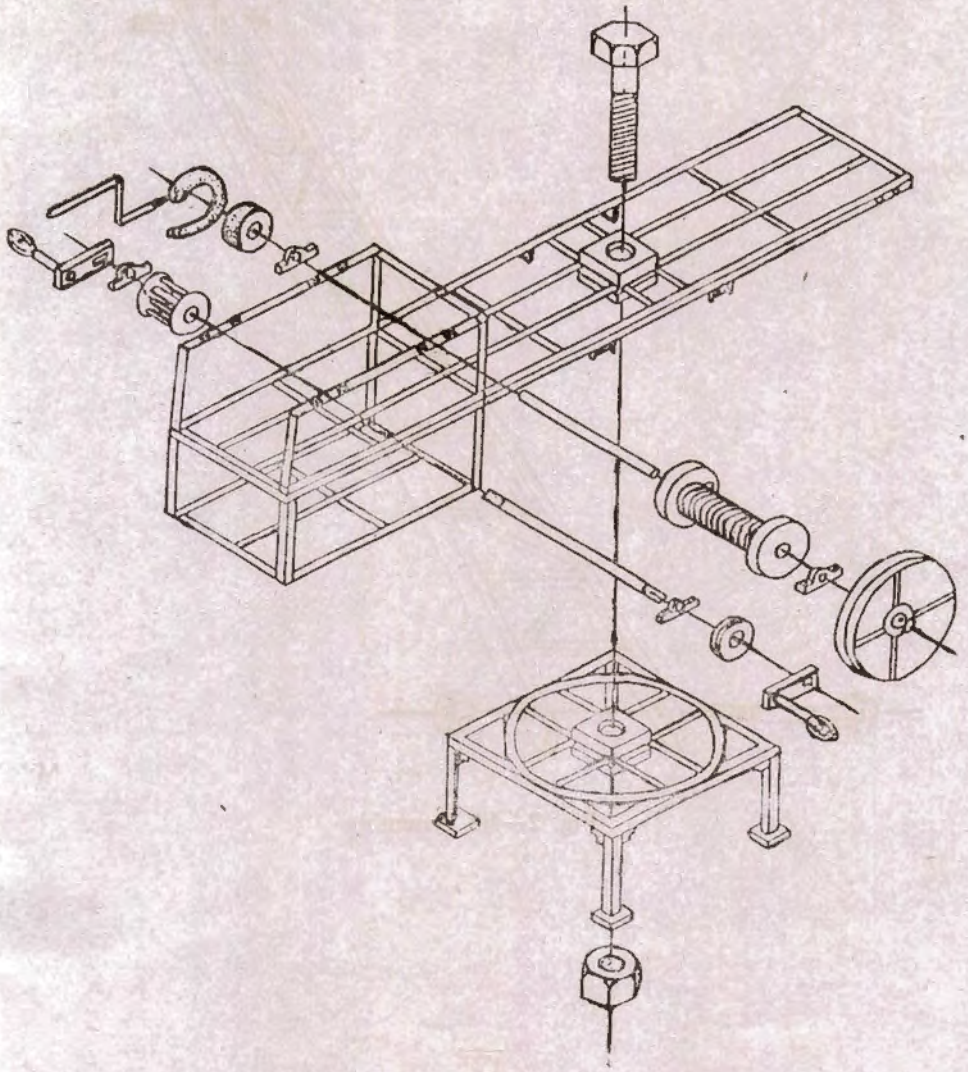


Fig. Table & Platform Assembly

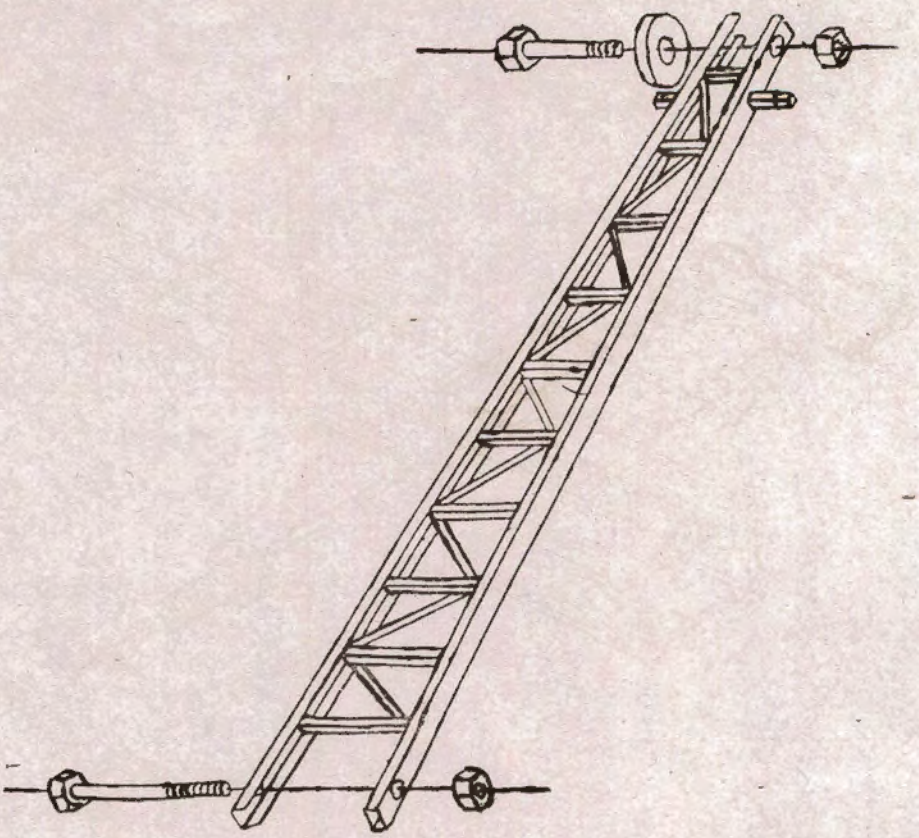


Fig. 2—Jib Assembly

SPOT LIGHT

FAST TECHNIQUE TO DETECT SOIL CONTAMINATION

The time needed to determine the extent of soil and water contamination at a site can be cut in half through a new approach developed by researchers in the United States.

Normally it takes four to five years, but Albert Robbat, Jr. and Kaisheng Jiao of Tufts University in Medford, Maryland, say their approach would require two to three years.

They use a portable gas chromatograph/mass spectrometer originally developed by the US army to detect and warn soldiers of biological and chemical agents on the battlefield.

Robbat and Jiao have modified the technology so that it can "recognise" and measure all 28 organic compounds currently on EPA's priority pollutant list.

The device lowers a probe into the ground and heats it to 300 degrees celsius. Pollutants in the soil vaporise, each at its own boiling point. The gas chromatograph/mass spectrometer samples and analyses these vapours. Robbat claims that a contaminant was detected at levels as low as 0.5 parts per million (ppm) with a margin of error of less than 30 per cent.

Tufts and Army scientists are testing the device at sites in Massachusetts to see if it delivers laboratory usable data at low cost.

CLEANER CHIMNEYS

A clean and green way to reduce acid rain has been developed by Chang Yul Cha of the University of Wyoming in Laramie. The process cuts sulphur dioxide and nitrogen oxides from coal fired smokestacks using char and microwaves. The gases are absorbed as they pass through a bed of porous char. The char is microwaved to stimulate a reaction between the gases and carbon atoms in the char that result in the release of nitrogen and carbon dioxide. The sulphur is cooled in a spray chamber and can be collected and sold.

If powdered coal is added to the char-gas mix, it gets converted into more char that can be used repeatedly. After about 40 cycles, the char can be used for filtration in waste water treatment plants. The process is cheaper and more effective than the limestone scrubbers now used to clean smokestacks.

FIBROUS SUBSTITUTE

Plastics are a major environmental problem because they are not biodegradable. One exception is polyhydroxsbutyrate-hydroxyvalerate (PHB-V), but manufacturing it is expensive and its use is restricted. A Swedish researcher has combined PHB-V with wood fibres to come up with an inexpensive he calls "fibrewood".

