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Editorial

Occassional news of success in development and adoption of technologies appropriate to the needs of the masses, through non-government and sometimes through Government agencies is really very satisfying. It strengthens the belief that all is not lost and there is a ray of hope in the midst of darkest hour of complete invasion by business empires, transnational as well as homespun. Introduction of Ayurvedic Systems of medicine, together with holistic healt concept, in Government hospitals in Kerala, mud-housing projects in Karnataka, Delhi and elsewhere, rehabilitation programmes for displaced persons and for others by certain leading public sector organisations are such examples which should be emulated, without delay, whereever possible. Radical change of Technology Policy by Government is a pipedream. Possibility of development workers uniting into a political party and rising to power structure, if at all, and without being polluted is equally remote. Therefore, the best option seems to be that adoptors, innovators and promoters of people's technology taking bold initiative of federating into a working alliance, at least on regional basis. Communication net work is the first and foremost prerequesite for such an alliance to take shape and to sustain it. Through this issue of RTJ we strongly appeal to leaders/captains of all lead organisation working in the field of rural technology, to take urgent, bold and sustaining initiatives.

the village based institutions and their resources with the community management system.

For purposes of monitoring, the inputs are matched with the management information system (MIS) and prioritised according to community needs on the one hand and Governments, plans and resources on the other hand.

With these principles, Water Quality Monitoring (WQM) and surveillance, and its management were conceived as one of the sub-system of the holistic approach to rural water supply services (RWSS) by the National Drinking Water Mission (NDWM) of India.

WATER SOURCES

In India, rural areas are characterised by a variety of water sources like open dug-wells, bore-wells, step-wells, small water reservoirs, pools, lakes, springs, rivulets and underground storages (as in arid zones). The community water supply managed by the Government includes piped water supply and deep-well hand pumps (India Mark-II and VLOM Mark-III). These sources, however, have different sanitary conditions and water qualities. The deep well handpump water is considered safer than all other sources. Nearly 85 per cent of RWSS are based on underground sources generally through deep-well handpumps (India Mark-II and VLOM Mark-III).

Contamination of Water Sources

Water from both surface and underground sources gets contaminated/polluted owing to a multitude of factors; open field defecation. use of the same source to meet both human and cattle need, lack of preventive maintenance, geo-hydrological changes in ground water, recurring floods and droughts, human behaviour in handling water, etc. The main reasons of pollution are over dosing of agricultural chemicals like fertilisers and pesticides, non-disposal of waste water and solid waste, unsustainable with drawal of ground water, and direct contact of human body with source water. The lack of community awareness about the relationship between water quality and

health further compounds the problem. A study by UNICEF, for instance, has shown that only 10-18 per cent of the rural population in India knows that diarrhoeal disease is caused by faecal contamination in drinking water. While men generally perceive fairly clear water with a sweet taste as acceptable for drinking, women give preference to 'soft water' to speed up cooking thereby saving fuel and time. The concept of purity of drinking water is thus limited to its visible impurities and does not include micro-organisms.

Genesis of Human Sufferings

The consumption of unsafe water due to this misconception has caused illness and great human sufferings, resulting in substantial loss of mandays (73 million mandays a year in India). People consuming water with excess fluoride have been crippled for life even at a young age. The pains of those suffering from guinea-worms cannot be stated in words. Water-borne/related diseases rank as major killers of infants and children. A study (1986) by the National Environmental Engineering Research Institute (NEERI), Nagpur has indicated that almost 70 per cent of India's available water supply is contaminated resulting in deaths of about 1.5 million children every year (3 children a minute). A WHO study points out, however, that 80 per cent of illnesses are preventable just by ensuring the availability of safe potable water and its regular monitoring. Fig. 1 gives a conceptual framework for transmission of diarrhoeal disease as illustrated by UNICEF (1991).

Water Quality Monitoring (WQM)

Water engineers responsible for RWSS appear to be more concerned with reaching the maximum population through organised community water supplies. The few water testing laboratories catered only to the urban areas, being situtated only in large cities. Water testing in rural areas were done only during emergencies and outbreak of diseases. Little effort was made to collect information about rural water sources and their quality. Reasons for this apathy for WQM in rural areas were :

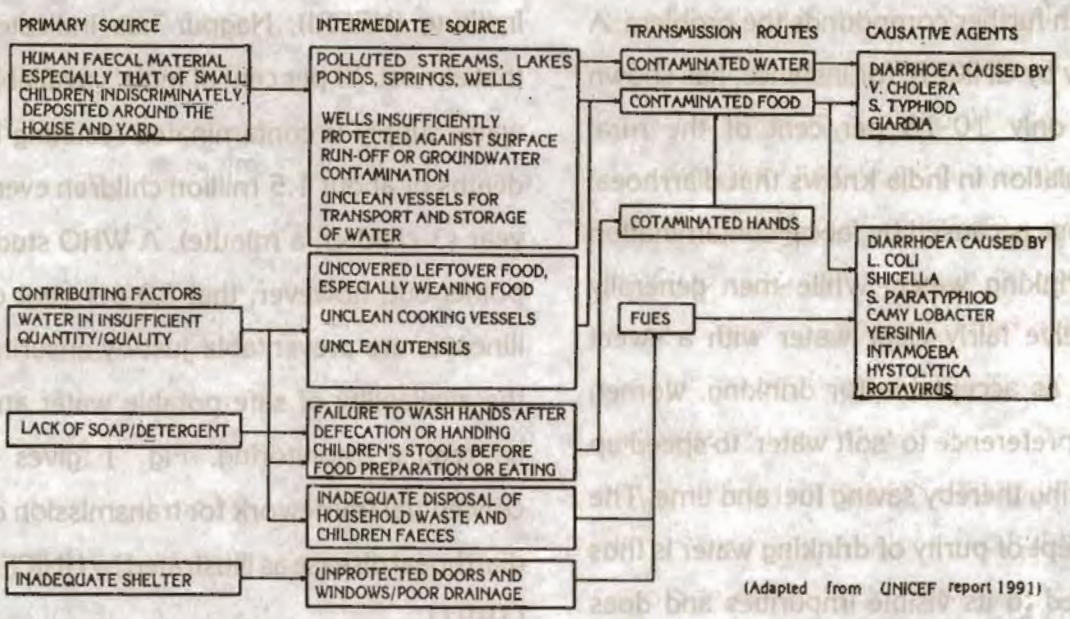

Fig.-1 : WATER SUPPLY POLLUTION IN RELATION TO DIARRHOEAL DISEASES

- A general lack of appreciation for WQM among policy makers and planners;
- little appreciation of cost-benefit, including social cost-benefit;
- lack of physical and financial resources;
- lack of training facilities;
- little understanding of and capacity for programme management and data handling;
- logistic constraints in covering remote and hill villages;
- little initiative in the application of modern technologies and management systems (software);
- no appreciation of community involvement;
- lack of community health education.

Such a situation, therefore, demanded urgent action for a planned process of WQM (including surveillance) of rural sources to meet the objective of 'safe water for health for all'. This presentation

is confined to water quality monitoring of rural sources and its organisation.

NATIONAL DRINKING WATER MISSION

Realising the urgency, seriousness and magnitude of the problems in RWSS, the Government of India launched in 1986 a national programme of integrated drinking water mangement in rural areas. The National Drinking Water Mission, set up under the Ministry of Rural Development, had as one of its in-built priorities the development of a broad based 'Water Quality Assurance' programme of RWSS with a regular WQM.

Mini Missions

This being a new concept, the Mission undertook action-research in WQM through the existing Public Health Engineering, Departments (PHED) of State Governments responsible for RWSS. The district (an administrative division in India) was considered as the lowest functional unit for implementation of the project. The Mission accordingly initiated the WQM programme in villages in its 55 mini-missions (pilot project districts having maximum problems relating to drinking water) covering the entire country. These mini-missions were expected to help evolve cost-effective models that could be replicated in other districts (the total number of districts in India being 454)

Technology Advisory Group (TAG)

A TAG on 'Water Quality Assurance' was constituted at the Mission headquarters to deliberate on the subject by bringing in multi-disciplinary interventions and seeking active support of the national scientific resources and institutions.

Status of Water Pollution/Contamination

In 1986, over 162,000 villages (out of the total of 0.58 million villages) of India were declared as 'problem villages' either having no drinking water sources or having their sources polluted by guineaworms, excess fluoride, excess iron, and brackishness/salinity. Water sources particularly the traditional sources in more than 70 per cent of all villages were highly contaminated with faecal coliform positing

serious threat to human health and productivity.

High concentration of nitrate ions was encountered in several water table aquifers, attributable to over-dosing of chemical fertilizers and other reasons. Contamination of ground sources by pesticides (mainly organochloride compounds), however, required investigation and quantification. Excess pollution load in river basins thus gets its way to rural water sources through irrigation canals and ground sources.

Base-line Survey

To ascertain the status of rural water sources and their water quality, the Mission assigned the task of base-line survey to the Council of Scientific & Industrial Research (CSIR), with which a memorandum of understanding (MOU) was signed to ensure their full support and collaboration in S & T for RWSS. This survey, conducted for the first time, brought out many revealing facts about the severity of contamination of water sources in terms of their sanitary, conditions, and bacteriological and chemical contamination. These were estimated as under (1987):

Sources of contamination	Number of affected villages
Guineaworm	8,811
Excess fluoride	8,700
Excess iron	2,900
Brackishness/salinity	17,500

CHALLENGES IN WATER QUALITY MONITORING (WQM)

The population of villages in India ranges from less than 100 to 20,000. While small villages generally have one water sources, large villages may have more sources including traditional and organised community supplies managed by the government (total number of inhabited villages 5.8 million). The water quality of each of these sources required to be monitored periodically at several points (or representative locations) and times, necessitating collection of a large number of water samples by many agencies; many of these samples required

to be analysed on the spot. Most of these sources have scattered characteristics and many are situated in remote areas and difficult terrains. The water quality data thus generated needed to be compiled and collected village wise/source wise for preparation of district-wise status reports for appropriate action by the concerned authorities.

Another challenge was non-availability of the required number of trained personnel for collection of samples, water testing and analysis, monitoring and surveillance and timely reporting of the information.

The magnitude of these tasks and their complexities required frequent changes in the entire planning strategy for WQM; networking with scientific institutions; extensive training programmes; and development of strong institutional base at different levels. These tasks also needed intervention of technology mix; communication for awareness generation, health education and community participation; surveillance on reliability of sample collection and data generation; application of MIS; and socialisation of the implementers and community. Finally, the action-research experiences required transplantation into a planned process of replication.

SYSTEMS APPROACH

The systems approach adopted by the Mission is briefly presented here.

Sensitisation of Decision-Makers

The Mission organised national and regional conferences of decision makers, planners, and senior managers of RWSS of the States to sensitise them about the water quality situation in rural areas, the need for WQM on a continuous basis, and the Mission's proposed action in tackling the problem.

Public health engineers were exposed to the science and art of WQM and related technologies developed by the national scientific institutions, and specialised agencies and provided opportunities for direct interaction with the scientific community. These sensitisation and consultation exercises culminated in a detailed action-plan for the WQM project.

Water Quality Parameters and Standards

The extent of distribution of chemical compounds in ground water in different parts of the country was worked out depending on the intensity and magnitude of their contamination/pollution. Accordingly, a national standard was drawn by the Bureau of Indian Standards (BIS), Government of India. Keeping in view the water quality situation in villages and the growing awareness of the need for safe drinking water, the Mission approached the BIS to review the existing national standard (IS : 10500/1983) of essential parameters of water quality and make appropriate recommendations with explanations so that WQM personnel and public health engineers could take appropriate decisions during quality assessment and may perhaps relax such specifications warranted by local conditions.

Mobile Laboratories

To reach remote and hill villages, the Industrial Toxicology Research Centre (ITRC), Lucknow and National Environmental Engineering Research Institute (NEERI), Nagpur developed mobile water testing laboratories (on wheels). These cost Rs. 1.2 million (US $ 60,000) a unit (1991), with an annual recurring cost of Rs. 0.15 million (US $ 7,500). The ITRC model has been provided with solar panels as an additional source of energy. These mobile laboratories also serve as communication media in villages and have become very popular. Seventeen ITRC mobile laboratories are already operating in the field (1991).

Institutional Setup

The Mission introduced a 3-tier system of WQM by establishing (within the existing PHED set-up) water quality testing laboratories at village, district, and state/union territory levels. It was targeted to have 1000 village level laboratories equipped with portable kits/mini-labs, 17 mobile laboratories, and 85 district/state level stationary laboratories by 1992.

