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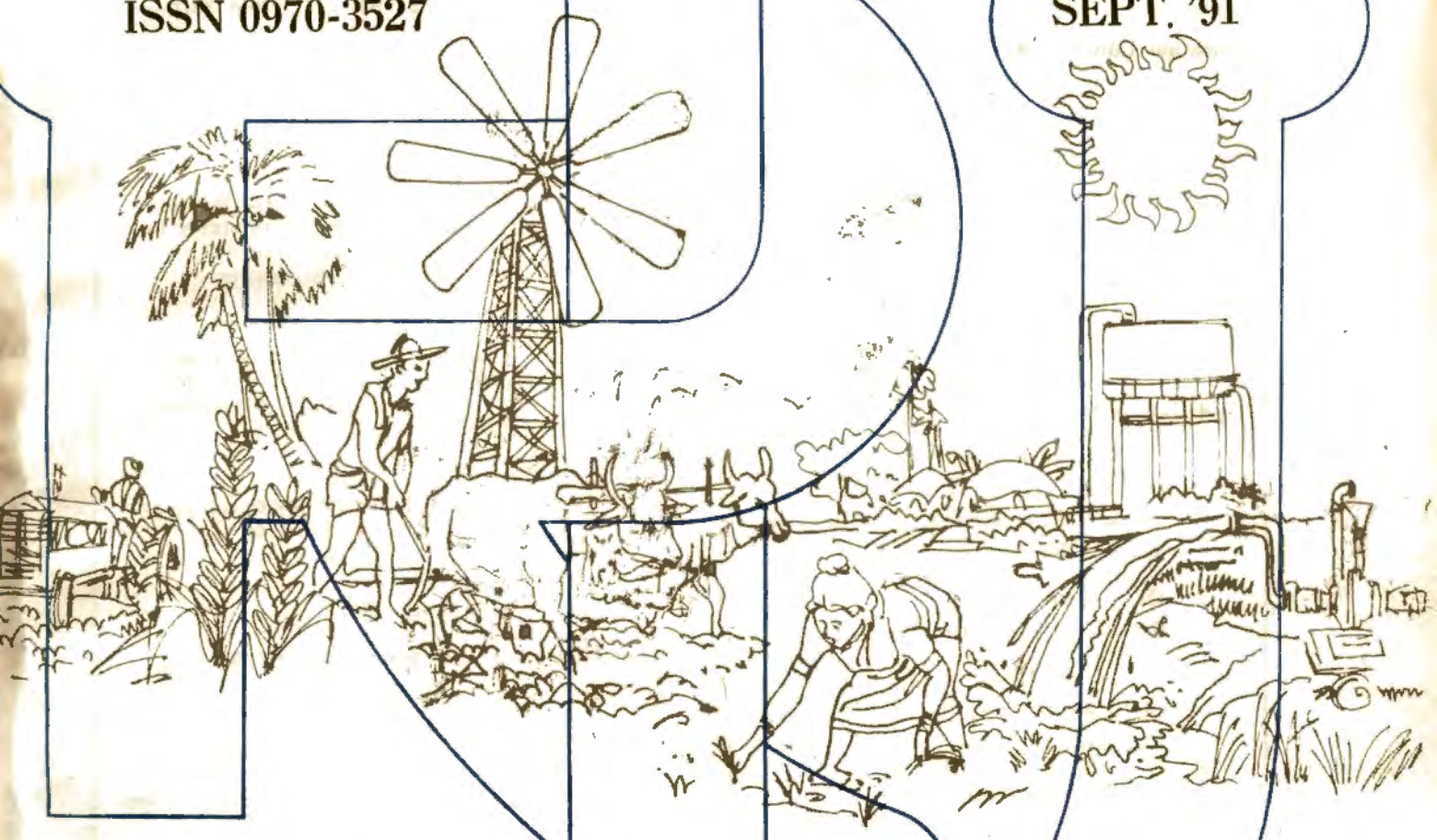

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SEED—INDIA'S FIRST VILLAGE REPUBLIC

Anil Agarwal and Sunita Narain

The authors has given brief description of management and policies adopted in tribal village SEED. They have compared the policies with another villages and suggested how these policies can be implemented in other villages.

Norway is a country equal in terms of population, to half of Delhi—about four million. Excluding Oslo, which is about half a million people, the country's remaining population is distributed within about 20 countries and 400 municipalities Therefore the lowest system of effective governance in Norway which also includes a high order of self-governance covers just about 9000 people.

In India, the lowest system of effective governance is the district—about 450 of them-which gives well over 1,50,000 people-per lowest unit of gevernance. And even at that megalevel, there is hardly any self-governance Not surprisingly. India is in a mess, especially its environment. But conditions can be different.

Unknown to all powers that be in Delhi or Jaipur, or even to most voluntary agencies who love to boast about their own projects. Seed a poor, small tribal village tucked away in the deforested Aravalis, is making environmental and legal history. Seed is a unique legally sanctified village republic where the village community has legal powers to plan for its natural resources, to implement its policies and to judge, penalise and prosecute. The village has a self imposed land use plan, the likes of which can hardly be found in any other village of India, which determines when and how grazing takes place or trees are cut. Offenders are fined and the village over the last ten years has levied and collected fines worth nearly five thousand rupees-an enormous sum for a poor tribal village-for cutting trees. Grazing is prohibited in areas and even for breaking leaves. The village was even about to prosecute a local forest officer but relented when he publicly apologised. The environmental result is dramatic. Areas demarcated as protected are green and afforested. Travelling through the barren moonscape of the Aravallis. Seed stands out like a green oasis.

The lesson of Seed is not the trees it has planted or protected but in its very system of being. Most environmentalists and government officials tend to see answers in grasses, trees, watershed management, smokeless chulhas or biogas plants. The government even has countless such plans and programmes. But most remain paper tigers Community participation, is today a slogan for the government. But it is dead in its content and distorted in intent. For what it really means is that the government will plan and the people will participate through their cheap labour. Seed shows a totally different way.

The village, located near Udaipur, is registered under the unique Rajasthan Gramdan Act of 1971, possibly the most radical action ever inspired by Vinoba Bhave. The act gives executive and legal power to the Gram Sabha for village assembly) which consists of the village's entire adult publica-

tion. The act does not provide for any elected village council (Gram Panchayat). So that we see in Seed is not representative democracy at work but participatory democracy. The Gram Sabha has full control over the common lands within the village boundary including those lands which were earlier with the forest and revenue departments. The village commons have been divided by the Gram Sabha into two categories—one on which both grazing and leaf collection is banned and the second on which grazing is permitted but tree, or even leaf, cutting is strictly prohibited. The protected area is green. even during drought periods. During the crippling drought of 1987, the village was able to harvest 80 bullock cartloads of grass from this patch, worth a fortune at that time, which was distributed to the families equally. The Gram Sabha does not allow even trees on private lands to be cut without its permission, which it gives only after assessing the needs of the family.

Enforcement is possible only because the village assembly has legal powers to fine and penalise. This legal control is vital for any village-based land use planning. Today, almost one third of the land in India, on which grasses and trees can grow is under governmental control, and almost half of this land is degraded. Under existing land laws, if villagers were to plant trees on degraded revenue or forest lands, they could legally go to jail. Strange for a country which talks about a massive afforestation programme.

Government officials normally nod their heads in agreement but, in the absence of good political leadership, invariably add, "but people are not ready for such ideas. Village institutions are corrupt and greedy and the poor are incapable". So what should the villagers do ? Wait for a bureaucrat who will act as their messiah.

Can we not change India's colonial system of governance ?

In Seed, the system of village governance is that the entire village collective takes decisions. This village of about a hundred households elects a *karyapalika* (the executive) as well as an *adhyaksh* (chairperson). The executive committee consists of representatives of all sections of the community, including women. But the *karyapalika* cannot undertake any work without the decision of the Gram Sabha. To streamline work, Seed has formed six committees—for crop loans, for forest and nursery development, for water resources development, for legal problems and disputes, a *vikas samtii* to oversee development programmes, and a *kosh samiti* for finances. But the bank account is in the name of the Gram Sabha.

Seed's villagers do not even have to face the terror of the petty *patwari*. The land records of the village are kept by the villagers and changes are made only with the permission of the Gram Sabha, which particularly takes care to check with the women in the household before transferring the land. This has given the villagers enormous power. They have not allowed any encroachment on village lands. During a survey of the village, we discovered that nearly one-third of its agricultural land was owned by one person. When we visited the village, we found that this was the only unmanaged and degraded plot within the village. We learnt that this land was owned by the former 'Raja' of the area, who wanted to sell it off. But Seed's a poor tribals told him that he could only sell it to people within the village. The Raja refused to sell and the land lies unused and degraded. The villagers are proud that they could assert themselves over a person still powerful in the area.

Give that over 75 percent of Indian villages have less than 200 households. Is it not possible to expect village adults to discuss and solve their problems ?

Rameshwar Prasad, one of India's least known environmental warriors, who has spent a lifetime of dedication in Seed, has a telling story. When Vinoba Bhave first came to the area in the 1950s, he told him that Indian villages have food self-reliance but it was necessary to move towards self reliance in other aspects of life.

Nearly thirty years later, Rameshwar Prasad finds that even food self reliance has gone. Worse, even wherewithal for food self reliance—water in the walls, for instance—has gone. With the Aravalis now a totally barren range of hills. Seed has never seen such a shortage of water in the wells and nalas and such an acute scarcity of fodder. This is the case of more and more villages in the country. No government is capable of dealing with such crisis. It can at best help the people to manage themselves.

Seed clearly shows what the role of the government must be— that of an enable rather than that of a doer. Seed's a villagers need new technological inputs. The government must give it to them. But the villages must decide choose and manage.

10 principles of sustainable development

1. *Consult with villagers, farmers and all other participants.* Reach agreement on both problems and solutions before taking action.

2. *Plan small-scale, flexible projects.* A plan should be a blueprint, not a prison. It should be able to incorporate new information that emerges during the project.

3. *Let the people benefiting from the project make the decisions.* The experts job is to share their knowledge, not impose it.

4. *Look for solutions that can be duplicated in the hundreds of thousands* for the greatest impact on development. But the olutions must still be tailored to fit local needs.

5. *Provide education and training*, particularly for young people and women, who remain the most effective agents of change because they are bound to the realities of the family's survival.

6. *Keep external inputs to a minimum* to reduce dependency and increase stability, Subsidies, supp'ements and inappropriate technology are unsustainable.

7. *Build on what people are doing right.* New ideas will be adopted only if they do not run contrary to local practice. New technologies must support existing ones, not replace them.

8. *Assess impacts of proposed changes.* A multi-disciplinary team, ideally including specialists from the same culture, should look at economic, social, cultural and environmental aspects.

9. *Consider both inputs and outcomes.* The failure of projects focusing on a single outcome, such as agricultural productivity, has proved that more is not always better.

10. *Maintain or improve the participants' standard of living.* Long-term environmental improvements are unsustainable unless they also address the problems the poor face today.

A NEW TECHNIQUE FOR PLANTATION OF KHAZOOR IN DESERT SOIL

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The authors have described about the techniques for plantation of Khazur in desert areas. They have also explained about successful experiment conducted in the area and results have been discussed in this paper.

The climatic endowments in the sandy region of Thar desert, of India are conducive for growing Khazoor (Datepalm). But the soils in desert region of India are excessively sandy, having very low moisture storage capacity (36 mm in 60 cm depth of profile). The sand fraction in the 80 cm profile ranges from 70.7 to 87.1 percent. The evaporative demand of the atmosphere is generally very high and pan evaporation values range from 5.4 to 19.1 mm per day. Most of the water percolates into the substratum due to very high infiltration rate (15-20 cm hr^{-1}). This implies that daily irrigation is required to be given to establish date suckers in desert soils. Due to high requirement of water of Date palm, the first two years are very crucial for proper establishment and survival.

A novel technique has been innovated which consists of placement of bentonite clay in the planting pits by using "iron mould" This technique reduces the frequency and total amount of water required and ensures sustained availability of moisture in the root zone of Date palm suckers for establishment and better growth.

FABRICATION OF "IRON MOULD"

The "Iron mould" consists of a cylinder made from simple iron sheet (as shown in Fig.) The diameter at the top is kept 80 cm and 60 cm at base. The top and base both of the mould are open. The height of the "Iron mould" is 90 cm. This size has been considered to be suitable for planting Date pa'm suckers.

PRINCIPLES OF WORKING

This technique works on two simple principles.

1. Water losses through deep percolation and lateral movement are minimized.
2. It creates greater potential gradient for upward movement of moisture in the pit which is due to minimized losses of water. Barrier checks the moisture movement both in horizontal as well as vertical direction in the profile.

METHOD OF USE

A pit of 90 cm depth, having diameter of 95 cm at top and 75 cm at base has to be dug manually at the place where planting is to be done. A layer of 10 kg bentonite clay is spread over the base of pit. Iron mould is placed in the pit in such a way that circular space of 7.5 cm. outside the mould remains available for bentonite placement in the pit. Another 10 kg bentonite mixed with soil in a ratio 2 : 3 is used for lateral piacement outside the mould.

The bentonite mixture is placed gradually around the circular space and simultaneously original soil mixed with F. Y. M. is placed inside the mould. The filling up of the bentonite mixed soil and the original soil outside and inside the mould respectively is done slowly in two to three steps. After filling of 30 percent depth, the mould is raised slowly upwards aad likewise this process is repeated two to three times because by filling up of the pit at one time. it will be difficult to pull out the mould.

EXPERIMENT

Suckers of datepalm Phoenix Dactyliferacv (Khadrawi) were transplanted from the nursery in the month of Sept. 1985. Treatment of surface mulch was also applied atter planting. Irrigation of 30 mm depth was given at 50% depletion of available moisture. Soil Samples were collected after each irrigation and soil moisture was estimated gravimetrically. Total nitrogen was also determined, using micro—kjeldahl method, at regular intervals and observations on plant growth were recorded at six month interval.

The data recorded on soil moisture storage (Table 1) reveal that placement of bentonite with this technique was very effective in increasing storage of soil moisture in the 60 cm depth of soil profile as compared to control. It was observed that 20 percent higher soil moisture was available than the soil moisture storage capacity of (0.12 m^3 m^{-3}) under control. The combination of barrier and mulch showed 75 percent higher moisture storage than control. However, there was no response of mulch alone as compared to control. Barrier also influenced moisture movement in the soil profile and 15–20 cm zone above the barrier was found near saturation until 2–3 days after each irrigation. Thus, a greater potential gradient for upward moisture movement is created which helps in constant upward moisture movement. Such movement. otherwise is very limited in coarse sand. Observation on height were recorded at regular intervals of six months (Table 1). The height was 60.0 cm and 96.0 cm under control and bentonite barrier treatments. respectively.