Paul Gatenholm of Chalmers University of Technology in Gotenborg blended the two normally incompatible substances so that the fibres can be coated with plastic. Gatenholm says his fibrewood can be used to replace heavier and more expensive fibreglass products and for car bumpers and fenders, heavy plastic wraps and food containers.

ENERGY AND WATER FOR ALL

ENVIRONMENTAL space may be defined as the total quantity of natural resources that can be used on a sustainable basis. For example, what is the total quantity of carbon dioxide that can be released into the air by human beings without damaging atmospheric processes such as global climate? To ensure equitable distribution of the total environmental space available. Northern countries should cut back their consumption levels to allow Southern countries to reach a common point of convergence in living conditions.

In terms of land available for food production, to achieve a basic healthy diet for all the people on earth by 2010, the North must cut back on its meat consumption by 60 to 80 per cent After conversion to sustainable agriculture, 0.25 ha of cropland is available per world citizen 0.19 ha of this is necessary for a healthy diet By comparison, an average Dutch person uses 0.45 ha, mainly because of high meat consumption. Over the same period, the North must also cut down carbon dioxide emissions by 60 percent and water use by 30 per cent to ensure that energy and water can be used equitably by all.

OIL FROM COAL

Researchers at the University of Queensland, Australia, have made a significant break through in the field of oil extraction from coal. The discovery reveals that in several instances coal can produce large quantities of oils. First direct evidence is available in microscopic studies which disclosed oil oozing from a predominant coal component, vitriniteB. The project came out of a small study of carbon dioxide reactivity of coal in iron smelters. The coal samples were re-examined and evidence of liquid hydrocarbons was found. Some organic-rice formations which conventionally have been regarded as very gas-prone are to be re-evaluated petrographically. Two different types have now been identified, vitrinite A which results from wood humus and does not generate oil and vitriniteB which represents the remains of leaf tissue and generates oil.

VITAMIN D MAY HELP IN DIABETES THERAPY

Vitamin D may have a beneficial effect in patients with diabetes mellitus, a global health problem that afflicts over one percent of the general population.

The vitamin may be used as an adjuvant to a diabetic patient's routine therapy, report M Raghunath and N Raghuramulu from the National Institute of Nutrition (NIN). Hyderabad.

The findings follow a series of studies conducted at NIN to examine the possible regulatory role of Vitamin D and a hormone called for short as 1.25-DHCC (1,25-dihydoxy cholecalciferol) in human diabetes mellitus.

While there is abundant evidence from studies in experimental animals suggesting a role of vitamin D and calcium in the regulation of insulin secretion and glucose metabolism, similar information is not available in humans.

1.25-DHCC is known to be an important regulator of calcium homeostasis and has been shown to be essential for normal secretion of insulin in experimental animals. The hormone is the active metabolite of Vitamin D.

Studies by researchers abroad have shown impaired glucose tolerance in Vitamin D-deficient rats and rabbits, which was normalised by treatment with 1.25-DHCC but not by increased calcium alone.

NIN conducted studies on 42 patients of non insulin dependent diabetes mellitus (NIDDM) and six of insulin dependent diabetes mellitus (IDDM), who were given 75 grams of glucose, followed by a single massive dose of 3,00,000 international units of calcium injected intramusculary.

The patients' serum insulin, calcium, phosphorus and cholesterol levels were analysed before and four weeks after Vitamin D admministration.

The results indicated a significant improvement in the oral glucose tolerance of both NIDDM and IDDM patients four weeks after Vitamin D supplementation.

Also any slight reduction of calcium levels seen in the diabetes patients was corrected by Vitamin D treatment, and all patients reported feeling better physically.

The NIN researchers say the exact mechamism of the benefical effect of Vitamin D supplementation is not clear yet.