Harnessing Technology

A major gap in the WQM programme was identified as non-availability of an appropriate portable and composite unit for conducting qualitative and quantitative tests at the source. Table-1 provides salient features of equipment developed by scientific research organisations of India at the instance of the Mission. These have been commercialised and are in use in the field. For establishing fluoride in drinking water in precise quantitative measure, ION-85 ION analyzers were imported through WHO from M/s Radiometer, Copenhagen.

Financial Incentives

The capital (excluding building), recurring and manpower costs for stationary and mobile laboratories and surveillance kits were provided by the Mission for the first five years. For the stationary laboratory for instance, the cost worked out to Rs. 0.19 million (US $ 9550) towards capital and a similar amount as the annual recurring cost (1991). (See Table : 2).

Training

The Mission with the support of national scientific institutions designed tailor made training programme for the PHED engineers, Laboratory chemists and supporting staff in WQM and surveillance in villages. In addition, a special programmes were prepared for training of trainers of the State Governments. The NGOS voluntary agencies were expected to organise awareness generation camps and training in WQM for school teachers, members of village W & S committees and women workers/activities. The Mission in association with CAPART (Council for Advancement of People's Action and Rural Technology, Ministry of Rural Development) provided financial and communication support to these agencies.

Table 1 : TECHNOLOGICAL INNOVATIONS IN DEVELOPMENT OF PORTABLE EQUIPMENT FOR TESTING WATER QUALITY

S. No.	R&D Project and Institutions	Kind of Equipment	Parameters Covered	Measurement Mode	Energy Need	Dimension/ Weight	Cost Rupees	US$
1.	Light weight kit defence laboratory (DL) Jodhpur (Rajasthan)	Composite Portable Kit (can be carried on bicycle)	Residual Chlorine, Fe, F, Nitrate, Hardness, Chloride, Acidity, Alkalinity, and Bacterio logical Quality	Qualitative only presumtive 3-8 hours test for bacteriological test	Mains power 230 v 50 Hz or Battery	43x27x20 cm 8 Kg.	5000	200
2.	Mini Laboratory Industrial Toxicology Research RCH Institute (ITRC), Lucknow U.P.	Composite Aimil Colorimeter Titration Kit Bacterio logical KIT	-do-	Qualitative and Quantitative Presumtive 48 hours MPH test or 24 hours MF test	Mains or Generation for Colorimeter and Incubator	50x35x28cm 16kg.	9000	360
3.	Mini Laboratory National Environmental Engineering Research Institute (NEERI) Nagpur (Maharashtra)	Split Unit Includes rapid aqua tester tritrimetric analyser rapid bacteriological tester Rapid Aqua Tester (Chloroscope S type)	-do-	Quantitative Presumtive 7-12 hours confirmatory test (1/100 ml sample) for Faecal Coliform Quantitative	6V/12V Car Battery or Solar Cells (60 W)	350 x 170 x 186 (mm) 4 kg., 490 x 340 x 300 (mm) 10 kg. 6.5 x 4 x 9.5 cm.	1500 250 4000 4600	60 10 160 184
		Digital Mini Turbidity meter (nephelo metry system digital)	Turbidity	-do-	Battery opereated	16x10x8cm 5kg.	4500	180

TABLE 2 : COST OF ESTABLISHMENT OF WATER QUALITY TESTING LABORATORIES (1990-91) NATIONAL DRINKING WATER MISSION, INDIA

	COST	
	Rupees	US$
1. Village Level Laboratory		
(Portable kit for qualitative testing)		
Also For Surveillance		
(i) Capital	5000	200
(cost of composite kit)		
(ii) Cost of refills depending upon number of samples to be tested	3000 (a year on average)	120
2. District level stationary laboratory		
(i) Capital including equipment, furniture, two bicycles, but excluding building	186,500	7460
(ii) Recurring (a year) including cost of manpower, consumables and services	186,000	7440
3. Mobile Laboratory		
(i) Capital including cost of vehicle, furniture, fixtures and equipment, also including diesel generator for airconditioning and solar pannels for generating solar energy	1200,000	48,000
(ii) Recurring (a year) as above in case of stationary laboratory	150,000	6000

QUALITY SURVEILLANCE AND COMMUNITY PARTICIPATION

In the context of rural areas, water quality surveillance involves a regular watch of water quality, reporting to concerned authorities, advising on and assisting in improvements wherever possible. It may also include more general activities to promote the safety of water supplies, besides education and training of the community in environmental sanitation and health.

To promote village level water quality surveillance, the Mission initiated the programme of social mobilisation for community participation through village level institutions (panchayats in India) together with awareness generation about the project and the inter-relationship of water, sanitation and health. Those voluntary agencies having roots in the villages and interested in the programme were also involved. A special project was sponsored at the Centre for Environmental Education, Ahmedabad to develop methodology for involvement of school teachers. All such participating institutions/schools were given portable testing kits (DL) and related reporting proforma. The DL kit was so designed that the basic parameters of water could easily be monitored even by the rural community, school teachers, voluntary agencies, etc, after a short training.

Role of Voluntary Agencies (VAs) and NGOs

The VAs/NGOs have been working in India for socio-economic development programme including the field of Rural Water Supply and Sanitation Services (RWSS). In doing so, some of them have developed expertise and professional competence to carry out water quality monitoring and surveillance including awareness generation about relationship between safe water, health and productivity, education in environmental sanitation (both in home and outside) and in the role and responsibility of community in prevention of contamination of drinking water from source to actual consumption.

The strength of such agencies, however, lies in their capabilities and capacities in mobilising the community including community women to participate in 'water safety and quality assurance', and offer this programme of a scale that they can manage. The VAs/NGOs also need recognition and support of water engineers and the government.

INTEGRATED MANAGEMENT

The 'Water Quality Assurance' programme needed backward and forward linkages and integration between functionary units (laboratories and grassroot institutions), the managers of RWSS at the district level, the policy/planning levels at the state and Mission headquarters, the national scientific institutions and the suppliers and manufacturers of equipment. To decentralise the management process the Mission divided the country into 5 parts and set up 5 Regional Centres (RCs) earmarking regional groups of states covering the entire country. The RCs identified from among the scientific institutions were expected to make area-specific need assessments, provide training and consultancy to states in strengthening their WQM activities, undertake random checking of water quality and related data, and guide the surveillance programme.

Networking

To coordinate the entire programme from the village level upwards, the Mission constituted a Central Coordination Committee (CCC) under the chairmanship of a senior scientist. The National Industrial Development Corporation (NIDC), a Government of India undertaking, was inducted as management consultant. The CCC has the charter of networking with the entire project, acting as a watch-body and facilitating linkages and management monitoring at various levels. This network is illustrated through a schematic diagram; (see Fig. 2). Similarly coverage of various levels of water quality testing activities has been shown in Table 3.

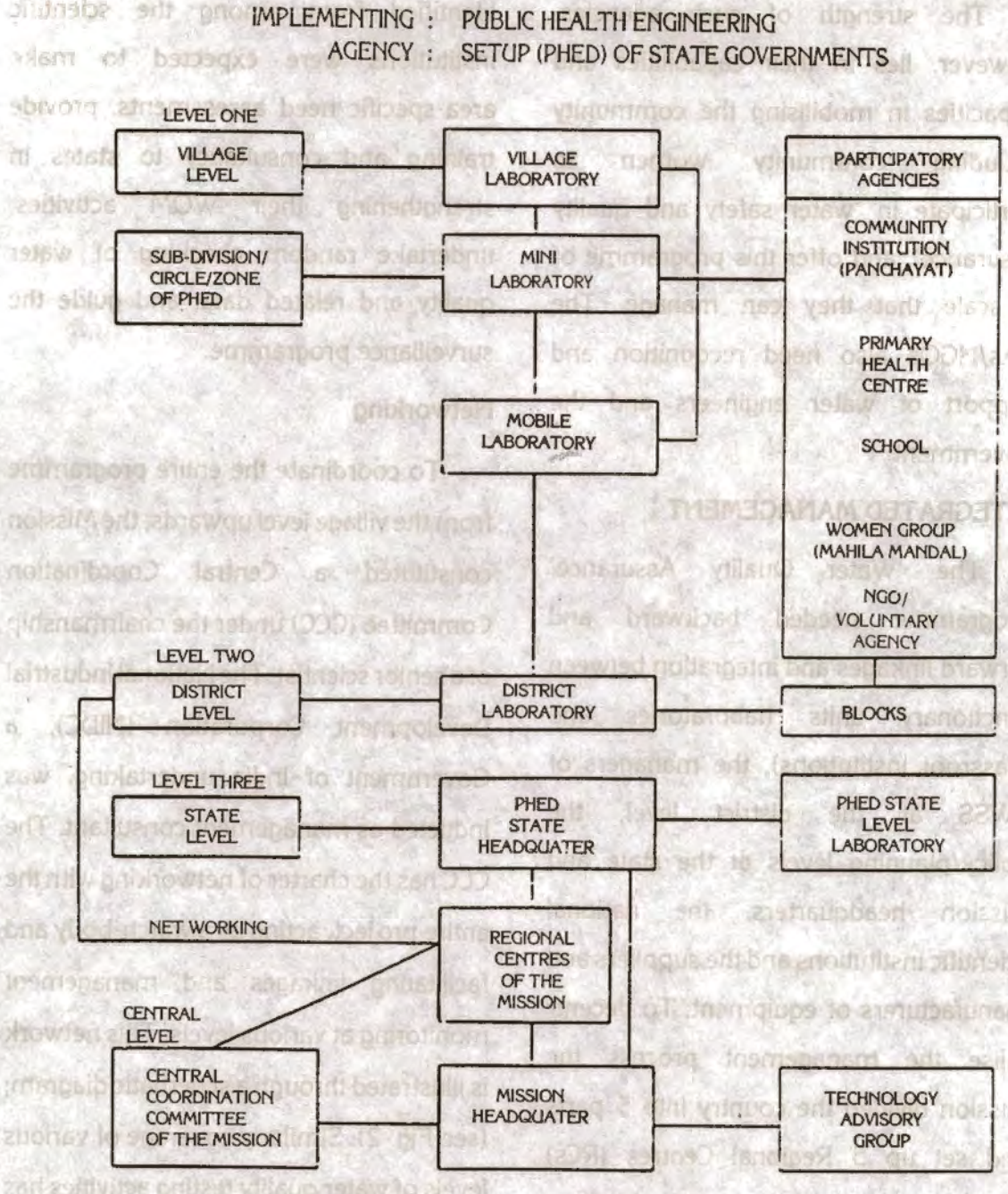

Fig.2- WATER QUALITY MONITORING AND SURVEILANCE NETWORK FOR RURAL WATER SUPPLY SYSTEM IN INDIA

TABLE 3: COVERAGE OF VARIOUS LEVELS OF WATER QUALITY TESTING LABORATORIES NATIONAL DRINKING WATER MISSION, INDIA

Level	Type of Laboratory	Measurement Mode	Institutions Involved	Area Covered	Remarks
ONE	1. VILLAGE LEVEL (water quality monitoring and surveillance) DL. Kit	Qualitative (accept/ reject)	village level institutions	2-3 adjoining villages	Light weight (8 kg) composite unit
	2. MINI LABORATORY (ITRC/ NEERI) Equipment	Qualitative and Quantitative	Public Health Engineering (PHED) setup to cover organised sources, newly developed sources and treatment plant.	Number of sources under control of PHED setup (Blocks)	Mini Lab acts a portable and stationary laboratory.
TWO	DISTRICT LEVEL				
	1. Stationary Laboratory	Quantitative for tests	PHED setup at the all districts	2-3 District	Located at district
	2. Mobile Laboratory	-do-	-do-	Remote villages and hill areas as per jurisdiction decide by PHED setup.	
THREE	STATE LEVEL	All tests including complicated tests special fluoride test by N 85 analyser	-do-	To Provide support to districts and undertake important investigations.	

Management Information System (MIS)

To manage the complex data originating from various sources and levels and its colation for assessment of water quality status, MIS was designed with a computer-compatible module. All data thus collected at the district level were fed to the PHED Monitoring Cell at the state level, to be communicated to other concerned departments and Mission headquarters. The information includes trends in water quality and magnitude of contamination; extent of participation of community, schools and voluntary agencies; awareness generation camps held; and maintenance of testing kits provided to village level laboratories. The MIS is under action study and finalisation (Table : 4).

DOCUMENTATION

To facilitate understanding of WQM and surveillance system and its application at various levels, a number of documents were produced by the Mission. These included district-wise water quality status, action plan, executive guidelines for establishing laboratories, operational manual for water quality analysis, manual on the use of portable kits, mini and mobile laboratories, training in WQM and surveillance, standards for water testing methods (BIS), water quality standards (BIS), and manual for training of various level of functionaries including trainers and NGOs.