MERITS OF THE TECHNIQUE

1. Very low cost (Rs. 150/-) and durable device.
2. Percolation, seepage and evaporation are checked.
3. Suckers growth is faster.
4. Promising in sandy soils.
5. Regulates supply of moisture.
6. Saves labour.
7. Wastage of fertilizer is checked.
8. Material is indigenously fabricable.

Table 1 : Effect of bentonite barrier on soil moisture storage and growth of date palm suckers.

Treatment	*Moisture profile	Storage in 60 cm soil (m^3 m-3)	Growth in height (cm) 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.

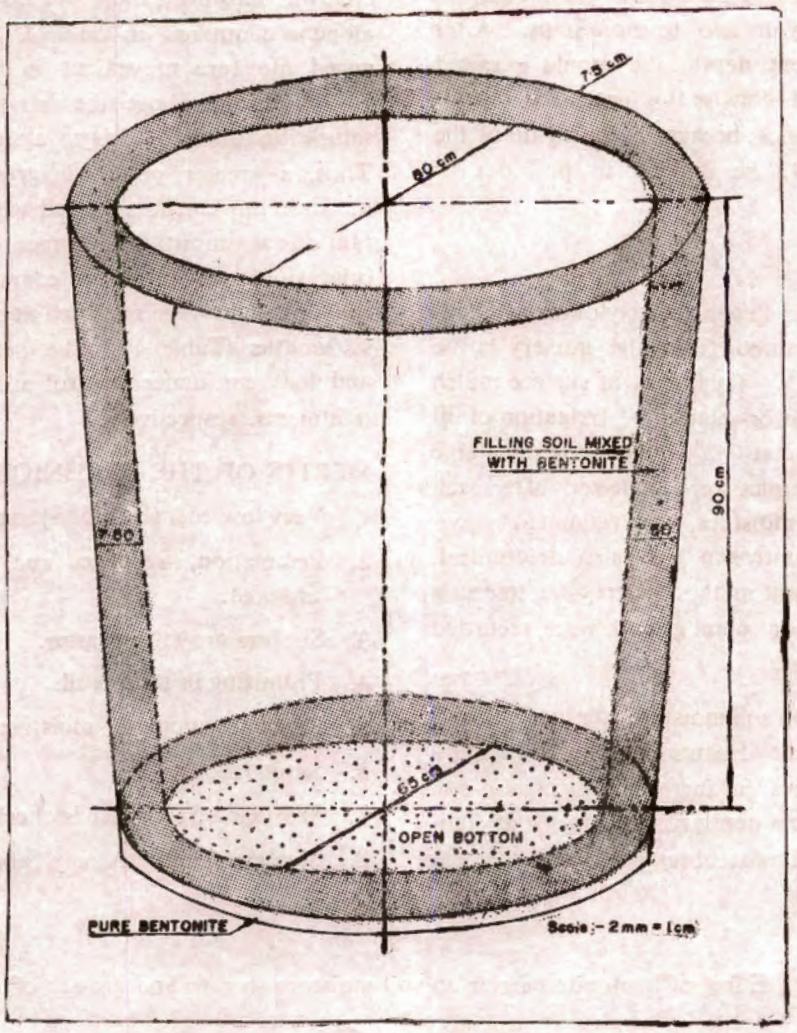

Fig.—IRON MOULD

THE SILENT PAINS OF RURAL WOMEN IN INDIA WITH SPECIAL REFERENCE TO HEALTH RISKS

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In the rural areas of developing countries, women constitutes nearly 50 percent of the population and form a visible majority among the poor. Women work not only in their homes and on their farms, but also as wage earner working on others farms and undertaking co-farm and non-farm occupations. In addition, they generally serve as fuel, fodder and water carriers for their families and this involves daily coverage of tiresome distances with heavy loads on the body for long hours of the day. In all they undertake 10-12 hours of hard physical labour. The women are on the other hand, unduly vulnerable to many health risks, problems and hazards in performing these tasks. Continuous hard work on the farm causes muscle fatigue and strain which does not allow them to recoup their strength or to build-up their defence mechanism.

The Socio-economic conditions of women compel them to take-up occupations which are often hazardous.

The paper presents a broad picture of domestic, farm and co-farm occupations having larger participation of rural women in India, posing serious, persistent and dominent health problems of toxicological and ergonomic nature and the resultant pains and sufferings.

INTRODUCTION

India is an agricultural country and about 75 percent of its total population (685.2 millions) lives in 576,000 villages (1981 census). Women constitutes nearly 50 percent of this population. Agriculture is the main occupation in rural areas and women are equal partners in agricultural production. The incidence of poverty was 48 and 37 percent in the years 1977-78 and 1984-85 respectively and the majority of poor were under employed having only irregular marginal jobs in difficult and substandard working environment (India's Seventh Five Year Plan, 1985-90).

The role of women in rural life in terms of their input in various occupations vary according to socio economic status of the family. All women however, devote their energy in domestic chores. Besides, female workers as a rule are vital bread earners in poor families. Indeed, their participatory role in augmenting the family income is generally at the cost of hardship, exploitation and drudgery.

Several studies have been undertaken to work out time, effort and energy, women spend on important subsistence tasks (Srivastava, 1985). The time budget on a typical day of the rural women is given in the following table (CSV, 1981).

In all, they undertake 10-12 hours of productive physical labour. Some of these activities are generally shared by female children. In most of these occupations, women are, however, subjected to many health risks. It has been noted that owing to peculiar female biology and its special characteristics, the responses of women to environmental toxins and ergonomics, as emerging from various occupations and production processes, are different from those of men. For example, pregnant women are forced to keep working (often up to the moment of child birth) because survival tasks have to be carried out without a day's break (Kishwar, 1984). During mensuration, women lose lot of blood of the body which they are not able to recoup. Due to their inherent nature of tolerance, women are prone to suffer more than men.

WORK TIME OCCUPATION OF RURAL WOMEN IN HOURS/DAY

Item of work	Landless labour	Small and marginal farmer	Average farmer	Land holder
1. Cooking and serving	2.0	2.5	3.0	4.0
2. Collecting Fuel and cattle dung and making dung cake (1)	4.0-5.0	3.5-4.0	3.0	—
3. Drawing and fetching water	3.5	3.5	3.0	2.0
4. Washing clothes (2)	1.5	1.5	1.5	1.0
5. Sweeping and cleaning (3)	1.0	1.0	1.0	1.0
6. Care of cattle (4)	1.0	1.0	2.0	—
7. Caring children	0.5	2.0	2.0	1.0
8. Working in the farm (5)	8.0	5.0	4.0	—
9. Marketing and food processing	—	3.0	2.0	3.0

1. Some families take the fuel wood as headload to market for sale.
2. Excludes washer women families.
3. Activities involves bending posture.
4. Includes collecting fodder, taking cattle for grazing and milking.
5. Stands for seasonality at sowing. transplanting, interculture operation, application of fertilizer and pesticides, and harvesting and threshing of crops.
6. Cover cleaning, drying and storing food grains, making curd and butteroil and selling milk products, fruits and vegetables.

This study brings into focus the physical health problems and risks faced by women, in various occupations in rural environment. This, therefore, does not aim at excluding them from their age old linkages with family, farm and other productive activities ; rather it aims at presenting their 'drudgery' and finding solutions of mitigating their sufferings, a silent expectation of every rural women.

DOMESTIC TASKS

Some of the domestic tasks leading to various kinds of health risks and problems are discussed below :

COOKING

Cooking food is a daily routine involving 2–4 hours a day. The traditional cook stoves are generally inefficient in terms of usable thermal output and produce considerable amount of smoke in poorly ventilated kitchens. The combustion of biomass or fuel wood produces a range of polycyclic hydrocarbons and carbon monoxide which case inflamatory action on the conjuctive and mucous linings of the respiratory track from the nose to the bronchi. Such combustion also results in an exposure of 700 micrograms of particle matter per cubic metre as opposed to the safety level of less than 75 micrograms (Srilatha. 1984, and Agarwal, 1987). This smoke contributes to a higher incidence of cough (with or without expectoration) and dysponea. Prolonged exposure to smoke also produces opacity of eye lens and other disabling occular lesions due to irritating effect of smoke. According to another study, the smoke of cattle dung cake causes placental transfer of carcinogen hydrocarbons. There are also chances of foetal damage by the benzpyrene inhaled by females (DST, 1984). This is an important aspect to be assessed in pregnant women.

FUEL COLLECTION

Collecting fuel wood/biomass is a hazardous occupation. In addition to covering tiresome distances (including up and down hills) in search of fuel for cooking and warming, the women often suffer injuries by their own axes while cutting wood when it slips out of hand (CSE, 1985). They are also exposed to hot sun and rains for long hours. Very often in the forest, the sharp edges of branches and thorns cut into their bodies and create wound. Thorny bushes create paranocia and osteomyelitis of fingers. Plants having sharp edged leaves produce skin lesions due to mechanical injuries. This sitation often leads to a variety of dermatoses called phytodermatoses (Pasricha, 1988). The back-breaking operation of cutting wood and stress of headlifting to home and market by covering 6-8 km daily and the poor nutrition undermines the health of women considerably and creates fatigues and hypertension. Women fainting on way is not an uncommon sight (CSE, 1985). This job continue to be the major cause of musculoskeltal problems. Ability to match the women's muscular capacity with the physical requirement of this occupation remains an important issue.

FETCHING DRINKING WATER

Women have to traverse long distances to fetch water and transport it on their body in large vessels. In hard rocky areas and in semi-arid regions, they have to draw water from very deep wells or deep step-wells. Collection of water from higher altitude or down hills adds to stress and fatigue. This operation generally takes 2-5 hours depending upon the distance, altitude and depth of water source. It has been estimated that a track of this distance can consume 600 calories or more, adding upto one third of the daily nutritional intake (UNICEF, 1988). In carrying water, women experience intense pain in different parts of their body particularly the legs, waist, hip and shoulders. According to medical opinion, continued lifting of water vessels may lead to a prolapsed uterus (Prabha Rani, 1983).

Lack of quality consciousness of drinking water, ignorance about general hygiene and sanitation and the unhygienic environment created due to defeca-

tion by the rural people in open fields further compounds the health problems.

In the workplace or on the farm, they have to accept whatever water is available for drinking. Women who are frequently ill due to repeated attack of water-borne diseases are not able to provide even the basic needs of the family. It has been estimated that India loses nearly 1800 million person hours each year due to these diseases (UNICEF, 1987).

WASHING CLOTHES

The washerwomen in villages have to stand long hours in knee-deep water even in extreme climate and during advance pregnancy for washing clothes as their occupation. The process involves beating the wet clothes on a stone platform by repeated bending the waist downward and simultaneously rinsing clothes in water till these are cleaned. Normally, this work requires 6-8 hours hard labour daily. The consequences are muscle fatigue, backache and pain in the waist and shoulders. In addition, most washerwomen suffer from fungal infection, eczema and skin diseases in fingers hand and foot due to constant exposure to dampness and water.

Due to developing market linkages. washing soaps and detergents have found their way to villages. Rural washerman families now mix these detergents in their traditional cleaning agent. Due to economic constraints, the choice generally falls for a cheaper and poor quality. Contact with toxic ingredients of these cheap detergents cause hypersensitive reactions and related skin rashes (DST, 1984). During the author's own investigation increasing number of cases of dermatitis on dorsal aspects of finger and hand (exposed areas used for washing and cleaning), mainly due to toxic effect of the use of substandard detergents and soaps, were reported.

FARM OCCUPATIONS

Women agricultural workers face many health problems related to particular work processes and postures. The vagaries of weather worsens their plight as they sweat (losing precious water and salt) while working on the farm. The occupations having major participation of women and entailing serious, persistent and dominant health problems are discussed here.

SOWING SEED AND FERTILIZER APPLICATION

About 80 per cent of crop sowing is done manually, Women's main task is dropping the seed behind the plough. Central Institute of Agriculture Engineering (CIAE), India has estimated that in this process she has to walk nearly 40 km to sow a hectare of land. This is a repetitive job in a bending posture. The same posture and activity is followed in application of fertilizer behind the plough. For uniform distribution of these inputs (through out), requires a high concentration of mind.

WEEDING AND INTERCULTURE

Women do much of these operations with the help of a traditional short handle hand-tool ('Khurpi'). It involves squatting and repeated forward movement in the same posture. This operation may continue for 3-4 hours at a stretch. This causes fatigue, backache and pain in the waist and leg joints.

TRANSPLANTATION OF RICE

Rice transplantation is conventionally performed by women. In this process, they have to almost double up their body forward while planting the seedlings. They can stretch their backs only after one row of planting is over, before starting on the next row. Further, during the entire process, they have to move in the backward direction. In this back-breaking occupation, they stand bare-foot for long hours in hot sun in the puddle (swampy soil) and quickly insert the roots of the seedling into the soil with the help of their thumb. In this process, many a time the women workers accidently damage their thumb bone and nail. These operations also entail health problems like, (i) backache, muscular pains and fatigue coupled with

climatic cramps, exhaustion and strokes due to tropical heat ; (ii) skin diseases in the feet caused by long exposure to dampness and stagnant water ; and (iii) constant pressure on the abdomen and uterus resulting in foetal losses among pregnant women. The seasonal health hazard leading to mortality among infants and children as also morbidity and mortality among women are comparatively higher in rice growing areas (Deshwani, 1984 and Batliwala. 1988).

APPLICATION OF PESTICIDES

Women workers have to spread pesticides on the standing crop by bare hands and without any protection against exposure to toxicity and air pollution, resulting in transfer of the chemicals to the body (by ingetion and inhalation). The health problems related to pesticides poisoning were noted as persistent digestive and respiratory disorders (nausea, vomitting, diarrhoea, headache and cough). It creates neurological disorders and sometimes the serum cholinesterase may tend to paralyse. According to a study carried out in Coimbatore (Tamil Nadu, India), 70 per cent of the breast milk (the only nutrition for infants) samples contained BHC and 29 percent contained hepta chlor (Hindu, 1985). Many other agrochemicals are also known to seriously affect the reproductive functions and organs in women (DST, 1984).