SCIENTISTS PERFECTING PROTEIN-RICH POTATO

SCIENTISTS have enhanced the nutritional value of the potato by inserting a synthetic gene into the plant and are now considering how to use genetic engineering to provide the plant with resistance to pests and disease. The International Potato Centre (CIP) in Peru collaborated with Louisiana State University to produce the synthetic protein rich in certain amino acids. Although the potato has a high protein content, it is deficient in amino acids such as lysine and methionine.

More research will have to be done before a modified potato with superior nutritional value is available for human consumption. This would be of importance in developing countries, where most people depend on a single source for plant proteins. CIP has initiated research projects in Italy to engineer resistance in the potato bacterial wilt and soft rot.

Besides inserting genes to make potatoes protein-rich, research in the West is concentrating on modifying the starch content and the sugar-starch balance. These applications are primarily aimed at industries making potato starch products such as French fries and chips.

HIGH COST OF PRODUCTION

Several factors come in the way of improving potatoes using conventional techniques. The cost of seed tubers is high and supplies are limited. The large volume of seed tubers that has to be produced, harvested, handled, stored and desprouted, makes production expensive. Farmers also have to invest in fertilisers and pesticides to boost yield and protect the plant. In addition storage, transportation and processing make the potato vulnerable to high temperatures, bacteria, fungi and insects.

For genetic engineering studies, the potato has some advantages over other crops. It is easily manipulated in tissue culture and is susceptible to commonly used gene vector systems. Besides improving quality, genetic engineering can play a role in the development of potatoes that are better resistant to pests, diseases and herbicides.

INDO-AMERICAN TEAM FINDS ANTI-AIDS ACTIVITY IN NEEM

A chemical extracted from the bark of the common neem tree can effectively block infectivity of the AIDS virus, report Indian researchers.

The neem extract has high anti-viral activity. Dr. Shakti Upadhyaya, a research scientist from the National Institute of Immunology in New Delhi, said in his report presented at the second International Congress on AIDS in Asia and the Pacific, in New Delni.

Laboratory experiments jointly conducted by NII and the Harvard Medical School have shown that a sugar-like extract from neem bark can stop infectivity of the virus, in human blood cells cultured in the lab.

"Rather than having a direct effect on the virus, we think the extract stimulates the immune system to produce a group of chemicals that help combat the infection". Dr. Upadhyaya said.

The NII study showed that the addition of the neem extract into a solution of human blood cells triggers off the release of cytokines that help destroy the virus and virus infected cells.

The levels of several cytokines including the most potent one known as gamma-interferon rose significantly when the neem extract was added into the solution of human blood cells.

The number of cells infected with AIDS-causing human immunodeficiency virus (HIV) dropped significantly after they were treated with the neem extract.

The release of the anti-viral cytokines triggered off by the neem extract might have led to the anti HIV activity.

One of the uses of neem in traditional medicine has been to boost general immunity. NII now plans to precisely identify the sugar-like poysachharide compound which diasplays anti HIV activity.

BUILDING MATERIALS FROM FLY ASH

India's Central Building Research Institute (CBRI) Roorkee, has developed a technology for the conversion of fly ashes from thermal power stations into useful building materials. CBRI has found the sintered flyash aggregate (bulk density 640-750 kg/m^3 brownish, spherical, hard nodules, size 5-12 mm) suitable for making structural grade lightweight concrete, precast masonry blocks and medium and large size walling and roofing units.

As the cost of natural aggregate and common building bricks is very high production of sintered fly ash aggregate and its use in building construction has good potential in the developing countries. Besides, lightweight aggregate is an ideal construction material for multistoreyed buildings.

USE OF THE NEEM TREE

The neem tree is a source of various insecticides, medicines and oil. GATE provides aid from its Small-Scale Project Fund to help non-Governmental organizations exploit the neem tree. One such organization in the Foundation Internationale pour Development (F. I. D.) in Senegal.

Use of the neem in crop treatment and conservation of stores. The organization report :

"Following many demonstrations in the various villages participat ng in the project, we are extremely pleased to note that the women are highly interested and motivated by the project.

Above all, it is a matter of arousing interest, creating awareness, and demonstration, Besides oil and extracts, we have succeeded in producing neem soap.