EXPERIENCES

The SWOT analysis of the project provided the following indicators :

- Strengths : National policy with financial allocation; S&T support of national scientific institutions; well defined objective; and involvement of governmental set-up (PHED) responsible for RWSS, states training institutions and industries for commercialisation of hardware and their delivery.
- Weaknesses : Lack of 'will to change' by implementing agencies; long gestation in decision making; bureaucratic strings; limitations and restrictions in new recruitment; lack of information about cost-benefit and

TABLE 4 : MANAGEMENT INFORMATION SYSTEM MODULES *

Information Sources	Equipment Used	Data Level (Output)	Module Proposed
Village Level			
A. Village Institution (Panchayat) or ● Village Water and Sanitation (W & S) Committee or ● School or ● Women/Youth club or ● Primary Health Centre	DL/NEERI Qualitative Test Kits for Yes/No results only	- Information Supplier (institution) - Source site and kind - Source Sanitation - Sample collection (sample points, time and season) - Qualitative report for above as per parameters - Alarming signal - Condition of equipment including supply of refills	1
B. Voluntary agency/ NGO working at the village level	-do- Qualitative Tests only	-do Community participation - Awareness generation - Training - Sanitation at source and drinking water storage point at home	1 1.1
C. PHED normal set-up at the sub-division/ circle level (as part of other activities)	ITRC MINI Laboratory for Qualitative and Quantitative Test DL/NEERI Kit	- Module 1 with reference to New Sources (under development) - Treatment plants (installed) - Emergencies	1

DISTRICT LEVEL

Remote areas and hill villages	ITRC Mobile Laboratory and on the spot testing kit of NEERI for all quantitative test (12-14 parameters)	Full Test	1	1.1
	DL kit for demonstration and, training at village level and for WQ Surveillance			
Stationary Laboratory	All equipment to undertake test of samples collected from villages/ sub-urban towns	Full Test	1	
	Special sampling of sources reported as alarming (by A & B)			1.1
	ITRC Mini LAB and NEERI portable kits (also for training purposes)			1.1

	Software for compilation of village data and those received from A & B and the mobile laboratory		2
	Analysis and action (Multiuser)		3
STATE LEVEL			
(or Union Territory Headquarter as in India)	All activities of stationary laboratory	Full Test Sophisticated Tests	4
New Laboratory	Hardware and Software	Feedback to district laboratories and to C for necessary action	2
Central Level	Software	Consolidation of all India data with a summary	6

★ Based on discussions held with water engineers, NGOs laboratory personnels, training institutes and RWSS managers.

★

DEVELOPMENT OF GARLIC CLOVE PEELING MACHINE

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Garlic (Allium Satium) is a perennial herb grown in tropical and subtropical planes of the country. The crop is widely used in the formation of spice mixture of various foods. It is also important from medicinal point of view as it is used in the preparation of medicines for curing heart, lungs and intestinal diseases.

Although the crop is so important yet no mechanical equipment is available to peel its product which is the foremost work in its utlilization. The present paper deals with one such machine. The primary tests conducted on the machine showed that it was successful in peeling garlic cloves effectively and economically.

INTRODUCTION

Garlic (Allium Satium) is a perennial herb grown in tropical and subtropical planes of the country. It belongs to the family liliaceae. In India it is grown as one of most important commercial crops for its aromatic characteristics. It is used either fresh or in dried form in the formation of spice mixture of luncheon meat, salad dressing, garlic salt and other foods.

The digestive, carminative and antirheumatic properties of garlic make it medicinally important. It is widely used in the preparation of medicines for curing heart and lung diseases, healing intestinal ulcos, checking the disorder resulting from child birth and for curing eyes, muscular pains and giddiness.

The product of garlic crop as obtained at hand after harvesting is in the form of a cluster or bulb consisting of separate membranous skin. Few more thin paper like membranous skins cover all these cloves of the bulb which are white or

pinkish in colour. The real stem is a flattish disc inside and at the base of the garlic bulb from which roots emerge below :

The foremost work in utilisation of garlic is its peeling. The peeling of garlic consists of removal of the outer most coverings of the garlic bulb, breaking the garlic bulb into individual cloves and then removal of outer skins of the individual cloves. The outer skin of the garlic clove should be removed with great care otherwise the inner portion of the garlic would be crushed or damaged which will reduce its quality.

The traditional method of peeling garlic consists of beating the garlic bulb to individual cloves, exposing the garlic cloves for 2 to 3 hrs to the sun and then peeling the garlic cloves by hand or by rubbing them against gunny bags on a hard surface. This method is time consuming and labour intensive. The chances of crushing of the garlic cloves are more and in most of the cases, when gunny bags are used, the epidermal cells are damaged.

To reduce the hazards and drudgery of the traditional methods it was decided to develop a mechanical equipment which can do the same work at fast rate and economically. In the year 1985-86. Jain and Bharati developed a garlic bulb breaking machine which was successful in breaking the garlic bulb to individual cloves only. Therefore in the present research emphasis was given to design an equipment which can peel individual garlic cloves effectively.

MATERIALS AND METHODS

The various methods in vogue at present for peeling agricultural products include abrasive peeling, flame and radiant heat peeling, lye peeling, steam peeling, brine peeling, oil peeling, and peeling by knives. Out of the above methods only abrasive peeling was found suitable for garlic because of its complex coverings. It was also felt that the other methods may destroy the aromatic properties of garlic by damaging the epidermal cells.

In abrasive peeling, the peeling surface, generally made of carborundum is given such a motion as to cause the

spinning or rotation of the commodity to be peeled, all the surfaces are equally exposed to the rasping action of that surface which rub off the soft peel. The losses may amount as much as 30 per cent.

Abrasive peeling may be done by providing relative motion to two carborandum coated rollers or plates. Rollers provide smaller contact area as compared to the plates and are therefore suitable for peeling commodities which are smaller in size like rice etc. For products like garlic cloves carborundum coated plates were found more suitable.

Description of the Machine

The machine (Fig-1) consists of the following components :

1. Hopper
2. Peeling unit
3. Power transmission system; and
4. Discharge chutes

Hopper : The hopper, made of 16 gauge m.s. sheet was sufficient to hold about 5 kgs of garlic cloves. The top as well as bottom of the hopper was trapezoidal in shape having dimensions 36x28 cm., at the top and 14x28 cm at the bottom. The height of the hopper was 32 cm. The width of the bottom opening of the hopper was 28 cm corresponding to the width of the peeling unit which was also 28 cm.

The bottom opening of the hopper can be varied from 9 to 2.5 cm to alter the feed rate.

Peeling Unit : The peeling unit was made of two wooden planks coated with 0.5 cm. thick soft and rough rubber at opposite surfaces. The lower plank rests on an angle iron frame at an inclination of 25^0. The upper plank was provided a reciprocatory motion over the lower plank with a small clearance between them in which the garlic cloves are fed. The relative motion of the upper plank against lower plank provides abrasive action to the garlic cloves causing them to be peeled.

The size of the upper plank was 61x28x4 cm. The length of the plank was taken 61 cm as it was observed that about 61 cm of the length of the gunny bag remains in effective use when garlic cloves

are peeled in traditional method. The width was taken as 28 cm to accommodate sufficient quantity of garlic cloves with convenience in constructing the machine.

The length of the lower plank was 71 cm to accommodate the amplitude of the reciprocating motion of the upper plank which is 10 cm. The width and thickness of the lower plank was the same as that of the upper plank. The lower plank rests on an inclination of 25^{0} which is more than the angle of repose for garlic cloves (21^{0}). This helps in automatic downward movement of the cloves due to gravity when they are fed between the planks.

An arrangement was provided to alter the clearance between the two planks from 0.5 cm to 2.5 cm. corresponding to the average size of the cloves which are to be peeled.

Small rubber strips were provided at the side of the planks to prevent the garlic cloves from dropping sideways.

Power Transmission System : The machine was driven with the help of a 1400 rpm, 1 h.p. electric motor. A 2" dia pulley at the motor drives a 12" pulley and a 2" dia pulley on the same shaft drives a 10" dia pulley reducing the rpm of the motor by 1/30 th of the original. This in turn provides motion to the eccentric which converts the rotary motion of the motor to reciprocatory motion of the upper wooden plank.

The rod that connects the eccentric to the upper plank is kept loose at both the ends. This helps in absorbing the vertical motion of the upper plank.

A spring was provided at the upper end of the upper plank which helps in upward motion of the upper plank.

Discharge Chute : The garlic cloves after passing through the peeling unit come to the discharge chute from which they are collected. The discharge chute has a width of 31 cm and thickness 8.5 cm at the top. From the top it gradually narrows down to a width of 27 cm. The thickness at the bottom is 7 cm.

In the process of peeling the garlic cloves are fed to the hopper, they pass through the peeling unit, peeled by the

abrasive action due to relative motion of the two planks and discharged to the chute from which they are collected.

RESULTS AND DISCUSSION :

In order to evaluate the performance of the machine various tests were conduted on the machine. The results of these tests have been shown in table 1 and 2.

Table-1 shows good peeling efficiency of the machine. On an average the peeling efficiency of the machine comes to be 76.09 per cent with a maximum of 80.86 per cent and a minimum of 89.57 per cent. The variation in the efficiency is due to the variables size of the garlic cloves. Thus it is obvious that the machine can be successfully utilized in peeling the individual garlic cloves. The percentage of crushed material is also very low as it is clear from Table-2. On an average the percentage of material crushed come to be 20.20 per cent.

TABLE-1 : PEELING EFFICIENCY OF THE GARLIC CLOVE PEELING MACHINE.

No. of passage-4 Total time in all passes (m) 22

S. No.	Wt of cloves fed (gm)	Wt. of garlic cloves after peeling (gm)	Wt. of husk removed after peeling (gm)	Wt. of unremoved husk (gm)	Peeling efficiency (%)
1.	250	235	15	3.55	80.86
2.	250	230	20	8.75	69.57
3.	250	232	18	5.35	77.08
4.	250	235	15	4.50	76.92
5.	250	231	16	4.25	79.01
6.	250	236	14	5.15	73.10
				Average	76.09

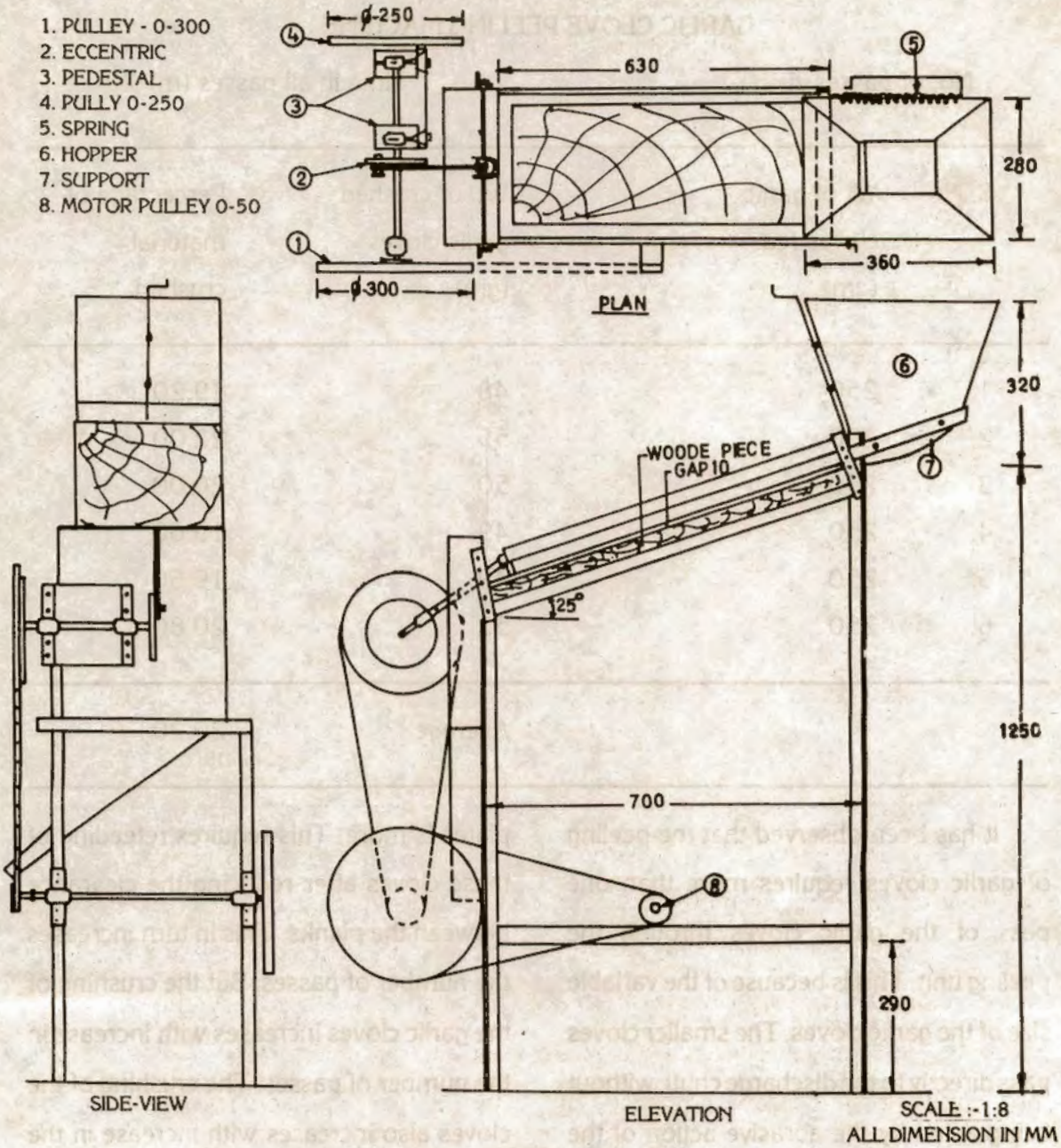
TABLES-2 : PERCENTAGE OF MATERIAL CRUSHED IN THE GARLIC CLOVE PEELING MACHINE

No. of passes-4 Time in all passes (m)-22

S. No.	Wt of garlic cloves fed (gm)	Wt. of crushed garlic cloves (gm)	Percentage of material crushed
1.	250	48	19.20
2.	250	55	22.00
3.	250	50	20.00
4.	250	49	19.60
5.	250	49	19.60
6.	250	52	20.80
		Average	20.20