HARVESTING CROPS

Of all the crops grown in India, about 90 per cent is harvested by a traditional short-handle circular shaped tool, called 'sickle'. While using this tool, women have to exert more energy and greater grip force (5500–6400 Kcal per day-ILO, 1983) from arm muscles to direct and pull the shear. The operation involves a bent or crouching posture holding the bunch of crop in one hand and cutting it with the other. In this process, the sharp edges of certain crops prick into the palm and create osteomyelitis of fingers and paranocia. The odd posture causes severe strin on the muscles of the back and legs. Often while working in a hurry (time pressure) or due to repetitiveness strain, the 'sickle' or the hand holding the crop slips and serious injuries take place, which may result in titanus. Friction forces also produce deformation of skin which in turn stimulates nerve endings and provides tectile feedback (Taylor and Lederman 1975).

CHILLY PICKING

Chillies have strong pungent characeristic and gives a burning sensation when repeatedly handled. In plucking chillies (a harvesting operation) by bare hands, one has to adopt a sitting or crawling posture in between the standing crop. This job develops severs pain in the belly and waist. The operation makes the hands and eyes burn. It a mother's chilly soiled hands inadvertently pat her suckling child, it causes so much agony to the baby that the women avoid touching their babies during plucking operation (Mrinal Pande, 1981).

POST HARVEST PROCESSING

Post-harvest operations involve carrying the produce as head-load to threshing, winnowing, cleaning or further processing. For example, in case of paddy (rice), women beat the bundles of harvested crop on a wooden log to separate the rice grain (dehusking). This operation is done with the use of hand or legs. Similarly, harvested wheat crop is threshed and winnowed to separate the straw and husk. In these operations, besides physical stresses. the workers are exposed to heavy concentration of air borne grain dust (DST. 1984). By the time they finish the work, their whole body gets covered with grain dust. This results in health risks called 'Farmers Lung' and the workers are subjected to pneumoconiosis mycosis, irritation of the respiratory system or respiratory and cutaneous allergies.

ACCIDENTS

It has been estimated that every year during wheat harvesting season, about 1000 farm workers become victim of thresher accidents. Sugarcane crushing and cotton ginning also result in frequent accidents (Dogra, 1982). By 1983 over 10,000 farm workers had been incapacitated by power threshers

(Batra, 1983). Accidents also take place in fodder chaff-cutters. These accidents, however, relate both to men and women workers.

CO-FARM OCCUPATIONS

Rural women are engaged in a number of co-farm occupations involving processing of rural based raw materials. The nature of 'drudgery' however, vary as some of these occupations are undertaken in addition to farm activities in cottage sector (National Commission on status of women, Government of India report, 1988). Nail dystrophy was detected in occupations like cashew and cotton processing.

HEADLOADING

This is an important occupation of women and relates to carrying (on head and shoulder) heavy loads of fuel wood/biomass, fodder, water, farm produce and other co-farm and non-farm products from one place to another covering tiring distances on foot. They also carry heavy loads of leaves (collected from forests) for making leaf cups and plates. The physical stresses involved is quite evident.

CASHEW PROCESSING

This occupation involves shelling, peeling, grading and packing of cashew nuts. Shelling is the most unpleasant operation because the cashewnut liquid emits a pungent smell and leaves a scalding and corrosive effect on human skin. The liquid often causes allergy and dermatitis and gives a burning effect on the hand.

COIR PROCESSING

This activity involves husking, shearing and weaving for making rope and other products from coir. The women beat the raw coir with wooden sticks which cuases laceration and burning sensation on the hands. They also develop reheumatism and asthma as they sit on they damp ground near the backwaters. Spinning accounts for the bulk of morbidity among women coir workers. This job causes hand injury (linear abrasion of palm, skin and fingers) while controlling the twist and feeding the raw material by gripping the coir yarm tightly. These injuries often bleed and are very painful. Maximum prevelence of respiratory disease (asthma) is observed in coir workers (NIOH. 1979).

TOBACCO PROCESSING

This involves pulverising of dried tobacco leaves and their sizing. The National Institute of Occupational Health (NIOH). India have discovered that the main hazard in this occupation is due to tobacco dust (absorption of nicotine). This was noted from excretion of nicotine and continine in urine. Tobacco dust also cause burning of eyes, conjuctivities rhinitis, mucosal dryness including that of the genital tract, occupational dermatitis, bronchitis and emphysema. Majority of workers were found clinically anaemic and had complained of headache, nausea and giddiness. Respiratory complains were also reported by 22 per cent of women workers. Most symptoms indicate that the work result in 'mild necotine toxicity" (NIOH, 1984). In addition, it created inflammation of the nasal mucous membrane. It is, however, a known fact that tobacco is a potent carcinogen. Almost similar type of health hazards are noticed in 'beedi' (like cigarette) making workers.

COTTON PROCESSING

Cotton pod shelling is another occupation involving health hazard. Here, the women work constantly in sitting posture which results in musuloskelatal problems. It has been observed that working in hot sun near the heap of white cotton the women's finger-tips start bleeding by the time they complete 20 Kg of pod shelling. The glittering whiteness of cotton reflects sunlight on the eyes of the workers and results in opthalmic problems like cataract and acute headache. Some women also complained of abnormal menstrual cycle (Dholakia, 1982).

SILK PRODUCTION (SERICULTURE)

Majority of workforce in sericulture are women. In a study of two genetically determined dermatoses viz. ichthyosis (ichthyosiform scaling on legs and

forearms) and palmo-planter were observed. Palmer maceration and pitted keratodysis of palms are prevalent among workers of boiling and reeling section which is caused due to the effect of prolonged immersion of hands in a warm alkaline water. Nail dystrophy was detected among cocoon sorters. Repeated friction by rubbing over the wire gauze net led to wearing away of the medial halves of the distal free edge of the nail plate in the little, ring and middle fingers on the right hand. A diffuse hyperkeratosis of the sole was noticed in almost all the workers (90 per cent). Palmer hyper-keratosis was observed in 60 per cent workers (asricha, 1987).

CONCLUSION

This profile of suffering and silent pains of rural women may not be complete (Srivastava, 1985). But whatever has been stated here is very depressing and alarming. In view of this scenario, it is high time that we have a hard look at the maladies afflicting women workers. While this valuable human resource must be retained, there is ample scope of making improvements in skills. techniques, tools, and production processes and preventive and curative measures through the intervention of science and technology. These treatments could be planned as 'action-research' projects in rural setting keeping in view the realities of ergonomics of work-place and tasks with special reference to female biology, their physical. economic and nutritional limitations in a developing country. A women biased systems approach and optimisation studies at the micro-level may also be developed to integrate women, their occupation, need for a living wage and their health. Health insurance could perhaps be an imperative necessity.

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Did You Know ?

A 57 SQUARE MILE Parcel of land covered by solar cells that convert sunlight into electrical energy would generate energy equal to the amount of energy generated by all the crude oil imported annually in the U.S.A. Only 2.7% of the land surface of New Mexico would suffice for this purpose.

CLASSIFICATION, METHODS OF CONSTRUCTION AND FINANCING THE RURAL ROADS–SOME ISSUES AND SUGGESTIONS

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In this paper brief introduction, design aspects and methods of Construction of rural roads has been described. The various financial resources and suggestions has given. The author has considered the economic aspect of construction of various types of roads.

1. RURAL ROADS DEFINED :

The term 'Rural Roads' has different connotation in different parts of the world. The concept of a rural road in many developed countries is that of a road which is not urban in the sense that it passes through rural and agricultural areas. In India, however, a rural road appears to have a different connotation in the sense that a road passing through rural areas could also be a National High-way, State High-way, Major District Road, Other District Road or a Village Road. It is, therefore, necessary that rural roads be defined in clearer and more precise terms. In the Indian Context it appears appropriate to define rural roads as roads with low traffic volumes in predominantly agricultural areas, the type of traffic being predominantly slow-moving animal-drawn carts most of the times As per the current practices rural roads include the categories of Other District Roads and the Village Roads which are defined as under :—

OTHER DISTRICT ROADS (ODRs) :

Other district roads are roads serving rural areas of production and providing them with outlet to market-centres, block development headquarters, taluka or tehsil headquarters or other main roads.

VILLAGE ROADS (VRs) :

Village roads are roads connecting villages with each other and to the nearest road of a high category.

The Road Plan 1981-2001 has proposed to designate these two classes viz., Other District Roads and Village Roads are the tertiary system. In the various plan schemes currently being implemented viz. Minimum Needs Programme (MNP). Rural Landless Employment Guarrantee Programme (RLEGP), National Rural Employment Programme (NREP), there is no distinction made between Other District Roads and Village Roads. Both these classes are considered as one, intended to connect villages. It is thus obvious that there exists no special reason for retaining the two classes seperately and they can be combined into one classs, to be called either "Rural Roads" or simple "Village Roads"

2. CLASSIFICATION OF RURAL ROADS :

Rural roads can be classified into the following three categories :

(a) Exterior Roads :

Exterior roads also termed village link roads are the roads which connect villages with each other or villages with town or village with main roads. These roads are not designed to serve through traffic. These roads provide approach to villages and center to all types of traffic.

(b) Interior Roads :

(i) *Village Ring Roads* : Village ring roads are laid to a rectangular or square pattern encompassing the entire village. These roads are connected to the link roads and provide entry for agricultural machinery, tractors, bicycles, bullock carts, etc. into the village and their exit from the village to farms.

(ii) *Village Radial Roads* : Village Radial roads starting from their junction with village ring roads would go upto the outskirts of the village proper. These roads are expected to cater agricultural machinery, tractor. bullock carts, etc.

(iii) *Village Streets* : Village streets are the roads which provide access to the houses situated on one or both sides of it. These roads can be further categorised as main interior streets and subsidiary interior streets. Main interior streets provide approach for certain categories of slow moving vehicles into the interior of the village. These link the village focal points with the extremities of roads. The subsidiary interior streets off-shoot from the main streets and provide access to the individual houses situated on one or both sides of it.

(c) Village Farm Roads :

(i) *Major Farm Roads* : Major farm roads are the roads which connect the central points in the farm areas out-side the village with the ring roads. These roads are designed to carry agricultural machinery, tractor, trolley, bullock carts, etc.

(ii) *Minor Farm Roads* : Minor farm roads off-shoot from major farm roads to provide access to individual farms, meadows and pasture grounds.

(iii) *Cattle Tracks* : Cattle tracks are provided for the movement of animals to pasture grounds, cattle ponds and animal shelters.

METHODS OF CONSTRUCTION OF RURAL ROADS

3. INTRODUCTION

Rural roads are essentially low-cost roads. It is so primarily because of the vast network of rural roads to be developed in the country during the next few years within the limited funds available for the purpose, It is. therefore of utmost importance that the related construction cost can be cut down to the minimum extent possible and yet achieve the minimum needed serviceability level under the anticipated traffic and climatic conditions. The conventional specifications for construction of rural roads in most parts of the country call for the use of hard stone metal which has often to be brought from long distances. But the use of locally available materials like kankar, laterite, moorum, dhandla brick jhama and other soft aggregates can significantly lower the construction cost. The extensive research carried out by CRRI, New Delhi in this direction has led to the development of various low cost road construction techniques, methods described in the preceeding paragraphs.

4. USE OF SCIENTIFICALLY COMPACTED SOIL IN PLACE OF STONE OR BRICK IN THE LOWEST LAYER OF A ROAD PAVEMENT

Almost all soils gain strength both under dry and saturated conditions, when compacted to increasing densities. Higher strengths can be achieved further by resorting to blending of soils i. e. mechanical stabilization. This fact can be utilised to a great advantage in the alluvial plains of India where there is a change in the texture of soil in comparatively distances. It is an economic possibility in most

cases to blen different local soils to produce a mixture which will be a positive improvement on the local subgrade soil. This mixture could be utilised to reduce the required thickness of hard crust, after full advantage has been taken of the natural subgrade soil by proper compaction.

(a) Economics of Construction :

A scientific replacement of stone soling in the lowest layer for a thickness of about 30 cm by locally available soils suitably blended, if necessary, can bring about saving to the tune of about 20 to 25 percent.

(b) Construction Procedures :

(i) Depending upon the natural moisture of the borropit soil, the borrow areas may be pre-wetted for facilitating excavation and addition of moisture.

(ii) The soil shall be excavated and clods shall be broken with wooden mallets or with hands so that, by and large, there are no clods larger than 10 to 12 mm. The soil shall then be spread in place to the required loose thickness. Requisite quantity of sand, if required, is hen added to it and the mass is cut and mixed two to three times for obtaining hom genous mixture. If required, additional water may be sprinkled (to bring the mass to the required moisture content) during cutting and mixing.

(iii) The soil-sand mixture is then formed to proper profile to a width larger than the pavement width on top by 15 cm on either side. In the straight reaches, the cruse slope of the crowned profile shall be 3 percent. The loose layer thickness shall be such as would meet the required compacted thickness, but will not, in any case, exceed 22.5 cm.

(iv) Rolling shall be done in the same manner by giving 6 to 8 coverages as for the standard specifications adopted for earthwork. The surface shall be well-finished to the proper profile before receiving the other layers on top of the sub-base thus prepared.

5. SCIENTIFIC USE OF NATURALLY OCCURRING GRAVEL MIXTURE ON ROAD CONSTRUCTION :

There are, however, areas which abound in deposits of hard gravel either as such or mixed up with varying percentages of fines. Such deposits can also be used in road construction after roportioning its gradients (Coarse and fine fractions). The aggregate impact value of gravel should not be more than 40 percent. The recommended specifications for the construction soil-gravel roads are as under :—

(*i*) *Base Course* : This shall consist of a compacted crust of graded soil-gravel mixture as per limits given below. Soil-gravel mixture shall be compacted at optimum moisture to the required thickness.

Grading Limits of Soil Gravel Mixture

I S. Standard Sieve	Percentage Passing
40 mm	100
20 mm	80—100
10 mm	55—80
4.75 mm	40—60
2.36 mm	30—50
600 micron	15—30
75 Micron	5—15

Liquid limit : Not exceeding 25 percent.

Plasticity index : Between 4 to 8 percent.

(*ii*) *Base Coat* : This shall consist of graded soil-gravel mixture as per limit given below. Soil-gravel mixture shall be compacted at optimum moisture content to the required thickness.

Grading Limits of Soil Gravel Moisture

I. S Standard Sieve	Percentage Passing
20 mm	100
10 mm	80—100
4.75 mm	60—85

2.36 mm	45—75
1.18 mm	35—60
600 micron	—
300 micron	20—40
75 micron	10—25

Liquid limit : Not exceeding 35 percent.

Plasticity Index : 8 to 12 percent.