Although we launched the project only five months ago, some women are starting to use the oil they have produced to preserve their neibe (a variety of beaned). Others have begun selling their oil.

At the F.I.D. we have established a special garden in our training centre, for experiments and to demonstrate natural crop protection methods. Tests were carried out for the treatment of various parasites".

NEEM EXTRACT AS A COATING FOR UREA FERTILISER

Godrej Soaps Limited, Bombay, has developed a neem extract as a coating for urea fertiliser, which is claimed to prevent nitrogen losses in fields.

Marketed under the name Nimin the product, when coated on urea fertiliser, results in higher yields and lesser pollution of ground water and atmosphere due to reduction in leaching and denitrification osses.

The product has been extensively evaluated at universities, the Indian Council of Agricultural Research (ICAR), state governments, research stations, cooperative sugar factories and farmers. fields.

A recent study by the Agriculture College and Research Institute, Madurai, and Tamil Nadu Agricultural University (TNAU), showed that coating urea with Nimin saves 55 kg nitrogen per hectare without any adverse effect on yield and quality.

A saving of 55 kg of nitrogen is estimated to result in a net saving of 120 kg urea per hectare. This would take care of 0.40 million tonnes of urea needed for the entire 3.40 million hectares of land under sugarcane cultivation.

Besides saving over a thousand million rupees the coating can help reduce import of the chemical to meet the domestic demand and save valuable foreign exchange for the country, the release adds.

SPOT LIGHT

TALL POTENTIAL

Elephant grass (Miscanthus sinensis) is tipped to play a major role in world energy production one day Because of its efficient metabolism, elephant grass can yield up to 40 tonnes of biomass per ha. According to Manfred Dambroth of the Botanical Institute of Braunschweig in Germany, tests carried out on the plant, originally from south Asia, have been successful in central Europe.

Dambroth says biomass could meet 8 to 12 percent of the world's energy requirements But the plant needs unpolluted soil to be a clean source of energy. The Germans are also hoping to use the grass as a source of cellulose– the main constituent of plant cell walls—in the production of textile fibres.

THE DDT BAN : KILLED MILLIONS

Excerpted here are the remarks of Gordon Edwards prepared for a press conference on the 20th anniversary of the ban on DDT.

DDT saved millions of human lives during the past 25 years, by controlling the insects that transmit disease to people—the mosquitoes that give us malaria, yellow fever, encephalitis and elephantiasis the lice that transmit typhus, the flea vectors of plague, and the tsetse flies that spread African sleeping sickness and nagana.

These horrible aliments are not simply a part of the "good old days before pesticides" ; they are still prevalent in many countries today. They are still being fought desperately by the World Health Organization, the Pan American Health Organization, the U. S. Public Health Service, the Centres for Disease Control, the Agency for International Development and many other dedicated groups of humanitarians, and pesticides are still their major weapons.

DDT has eliminated much of the illness that formerly prevented millions of inhabitants of tropical lands from performing a good day's work. DDT permitted people to occupy and produce food in large areas of Africa, India, and Asia that were formerly uninhabitable because of diseases-bearing insects and other arthropods. This was especially important, malnutrition in children causes irreversible brain damage, dooming the victims to a life of subnormal mentality and inferior accomplishments.

DDT and other pesticides contributed heavily to the spectacular agricultural success in the United States and abroad, boosting farm productivity, raising farm income and keeping food costs low. The many business that depend on agricultural prospered far more than they could have if crops still depended on arsenic, cyanide, fluorine, nicotine, lead, lime-sulfer and the other "natural" pre-LDT insecticides (and more than they ever will if pesticides are forcibly replaced by "alternative control measure").

DDT saved hundreds of millions of acres of forest in North America from decimation by gypsy moths and other insect pests, and thereby prevented extensive flood damage and loss of topsoil. When forests are destroyed, the natural home of much of our wildlife is also gone and the ecosystem is adverserly affected for decades, probably forever. In the 1950s, DDT eradicated gypsy moth populations in the eastern United States wherever it was properly applied.

Why Did Environmentalist Traget DDT ?