It has been observed that the peeling of garlic cloves requires more than one pass of the garlic cloves through the peeling unit. This is because of the variable size of the garlic cloves. The smaller cloves pass directly to the discharge chute without being acted by the abrasive action of the plates when clearance between the two plates is more. This requires refeeding of these cloves after reducing the clearance between the planks. This in turn increases the number of passes. But the crushing of the garlic cloves increases with increase in the number of passes. The crushing of the cloves also increases with increase in the speed of the machine.

1. PULLEY - 0-300
2. ECCENTRIC
3. PEDESTAL
4. PULLY 0-250
5. SPRING
6. HOPPER
7. SUPPORT
8. MOTOR PULLEY 0-50



GARLIC CLOVE PEELING MACHINE

Sometimes a large number of cloves have been found from which half the skin has been removed. This is due to the fact that only one surface of the cloves has been acted by the abrasive action. But the crushing of the cloves also causes half peeling. Almost all crushed cloves were found half peeled. This also reduces the peeling efficiency. It is clear from these two tables that when efficiency is more, percentage of crushed material is less and when efficiency is less, crushed material is more.

CONCLUSION

1. The garlic cloves can be efficiently peeled from the garlic clove peeling machine as its efficiency comes to be 76.09 per cent. The crushing of the material is also low about 20.20 per cent while in abrasive peeling the crushing may reach as much as 30 per cent.
2. The machine is recommended for lesser reciprocating speeds of the upper plank as high speed increases the crushing of the cloves.
3. An adjustment of the clearance between the planks of the peeling unit according to the size of the cloves gives good peeling efficiency.

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COMPARATIVE PERFORMANCE OF DIFFERENT DESIGNS OF NET-CASE INCUBATORS OF CARP HATCHERY SYSTEM

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A study was undertaken to compare the performance of different designs of net-case incubators from the point of view of uniform dispersion of eggs inside the incubators and mixing pattern of incoming water with a view to suggest the optimum design. The designs under study were cylindrical, divergent and convergent shaped incubators with full open, full cover, bottom open and top open sides. Thus, in total 12 designs were considered. The results indicated that for minimum creation of dead zones, cylindrical design was best followed by divergent and convergent designs. Most uniform spacing of eggs was found in the full cover and bottom open designs of cylindrical and divergent incubators. Considering both dispersion of eggs and removal of ammoniacal products, cylindrical design with top open was adjudged to be the best type of incubator.

INTRODUCTION

Good quality fish seed is one of the major pre-requisite for successful fish farming. In India, due to rapid development in the field of aquaculture during the last decade, carp farming has moved to intensive culture. As the traditional riverine fishery sources can not

meet the growing demand of carp seeds and they are often a mixture of desirable and undesirable species, the demand of induced bred carp seed is increasing at a fast rate. Several carp seed farms have been set up in the country with differnt types of hatcheries, the Chinese type circular spawning and hatching pool and Hungarian type hatcheries with net case incubators being most common among them. The engineering and hydrological parameters of different carp hatchery systems have also been studied (Ghosh, 1983, Hingorani, 1983, Jana et al. 1985, Khemriya, 1986). But no study aimed at evaluation of performance of the net case incubators that were already in use or improvement in the existing designs specially for hatching of major Indian carps. Hence, the study was undertaken to compare the performance of different designs of net case incubators in the light of uniform distribution of eggs and mixing pattern of incoming water within the incubators of different designs and to recommend a proper design for hatching of carp eggs (Khandagiri, 1988).

MATERIALS AND METHOD

The frames of three different shapes of incubators namely cylindrical, divergent and convergent types were fabricated as shown in Fig. 1 and were covered with net. Further, 4 designs of each incubator was prepared by covering different portions as follows:

(a) full open incubator (the net portion was not covered by any means)

(b) full cover incubator (the net portion was completely covered with transparent polythene sheet)

(c) bottom open incubator (the top half of net case i.e. 20 cm height from top was covered by transparent LDPE sheet)

(d) top open incubator (the bottom half of the net case i.e. 20 cm from bottom of the cylindrical portion was covered by transparent LDPE sheet).

Thus, by altering the position of the opening, 3 shapes of the incubators were made to serve as 12 different designs.

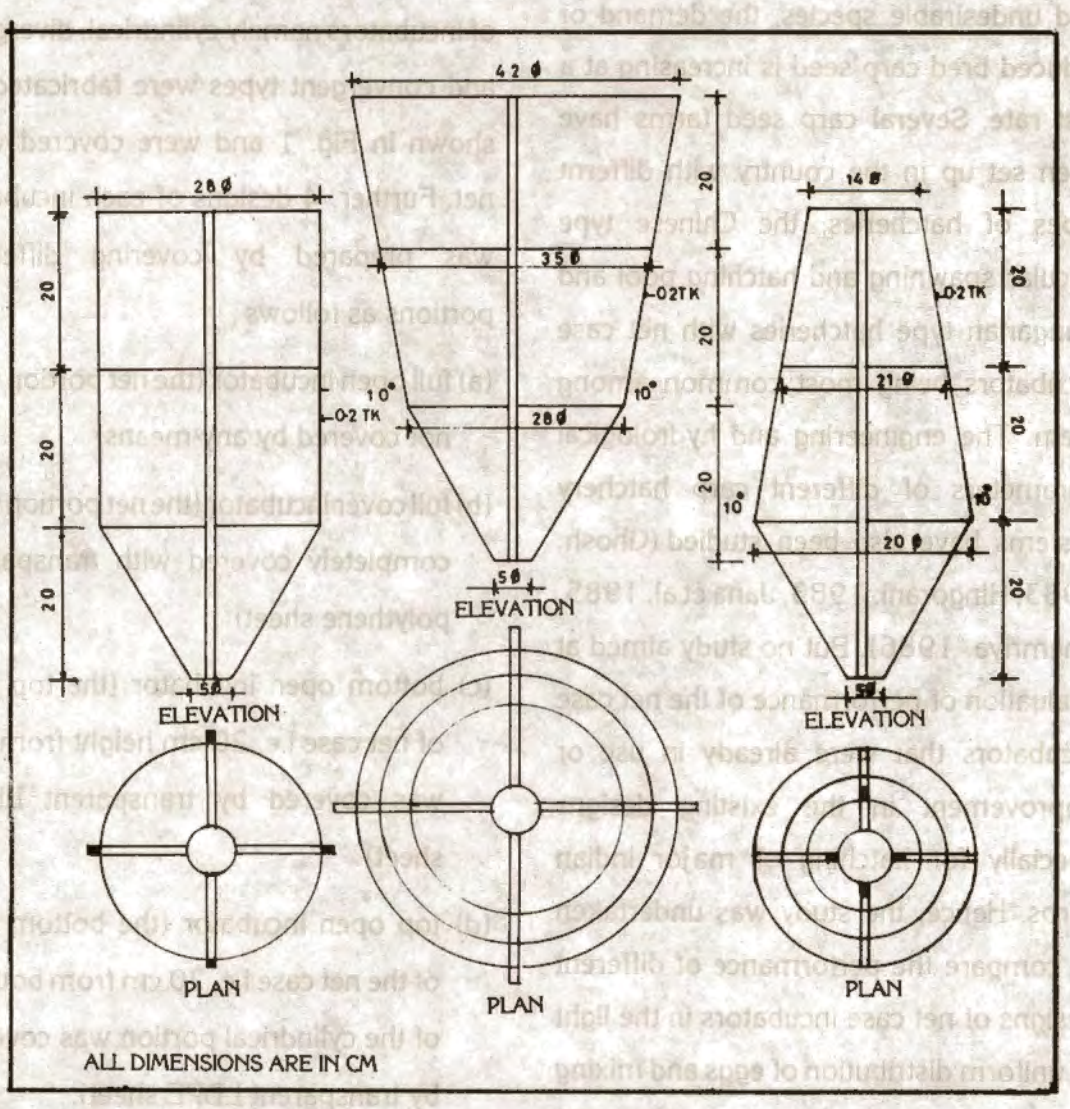


FIG.-1 DIMENSIONAL SKETCH OF INCUBATORS UNDER STUDY

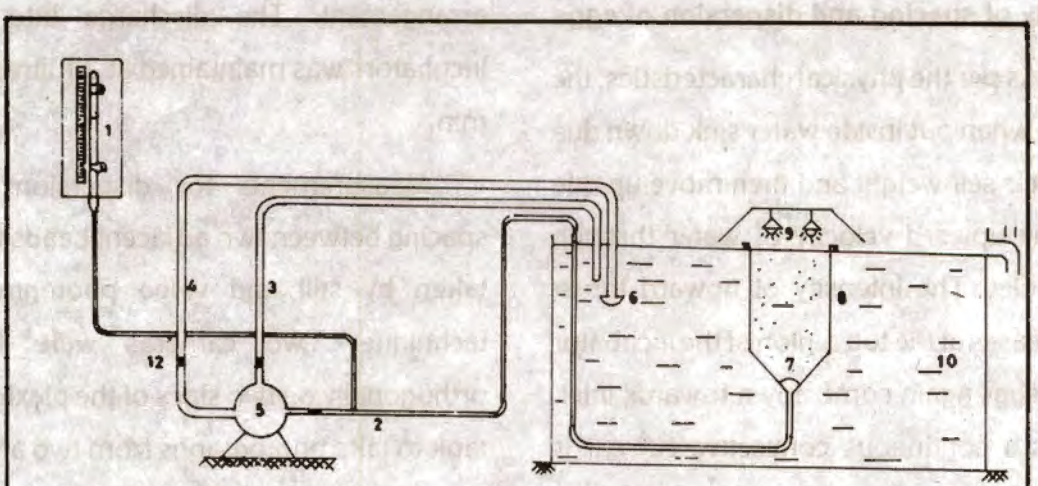
Study of spacing and dispersion of eggs

As per the physical characteristics, the eggs when put inside water sink down due to their self weight and then move up due to the upward velocity of water through the inlet. The intensity of upward thrust decreases at the top region of the incubator and eggs again come down towards inlet. Thus a continuous convective current is generated inside the incubator, keeping the eggs in suspension. Further, in an incubator eggs should traverse the whole volume of incubator to maintain uniform oxygen depletion throughout and the number of eggs per unit volume at all parts should be same. So to study the dispersion and spacing of eggs, the incubators were put inside a plexiglass tank for clear vision of eggs.

The experimental set up was as shown in Fig. 2. Fresh water was pumped into the cistern from a out side tank continuously to remove metabolics from the cistern and to supply dissolved oxygen. A constant water level, 55 cm above the bottom of the incubators was maintained in the plexiglass tank by overflow arrangement. The discharge into the incubators was maintained at 21 litres per min.