(a) Economics of Construction :

By replacing the conventional water-bound-macadam and stone soling with locally available hard gravel, economy to the tune of about 25 percent can be effected, the cost of surfacing being the same in both cases.

(b) Construction Procedure :

A number of samples shall be taken from the deposits both in a linear direction as well as towards the depth to know the areas which can give the material which would conform to the proposed specifications either of base course or base coat. The material conforming to the specifications of base course shall be stacked over the subgrade of the road previously prepared in the loose thickness of 22.5 cm. The material conforming to the specifications of base coat shall be stacked over the base course of the road previously prepared in loose thickness of 15 cm.

(*i*) *Optimum Moisture* : The optimum moisture of the stacked material shall be determined by the Proctor's apparatus. The allowance for evaporation of moisture shall also be taken into account.

(*ii*) *Compaction* : The compaction shall be carried out with 8-tonne power roller to a minimum of 95 percent of dry bulk density obtained by Proctor's apparatus.

(*iii*) *Curing* : The surface shall be cured by sprinkling water frequently for a period of about seven days.

(*iv*) *Surface treatment* : The road shall be subjected to controlled traffic for a few days before giving it bituminous surfacing. The bituminous surfacing will be laid according to the local practice, except that prime coat of a suitable bituminous cutback at the rate of about 9 kg. per 10 sq. metre shall be given prior to surfacing and allowed to penetrate into the crust.

6. PROVIDING SUB BASE OF LOCAL EXPANSIVE SOIL STABILISED WITH LIME IN THE CONSTRUCTION OF WATER-BOUND-MACADAM IN BLACK COTTON SOIL AREAS :

Almost 16 percent of the country's area abounds in black cotton soil. It has been observed that there is a tendency for the road surface to go wavy on account of the continued effect of poor supporting power of the subgrade and working up of the wet soil into large voids of the stone soling during the wet season. As a result of this phenomenon, the soling stone has a tendency to sink and cause appreciable wavingess in the riding surface.

It is, therefore, very necessary that a stable layer should be provided between the subgrade and the stone soling to avoid deterimental deformation of the road. Although a layer of moorum with low plasticity index has been found to be effective, its use is limited as many areas do not have such material. The other alternative is the stabilisation of black cotton soil with 5 percent lime by weight of the black cotton soil which improves its workability besides reducing the shrinkage and swelling properties considerably.

The compacted lime-treated soil develops adequately high CBR value and is, therefore, considered to be strong enough to prevent the sinking of the stone soling into the sub-grade, Recommendations are, therefore, made to provide a minimum of 10 cm of the compacted layer of local black cotton soil treated with 4 to 5 percent slaked lime. In addition to the use of black cotton soil treated with lime as a sub-base, it can also be used as a base course provided it is economically justified on the basis of CBR tests. The subgrade which consists of black cotton soil often gets saturated at the

recession of the monsoon and consequently results in loss of bearing capacity of the subgrade. This requires an additional thickness of at least 15 cm which can be economically provided by constructing sub-base with local soil stabilised with 4 to 5 percent lime by weight of dry soil.

(a) Economics of Construction :

The cost of local soil even when treated with 5 percent lime will effect saving to the tune of 20 percent, if used in lieu of the same thickness of crust provided in brick or stone soling.

(b) Construction Proceedure :

Black cotton soil existing in the borrow areas shall be pulverised to a degree of fineness such that 90-100 percent passes 25 mm sieve and not less than 50 percent passes 4.75 mm sieve. This degree of pulverisation can be effectively and economically achieved with the help of light agricultural machinery. The machinery shall be operated when the moisture present in the soil shall range between 18-23 percent. The pulverised soil shall be placed in the sub-grade in a loose thickness of 22.5 cm. Slacked lime (purity not less than 60 percent) shall be spread over the loose soil at the rate of 5 percent of the dry weight of soil. The soil-lime mixture shall be mixed thoroughly with a rotavator or disc harrow. The optimum moisture shall be added to the lime soil mixture and thoroughly mixed. This shall be com pacted with an 8-tonne power roller. This shall be cured for a week or so, before covering it with the next layer.

7. PROVIDING SUB-BASE AND BASE COURSES OF LOCAL NON-EXPANSIVE SOILS IN THE CONSTRUCTION OF WATER-BOUND MACHADAM ROADS IN WATER-LOGGED AREAS :

There are many areas in the country which are either water-logged or getting water-logged. On account of continued high water table, the sub-grade gets saturated resulting in the loss of bearing capacity. It is, therefore, very necessary that a stable layer of local soil stabilised with 3-5 percent lime by weight of soil, should be provided between the sub-grade and the stone soling to avoid deterimental deformation of the road. It has been seen that the compacted lime-treated soil develops adequately high CBR value and thus can be used as a sub-base or base course provided it is economically justified on the basis of C. B. R. tests.

(a) Economics of Construction :

The cost of construction by stabilizing non-expansive soil with 2 to 3 percent lime will be only about half of the cost of compacted crust of stone soling in the sub-base and base of the road crust. Apparently, therefore, this technique will result in significant savings in the construction costs.

(b) Construction Procedure :

The soil from the borrow area shall be collected after removing the top 7.5 cm of soil which is usually very hard. It shall be placed on the sub-grade in loose thickness of 22.5 cm Commercial fat lime 3 to 5 percent by weight of soil) shall be spread over the loose soil. The soil-lime mixture shall be mixed thoroughly with a rotary device failing which by means of manual labour. The optimum moisture content shall than be added to the stacks in small sections. After allowing it to remain over night, the wet soil shall be thoroughly mixed with rotavators. This shall then be compacted with 8-10 tonne power roller resulting in a consolidated drust of obout 15 cm.

8. STABILISATION OF SOIL WITH SOFT AGGREGATES FOR CONSTRUCTION OF ALL WEATHER CHEAP ROADS IN DRY AREAS :

In many localities, low grade or soft aggregates like laterite, kankar, moorum, brick ballast, dhandla etc. are available within more economic leads as compared to conventional hard stones. These low-grade aggregate can be used in construction of rural roads by suspending them in well graded soil, so that the strength of the resulting materix is derived not from the interlock of aggregates but from the cohesiveness of soil mortar. The proportion bet-

ween soil and aggregates is so fixed that there would be enough soil cosion around each particle of aggregate, not only to protect it from crushing but also to hold the adjoining particles together and to impart requisite strength to the compacted mass, under the range of moisture conditions likely to prevail in the region. This method is recommended for the following conditions :

(i) Rainfall — Upto 150 cm per year

(ii) Sub-soil water level — Not less than 1.3 metre from the surface.

(iii) Traffic Intensity — Not more than 500 tonnes a day.

(iv) Type of soil — Well graded.

(v) Stone aggregate — Not cheaply available.

(a) Base Course :

Soil with plasticity index 4 to 7.5 and sand content not less than 50 percent shall be laid at optimum moisture and compacted with about 8-tonne roller to a minimum dry bulk density of 1.8 gm/cc. The soil and water used for construction should be free from harmful salts like sodium sulphate. The sodium sulphate, if present in the soil collected, its content should not be more than 0.15 percent by weight of the soil. The compacted thickness of the base course shall vary between 7.5 to 15 cm. depending upon the corresponding thickness of soling, normally adopted in the area. The base course should have a camber of 1 in 24 and final density shall not be less than 1.8 or 95 percent of laboratory density.

(b) Upper Course or Base Coat :

Seven parts of soil with plasticity index 8-10 with sand content not less than 33 percent shall be mixed with three parts by volume of brick aggregates, kankar, moorum or laterite. The size of the aggregate shall be such that it posses 100 percent through 30 mm sieve and not more than 20 percent passing through 6 mm sieve. The aggregate impact value shall be about 40-50 percent. The mixture of soil and aggregate shall be brought to optimum moisture content and then covered with 25 mm size stone metal or over-burnt brick aggreg te at the rate of 0.2 to 0.3 cu. m. per 10 sq. m area The aggregate impact value of the stone used for grafting shall not be more than 30. The compaction shall be carried over with 8-tonne roller.

(c) Economics of Construction

The use of low-grade aggregates in the construction of roads effects saving to the tune of about 35 percent in comparison to the conventional construction cost for soling with hard stone metal, etc.

(d) Construction Procedure

(*i*) *Preliminary Soil Survey* :—A visual identification of soils along the entire length of the existing earth road of proposed alignment shall be done keeping in view the behaviour of different lengths under traffic in different weather conditions. Topographical data and figures of rainfall, etc. are also collected. The object of the survey is to fix the specifications.

(*ii*) *Soil Sampling* :—As a certain amount of banking is necessary to keep the road immune from flooding, the soil for stabilisation purposes has normally to be borrowed from areas outside the formation width of the road. In the alluvial plains of India, the characteristics of the soil deposits change at short intervals and, therefore, soil samples are taken from fixed points which can be located when the soil is to be actually borrowed. Soil samples are taken at points 200 m apart and 20 m from the centre line of the road, at 0.3 m. (being the specified depth of borrow pits) depth. Soil is sampled after removing the top 2 to 5 cm foreign matter which may be in the form of grass or any other loose matter. A representative sample of about 2.5 kg. in weight is obtained by the method of quartering, after mixing the entire quantity of soil dug out from 0.3 m × 0.3 m × 0.3 m pit. For location of pit for subsequent borrowing of soil, a numbered peg is driven. In addition to

sampling at regular intervals, a few more samples of admixtures like fat clay and sand available at economical distances from the road shall be taken to facilitate blending. Samples of local aggregates such as brickbats or any other local deposits of kankar, laterite or coarse moorum etc. are also collected. Samples of water which is likely to be used for construction shall also be collected in glass bottles.

(iii) *Despatch of Sample* : The Samples shall be put in paper bags to avoid loss of fine material. This, in turn, shall be enclosed in a cloth bag to which a tag shall be tied describing the exact location. Similar information written on paper shall also be enclosed in the bag itself. The samples may be despatched to the field laboratory for testing.

(iv) *Testing of Samples* : The following routine tests shall be carried out :

(a) Sieve analysis through ISS 2 mm, 425 micron and 75 micron sieves.

(b) Liquid limit

(c) Plastic limit and plasticity index.

(d) Sulphate content.

(e) Subgrade Formation :

If the formation is already existing, then the top 15 cm of the subgrade shall be raked, pulverised and rolled back with 8 to 10-tonne power roller at near optimum moisture content. In case of a new formation the top 30 cm of the embankment shall be compacted in loose layers of not more than 22.5 cm thickness in the same manner as mentioned above. The desired moisture may be attained by flooding the borrow area.

(f) Collection of Soils :

Soils, as specified in the designed mixtures, shall be dug out and collected in stacks in required quantities from every 0.2 km length.

(g) Pulverizing of Soils :

The soils shall then be pulverized separately with the back of spades to such a state of fineness that about 80 percent of the soil is under 8 mm size. In the case of fat hard clays (Plasticity Index over 20), the pulverization can be carried out more conveniently, if the clods are wetted a day or two in advance.

(h) Dry Mixing and Stacking :

The different soils in the case of base course, and soils with aggregate, in the case of wearing course shall then be mixed in the dry state by turning them over with spades and shovels. After this, stacks about 37.5 cm in height shall be prepared and levelled carefully on top.

(i) Checking up of Mixed Stacks :

A representative samples shall be taken from the mixed stack and checked up in the field laboratory for correctness of plasticity index and sand content. Any serious departure shall be set right by adding the requisite admixture in the soil.

(j) Addition of Moisture :

Optimum moisture shall be determined in the field laboratory and poured carefully over the stacks, small earth sides having been provided to retain the water. The water shall be added towards evening to stack earmarked for laying next morning and allowed to soak down over night. To ensure uniform distribution of water, the stack shall be divided into a number of sub-stacks on the surface with raised earth sides. Necessary allowances shall made for evaporation losses and absorption by brick aggregates as determined by actual experiments from time to time. The optimum moisture content is determined on weight basis, it will be necessary to determine the average weight of soil per cubic meter.

(k) Laying & Rolling of Base Course/Wearing Course :

After remaining in contact with moisture for several hours, the wet base course/wearing course

mixture shall be sliced-off from the stacks in small lots, mixed a required and laid on the prepared sub-grade/base course with the help of templates to a cross slope of 1 in 24 for unsurfaced and 1 in 48 for surfaced road (The mixing can also be done mechanically with equipment such as rotavator). The rolling shall be done with a 6-8 tonne flat roller to attain minimum dry bulk density of 1.8 gm/cc.

The wearing course shall also be rolled with a 6-8 tonne power roller. Rolling shall be continued till the wheels of the roller make no appreciable impression on the surface. A heavy sprinkling of of water shall then be given to the road and left over night. In the morning, the surface shall again be rolled to finish. Where stone grafting is specified, the following procedure shall be adopted.

On the first day the uncompacted upper course together with the layer of stone, 25 mm gauge, spread on the surface at the rate of 0.2 to 0.3 cubic metre per ten (10) square metre shall be sprinkled thoroughly with water and left off till next day. Next day, without adding more water, the surface of the road shall be rolled thoroughly for at least 6 times. The surface shall again be thoroughly watered and left for the rest of the day. On the third day again, the surface of the road shall be rolled after spreading some wet soil to blend the surface without any addition of water and this shall be continued till the road is thoroughly compacted. Out of these 3 days, the following and re-rolling on the second day shall be the heaviest.

(l) Curing :

The road shall be kept closed for traffic for 4 to 5 days and heavily sprinkled with water during this period. After this, water sprinkling of a lighter nature shall be continued for another 10 to 14 days and controlled traffic allowed to run over the road, beginning with motor traffic only and gradually extending to all kinds of traffic.

(m) Surface Treatment :

The crust shall be allowed to dry to a moisture of about 4 to 6 percent before bituminous surfacing is, given, which shall be done according to the practice prevailing in the area.

9. STABILIZATION OF SOIL WITH SOFT AGGREGATES FOR CONSTRUCTION OF ALL-WEATHER ROADS IN WET AREAS:

There are vast areas in the country where the rainfall is very high and rainy season also extends for a period of about six to eight months a year. The strength of the soil and soil aggregate mixture forming the sub-base/base course of the roads/pavements in such areas gets reduced considerably on wetting. This reduction in strength can, however, be made up by stabilishing with 4 to 5 percent lime. The technique No. 5 with minor modifications ot a stabilised base or sub base as the case may be, used for construction of roads in wet areas.