In view of these biological and humanitarian considerations, Rachel Carson, the Audubon Society, the Sierra Club, and the Environmental Defence Fund might have compaigned successfully for the construction of great monuments to DDT. Instead, the so-called environmental groups devoted million of dollars to the campaign against DDT. Their activities doomed millions of acres of forest, ruined the natural habitat by permitting needless devastation of native vegetation, depleted agricultural productivity, and doomed hundreds of millions of people to death from insect-boren disease, malnutrition, and starvation.

Their lack of concern for human life was exemplified by the Sierra Club president in 1971 when he told reporters : "the sierra club wants a ban on DDT, even in tropical countries where it has kept malaria under control". Similar statements have been made by leaders of most other so-called environmental organizations.

Why would these organizations take this strong anti-DDT position ? It doesn't take much research to arrive at an answer. Those opponents of DDT were better financed and better staffed than any other propaganda force in history, receiving donations from hundreds of thousands of citizens who have been convinced that the organizations deserve their financial support.

I believe the majority have good intentions and noble goals, but few realise the true objectives of the eco-industry. The major goals of those groups are first the accumulation of money and property, second, the enhancement of political power, and third, the decimation of humans in the third world countries by any means possible.

Dr. Charles Wurster (alleged to be the "Chief Scientist" for the Environmental Defence Fund) wrote in Bio-Science : "If the environmentalists can win on DDT, they will achieve a level of authority they have never had before. In a sense, then much more is at stake than DDT".

They had only a few million dollars with which to fight against DDT. but they succeeded (thanks to William Ruckeishaus, who overruled the judge after seven months of EPA hearings). Now they have billions of dollars and almost total media support to launch even more destructive fraudulent propaganda concerning" global warning", "the greenhouse effect", "the hole in the ozone" and so on and on and on.

SCIENCE AND TECHNOLOGY IN THIRD WORLD DEVELOPMENT

Science, Technology and Development Forum, U.K. is organising its triennial "International Conference on "Science and Technology in Third World Development" from 5-7 April '93 at University of Strathclyde, Glasgow, Scotland.

Science and Technology plays an increasingly important role in the development process. Yet fundamental questions still remain and new questions continue to arise about the role and progress of Science and Technology in the Third World Coun tries. This conference will give an opportunity to discuss the issues like-Science and Technology Education and Policy, Technological capability, Innovation and Technology Transfer. The conference will also focus on some technologies e. g. Agricultural, Energy, Industrial, Intermediate, Water and Sanitation and New Technology.

For further information contact :

Dr. Richard Hecks
IDPM, Manchester University
Precinct Centre
Manchester,
M 13 9 QS
U. K.

IMPROVED TECHNOLOGIES IN SERICULTURE

Aslan Institute for Rural Development, Bangalore, will organize following, eight days training programme on different topics at its International Training Centre in the year 1993.

1. Income Generation and Entrepreneurship Development for Rural Youth and Women, from July 1-8 1993.
2. Environmental Management and sustainable development for Rural Youth and Women, from July 10-17, 1993.
3. Leadership Training for Rural Youth and Women from July 20-27, 1993.
4. Improved Technologies in Sericulture development from August 20-30, 1993.

For further information contact :

AIRD International Training Centre
12/1-2 Kathriguppa Main Road
Banashankari III Stage
(Near Vidyapeetha Circle)
Bangalore-560085.

SUSTAINABLE FARMING AND THE ENVIRONMENT

The United Planter's Association of Southern India (UPASI) proposes to hold an international workshop on "Sustainable Farming and the Environment (SaFE) 93, from 28th to 30th April 1993, in Cochin, Kerala.

The objective of this workshop are : (1) To bring together farmers big, small and medium on a common platfom to share experiences, problems and insights (2) To evaluate methodically the problems associated with sustainable agriculture in India (3) To provide a base for networking farmers, agencies, consumers, input suppliers, marketers and promotors of sustainable agriculture within the country and abroad and thereby establish an info-exchange system that will benefit all, (4) To promote small scale organic farming amongst small and marginal farmers both for food and the market.