Measurements for dispersion and spacing between two adjacent beads were taken by still and video photographic technique. Two cameras were fixed orthogonally on two sides of the plexiglass tank to take photographs from two angles simultaneously with a view to find out the distance between two adjacent beads accurately. For video recording also, similar placing of video cameras were adopted.

After completion of the video recording, measurements were taken by replaying the system. On the TV screen each section of the incubator was divided into 12 zones by putting hypothetical horizontal lines at 10 cm interval and considering the vertical axis as a vertical hypothetical line and the number of beads in each zone was calculated (Fig. 3). As volume of each zone was not same, the counted numbers were converted to numbers present in equal volume (V/12 for each incubator) by multiplying with



1. Pezometer
2. Delivery Line
3. By pass Line
4. Suction Line
5. Electric Pump
6. Strainer
7. Shower
8. Cylindrical Incubator
9. Electric Bulbs
10. Piexiglass Ostern
11. Over flow pipe
12. Gate Value

Fig.-2. SCHEMATIC DIAGRAM OF THE EXPERIMENTAL SET-UP

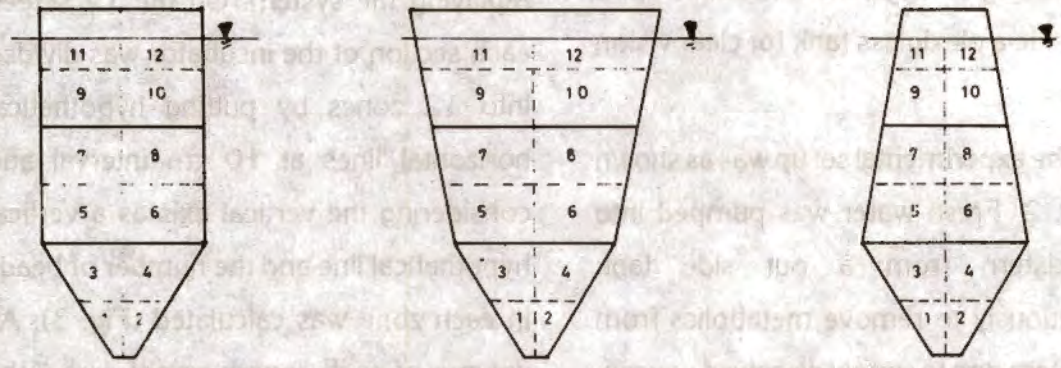


FIG.-3 SKETCH SHOWING DIFFERENT ZONES OF THE INCUBATOR

$V/12V_z$, where V was the total volume of the incubator and V_z, the volume of the zone being considered.

The main factors responsible for uniform dispersion of eggs inside an incubator are the inlet air velocity, specific gravity of eggs, shape of incubator, type of water jet and covered area of incubator. In this study, all factors except the shape and covered area of incubator were kept constant. A counted number of beads (100 nos.) were placed in the incubators in each case. As live eggs were not always available, plastic beads of same size and specific gravity were selected for some experiments, which responded in the same way as live eggs.

Mixing pattern in incubators

Dye experiment was conducted to trace the mixing pattern of incoming water within the incubators. This give a measure of efficacy of the design for removal of ammoniacal products from the incubators. Alta, a bright red dye was diluted by mixing with 4 times volume of water and the solution was pumped through the shower (Fig.2) which gradually got mixed up within the incubator. The mixing pattern in different designs were recorded by a video camera and later sketched on paper. The time taken by the dye to reach the top of the incubator as well as the time of removal of dye from the incubator was noted, which represented the time of ammonia removal.

Based on the results of the above studies, the best design of the incubator was recommended.

RESULTS AND DISCUSSION

Spacing of eggs

It was observed that for each design, about 50 spacings could be measured properly and finally only 50 values were considered in each case for the analysis work. The different values of spacings were grouped into class intervals and the frequencies of the class intervals indicated that the distribution pattern was not very much uniform in any of the incubators. The spacing varied between 4 to 14 cm. However, in some designs the variation

was limited mostly between 4 to 8 cm. Based on the statistical analysis of spacing values of different designs, the ranking of the incubators was done (Table 1). A persual of all the C_v values indicated that the cylindrical design was the best followed by divergent and convergent shaped incubators. For a particular design, better spacing of eggs was observed for the incubators with full covers followed by bottom open, top open and full open systems.

Dispersion of eggs

It was observed that the number of eggs per reference volume (V/12) in different incubators varied from 8 to 25. The variation may be attributed to different shapes of the incubators, their coverage, volume of dead zones and some uncontrollable parameters. More dead zones were observed in divergent and convergent shaped incubators. The ranking of different designs regarding dispersion of eggs was also done by statistical analysis as presented in Table No. 2.

Mixing characteristics within the incubators

The experiment with dye to indicate the mixing pattern and removal of metabolics indicated that the dye took a minimum time of 2.5 sec to come out of the cylindrical incubator with top open. In the full open incubators, the dye at first reached surface layer and then came down along the side wall. While coming down the side wall the dye came out not only from side wall but from the surface layer as well. The areas where dye reached last were found to be the suspected dead zones as found in earlier experiments. In no other design time of removal of metabolics was less than 4 seconds.

In the earlier experiments it was found that spacing and dispersion of eggs was best in cylindrical incubators with full cover. But the dye experiment indicated that the removal of metabolics was not at all satisfactory in the particular design. Other designs like cylindrical incubator with bottom open and divergent incubators with full cover and bottom open, though were slight better than the

cylindrical incubator with top open for spacing and dispersion of eggs (Table 1 and 2), but their performance regarding metabolic removal was not at all satisfactory.

Hence considering the spacing and dispersion of eggs alongwith the removal of ammoniacal products, the cylindrical shaped incubator with top open may be considered to be the best design for carp hatchery system.

CONCLUSION

The summary of the observations on different types of incubators are stated below.

1. To minimise the creation of dead zones, cylindrical design was best followed by divergent and convergent designs. For uniform spacing of eggs, full cover and bottom open designs of cylindrical and divergent incubators should be prefered.
2. The bottom open and top open designs of both cylindrical and divergent incubators offered the best dispersion of eggs.
3. The mixing pattern inside the incubator and removal of metabolics was best in cylindrical incubator with top open.
4. Considering both spacing and dispersion of eggs alongwith removal of metabolics, cylindrical incubator with top open was considered to be the best design.

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TABLE-1 : STATISTICAL ANALYSIS FOR SPACING OF EGGS IN DIFFERENT TYPES OF INCUBATORS

	Type of the incubator	Mean (μ)	Standard deviation (σ)	Coefficient of variation (C_v), %	Rank according to sapcing
1.	Cylindrical type				
	(a) full open	7.68	2.29	29.81	7
	(b) full cover	4.91	0.95	19.43	1
	(c) bottom open	6.35	1.42	22.33	2
	(d) top open	4.10	1.04	25.28	5
2.	Divergent type				
	(a) full open	6.15	1.91	30.16	9
	(b) full cover	6.00	1.34	22.39	3
	(c) bottom open	6.77	1.71	25.26	4
	(d) top open	6.97	2.09	29.95	8
3.	Convergent type				
	(a) full open	5.42	2.16	39.89	12
	(b) full cover	6.98	1.97	28.23	6
	(c) bottom open	7.23	2.19	30.24	10
	(d) top open	5.24	1.71	32.50	11

TABLE-2 : STATISTICAL ANALYSIS FOR NUMBER OF EGGS IN DIFFERENT ZONES OF THE INCUBATORS.

	Type of the incubator	Mean of number of eggs per zone ( )	Standard deviation ( )	Coefficient of variation (c_v), %	Rank
1.	Cylindrical type				
	(a) full open	10.66	4.13	38.71	7
	(b) full cover	12.44	2.59	20.83	1
	(c) bottom open	13.03	3.12	23.93	2
	(d) top open	14.25	4.59	32.24	5
2.	Divergent type				
	(a) full open	14.05	5.18	41.35	9
	(b) full cover	16.92	4.29	25.39	3
	(c) bottom open	10.49	3.29	31.34	4
	(d) top open	6.94	2.7	39.0	8
3.	Convergent type				
	(a) full open	8.75	4.95	56.64	12
	(b) full cover	10.55	3.90	37.04	6
	(c) bottom open	11.08	5.20	46.92	10
	(d) top open	12.43	6.96	55.99	11

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APOLY IMPROVED SMOKELESS AND DAMPERLESS COOKSTOVE

Housewives have to face smoke problem by the use of Conventional Cookstoves which leads to diseases like tuberculosis and breathing troubles. Eye gets damaged and lungs also gets effected (see fig. No.-1A and IB). The smoke comes out from the chimney by the use of improved cookstoves and since cookstove is scientifically constructed hence 20% to 40% fuel can be saved.

(Fig. — 1A)

In an improved cookstove two items can be cooked simultaneously. Improved Cookstove is constructed by the mixture of clay, rice husk, and cowdung. The shape of the device is compatible with the size and shape of cooking pots, so that fuel can be sufficiently and better utilised.

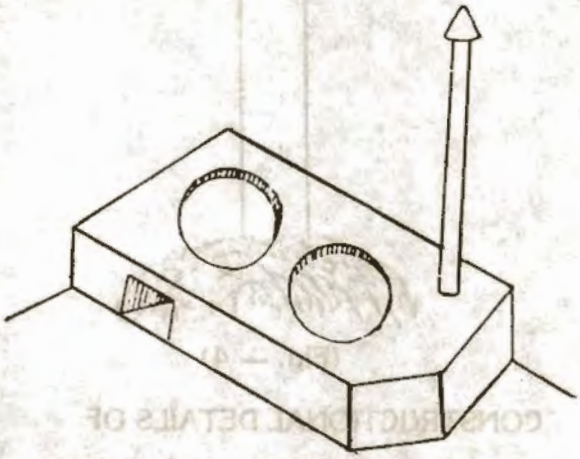
(Fig. — 1B)

WHAT IS APOLY IMPROVED SMOKELESS AND DAMPERLESS COOKSTOVE:

The APOLY cookstove is an improved version of the traditional mud cookstove.

It has an enclosed fire box or combustion chamber connected to the chimney by a tunnel. One or two additional cooking holes can be provided above the tunnel.

Two food items can be cooked, on this model simultaneously with only one fire, hence the house wife can save cooking time and fuel (see fig. 2).



(Fig. — 2)

THE MAIN COMPONENTS OF THE APOLY SMOKELESS AND DAMPER-LESS COOKSTOVE

1. The Fire Box :

The space below the first pot where fuel is burnt is called the 'fire box' and serves as the combustion chamber.

2. Space for Cooking Pots :

The top portion of the combustion chamber on which cooking pot is placed and the top portion of another chamber on which another cooking pot is placed are called pot sheet. Generally the diameter of the pot sheets are 15 to 25 cm. in domestic cook stove. It's number varies from 1, 2, 3 or even more depending upon the requirement.

3. Tunnels :

The channel which is used to transfer the thermal energy from flue gases to the cooking pots is known as tunnel. It connects the first and second cooking pots so that the heat can be transferred from the combustion chamber to second cooking pot and from second pot hole to another tunnel.

4. Chimney :

A chimney is a necessary part of cookstove through which waste flue gases are disposed into the atmosphere and also helps in creating draught to draw more air into the combustion chamber.

5. Cowl :

It is a conical shaped cover which is used to protect the chimney from rains and dust storm (fig. 3 A-B and see fig. 4 chimney with cowl).

COWL

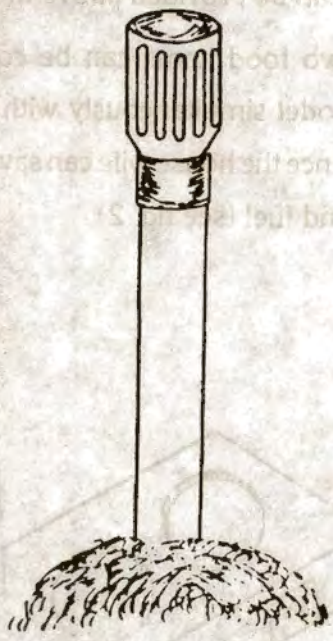
(Fig. 3-A)

COWL

(Fig. 3-B)

6. Baffles :

A baffles or a series of baffles serve two purposes. It prevents the direct escape of the hot gases, allowing them to burn more completely. Baffles can be placed at the exit of the combustion chamber.



(Fig. — 4)

CONSTRUCTIONAL DETAILS OF APOLY SMOKELESS AND DAMPER-LESS COOKSTOVE

1. Selection of clay and preparation of mixture :

The proper selection of clay and ratio of ingredient in preparing the mixture is important for construction of Chulha (cookstove).