10. SOME FEATURES OF DESIGN AND CONSTRUCTION OF RURAL ROADS :

In the design and construction of rural roads the type of traffic to be reckoned is mainly the bullock carts with their high intensities of contact pressure. However, the crust thickness should be adequate to stand the heavy but occasional runs of trucks and tractors which cannot be ruled out these days A systematic approach must be followed for design and construction of these roads. Some of the steps in this direction could be :

(i) A classification of the local soil and basic tests which will enable to judge the possibility of its use and the choice of method of stablization needed for its improvement.

(ii) Normally, machnical stablization with sand or use of 3 to 5 percent of lime can be adopted to improve the properties of a clayey soil. A sandy subgrade can be used directly as subgrade, but after adequate compaction.

(iii) The formation must be raised adequately above the adjoining fields, to avoid undue satu-

ration of the subgrade. The slopes must be made stable, by a cheaper type of stablization or by at least providing a suitable turfing. Provision of intercepting side drains and cross-drainage works should not be overlooked. The culverts may be of low-cost type such as hume pipes, brick or stone masonry or even burnt clay pipes.

(iv) Investingations on locally available cheap materials, namely soft aggregates laterite, kankar, moorum and industrial waste materials like fly-ash, molasses, rice-husk ash, baggase ash should be made to find out their suitability in road construction. Although some of the soft aggregates may not satisfy all the rigid standards, they will be quite useful in the preparation of base courses under light to medium traffic, provided they are properly graded and compacted.

(v) Stablization of soft aggregates, with moderate amounts of lime, fly-ash or molasses will even make them more stronger, durable and fit for surfacing under light traffic. Soil-aggregates mixes and soil-cement will also prove to be economical propositions.

(vi) In the design of base courses and road crust, the Group Index Method or the C. B. R. method can be adopted. Where facilities for determining the C. B. R. value are not available nearby, the values can also be determined from a knowledge of the gradation and index properties of the soil and using the empirical formulae given by Bhanot and others

(vii) High class technologies and mechanised constructions should be totally outside the philosophy of rural road development. Use of locally-developed construction tools and adoption of labour-intensive methods will help in providing employment potential to the local rural population. There should be, however, no compromise on the question of making the specifications sound and suited to the traffic, and making the construction suitable and durable. The artisans and the labour are to be trained to develop the needed skill for the jobs of supervision and quality control.

FINANCING THE RURAL ROADS—SOME ISSUES AND SUGGESTIONS :

The construction of an adequate rural road network has become a matter of national concern in Iudia. It is seen as an essential infrastucture enabling the development of three quarters of the total population of the country living in rural areas. It has been estimated, Swaminathan, et al (1981 , that 9 lakh kilometres of fresh road construction are required to provide a satisfactory rural network to all villages. This will involve an expenditure of Rs. 11,000/- crores at 1979 price level, and will take at least two decades even (if further price escalations are ignored). The length of rural roads in the country in 1981 was about 9.13 lakh kms, and is expected to more than double itself by the end of the Century. The Twenty-Year Road Development Plan (1981-2001) envisages that total length of rural road network by 2001 to be 21.80 lakh km, or an addition of about 12.67 lakh kms to the rural roads ensuring linkage of all villages as per Nagpur Plan. This requires an annual investment of not less than 1700 to 1800 crores as against the present annual average invesment of nearly 500 crores. In addition to this, the funds are also required for the maintenance of the existing roads. The resource gap in this sector is a persistent problem.

The financial inputs for all road works generally comes from Government resources which may be Central, State Municipalities Development Board, Town Area, etc. Since the village is the smallest unit of a group of families, it has hardly any money for a welfare and service activity, and obviously largely depends upon the Government resources for such activities as construction of roads. There is little hope for finding all the funds needed for this stupendous task of rural road development from the normal Plan provisions. Therefore, ways and means of stepping up the paec of development by

additonal resource mobilisation will have to be found to achieve the targets by the turn of the century. Some of the possible means of finding resources are discussed below (9) and pertinent suggestions made, in regard there to :—

1. Some part of the land revenue collected from the village could be ploughed back for village development. A minimum percentange of land revenue should be earmarked for the development of rural roads.

2. The other source of raising funds for the rural road development could be levying a sort of cess on the saleable agricultural produce. This could be collected from the farmers at the market place, sugar mills, rice mills, etc. Many market places (Mandis) do levy a cess on the parked vehicles and the agricultural produce sold, for the development of market place and for the facilities provided. Even the private wholesale dealers charge commission over the sale. At present, most the farm produce is purchased by the governmental agencies and the price offered is according to the rates fixed or predetermined by the Government, thus the cess to be collected may from a part of the price offered. The cess collected from a market place may be distributed amongst the villages feeding the market place.

3. Village Panchayats can collect a type of 'Road Tax' from the vehicles in the villages. The rates could be different for different types of vehicles. A toll tax can also be collected by Panchayat from the vehicles visiting the villages. The Panchayat may also accept loans and donations from the villagers who are getting direct advantage from the road construction in the village. Best use should be made of the potential of villagers contribution in making available land for road construction and for doing earth work.

4. The Government can also provide matching grant to the funds raised by Panchayat by tax collection, donation, etc. for link approach road construction to backward villages. Even the weightage could be attributed to different factors to choose the village to be given the matching grant. In this regard, the following factors could be considered :

   (i) Population of the village.

   (ii) Economic condition of the inhabitants or per capita income.

   (iii) Extent of the conditions and or economic status of villagers to be raised.

   (iv) Quantum of traffic anticipated on the road.

   (v) Nature of vehicles anticipated to ply on the road.

   (vi) Whether the access road is a terminal village road or it forms a missing link on the road network.

   (vii) Whether proper land or raised embankment exist for the access road or whether it can be made available.

   (viii) Whether the access road acts as flood protection also.

   (ix) Quantum of funds raised by the Panchayat.

   (x) Type of road construction envisaged at first stage.

5. The State Government may also frame policy to make it obligatory for a Panchayat/villagers of a particular village to deposit at least 20 percent of the total estimated cost of road construction, their village should be connected with metalled road on top priority.

6. Banks can also be asked to liberalise their policy and should consider advancing loans to village Panchayats at nominal interest for construction of rural roads providing access to the village which would not involve greater risks than that of existing procedure of advancing loans to artisans etc. for setting up their shop, workshop, etc. for increasing their income.

7. State Government may impose 'Rural Road Tax' at the rate of Rs. 300/- per year on commercial vehicles viz. trucks, buses, metadors

etc. and Rs. 100/- per year on other vehicles. The tax so collected by the State Government should be utilized only for construction and maintenance of rural roads in the country.

8. Rate toll tax collection of a major bridge is fixed on the basis of construction cost of the bridge. It is proposed that the basis should include the construction cost of the bridge and the highway on which it is situated. The extra tax collection should be invested on the construction and maintenance of rural roads linked with this highway.

9. Excise and Revenue departments are collecting heavy revenue from rural roads, these departments should revise their rates and a provision of 10 to 15 percent of collections should be kept for construction and maintenance of roads in rural areas. A well-knit road network in rural areas definitely, in turn, will increase the revenue collection by these departments.

10. Industrial houses. commercial undertaking, banks, etc. can also be asked to adopt villages for upliftment. Villages selected should be similar to the selection of poor families in a village or district for their upliftment. These families age given some funds for raising their means of livelihood. Similarly, a few villages in a block or a district can be selected on the basis of the backwardness, etc., but with greater importance being given to access roads. The expenditure incurred in construction of these roads can be treated as subsidy/grant, and expenditure incurred on other developmental works in the village may be treated as loan. This type of subsidy is akin to the subsidy provided to farmers on fertilisers or grant given for the erection of wind mills, solar pumps, biogas plants. etc.

11. In situation, where the rural roads are primarily meant to meet the needs of a particular industry of project, the concerned beneficiaries should bear or contribute towards construction and maintenance of these roads. Agro-industries like sugar factories could be encourged to pool resources to construct their own roads which could be allowed to be maintained by them. This will give a sense of involvement to the people and will make them aware of the possible benefits of the road project.

12. The last but not the least, it is proposed that an organisation like Rural Electrification Corporation (REC) may be set up at State Level to look after the whole issue of rural road development and their accessibility pattern. The organisation will be an apex body which will also co-ordinate the functions of various agencies involved in the development of rural roads should be done by this organisation. This step will monitor the projects and ensure that the funds alloted for rural roads are spent on rural roads only. All the bottlenecks could be removed effectively as the organisation will be dealing with the rural roads only.

The above suggestions, if accepted by the Government the dream of connecting all villages with metalled roads may be fulfilled earlier than the turn of century.

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CSIR TECHNOLOGIES FOR RURAL DEVELOPMENT

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The author has described various technologies developed by CSIR which are useful for rural development. These technologies may add income to rural & tribal areas. The necessary help being provided by CSIR.

Nearly 80% of the population of the Country lives in rural and tribal areas. For integrated development of the Country it is essential to develop this section of society. Government and financial institutions are doing excellent job in developing rural and backward areas by introduction of various schemes. In this era Science and Technology has very important role to play and it is essential to introduce Science and Technology for development of society. Our Prime-Minister who is also President of Council of Scientific and Industrial Research which I represent in Madhya Pradesh has very rightly emphasized the role of S and T in Rural Development.

At present job opportunities in rural areas are minimal and population is forced to migrate to cities in search of job/Livelihood there-by creating slums in the cities. It is very essential to stop this trend if not possible to reverse it for the present. Govt. of India has set up Food Processing Deptt. to boost agro-based industries in rural areas which will generate employment potential and also farmers will get adequate price for their produce. At present in certain areas of Country some fruits and vegetables are available at throw-away prices and leave the farmers in helpless State since it is not possible to transport this produce due to its perishable nature. There is also need to use techniques for preservation of fresh fruits and vegetables like wax emulsion improved packaging materials so that losses are minimised. Setting up of Agro-based industries will go in a long way in rural development. There is scope for fruit and vegetable processing such as tomato puree, paste, spray dried powder, orange juice concentrate, mango nectar, guava juice and jelly. Banana juice, papaya tutifruty papain, vinegar, processing of Jack fruit, dry and wet pickle, Dehydration units for Garlic, onion, ginger, Peas, Mango (unripe), green chillies. There is scope for Chilli, Dhania, Garlic, ginger, Turmeric, oleoresin and oil of these spices. Setting up of such food processing plants would encouage farmers to grow these horticulture products to improve their income. Cultivation of garlic in Mandsaur due to setting up of Garlic dehydration units and growth of Soyabean and coming up of solvent plants are examples of interdependence. At present there are 50 solvent extraction plants in M. P. Production of Soyabean has reached to 1.0 m Tonne. There also exist scope for setting up processing units for cereals pulses. It is felt that cereals and pulses should be processed in the rural areas itself so that farmer is able to add value to his produce, generate employment in rural areas. Moreover, powder and husk is also retained in the village itself for use as cattle feed. I have seen farmers transporting cattle feed (husk etc.) from cities to rural areas. Manufacture of these machines has started in M. P. with the help of PTC. CFTRI Mysore have deve-

loped a hand operated pulse milling machine (50 kg/hr cost Rs. 5000/-) which can be set up in pulse growing rural areas. This can help in employment generation and reduce the cost of pulses to the consumer. With one machine we can generate employment for 3—4 persons. This "Small and beautiful" machine should be widely promoted under Technology Mission for oilseeds and pulses. Similarily, bakery flour mills having capacity of (100 Kg/hr and costing Rs. 85,000/-) should be set up in wheat producing pockets and where roller flour mill does not exist. Entrepreneurs can set up these plants for producing Maida, Suji, Atta etc. There is a need to develop a small hand/power operated flour mills although one design is available but it has not been found efficient. A unit has been set up in M. P. through PTC.

There is wide scope for introducing mini-rice mills like one developed by CFTRI which Costs Rupees 75,000/- and its capacity is 500 kg/hour of paddy. One firm in Kanpur is also manufacturing a machine having capacity of 200 kg/hour and Costing Rupees 25-30,000. These plants are now being set up in M. P. Mini-maize mill should also be set up in backward areas for degerming of corn, atta and Suji etc.

SOYA MILK :

There is growing shortage of milk in urban as well as rural areas and prices are ever increasing. It is very essential to supplement requirement of milk by introducing alternatives like Soya milk. This can be produced at domestic/cottage level. Value of protein/carbohydrates in Soya milk is same as that of Cow/buffalo milk. Milk is suitable for making Tea/Coffee, Curd, Ice-cream, drinking purposes etc.

MUSHROOM CULTIVATION :

Few years back Mushroom Cultivation had been monoply of Jammu & Kashmir and Himachal Pradesh. PTC introduced cultivation of Mushroom in M. P. in the year 1984. Growth as been very encouraging ; two types Button and Dhingri-Pleurotus have been adopted as cottage/rural industry. A Laboratory for prodncing 'Spawn' has also been set up. Regular training programme are being organised by M. P. Horticulture Deptt. to whom technology has been transferred. Button can be cultivated in cold regions white Dhingri can grow in places where temperature does not exceed 45°C. At the most a desert cools may be provides.

MEDICINAL & AROMATIC PLANTS :

Country has been divided into 17 Agro-Climatic zones Certain agro-climatic areas of M. P. like Betul, Panchmari, Malwa region, Bastar etc. are suitable for cultivation of Aromatic grasses like Palmarosa, Lemon grass Citronella, Mentha species and medicinal plants like Catharanthus Roseus (Sada Bahar), Vetiver (Khus), Geranium, plant raw material for tropane alkaloids. Egyptian henbane, Dubosia Diasgenin, cyprus, Damascus Rosea. Cultivation and Extraction of these species can give higher monetary gains to farmers than conventional crops A start has been made with the efforts of PTC by entrepreneurs. M. P. orest Development Corp has also started cultivation of palmarosa and extraction of essential oils. Introduction of these crops is very essential.

RABBIT FARMING :

Rabbit farming has again been monoply of Jammu & Kashmir and Himachal Pradesh. PTC introduced very recently Rabbit Farming in M. P. in view of increasing demand of Furr. It has good export potential as well. Recenrly, a training program was organised at Shivpuri (M. P.) in collaboration with a voluntary organisation. Another program will be organised by M. P. Antyavasyee Nigam for tribals of M. P. It suits cold regions of Country where temperature does not exceed 35°C. Rabbit farming could be good rural industry which can give rise to allied industry like 'Shawl and Sweaters.

LEATHER PROCESSING BY RURAL TANNERS :

In M. P. about 80 million hides and skins are available annually and hardly 5% of this valuable

wealth is processed within the State and rest is traded off to other provinces. It is our effort to increase its processing with the State. PTC organise training programs in collaboration with CLRI Madras for improving the efficiency and quality of leather processed by rural tanners. M. P. Leather Development Corporation takes follow-up action and provides support to these tanners by way of supplying raw materials and chemicals required for tanning and buying the produce. Such programs should be adopted in other areas also.