The workshop will be divided into five sessions— (1) Eco-philosophy for farming (2) Farmerspeak (3) Technology in sustainable agriculture (4) A look at policy economics and market and (5) Transfer Transition.

For further information contact :

Jacob Mani Mannothra
The 'UPASI' R & D Centre
for Rubber

Ancheril Buildings
Union Club Road
Kottayam 686001
KERALA.

MUD CONSTRUCTION TECHNIQUES

ARTEFACT will hold following workshop at Glucksburg Germany in July and Septen ber.

1. Introduction to Mud Construction Techniques–July 2–4–93.
2. Construction of Compost Toilet–July 9–11–1993.
3. Independent Energy supply with Wind and Solar Power–Sept. 24–26–1993.

For further information contact :

ARTEFAT Halb jahresprogramm 1/93
ARTEFACT
Bremsberg
D–2392 Glucksburg
Germany.

RENEWABLE ENERGY : PROJECT IMPLEMENTATION & MANAGEMENT

Centre for Energy studies (CES) Indian Institute of Technology. Delhi (II TD) in collaboration with the Ministry of Non-Conventional Energy Sources is organising an International Workshop on Renewable Energy. Project Implementation and Management from 22-28th March 1993. At IIT, New Delhi. The workshop is sponsored by the United Nations Fund for Science and Technology Development (UNFSTD)/United Nations Development Programme (UNDP).

The main objective of this workshop is to acquaint project managers engaged in Renewable Energy Programmes from the developing countries with the latest technological developments, implementation and management techniques in the fields of Renewable Energy Utilization.

For further information contact :

Prof. H. P. Garg
Head, Centre for Energy Studies
Co-ordinator, Solar Energy Programme
Indian Institute of Technology, Hauzkhas
New Delhi–110016.

ROSEWOOD

Nitrogen Fixing Tree Association of Hawaii, USA Plans an International Workshop on, "Rosewood (Dalberjia/ssp) Multipurpose and High Value Timber Nitrogen Fixing Tree," from May 31st—June 4, 1993 at Hetauda, Nepal. The workshop is for researchers and practioners in the same field.

For further information contact :

Nitrogen Fixing Tree Association (NFTA)
1010 Holomua Road
Paia. Hawaii 96779
USA.

ENVIRONMENTAL ENERGY IMPACT ANALYSIS

Global Warming is the second greatest problem facing mankind today. It may not be long before it assumes the major role. In recent years there have been a number of unusual, violent, localized weather disturbances which may arttribute to wider than normal excursion in the average weather pattern these have also been change in regional weather pattern on a global basis.

Energy is the convertible currency of technology. Without energy the whole fabric of society as we know it would crumble the effect of a 24 hour cut in electricity supplies to a city shows how totally dependent we are on that particularly useful form of energy. Enhanced life style and energy demand rise together and the wealthy industrialized economics which contain 25 percent of the world's population consume 75 percent of the world energy supply. It shows that energy is the ultimate resource and at the same time the ultimate pollutant. And this the dichotomy between energy's roles as ultimate resource and ultimate pollutant that generates the deepest of the several ditemmes that make up "the energy problem".

The book is divided into three parts Energy, Energy Impact Analysis and Energy Sources.

"Environmental Energy Impact Analysis", by S. K. Shukla & R. P. Srivastava, Published by Commonwealth Publishers, New Delhi. pp. 415 , Rs, 400/-, English.

FOREST ECOSYSTEMS OF THE WORLD :

The Growth-oriented development philosophy of our time has inculcated a typically commercial attitude towards vital resources. In the biospheric system forests occupy a key position. The economic development of the last few decades has shown an utter disregard to the ecological consequences as a result of which different natural ecosystems have been subjected to stresses and strains beyond their tolerance limits. The greatest sufferers in this regard have been the different type of forest ecosystems. Destruction and degradation of forests, therefore, initiates a chain reaction which, if not controlled, destablize the entire biospheric system. The extension of agriculture, the growing need for fuelwood in the developing world, industrialization and urbanization have necessitated in reckless destruction of forests in many parts of the world. Forest ecosystems play a vital role in maintenance of the ecological health of the planet.