7. Materials requirements :

To prepare the APOLY COOKSTOVE you should collect the following materials in said quantity as below :

Material	Quantity
Clay	50 kg
Husk	05 kg
Sand	20 kg (or as required).
Cow dung	10 kg
Chimney	02 Nos. (6' length & 3" dia)
Cowl	01 No.

You should check that if soil contains sand then it is not necessary to add additional quantity of sand.

Cow Dung
(Fig. - 5)

Sand
(Fig. - 6)

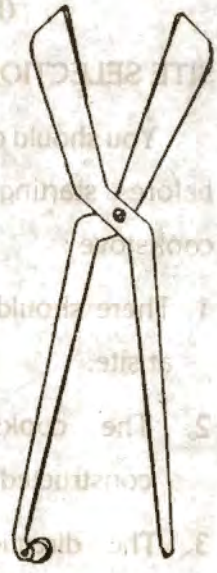
Chopped Straw
(Fig. - 7)

TOOLS REQUIRED FOR CONSTRUCTING AN APOLY CHULHA :

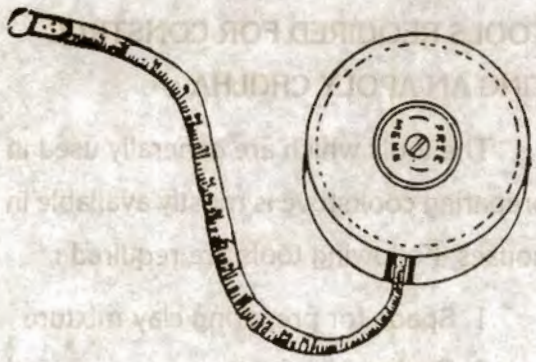
The tools which are generally used in preparing cookstove is mostly available in houses. Following tools are required :

1. Spade for preparing clay mixture
2. Bucket
3. Trowel
4. Hack saw
5. Measuring Tape
6. Knife
7. Mould

Trowel
(Fig. - 8)

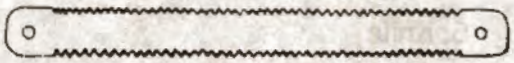


(Fig. - 9)



Measuring Tape

(Fig. - 10)



Hack Saw Blade

(Fig. - 11)

SITE SELECTION FOR COOKSTOVE :

You should check the following points before starting the construction of cookstove :

1. There should be no moisture sealing at site.
2. The cookstove should not be constructed in the open place.
3. The direction of the combustion chamber is kept in such a way that there should be no direct effect of air.

CONSTRUCTION PROCEDURE OF COOK STOVE :

The ratio of clay, husk, sand and cow dung is decided in such a way that after preparing the mixture the cracks should not be developed in chulha after drying. There should be no foreign material in the clay. The ingredients should be properly mixed to each other (see fig. 12, 13 and 14).

"Well made gara will make chulha strong and neat".

(Fig. 12)

(Fig. - 13)

(Fig. - 14)

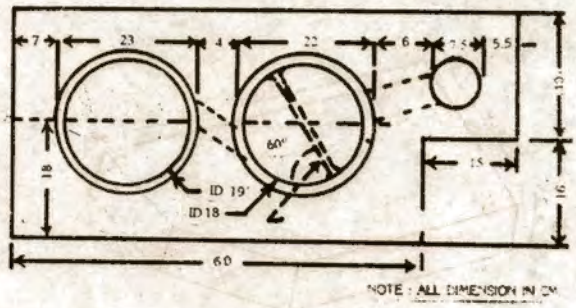
Now you should mould the prepared mixture in the pencil form so that it's length becomes 10 cm. It is placed horizontally and carefully handled by finger and thumb if other end bends downwards but does not break, then mixture is prepared.

First of all lay out on the ground surface (selected place for cook stove) 85 cm x 36 cm for preparing over this a mud (prepared mixture) block of size 85 cm x 36 cm x 26 cm and left for a day (As shown in the fig. no. 15).

Do the marking on the block (fig. 15) according to its design mentioned in the fig. 16. Then one pot is cut up to depth of 20 to 25 cm and the second pot is also cut up to depth of 7 cm.

Prepared Block of Soil (Gara)

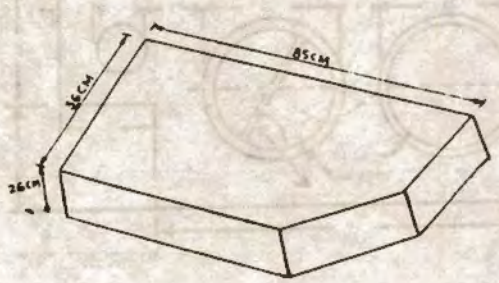
(Fig. - 15)



(Fig. - 16)

For construction of combustion chamber you cut the soil from the front portion of the block of 15 cm. wide x 16 cm. height. Now you mark a circle of dia. 5 to 6 cm. and height of 7 to 8 cm. from base in first hole and it is cut at an angle of 45^0 between first and second pot. Then cut a circular hole up to depth of 15 cm. in third hole and make a tunnel of 6 cm. dia. between the holes of second pot and chimney opening. Now the space for installing chimney is prepared.

Again mark a portion of size 7 cm. x 7 cm. at the height of 5 cm. and take off. This portions exit the smoke from chimney (see the construction drawing from fig. no. 17 to 23).

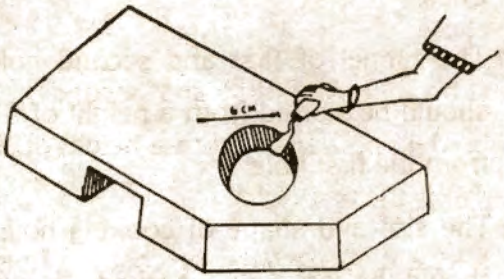


(Fig. - 17)

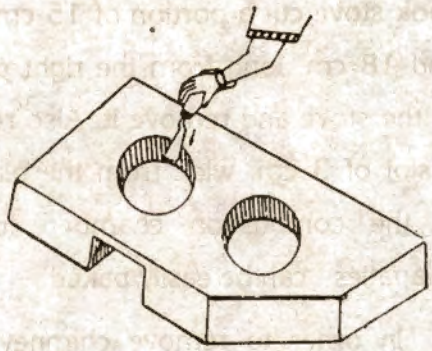
(Fig. No. - 18)

Now fit the chimeny at its suitable place in a way that the hole cut in should face the second tunnel. Then construct a baffle in such a manner that it should maintain a gap of 2 cm. from cooking pot. Again cut another tunnel of one inch (1") deep on the baffle so that flue gases/smoke may exit easily.

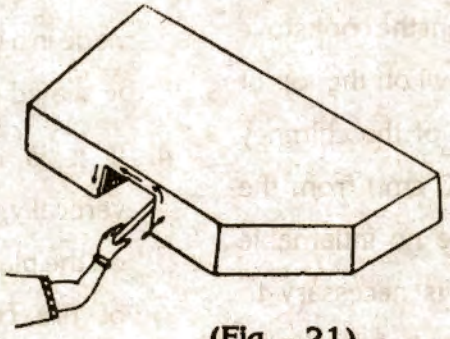
You make the top portion of the second hole according to suitability of the cooking pot. (If the dia. of the cooking pot is less then the hole dia. it can be reduced by putting more clay inside the hole).



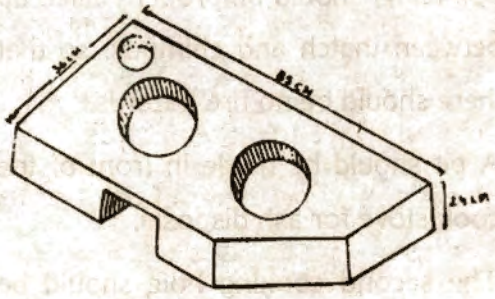
(Fig. - 19)



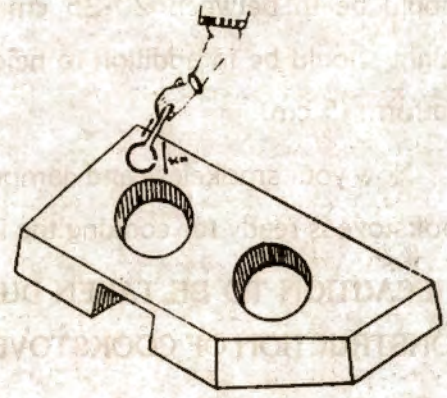
(Fig. - 20)



(Fig. - 21)



(Fig. - 22)



(Fig. 23)

To reduce the thermal mass of the cook stove cut a portion of 15 cm. wide and 18 cm. long from the right portion of the stove and remove it. Also remove a slot of 3 cm. wide from the platform in the combustion chamber so that Chapaties can be easily baked.

In order to remove chimney from thatched roof you fill up the soil/clay in the space left between chimney and thatched roof and to prevent the cookstove from rain water fit the cowl on the top of the chimney. The height of the chimney should remain 2 feet (60 cm.) from the roof and there should be no inflamable material kept nearby. It is necessary to mention here that the height of the device should be in between 20-25 cm. This height should be in addition to height of platform (5 cm).

Now your smokeless and damperless cookstove is ready for cooking the food.

PRECAUTION TO BE TAKEN DURING CONSTRUCTION OF COOKSTOVE:

1 The tunnel which leads to chimney should be thoroughly cleaned. If the tunnel is blocked by dry or hard clay then it should positively be cleaned at once.

2. The tunnel of first and second hole should be started from a height of 3" from the first hole.

3. The size and shape of cooking holes should be properly checked. If two cooking pots of different size are used then the cooking pot holes should be made in a way that both the pots should be seated properly.

4. If it is desirable to bake Chapati vertically, then a channel should be cut on the platform at the side of right wall of fire chamber and the depth of channel will depend on the size of the Chapati.

5. Soil (clay) should be properly filled up between thatch and chimney, so that there should be no fire hazards.

6. A pit should be made in front of the cook stove for ash disposal.

7. The second cooking hole should be covered always with a clay cover when it is not in use.

PRECAUTION TO BE TAKEN WHILE USING THE COOKSTOVE:

1. Only dry fuel should be used, if cowdung cake is being used then ash should be cleaned at regular intervals.
2. The fuel should be added at the time of cooking gradually. Don't block the mouth of the fire chamber by any type of excess fuel.
3. If any cracks develops on the surface of the cook stove, it should immediately be repaired.
4. Chimney should be thoroughly cleaned at least once in a month so that carbon particles and ash collected inside the chimney may not restrict draught (follow fig.—24 & 25).

(Fig. 24)

(Fig. 25)

5. The tunnel should be cleaned daily.
6. Cover the cooking pots with clay or metal cover at the time of cooking.
7. If the cooking pot used is smaller than the cooking hole then iron plate or clay cover should be kept on cooking hole so that smoke does not come out of cooking hole.
8. If the tunnel path gets reduced in size then it should be scraped off.

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FUEL CELLS FOR CO-GENERATION OF POWER

Fuel cells of 200 kW capacity will become a co-generation power source option early in 1992, according to International Fuel Cells Corp. (IFC) of the USA. A range of fuel cell sizes from 50 to 1000 kW to provide electricity and heat for individual commercial buildings and light industrial plants will be available.

Fuel cell technology uses an electro-chemical process to produce electricity and heat from natural gas. The process offers the cleanest fossil-fuelled power generation technology commercially available. The technology is also efficient, with up to 36 per cent of the fuel's energy content converted to electric power. Overall efficiency can reach 72-80 per cent when the heat is utilized as in co-generation.

Gas companies in the US, Japan and Europe have already ordered more than 50 of the 200 kw units. They will be installed by the companies in customer-owned buildings and facilities, possibly on an energy service basis.

IFC independently supported development and testing of the 200 kw version. Four prototypes were operated in 1988 and 1989 to verify performance. The cells produce alternating current electricity and can operate either connected to, or independent of, an utility grid. They ensure instantaneous load-following response with light frequency and voltage control even during transient operating conditions.

For the layman, a fuel cell is basically a continuously operating battery. Fuel is oxidized at the anode, releasing electrons to an electrical circuit. Hydrogen ions from the anode travel through the electrolyte to recombine with oxygen and produce steam. So long as fuel is supplied, conversion to electric power continues without interruption.

HOW TO MAKE USE OF INDUSTRIAL WASTE

To augment energy resource availability, The Gujarat Oil and Industries Ltd. (GOIL) is planning to set up a Rs. 15 crore plant for the production of briquetted fuel similar to coal from the industrial waste at Panoli, Gujarat, using a technology developed by the company.

The plant will have an annual capacity of one lakh tonnes in the initial stage, the capacity will be increased from year to year and would finally go upto one million tonnes annually by the end of the year 2000.