FOREST PRODUCE :

There is ban on felling of trees through-out the Country but we can utilise the minor forest produce like leaves, myrobalan, Chironji, tamarined, medicinal plants etc. For utilisation of leaves Leaf cup machine developed by CFTRI was introduced 7-8 years back, now 300-400 machines are working in M. P. and 'Dona' has become very popular and available in market. Two manufacturers are producing these machines Costing around Rs. 3500-5000 depending upon requirement of dies. Myrobalan is required by Leather processing as well as pharmaceuticals. At rural level grinding units can be set up for supplying power to Ayurvedic units.

HOUSING AND SANITATION :

Construction Cost is increasing day by day due to enhanced Cost of building materials. Efforts are being made to develop cheaper alternatives. Mud housing is prevalent in rural areas since primitive days. It is befetting to develop mud housing techniques. CBRI Roorkee has developed non-erodable mud walls and fire proof thatch. Cost of construction is Rs. 25-30/-Sq. ft. RRL, (Trivendram) has also developed fire and water proof thatch using palm leaves. Similarily, technology for stabilised mud blocks (with 5% cement) has been found suitable since it is possible to achieves strength of 20-25 kg/sq.cm Secondly, these block does not require firing resulting in saving of fuel and saving the environment from pollution. These blocks have started being used in urban areas. Rice Husk cement could also be used in rural housing to bring economy.

Sanitation is integral part of rural housing. Two pit rural Latrine with improved seat (having 45° slope) has been quite appropriate. Several Latrine have been made in M. P. and all over the Country. Waste water disposal system should be adopted to avoid spreading of muddy water in lanes which give birth to harmful bacteria.

CBRI, RRL (B) and PTC have jointly launched a demonstration-cum-training program in rural housing. In the first phase 5-programs will organised under Govt. of India's 35-point program.

DRINKING WATER :

Water is very essential for life and irrigation. CSIR Labs have developed technologies for identification of aquafiers and their assessment and purification of drinking water such as Water filter candle which could be fitted in earthen pitchers, purification of well water iron removal, flouride removal, separation of salts, removal of guinnea warms etc. Ferrocement tanks developed by SERC (Roorkee) are much better and cheaper compared to plastic tanks. These tanks are being used by State Deptts. in M. P. and there are 4 manufacturers. This technology should be adopted through out the country.

JAL SHAKTI :

It is worth mentioning the development of 'Jal Shakti' a polymer developed by NCL Pune and being manufactured by a Bombay firm. This polymer absorbs water up to 500 times its weight and keep the root/seed wet for 15-20 days. It is suitable for cultivation in water scarce areas Results of trials have been very encouraging. Higher yield to this tune of 30-40% has been achieved for many crops.

At present Technology delivery system involves :—

— Publicity of technologies through mass media, Journals.

— Lectures in seminars, workshops, training programs, orientation programs.

- Providing S and T inputs to DICs, DRDAs, Tribal welfare deptt., Banks Financial Instt. for incorporation in their plan of action.
- Interaction at Secretary level for incorporation of S and T inputs in State Plans.
- Direct interaction with entrepreneurs.
- Arranging Demonstration and Training programs.

It has been felt that more vigorous efforts are needed to achieve faster pace of development. Proposal has been made to Government of Madhya Pradesh to set up Rural Technology Demonstration -cum Training Centres (NRDC Model with modifications) at District Level since "Seeing of delieving" creates more impact then any other approach. These centres should become self sufficient after two years of their setting up.

Did You Know ?

- 50% to 70% of U.S. energy use could be supplied by renewable sources of energy by 2030. according to a new study by U.S. government scientific laboratories.
- A 60% to 80% Reduction in carbon dioxide (CO_2 emissions around the globe will be required in order to stabilize the climate, according to recent international meteorological studies and projections.

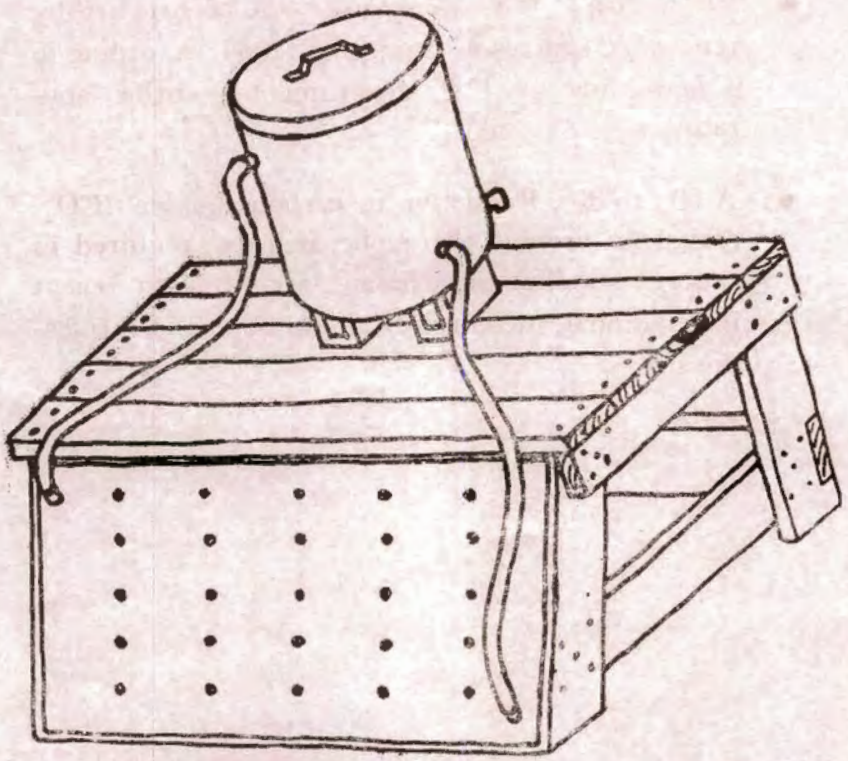
SOLAR WATER HEATER

Hot water is more effective than cold water for many purpose. In some areas hot water is not used because fuel is so expensive, it is used only for essential tasks. Solar water heater can supply hot water without using up available fuel.

Heat from sun's rays are easily captured. Black painted surfaces exposed to sun will get hotter than those of any other colour. A metal surface painted flat black and placed in contact with water will heat the water. Black metal plate is called *absorber*.

Water can be kept hot with the help of insulation. The insulation may be given such as glass wool, straw, sawdust or polyurethene foam. The absorber may be covered with the glass cover. Glass transmits high radiation from sun that heats the water, but stops low energy infrared radiation that is reradiated from hot absorber. It also keeps air from passing over absorber causing heat loss. The reduction of two forms of heat loss makes glass an ideal insulator.

Solar water heater presented here can provide hot water year round.



This system will heat 70 litres of water to 60°C between sunrise and noon, on a clear day with an average ambient temperature 32°C.

CONSTRUCTION

It consists of two main parts (1) heating absorber collector (absorber) which is made of aluminium sheet (22 SWG) and (2) storage tank that holds the water for the system.

The metal sheet is housed in a wooden box, filled with insulating material like glass wool, straw, sawdust, polyurethane foam. Glass wool & Polyurethane foam are better insulating material than others. Wooden box is covered with glass sheet, which transmits the solar radiation to absorber plate which absorbs heat but reverse is not possible. Storage tank can be made of Galvanised iron this may be oil drum but in this case one has to be seen that one end can be lifted off to serve as lid.

METHOD OF CONSTRUCTION

MATERIALS REQUIRED

1. Aluminium sheet 22 SWG thick 90 cm × 180 cm —2 off
2. Galvanised iron pipe 2.5 cm dia × 5 cm long —2 off
3. Galvanised Stove Bolts 6 mm dia × 2.5 cm long —28
4. Metal washers 6 mm —56 nos.
5. Rubber washers 6 mm —56 nos.

METHOD

1. Cut 2 cm off the length and width of one of the sheets of aluminium sheet so that it will be 1 cm smaller than the other sheet on all four sides.
2. On the smaller sheet drill two 3 cm ($1\frac{1}{4}$") holes for the two connectors. Drill 4 cm in from edges. (Fig. 2 for Aluminium Sheets)

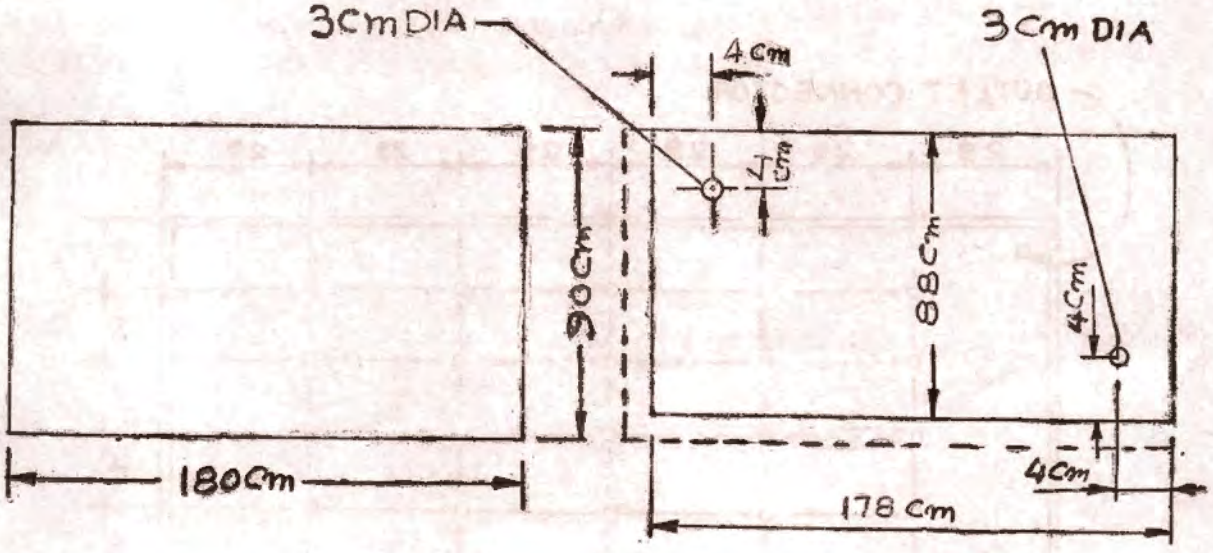


Fig.—2 Aluminium Sheet

3. Place the two Aluminium sheets together. Using a hammer and anvil fold 1 cm over lapping edges. (Fig. 3 for Edge fold side view)
4. Fold the edge 1 cm again and solder them to make airtight seal. (Fig. 4 for Soldered Fold)
5. Drill holes for 6 mm bolts at regular interval like button on mattress. Bolts will keep the sheets being forced apart when absorber is filled with water. (See Fig. 5)
6. Place bolts in holes with rubber and metal washers at each end of bolts to ensure a water tight seal. (Seee Fig 6)
7. Use 2 5 x 5 cm G. I. pipe to make connectors. Place the pipe flush with solar collector sheet covering 3 cm hole. Solder the pipe to sheet. (See Fig. 6)
8. Paint the front of heater with black paint so that it will absorb sunlight rather than reflect it.

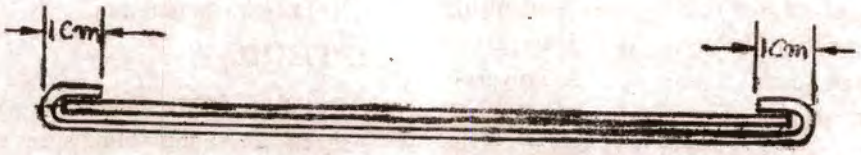
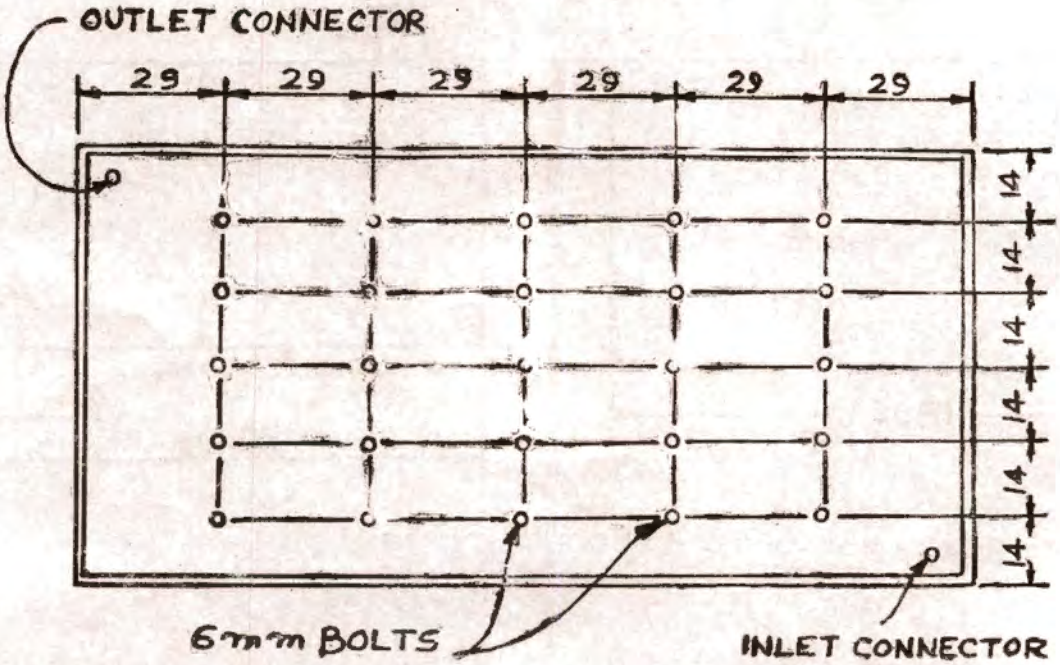


Fig.—3 Edge fold Side View

Fig.—4 Soldered Fold



Fg.—5 Spacing of bolts

Fig. No. 6

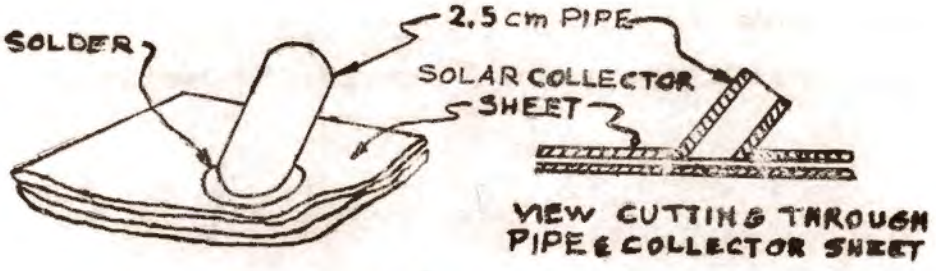


Fig. No. 7

MAKE STORAGE TANK

Take oil drum whose one end can be lifted off to serve as a lid.