The book is an attempt to focus attention of some of the major issues involved in forest utilization and management. It also examines various aspects of forest ecosystems in different parts of the world.

The book has been divided into three sections. Section I—Forest Ecosystems and Ecology-which examine various issues involved in the exploitation and management of forest resources in a global ecological context Section II—Crisis of Forest in the Developing world-deals with the crisis in the forests of the tropical world. Section III—Utilization and management of forests in the Developed World-is devoted to the problems of forests and woodlands of the industrialized countries of the temperate region.

Ecologists, Foresters, and Development Planners should find the book useful.

"Forest Ecosystems of the World, "by Mohammad Shafi and Mehdi Raza, Published by Rawat Publications" New Delhi, pp. 214, Rs. 250/-. English.

SOLAR HYDROGEN ENERGY :

We are very well aware that our atmosphere is being polluted and spoiled by actions which are

beyond our control, and yet in which we play a vital part. Gradually, inexorably, the levels of pollutants and carbon dioxide in atmosphere are increasing. The resulting global warming acid rains and pollution are seriously damaging the biosphere of the earth. The increases in carbon dioxide and other pollutants such as carbon monoxide, oxide of sulphur and nitrogen, hydro-carbons, are due to the fact that we obtain our energy by burning oil, natural gas and coal. For the sake of our health and environment, we have to stop this dependence on fossil fuels, which each day it continues-puts even more carban dioxide and pollutants into our atmosphere and makes the situation worse. And if we continues to use these fuels, we are threatening the very survival of the planet. Solar-hydrogen energy system-a system that is supportive of its ecosystem—is a safe, clean and permanent alternative—and also a solution to the world's dependence on fossil fuels, and a way to reverse their damaging effects.

The book is the first to give a clear and lucid description of, when and what can be done to solve the problem-and indeed how the reader can be part of the solution.

The book is into two parts—part one describes the clear picture of the present scenario of energy and different causes of pollution, greenhouse effect, acid rain, hole in the ozone layer etc. Part two is the answer of the part one, that how and when we can control our above problems by Solarhydrogen coupling.

"Solar Hydrogen Energy-The Power to save the Earth", by John O'M Bockris *et al.* published by Macdonald & Co. (Publishers) Ltd., London, 1991, pp 147, English.

INDIA'S RURAL PROBLEMS :

Agriculture is the backbone of the Indian Economy. It is the largest and most important sector from the standpoints of relative share in national income, supply of food and raw materials, trade, public sector outlay, employment and demands for the products of other sectors. However, agriculture is the most backward sector of all. The major weaknesses of Indian agriculture comprise slowness and unevenness of its growth, insufficiency of its capacity and modernisation, inadequacy and ineffectiveness of the land reform measures and the grinding poverty of the landless agricultural labourers.

Problems of the rural sector, including those of agriculture which has diverse aspects, have been viewed in this book from the standpoint of economic development.

The book should interest the administrators, the bankers, the co-operators, the planners and the legislators apart from the research scholars.

"India's Rural Problems" by K. N. Prasad, Published by Concept Publishing Co., New Delhi, 1991, pp 472, English.

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RURAL TECHNOLOGY JOURNAL

AIMS AND SCOPE :

Rural Technology Journal is published by Information Service Division, Centre for Development of Rural Technology, Institute of Engineering and Rural Technology, Allahabad (India). The purpose of Journal is to provide a forum for exchange of views, information and create awareness in the field of Rural Technology, its development and transfer to the rural areas, technological products and processes, methodologies and approaches etc. Effort is being made to ensure that this Journal become relevant not only for this country but to all those nations, groups and individuals, in any part of the Globe who have concern to contribute towards the welfare of the under privileged rural communities. The Journal is divided into following main sectons :—

1.	Portfolio	—	(Articles/Papers)
2.	Tool Box	—	(Information on Rural Technology/Processes)
3.	Spot Light	—	(News and Views)
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