This solid briquetted fuel will have calorific value equal to that of coal and can be used as a substitute for coal in processing units, industrial and household appliances. The raw materials, sludge and other waste are available in plenty from the group companies, agricultural waste and other organic/hydro carbon from petroleum/chemical/fertilizer companies.

However, GOIL has planned to set up and agro based unit in about 100 acres of waste land nearly and use its waste as raw material. The fuel would prove cost effective and would contribute effectively towards energy conservation.

SOLAR HYDROGEN: THE EMERGENCE OF PRACTICAL ENERGY ALTERNATIVE

Hydrogen, a clean burning fuel that can be added to natural gas or used independently for power engines, is attracting renewed interest. The reason is simple; technologies have been developed to produce hydrogen through the use of solar energy. Attracted by these promising developments, power supply companies and industry are investing in solar hydrogen research. A primary example of this is the world's first experimental solar hydrogen plant, which is now being built in Neunburg vorm Wald in the Federal Republic of Germany by a consortium including Bayernwerk, BMW, Linde, MBB, and Siemens.

POWER GENERATION FROM WOOD WASTES IN ANDAMAN AND NICOBAR ISLANDS

Using waste wood from a saw mill as an energy source and sea water as a coolant, researchers from the Indian Institute of Science (IISc), Bangalore, have successfully set up a 100 kilo watts power generation system in the Andaman and Nicobar Islands.

The system has been developed by IISc's Centre for the Application of Science and Technology to Rural Areas under a project sponsored by the Department of Non-Conventional Energy Sources.

It consists of a wood gasifier using waste wood from a saw mill and a diesel engine genset, and its economics is comparable with that of a similar system of 3.7 kw capacity.

Such systems based on renewable energy resources can save 60-80 per cent of diesel consumed in normal diesel-based generation, a report published by IISc Scientits.

The time is ripe for studies on renewable energy systems because of increasing costs of petroleum fuels and the fact that other cheaper sources are nowhere in sight.

The IISc team designed a 100 kw double walled gasifier with an inner diameter of 35 cms and provided with annular spaces to carry hot air to heat the walls.

Air taken in from the top helps burn wood pieces in contact with the hot walls of the gasifier.

A water seal introduced at the bottom of the gasifier helps in continuous disposal of the ash.

The scientists have also provided the gasifier with a cooling system comprising two collers which are fed with sea water. The cooling water, apart from removing the heat from the hot combustible gases leaving the reactor, scrubs the gas and reduces any tiny particles of tar present.

About one kg of sea water flows through the system to cool the gas to near ambient conditions, the IISc team reported.

To remove all traces of dust and moisture present in the gases, the gasifier has been provided with a filtering system to separate the dust particles. while a mist eliminator based on coir pith absorbs all moisture.

The team also ingeniously designed a system to process the wood wastes into suitably sized pieces by fitting a 2 ton hydraulically operated power press with a steel cutting tool. The system could process about 100 kg of wood in one hour.

The maintenance cost of the system operating on diesel or dual-fuel mode is the same, except for the additional cost of lubrication oil recommended more frequently in the dual-fuel mode.

One skilled and one semi-skilled helper are enough to operate the IISc gasifier system. Results show that the cost of energy from dual-fuel operation is substantially lower than from diesel alone.

The system can be used to pump water and generate electricity at various power levels.

Also, electric supply to an industry with 25-35 per cent load variation can be handled by a diesel engine in a dual-fuel mode easily.

Although the present gasifier design is rated at 100 kw, Dr Baliga, scientist of IISC and his coworkers say they see no difficulty in designing an efficient gasifier for megawatt power levels.

An economic analysis shows that at power levels of about and more than 100 kw, an investment into gasifier-based power generation systems will be an attractive commercial proposition.

There is an additional benefit for a large number of users, plantations and industries already having diesel engine pumps or electricity generation systems. In such cases, investment on a gasifier system and its auxiliaries is reduced.

NEW SOLAR COOKER

A new solar cooker developed by researchers at the Aachen Technical College in Germany uses the sun's energy

to heat up two hot plates to more than two hundred degrees celsius—enough to prepare meals for large groups of people.

The invention, devised by a team of scientists led by Professor Klemens Schwarzer in the solar technology department of the Aachen college, is said to have several advantages over other solar cookers, reports German Research.

Solar energy is magnified by reflectors and then concentrated so that it heats up cooking oil which becomes lighter, rises up into the cooking apparatus, and raises the temperature of the two hot plates to up to more than two hundred degrees celsius.

The model is said to be inexpensive, fairly easy to set up and above all suitable for serving large groups of people. It can boil three litres of water in just 13 minutes. Excess heat is stored in a thermal accumulator so that cooking can also be done in the evening or during the night. The solar oven can even be operated in winter. The new device is particularly suited for use in schools and hospitals in hot countries in the tropics.

In field trials conducted in Chile, the solar cooker was operated with light from halogen lamps substituting for natural sunlight. This will enable the use of the solar cooker even on overcast days, the report said.

The mirrors which focus the sun's rays on the collectors can be folded up at night to protect them from damage. Pots and pans are superfluous. Instead the hotplates are indented into the cooker in a concave form. This means less thermal energy is lost. As the solar cooker is fitted with wheels, it can always be pointed towards the sun, the report said.

The first solar cooker which weighted some 300 kg was transported to Chile by ship. The others will be built on site, which also creates local jobs. Thus a small company in India has assembled the solar cooker. It is being used to cook meals for

a children's home without using wood or gas.

The Aachen research team is currently working on a model that could cater for up to 50 people. A byproduct of their work on the solar cooker has been a solar baking oven.

ACTIVE CARBON FROM COCONUT SHELLS

The Indian Institute of Technology (IIT), Madras, has devised a method to produce highgrade activated carbon from coconut shells.

The IIT method is based on the fluidised bed principle, wherein a cushion of air or hot gas is blown through the porous bottom slab of a container to float a powdered material for burning.

The fluidised bed process is claimed to be more efficient than the numerous other methods currently employed to produce activated carbons, as it offers high heat and mass transfer and gives a better-quality product at a much lower temperature.

The researchers employed nitrogen as a fluidising medium, and zinc chloride or phosphoric acid as the activating agent for charcoal.

Zinc chloride showed better activation in the optimum temperature range of 300-500 degrees celsius, but phosphoric acid gave a higher yield.

However, the lower yield obtained when zinc chloride is used to activate charcoal is more than compensated by the good quality of the product.

SORGHUM COBNIPPER

Harvesting sorghum cobs can be quite a problem due to non-availability of labourers. Scientists of the Punjabrao Krishi Vidyapeeth at Akola, Maharashtra, have tried to overcome this problem by developing a new machine which they call a sorghum cobnipper.

The mobile cobnipper consists of a steel frame, a kerosene engine, power-supply unit, a cutting knife and cob-collection trays.

The cob-collection trays are fixed to the machine in a telescopic arrangement to facilitate adjustment of the cutting unit

at a distance of 125 to 160 cm from the ground level. The cutting unit is adjusted according to the height of the plants.

Two male labourers take eight hours to move the machine for nipping cobs in a hectare full of crop. The speed is maintained between 1.48 and 1.56 km per hour. The cob cutting efficiency of each row varies due to different number of cobs at different heights, but the average works out to 82.5 per cent.

The cob-nipping operation costs about Rs. 160 per hectare of sorghum against the manual nipping cost of Rs. 216. Field trials have shown the machine to be more economical than manual nipping.

EFFICIENT DISPOSAL OF HAZARDOUS WASTE

Two Finnish companies, Outokumpu Eco Energy and Ekokem, have jointly developed the technology for the efficient disposal of hazardous wastes. The treatment plant comprises an incineration line, a physico-chemical treatment line and a landfill. Currently, there are two such plants in operation in Finland.

The incineration lines developed by Eco Energy comprise a receiving station for classification of waste, a pretreatment station, a rotary kiln followed by an after-burning chamber, a heat recovery plant (boiler), and a gas cleaning system.

Research and development jointly carried out by Eco Energy and Ekokem has introduced substantial improvements to the waste-handling technology. The aim has been to maximize plant safety while at the same time minimizing the impact on the environment, that is, air, soil and water. Technical improvements have been developed throughout the process from pretreatment, waste feed, combustion and after burning technology to gas cooling and cleaning.

The pretreatment line developed by Ekokem represents significant gains in safety at work and in productivity. The current barrel-handling process is as follows. After classification and suction emptying barrels containing paste and soild waste are shredded in a special

nitrogen gas blanketed machine. The solid part is conveyed to the solid bunker and the pumpable fraction is handled by the paste system.

All solid in the bunker are thoroughly mixed and transferred to a shreder screw that feeds the waste continuously to the rotary kiln. Ekokem's both rotary kilns feature cooling systems allowing combustion temperature of up to 1400°C without the brick line wearing rapidly. At this temperature slag is totally liquid and when cooled in water it ends up finely granulated and vitrified. According to American leaching tests for landfill materials, the slag of the Ekokem plant exhibits less than 1% of the permissible solubility of heavy metals.

Ekokem was among the first to apply a semi-dry gas cleaning system with a bag filter. It is still an efficient method, but for the new incineration line an even more efficient wet system was chosen. As the new line includes no boiler, all waste water produced by the gas cleaning system is evaporated. The wet system is more efficient for HCl, heavy metals and dioxins.

Emissions from the first incinerator have consistently been kept below permissible values. Even stricter limits have been set for the second incinerator on emissions of dust, HCl, Hg and TCDD.

A VERSATILE COOKING APPLIANCE

A novel multipurpose appliance designed and marketed by Solar Manufacturing Co., NOIDA, Ghaziabad, UP, under the trade name 'USHMA' possesses the capability to function as (1) Solar cooker, (2) Electro-solar cooker, (3) Electric cooker, (4) Food warmer, and curd maker, and (5) Electric oven. The appliance has been developed under a project financed by the Indian Renewable Energy Development Agency Ltd.

In USHMA, heat loss to the environment is prevented through the use of a specially designed insulated cooking chamber fixed to a sturdy body. The chamber is locked by a double glass lid

and the air between two glasses works as insulation, preventing convective heat losses from inside.

On sunny days, the appliance serves as a solar cooker, but in winter, when the solar insolation is less than 800 W/m^2, it assumes the role of an electro-solar cooker, cooking being done by the combined use of sunlight and electricity. In the total absence of sunlight, it can be used as an electric cooker. For making cakes, biscuits, bread, etc., the appliance can be used as an electric oven. For this, the thermostat knob has to be set at 'Electric oven' position. For use as food warmer, the thermostat is to be reverted to 'Food warmer' position after the cooking is over. Under specified conditions, it can be used as a curd maker.

FROM PHOTOCOPIERS TO SOLAR CELLS

JAPAN'S Canon company, world famous for its cameras, has adapted a technique used in making photocopiers to produce cheaper and more efficient solar cells.

The technique involves sandwiching amorphous silicon between two layers of amorphous silicon germanium (New Scientist, Vol 137, No 1865). Silicon and germanium are semiconductors, which means while they are not conductors in their pure form, they become conductors when doped with impurities.

Solar cells are now made using either slices of crystals such as silicon or non crystalline semiconductors. The former are more efficient but they are expensive; the latter are cheaper, but their efficiency is low. Canon claims its solar cells will be cheaper than both and more efficient than amorphous cells.

FERTILISER USE IS INCREASING IN DEVELOPING WORLD

DESPITE environmental pressure the use of chemical fertilsers, world fertiliser production increased to 158 million tonnes in 1989, which is a 32 per cent

increase over production in 1982. However, in some Northern countries, fertiliser output declined because of controls on crop production imposed in the 1980s as a result of low grain prices. Statistics show the developing countries are fast catching up with the North in both production and consumption of such fertilisers. More ominous are predictions that consumption of all categories of fertilisers will continue to increase in the South. India and China will continue to account for most of the increase in the world's consumption of nitrogen fertilisers. Asian rice-growing countries are expected to increase use of potash fertilisers to compensate for loss of potash content in the soil as a result of high use of nitrogen fertilisers. On the other hand, attempts to set standards on nitrate pollution in groundwater because of heavy use of nitrogen fertilisers, has reduced their use in the European Community.

ENERGY EFFICIENT PUMPSET FROM BHEL

A compact 5-Horse Power energy efficient pumpset for agricultural operations has been developed by researchers at the Corporate Research and Development Centre of BHEL in Hyderabad. Field trials of the pumpset have established its performance at 72% efficiency, compared to 65% efficiency of other indigenous pumpsets currently in use. It can be a handy tool for small farmers and its high energy saving capacity helps cut down costs. It is estimated that if all the existing 5-HP pumpsets are replaced by the new type the country can easily save Rs. 3000 million per annum. In terms of energy conserved, it amounts to 1500 Kilowatt hours.