Paint oil drum with water proof paint.
Insulate outside by covering with mud, a mixture of tar and straw.

Drill holes for inlet and outlet connectors and solder pipe in place at bottom and top respectively.

CONNECT TANK AND COLLECTOR

Attach a section of hose to lower outlet (cold water) on tank and attach it to the lower right (cold water) inlet on collector.

Attach other section of hose to upper inlet (hot water) on the tank and attach to the upper left outlet on the collector.

MAKE THE COLLECTOR AND STORAGE PLATEFORM

Place so that collector faces south and is at a 45° angle.

Build a portable stand (A portable stand is usually cheaper and can be easily moved the track the sun). Wooden table can also be used as stand.

OPERATION AND MAINTENANCE

OPERATION :

1. Remember to keep the Collector at 45° angle if the latitude of your area is unknown. Latitude plus 10° in temperate zones.
2. The hot water will rise to the top of tank. When all of the water is to be used, it can be drained from fancet. When only a small amount of water is needed hottest water can be taken from the top of tank.
3. Whenever water is being heated water level should be kept above the tank's upper house connector to allow the water to circulate or thermosyphon will not work.
4. The water heater works best when the connecting hoses are as short as possible.

MAINTENANCE

1. Replace rubber hoses every two or three years, if necessary.
2. Paint the metallic parts with rust proof paints and check periodically for every six months.
3. Paint oil drum with waterproof paint and check regularly.
4. Check the water leakage.

APPLICATIONS

Water heating

Washing clothes

Personal Hygiene

ADVANTAGES

1. Easy to build and operate
2. Provides heated water 60°C within two hour period.
3. Portable
4. No fuel costs

CONSIDERATIONS

Has to be filled manually
Life Expectancy of two years.

Heats water only on Sunny days. Does not operate at night.

COST ESTIMATE

Approx Rs. 1500/- based on current prices of raw material.

MAKING WATER SAFE FOR HOUSEHOLD USE BY CHLORINATION

This recipe makes a concentrated (stock) solution of the chemical, which can be used to treat larger quantities of water. Do NOT drink or use this solution undiluted and keep it out of the reach of children.

To make up the concentrated solution, add 4 teaspoons (16 grams) of sodium hypochlorite, OR 10 teaspoons of bleaching powder (40 grams) to one litre of water.

Always add this concentrated solution to water, to ensure proper mixing, as follows :

1 litre water : 3 drops stock solution. 30 litres water : 1 teaspoon stock solution. 4550 litres water : 1 litre stock solution.

Treated water should be allowed to stand half an hour before using.

BIOGAS PLANT BASED ON KITCHEN WASTE

In our country most of the biogas plants installed are based on cowdung. One important biomass which has great potential for biogas generation is kitchen waste.

With the rapid industrialization of the country large number of industrial units have been set up. The industrialization has also resulted in development of hotel and restaurant business. There are also large number of educational institutions having residential facilities and religious places in the country. Most of these places have community kitchens to serve food to the workers, to the students, to the pilgrims and to the public. Large quantities of kitchen waste remains contain cooked food like rice, pieces of chapati, puri, dal, vegetables and uncooked food like skins of vegetables, rotton vegetables etc. accumulate every day in these places. Disposal of such waste creates serious problems in time and money. These kitchens usually use conventional fuels like LPG, kerosene, electricity, steam, coal, wood, diesel etc. As the kitchen waste is a potential source for biogas generation, the installation of biogas plant in the vicinity of community kitchen would serve the following :

1. Disposal of produced kitchen waste would be free.
2. Produced fuel in the form of biogas could replace the consumption conventional fuel substantially, if not totally.
3. The slurry coming out of the plant would become a good manure to be used in garden or in the farms.
4. It will help to maintain clean odour free environment.

Sardar Patel Renewable Energy Research Institute, Vallabh Vidyanagar has designed and developed one 0.9 cu m capacity pilot biogas based on kitchen waste. On successful development of pilot plant, the Institute has set up three more such plants at the following locations in Vallabh Vidyanagar for field study.

1. Gunatit Jyot Mahila Kendra — 10 cu m
2. Akshar Purshottam Chhatralaya — 12 cu m
3. Shri Swaminarayan Chhatralaya — 10 cu m

All the three plants are in operation and the working is found satisfactory.

For setting up the biogas plant on kitchen waste the following points may be noted :

1. 100 kg of kitchen waste is required to operate, 10 cu m capacity biogas plant. As per requirement small capacity plant can also be installed.
2. $10' \times 10'$ open space near to kitchen is required.
3. Expected expenditure is around Rs. 16,000/- for 10 cu m capacity biogas plant.
4. Operation of the plant is simple and the environment is free from odour.
5. Operational cost is nominal.
6. 10 cu m capacity plant operated at designed full load condition produced gas which will save 4.8 kg of LPG or 16 kg of coal or 6.9 litres of kerosene or 39 kg of fire wood.
7. The rate of gas production depends on quantity and quality of kitchen waste, enviromental conditions as well as day to day care to be taken for operation.

BIOGAS PLANT BASED ON WATER HYACINTH

Development of the renewable energy sources is perhaps the only choice left with us in this age of available is biogas. Considerable work has been done on the biogas plants based on cowdung. The Sardar Patel Renewable Energy Research Institute has developed a biogas plant working on water hyacinth. Water hyacinth is a plant which is not used either as fuel or fodder. It has capacity to double itself within short period of 1.5 to 12.5 days. So, if it is supplied to a biogas plant, then the nuisance of weed growth is controlled. Also at the same time, gas produced can be used as a valuable fuel and the digested slurry obtained at the end of the process is useful as manure. About 1 kg of green water hycinth containing 93% of moisture, generates 50—55 litres of biogas. The methane content in biogas varies in the range of 65—70%.

Here, a RCC digester is constructed below ground level. A mild steel gas holder is provided at the top which remains in floating condition when gas is collected in it and falls to its original position as the collected gas is consumed. For effective digestion water hyacinth is cut into small pieces of about 3 cm size and are fed into the digester through inlet pipe. A plunger is used to push these pieces pieces into the digester. Water is also added to the digester according to the quantity of water hyacinth fed. For complete digestion, mixture of water hycinth and water should be thoroughly mixed and hence a stirrer is provided. The digested material is withdrawn from outlet pipe. This slurry is very effective when used as manure and the gas produced is good as fuel for cooking, lighting and for mechanical power generation. Biogas is a useful and cheaper fuel for replacing diesel in diesel pumpsets. It is observed that about 4/5th of diesel can be replaced by biogas thereby saving the valuable diesel. If a 5 cu m plant operates at its full capacity, then the gas produced can run a 5 hp diesel pump for 2.5 to 3.0 hours. Diesel pumpsets thus provided can also be used for the supply of drinking and irrigation water.

The operation and maintenance of biogas plant is easy and economical, also. About 20 kg of green water hycinth and 10 litres of water per cu m capacity are required everyday. For 5 cu m biogas plant, about 2000 sq m of water body is sufficient so that constant supply of water for the installation of a 5 cu m biogas plant is approximately Rupees 15,000/-. The cost includes construction of digester, gas holder, stirrer, inlet and outlet arrangements and plunger. The plants can be constructed of varying capacity depending upon the availability of water hyacinth and requirements of the individual. Keeping in mind the characteristics of water hyacinth, the Institute has designed 5 cu m plant and a few plants are installed at various places for field observation. Their performance is found satisfactory. If you are interested and are in need of more information, please contact at :

SARDAR PATEL RENEWABLE ENERGY RESEARCH INSTITUTE
NEAR BVM ENGINEERING COLLEGE
VALLABH VIDYANAGAR—388120

SPOT LIGHT

NEW SOLAR CELL

A new kind of solar cell, more efficient than the ones currently in use has been developed in West Germany. The cell absorbs sunlight on both sides and transforms it into electric power. According to Dr Rudolf Hezel of the University of Enlarge Numberg, who has developed the cell, a finely-laid metal grid provided at the open back side allows the cell to absorb sunlight through both the sides. The new cell is cheaper, lighter and longer lasting compared to the conventional cells. It is claimed to convert 20-24% of incident light into electric energy as against 15% efficiency of the present cells.

MUSTARD PLANTS TRAP MAJOR CABBAGE PESTS

Entomologists in Bangalore have found a unique system of biocontrol of cabbage pests that will minimise the use of insecticides—using mustard plants to trap the insects.

Cabbage pests can be lured away onto mustard plants grown in paired rows after 25 cabbage rows, according to scientists from the entomology division of the Indian Institute of Horticultural Research in Bangalore.

IIHR scientists, K. Srinivasan and P. N. Krishna Murthy reported their findings in the journal *Indian Farming*.

Pests such as the diamond-back moth, leaf webber, caterpillars and aphids frequently attack cabbage crops and farmers often have to resort to as many as 16 sprays of insecticides in a single crop season to control the pests. Sometimes they even spray a mixture of two or three insecticides.

But the indiscriminate use of pesticides has brought in its wake several problems. They leave behind toxic chemicals on the cabbage leaves, affecting human health, eliminate natural enemies of the pests from the natural ecosystem and the pests are resurging due to increasing resistance to the insecticides.

Laboratory, green house and field tests by the Bangalore scientists have shown that the pests preferred mustard to cabbage when a choice is available.

According to the scientists, the ideal intercrop combination is nine rows of cabbage followed by two rows of mustard. In one row, the mustard should be planted 15 days before cabbage is planted and in the second 25 days after. With this combination, the cabbage remains free of pests upto the head initiation stage.

The preferred host, mustard, can then be checked easily with insecticides. Only small amounts of insecticides in two sprays are then needed to control the insects.

BIOGASIFICATION OF SORGHUM

The Institute of Gas Technology has been operating a 1200 gallon anaerobic solids-concentrating digester at the Walt Disney World Resort Complex, Florida. This digester development work is part of the larger effort to provide an effective community waste treatment and energy recovery concept for smaller communities. In 1986, a programme was initiated to test the digestion of sorghum. Performance data were collected at both mesophilic and thermphilic operating conditions at total organic loading rates of 0.25 and 0.5 pounds per cubic foot of digester volume per day, respectively. Excellent methane yields were obtained during twelve month of stable and uninterrupted operation. This paper summarizes the performance data obtained on sorghum in this digester.

VEGETABLE OILS AND THEIR ESTERS AS DIESEL SUBSTITUTES

Indian scientists have identified a range of vegetable oils and their methyl esters which can serve as effective fuels for diesel engines.

These potential diesel substitutes were identified as part of a wide survey on several vegetable oils being considered worldwide for use in diesel engines. These include cottonseed oil, maize oil, ricebran oil, rapeseed oil, sunflower oil, linseed oil and soyabean oil.

The oils along with their esters were evaluated for their performance in a Kirloskar AV1 engine, which is a single cylinder, four-stroke, water cooled, direct injection diesel engine. The trials were conducted by a team of scientists from the Indian Institute of Technology, Madras.

The esters were produced by a chemical reaction called transesterification where the glycerol in the oils was substituted with three molecules of monoalcohols such as methanol. This led to the formation of three molecules of methyl ester of the vegetable oil.

The IIT scientists tested three parameters—the performance of the engine with the vegetable oils, the engine performance with methyl esters of the vegetable oils, and finally the performance of the engine with karanji oil, obtained from "karanji" or Pongamia glabra, a plant widely found in India, which was specifically compared with diesel oil.

Preliminary studies indicated that pure vegetable oils could be used in diesel engines without any major problem. The findings were reported by IIT researchers P. Srinivasa Rao and K. V. Gopalakrishnan in the "Indian Journal of Experimental Biology."

The brake thermal afficiency has been found to be lower for vegetable oils and the smoke density is higher than that of diesel oil.

The scientists noticed a few typical problems associated with vegetable oils, like bad smell. Palm oil, especially, produced a typical exhaust stench around the engine, particularly at higher loads.

Ricebran oil, with its high viscosity, gave rise to problems of flow in the fuel line. A second problem with it was the dark colour of the exhaust.

The study concludes that both vegetable oils and their methyl esters perform with acceptable thermal efficiencies as fuels for diesel engines. If it is certain that an engine will be operated on a vegetable methyl ester for a long time, then the injection timing can be readjusted to obtain better thermal efficiency.

WOOL PROCESSING AND CARDING MACHINE :

The project was sanctioned by Department of Science and Technology for designing and installing wool carding and processing machine for feeding slubbing to the wool spinning charkha. An assembly of various parts like opener, cleaner and dust extractor 2 carding machines and a condenser for making slubbings were installed at Mohanlalganj workshop and tested. Its capacity was established at 100 kg. of siubbings in three shifts of 8 hours each. These slubbings will be able to feed 100 wool spinning charkhas in rural areas, mostly hill areas. It has thus established a technology complex of cottage wool spinning with one processing machine of 100 kg. capacity and 100 wool spinning charkhas distributed in the rural areas.

VILLAGE TANNING AND CARCASS UTILISATION :

The tanning of hide and skin already started locally and efforts are being made to improve the quality further. For the carcass utilisation work a bone digester with pressure guage and safety valve having a capacity to accommodate carcass of one to two animals according to size has been designed, fabricated and installed. In addition to that the old technology of boiling carcass in open cauldron was also continued. Solar drier has been designed for drying the flesh meal after boiling and separation of tallow etc. At present there is no trained person to work on bone digester but efforts are being made to train two local persons at Mangroth for this work. It will-provide self employment to about 30 tanners and flayers earning at least Rs. 30/ - per day.

GUR PROJECT :

(Bullock driven crusher and furnace).

The project of designing a 4 roller bullock driven crusher was completed and report is being prepared. This has been proved this year working in field condition and the equipment designed will be released after the publication of the report.

An efficient gur making furnace has also been designed with recouperators and blowers from which it is possible to obtain efficiency of more than 35%. This was also tested in field conditions and proved successful.

RICE BRAN OIL AS DIESEL ENGINE FUEL

Rice bran oil might turn out to be a good substitute fuel for diesel engines. This has been indicated in recent research at the Indian Institute of Technology, Madras, where scientists have investigated the use of this oil and its ester derivatives as a fuel.

Researchers believe the work paves the way for the development of a new fuel substitute. India is the world's second largest producer of rice bran oil, with production in recent years averaging to 150,000 tonnes a year of which 15,000 tonnes are of edible grade.

The IITM researchers have reported that the performance of diesel engines with regard of thermal efficiency, combustion parameters such as combustion duration, smoke emission are comparable to other vegetable oils. The scientists have also reported that methyl esters of rice bran oil are more efficient than the oil itself.

The viscosity of oil is always higher than that of diesel oil. This leads to problems in pumping in the injection system of the diesel engine. The high molecular weight of the oil leads to high carbon residues and heavy smoke emmissions. And the oil has a cetane number, short of the minimum required for diesel engines.

Modifications to the rice bran oil can help get over these problems. One of these is to heat the oil at moderate temperatures 20 to 100 degrees celsius to split the oil into lighter oils. Boiling the oil with methanol produces three molecules of methyl esters.

The carbon residues of the esters are relatively low. This helps reduce the smoke emission. Following esterification, the oil also shows a thermal efficiency better than that of diesel oil itself.

SORGHUM STRAW REMOVES METAL CONTAMINANTS FROM WATER

Sorghum (jowar) straw can be used to decontaminate waste water containing heavy metals, according to scientists at Vikram University in Ujjain (Madhya Pradesh).

The scientists from the department of Botany investigated the possibility of using this agricultural byproduct alone and in combination with calcium carbonate to remove metals from water.

Sorghum (jowar) is an important millet crop of India and yields thousands of tonnes of straw every year which is either used as cheap fuel or as fodder for cattle.

Reporting their findings in the journal *Current Science*, the researchers D. M. Kumawat and P. S. Dubey said the straw and a combination of straw and calcium carbonate can be used to remove copper, lead, nickel, cadmium and cobalt.

Although methods like the use of ion exchange resins, adsorption of activated charcoal, electrodeposition and reverse osmosis are already in use for metal removal from waste water, a search for low cost agricultural byproducts such as foliage powder and sawdust for pollutant removal has been under way.

In a series of experiments, the Vikram University scientists used two categories of straw—well-groun-

ded, oven-dried (untreated) straw and washed straw made by boiling the straw and then washing it thrice with distilled water. The researchers found that the material most efficient in removing heavy metals from solutions was activated charcoal, followed by straw (untreated), straw (washed) and calcium carbonate, straw (washed) and teak sawdust.

Calcium carbonate alone also showed a high removal capacity. Untreated straw removed metals about 3 to 26 percent more efficiently than washed straw while combination of washed straw and calcium carbonate had roughly 4 to 18 percent more efficiency than untreated straw.

The ample availability, lower cost and simple technique of use make sorghum straw an important material in heavy metal pollution, the scientists said in their report.

GEODESIC DOMES

The geodesic dome that Buckminster Fuller (for more information see June 31 isssue) invented and popularised, revolutionised low cost architecture, and is of great-relevance in today's context of high construction costs.

Now, these domes are available in India—ready-made in the form of a kit Called Pabal, these domes are designed by Vidyanad Ashram.

What is so special about geodesic domes ? Well, for one, the spherical shape of the dome allows for the uniform distribution of load. For all possible three-dimensional shapes, the dome achieves the minimum surface area and maximum strength, making it a most cost effective form of construction. The Pabal dome provides a viable living space at just Rs. 40 to Rs. 50 per sq. ft. Because of its uniform loading, the Pabal dome does not require deep foundations. A team of eight people can complete the construction in less than a fortnight, while the basic kit can be assembled in a day.

The Pabal dome is constructed of steel and cement, and is much more durable than other lightweight structures. The standard Pabal dome kit is available in two sizes, with diameters of 6m and 4m, and carpet areas of 280 sq ft and 120 sq ft,

Other sizes of 3m., 5m,, and 7m can be supplied on order. For enquiries contact : Pabal Geodesic Domes. Dr. S. S. Kalbagh, Vidyanand Ashram, Pabal district. Pune 412 403.

SOLAR ENERGY CONFERENCE

An International Solar Energy Conference on "Economic and Political Initiatives for Applications of Renewable Energies in Developing Countries" will be held in Harare/Zimbabwe, from November 14th to 17th, '91. The conference is organised by FES, EUROSOLAR, UNSEGED, Solar Society of Zimbabwe and others.

The objective of the conference is to discuss strategies for the transfer of or introduction of solar technologies in Third World Countries. There will also be an exhibition of applied small-scale solar technologies which have proved to be workable in developing countries.

For further information contact :

EUROSOLAR

P. O. Box 120618

D—5300 Bonn 1

F. R. G.

OR

Friedrich-Ebert-Foundation

P. O. Box 4720

No. 6 Ross Avenue

Harare

Zimbabwe

ECOLOGY AND ENVIRONMENT

The Institution of Engineers (India) is Organising Sixth Engineering Congress at its Pune Centre From 20th to 23rd Dec. '91. The main theme of congress is "Transdisciplinary Premises of Ecology and Environment," with the sub-themes : Geo-Bio Frame Atmosphere, Eco-interactions, Environment, Eco-Modelling, Strategies, Analysis for Global change of Geo-Biosphere, Balance of Nature, Impact of climatic change and Human Activity, Pollution Dynamics and Pollution Control and Clean Technologies.

For further information contact :

Dr. S. N. Deshpande

Convenor, Technical Seminar Committee

6th Indian Engineering Congress

Institution of Engineers (I)

Pune Local, 1332, J. M. Road,

Shivajinagar

FORESTRY FOR RURAL DEVELOPMENT

Forestry for Rural Development is a post graduate diploma course organized jointly by the International Institute for Aerospace Survey and Earth Sciences (ITC) and Forestry Manpower Development Consultants (FMD).

The course starts on the second Tuesday in October of each year, for eight months.

Applicant should have a B.Sc. or equivalent academic qualification, in forestry, agriculture or a related descipline.

For further information contact :

ITC Student Registration Office

P. O. Box 6

N. 7500 Enschede

The Netherlands.

SOLAR ENERGY CONVENTION

Solar Energy Society of India will be conduct a "National Solar Energy Convention '91, at Pune from 16th to 18th December '91.

For further information contact :

Prof. M. G. Takwale,

Organising Secretary

National Solar Energy Convention '91

Dept. of Physics,

Pune University

Pune – 411007

RURAL STOVES

The Intermediate Technology Development Group (ITDG) of the UK in collaboration with GTZ, Germany is planning to arrange a 'Rural Stoves Workshop for Francophone African countries.' The workshop is tentatively scheduled to be held in Mali in November '91. The aim of the workshop will be to bring together stove project personnel from francophone countries to share ideas and experiences from their respective countries.
For further information contact :

Peter Watts
ITDG
Myson House
Railway Terrace
Rugby CV 21 3HT
U. K.

MONITORING AND EVALUATION METHODS AND TECHNIQUES IN RURAL DEVELOPMENT

CIRDAP will conduct the Third Regular Regional Course on Monitoring and Evaluation Methods and Techniques in Rural Development during October '91, for three weeks duration. The course is intended for middle level to top level officials engaged in planning, implementing, monitoring and evaluating IRD programmes. This course is also considered useful for Senior/Middle level Government/NGO officials in charge of rural development programmes.

For further information contact :

Course Director,
Mr. Mohd. Yahya Waliullah
CIRDAP
Chameli House
17 Topkhana Road
GPO Box 2883
Dhaka—1000
Bangladesh

DIPLOMA COURSES

WEDC introduces some new diploma courses of 10-12 weeks duration in 1991-92, on 'Solid Waste and Environment Management', 'Waste Water and Irrigation', and 'Women Managers in Technology for Development'.

For further information contact :

Kathy Haywood
Water, Engineering and
Development Centre (WEDC)
Loughborough University of Technology
Leicestershire, LE11 3TU England

SHELTER IN INDIA

Shelter is more than simply a basic need. It represents a powerful integrating concept for the design of interventions at the household level, which can contribute to rapid and sustainable development. Rapidly increasing homelessness throughout the world has promoted major new initiatives on the policy, institutional and technological fronts to tackle the problem with a renewed sense of urgency. Unfortunately, to-date in India, shelter-related sectors continue to rate a low priority for development investment, especially in rural areas where the bulk of the problem lies. To design effective approaches to the construction sector in general and the housing problem in particular, the first step is to obtain an accurate picture of the existing state of affairs and to identify the major issues needing attention.

This study analyses date obtained from government and published sources is an attempt to understand the major problems in the housing field in India, and to elicit the gaps in action and knowledge which must be filled before the housing gap can begin to be closed.

The book identifies the major issues of resources, technologies, institutions, and policies which must underlie any action in this area and carries out a detailed analysis of public action on housing during the period since independence. It presents a number of conclusions regarding the relative magnitude of the governmental and/or formal effort in this sector and on the deficiencies in information and knowledge without which further progress can only be very slow. On the basis of this analysis, a detailed research agenda is outlined which can provide a starting point for government laboratories, research institutions and voluntary organisations to initiate useful work in this field.

"Shelter in India, by Aromar Revi published by Development Alternatives, New Delhi, 1990 Rs. 195/ –

SOLAR ARCHITECTURE AND EARTH CONSTRUCTION IN THE NORTH-WEST HIMALAYA

It is not common find a point of time when vernacular tradition in architecture becomes relevant, socially acceptable and futuristic at the same time. This is what has happened to the definitive but not entirely conscious tradition of energy conscious earth buildings in two high altitude cold desert areas of the north-western Himalaya ! Ladakh and Spiti. The book represents the efforts of architects, engineers and Scientists, and describes the status of building construction and design in these two Himalayan areas in India. The text also incudes three live design projects for 'solarisation' undertaken by the authors and supported by calculations of thermal performance.

This book profiles the existing topography vegetation, climate resource and energy situation, going on to describe the current state of building technology and design and includes eight case studies of existing buildings with three design projects for energy concious buildings. The first part of the book describes the general context of the region, including its location, topography, vegetation, climate, resource and energy situation. The next part describes the current state of building technology and design in these area. And the last part describes three on-going design projects for 'solarisation' undertaken by the authors. The text of the book should be useful to administrators, architects, engineers and scientists working in the cold desert areas, earth construction technology, energy conservation and passive solar architecture.

"Solar Architecture and Earth Construction in the Northwest Himalaya" by Sanjay Prakash published by Development Alternatives New Delhi, 1991, Rs. 150/-.

BIOENERGY AND THE ENVIRONMENT

Globally biomass fuels represent the largest source of energy used throughout the world, after fossil fuels, biomass fuels-wood, animal, crop wastes and alchohols. In developing countries, about two thousand million people rely almost entirely on biomass fuels for their energy needs. What are the impact of these renewable fuels on the environment, aad how can they most effectively be used ? This book addresses these quesiions, showing the contributions of well-managed and environmentally sound biomass systems to sustainable development.

One of the keys to the future of biomass will be the synergistic development of two separate, but strongly interrelated areas, namely the production of biomass for food and feedstocks and the production of biomass for energy. Focusing on bioenergy-dependent countries, the author examine the overall impacts of bioenergy systems versus conventional fossil fuels. They show that bioenergy systems may be less damaging to the environment because of the many relatively small impacts on the surrounding environment in comparison with fossil fuels, which have more severe impacts affecting greater areas. The importance of bioenergy renewable and inexpensive resource for developing countries should not be under-estimated, and in future bioenergy is probably going to increase its importance. The authors conclude. not only in terms of the local economy and environment but also globally.

"Bioenergy and the Environment", by Janos Pasztor & Larz A. Kristoferson (Eds.), Published by Westview Press, Oxford, 1991.

ENVIRONMENTAL MANAGEMENT FOR DEVELOPING COUNTRIES

In contrast to western industrialised nations. environmental protection agencies in developing countries have to combat environmental degradation with scarce funds, often inadequately trained technical and managerial manpower, bureaucratic constraints and without general public awareness. It is apparent that, in order to protect the quality of the environment without geopardising the badly needed industrial and economic progress, the situation calls not only for appropriate technological situations but even more for sound management approaches, The seminar on which these volumes are based were designed specially help senior environmental specialist in Asia with a development of an efficient environmental strategy.

This continuing Education Centre Series is in three volumes on Environmental Management. The first two volumes address water pollution control and solid waste management. The first is principally concerned with the options for control, second examines the management, economic and decision making aspects and includes the case studies. Third volume covers the wider topic of environmental assessment and its integration into the planning process.

The purpose of these volumes (and the seminar upon which they are based) is to argue that additional ingredients of good local planning and management are essential if the resources available for environmental control and management are to be used effectively. These volumes are very useful to everyone who are involve in environment nelated programmes.

"Environmental Management for Developing Countries Three (volumes) by Gunter Tharun, N. C. Thanh and Rabin Bidwell (Eds) Published by Asian Institute of Technology Bargkok, Thailand.

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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 sections :—

1.	Portfolio	—	(Articles/Papers)
2.	Tool Box	—	(Information on Rural Technology/Processes)
3.	Spot Light	—	(News and Views)
4.	Futurama	—	(Forthcoming Events : Training Programmes, Seminars, Symposium, Workshop etc.)
5.	Book Bag	—	(News on Books and Publications)

Note for the guidance of authors :

Papers/articles information packages, technical queries and related materials are cordially solicited. Manuscripts should be sent to :—

The Editor
Rural Technology Journal
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Centre for Development of Rural Technology
Institute of Engineering and Rural Technology
26, Chatham Lines, Allahabad—211002 (India)

There is no limit to the length of contribution but it is suggested that a maximum of 6,000 words or equivalent be used as a guide (approximately 6 to 7 pages).

1. The complete manuscript should be written in English and the desired order contents of Title, Abstract, List of symbols, Main Text, Acknowledgement, Reference and Appendices. The Standard International System of Units (SI) should be used.
2. The manuscript should be typed on one side of the paper only (preferably 8" × 11" bond paper) with double spacing between lines and 1½" margin on the left.
3. Two copies of the manuscript and illustrations (one set original) should be sent to the Editor.
4. The title should be brief (maximum of 150 characters including blank in between words or other non-alphabetical characters) and followed by the author's name, affiliation and address.
5. Internationally accepted standard symbols should be used. In the list of symbols Roman letters should precede lower case.
6. Graphs, charts, drawing sketches and diagrams should be black and white prints on glossy paper and preferably 3½" × 7" size.
7. Illustrations should be numbered consecutively, given proper legends and should be attached at the end of the manuscript.

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