The pumpset is compatible with an energy-efficient motor also developed by BHEL as a monoset.

VERMI-WASH PROMOTES CROP GROWTH

A Simple method to extract vermi-wash has been developed by technologists at the Yusuf Meherally Centre, Panvel, in Raigad district of Maharashtra. "We have designed a low-cost system that can yield about 1.5l of vermi-wash a day. The wash can be

applied to crops as a nutrient solution or its diluted form can be used as a foliar spray to boost crop growth."

The system consists of a 1001 plastic barrel, and a uses perforated plastic waste paper basket of 101 capacity and a central one-metre plastic pipe 5 cm wide with holes up to 7.5 cm height at the dipped end.

The wastepaper basket is placed upside down at the centre bottom of the barrel; and broken bricks and sand packed around it up to 7.5 cm deep. Above this comes layers of humus along with about 5,000 earthworms. The ripe humus serves as a bedding material for the worms.

The plastic pipe should pass through the centre of the wastepaper basket such that the end with the holes touches the base of the barrel. The whole assembly is kept inside a thatched shed or any cool corner of a farm shed.

Every day, two to three tablespoons of fresh cowdung slurry must be poured on the humus as feed for the earthworms. Watermelon rinds, banana peels, sapota skin and vegetable wastes can also to be added as feed for the earthworms.

Also, about two liters of water must be poured everyday from the top. The water slowly percolates down and collects at the bottom of the barrel. "This is the vermi-wash. As it passes through the earthworm burrows, a part of it washes down the gut of the worms as also the castings, which is known to have excellent growth promoting compounds."

On an average 1.51 of vermi-wash can be collected from the barrel using a simple siphoning mechanism. Plastic siphons used for transferring kerosene from large drums to smaller containers can be used for this. The vermi-wash can be directly applied at the root zone of plants, at 100 ml each, every week, or diluted four times with water for use as a foliar spray.

"We have tried the vermi-wash on

vegetables such as tomato, brinjal, chillies and a variety of gourds and found that the quality and quantity of yield improved markedly. Vegetables grown with vermi-wash had more flesh and were tastier with vermi-wash had more flesh and were tastier.

The foliar spray is used when plants yellow. Their foliage turns dense green in two to three days of spraying. Weak seedlings grow vigorously and yield well after the use of vermi-wash.

When the vermi-wash was added to compost pits, the decomposition process hastened. The compost was ready in 22 days as compared to the normal 35 days.

Facing facts

- *One out of five people in the world is hungry.*
- *40,000 children die each day due to weakness from poor diets and lack of resistance to disease.*
- *More than 200 million children under five are stunted by lack of food.*
- *More than 20 million children are born underweight each year.*
- *40 million children are estimated to be vitamin A deficient. One million die as a result and as additional half million go blind.*
- *1.6 billion people are estimated to suffer from iron-deficiency anaemia.*
- *One billion people either suffer from, or are at risk of, iodine deficiency which causes mental retardation, reduced work capacity, stunted growth and disfigurement.*

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SCIENCE, TECHNOLOGY AND SOCIETY

Course Department of the British Council will hold an International Seminar on "Science Tech. and Society - Appropriate Science Education for the Twenty First Century", at university of Oxford, from 6th to 16th September' 1993.

The Seminar will be aimed at a broad spectrum of science educators all those who have responsibility for the planning, teaching and evaluating of new science courses. Each of the participants will be asked to give a twenty minute paper on some aspects of science, technology and society (STS)-appropriate science education in their own country.

Development and Research activities of the following issues will be discussed:

— The nature of STS as education.
— Industry and STS
— STS in developing country
— Law, values and decisions about the environment
— New curriculum materials
— Teacherrs and in-service education
— Informal knowledge and public understanding of science.
— Objectives and the evaluation of courses.

For further information contact:

The British Council
10, Spring Gardens
London SW1A 2 BN

OR

from your nearest
British Council Office

ENVIRONMENTAL EDUCATION AND HUMAN ECOLOGY:

Research Unit on Environmental education and development, university of Brod ford, will organise a workshop on "Environmental Education and Human Ecology", on 3rd August at University of Vienna, Austria.

The aim of the workshop is to bring together both researchers and practitioners from Europe and from the developing world, to discuss the human components of Environmental Education.

The workshop will cover the topics: Enviromental education in rural areas, Environ- mental education and training, Environmental education, human ecology, and sustainable development, Environmental adult education etc.

For further information contact:
Dr. Walter Leal Filho
Workshop Co-ordinator
Research Unit on Environmental Education and Development
University of Bradford
Bradford BD7 1DP

COMMUNITY ORGANISATION AND COMMUNITY DEVELOPMENT:

'THREAD' Sidharth Nagar, will organise a three weeks course on "Community Organisation and Community Development", from 15th July to 4th August at its centre.

The training progamme is designed to create opportunities for realizing: Effective interaction between individual and group, Role and commitments in development works, Leadership and decision making, Work with group through participatory methods, skills for conducting effective village meeting, strategy development, and effective communication.

For further information contact:
THREAD
Siddharth Village
P.O. Box No. 9
Jatni
Dist. Puri
ORISSA - 752 050

MICRO-HYDRO POWER:

Intermediate Technology Development group (ITDG), U.K. in collaboration with Mini-Hydro Power Group (MHPG) will organise a training course in "Micro-Hydro Power", at Pokhara, Nepal from 13th Sept. to 8th Oct. '93.

The course is suitable for engineers and technicians with experience in mechanical, electrical or civil engineering. It is also useful for staff of rural development and credit organizations and government officers whose work is related to energy promotion. The course is for engineers, technicians and funders from all countries on the design, planning, implementation, component, manufacture, operation, maintenance, and mangement of Hydro schemes from 0.5 KW-300 KW.

The topics to be covered in the courses

are: Site measurements, Hydrology, Intakes, Settling, Forebay tanks, canals, penstocks, Turbine design, Local manufacture, Drivers, Alternators, Induction, generators, electonic bad controllers, Transimission lines, contractual costing Economics Funding and Tariffs, Ownership and Management, operation and Maintenance.

For further information contact:

Co-ordinator
Micro-Hydro International
Course, ITDG
PO Box 2325
NEPAL

OR

Adam Harvey
ITDG
Myson House
Railway Terrace
Rugby CV 21 (3) HT-UK

NEW ENERGY TECHNOLOGIES AND CLEAN ENVIRONMENT:

Dept. of Mechanical Engineering, University College of Engineering, Osmania University, Hyderabad, will organise a "National Semiar on New Energy Technologies and clean Environment Future Development Perspectives," at Hyderabad on 3rd & 4th December' 93.

The Seminar is aimed to bring scientists, Engineers working in Industry/ Institute/Research Laboratories to come together for exchange of ideas and contribute to the sustainable growth of nation and also to meet the energy demands of rural masses.

The main topics be covered are: Solar Energy, Wind Energy, Bio-mass/ Bio-Conversion, Ocean Energy, Geothermal Energy, Waste heat recovery systems, Combined cycle power plants, Co-generation, Waste recycling, Air/Water Pollution, Environmental control, Co_2 emission and Global warming, Energy conservation, Energy management, energy audit etc.

For further information contact:

Prof. D.N. Reddy
Convenor
Department of Mechanical Engineering
University college of Engineering
Osmania University
HYDERABAD - A.P.

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RURAL TECHNOLOGY MANUALS

We are in a age of constant change. It is occuring at such fast pace that new methods are needed to adopt the changes. Innovation is a deliberate planned change to improve a system or accomplish an objective. Technology and Technolgy Transfer are tools of innovation that are used, to help bring about a change. The promotion and dissemination of technology to rural areas can be achieved successfully through an effective delivery system. This transfer of technology entails various methods like, training, demonstration, awareness generation, policy support etc. But the most important tool in technology transfer is availability of appropriate literature for various groups like, users, policy makers, technicians, extension specialists, manufacturers etc.

Rural Technology Manuals are designed to serve this need of the society. Information Division of Institute of Engineering Rural Technology, under its International Development Research Centre, Canada., sponsored project "Establishment of Rural Technology Information Services" has published a series of useful Rural Technology Manuals (RTM) on selected proven technologies. Some of the most useful manuals from this series are as under:

RTM ON IMPROVED SMOKELESS AND DAMPERLESS COOK STOVE

In India, approximately ninty percent of the house-hold fuel wood and agricultural wastes, used as fuel, for cooking at a consumption rate of around 225 million tonnes per year. It is now well known that a significant quantity of energy can be saved from house-hold sector by burning these materials in more scientific manner. With the improvement of life style, cooking style are being changed. This is of considerable significance, where wood is the main fuel (specially in the rural areas). It was therefore, found absolutely necessary to design and propogate Smokeless and Damperless Cookstove, suitable for different geo-physical,

socio-economic and cultural conditions to bridge this vicious circel.

The aim to publish the Rural Technology Manual on Improved Smokeless and Damperless Cook Stove is to inform interested users, programme implementors, policy makers and extension specialists about the positive features of this simple appropriate technology. The intital chapters of the manual are very much informative, basic concept and main technical features are elaborated specifically. Later part of the manual elaborates the constructional procedures of the device. The write up is well supported by illustrations, designs and drawings of Improved Cookstove. Instruction for beneficiaries, problems and their solutions have also been discussed adequately in the last chapter of the manual.

"Improved Smokeless Cookstove" by Partho Protim Lahiry, Published by Information Division, CDRT, IERT, Allahabad, Pp 29, English, Rs. 50/-

RTM ON BOX SOLAR COOKER

By the finding of the research in the field of energy, it is by now clear that fossil fuel era of non-renewable sources is gradually coming to an end. One of the promising options is to make more extensive use of renewable sources of energy derived from the Sun. Solar Energy can be used both directly and indirectly. It can be used directly in variety of thermal applications like heating water or air, drying, distillation and cooking. The pattern of energy consumption in our country shows that household sector is an important consumer of energy, and nearby fifty percent of the total energy consumption in this sector is for the purpose of cooking only. Solar Cookers are the best tool for conserving the cooking fuel and exploring the use of new and renewable source of energy to meet the cooking energy requirement. Application of Solar Cookers are also the best use of pollution free renewable energy.

In this direction, Centre of Dev-

elopment of Rural Technology, at IERT, Allahabad., has also made efforts to develop some useful models of the Solar Cookers. The present manual on "Box Solar Cooker" describes about; Solar Energy, its radiation, basic solar thermal technologies and solar cooking devices. Chapter four of the manual gives details of construction, working methodology, operation, performance and maintenance of F.R.P. Box Solar Cooker. Stepwise final assembly of different parts of the solar cooker has been described with elaborated illustrations. It is hoped that the manual would be informative and useful.

"Box Solar Cooker", by S.C. Srivastava, Published by Information Division, CDRT, IERT, Allahabad., Pp 76, English, Rs. 75/-

RTM ON IMPROVED WATER MILL

The preparation of food for the family is an important task, that is almost undertaken by women. In ancient period a considerable amount of time and labour of women was wasted on processing of food vig., grinding and hulling of cereal, grains, pulses and rice. Later, some traditional technologies are used to reduce the amount of manual labour involved in this process. The Traditional Water Mill (Ghatta) is one of such technology which is very useful device in many hilly regions of India. It works by using available water power to turn the grinding stone for grinding of wheat. The Traditional Water Mill was quite well for the need of the time, but with rapid increase in population, it fails to fulfill the need, because of its extremely low out put. The Improved Water Mill has increase the effeciency of Traditional Water Mill, and make it possible to use the water mills for operating small machines, as well as agro-processing machines.

Due to the lack of proper literature, persons whom are involved in this field are not very well aware by the status of the improved design of the Water Mill. The

Rural Technology Manual on Improved Water Mill is an effort to sumup the practical experiences made by the Centre for Development of Rural Technology at IERT, Allahabad., in the hilly regions of Uttar Pradesh, to develop and install the Improved Design of Water Mills. The manual has been classified into sixteen chapters with useful illustrations. In the first three chapters Introduction, Technology and its Development and, different three units of Improved Water Mill has been elaborated. The next three chapters describe about the material requirement, equipments, machines, tools required for fabrication. Seventh and eighth chapters of the manual, which provide in depth study and explaination of fabrication and installation procedures of the water mill with complete illustrations, are the most informative part. Man Power and space requirement for installation of whole unit, precaution, care, mintenance and salient features of the device have also been discussed in the last chapters of the manual. It is expected that the manual will be useful for the researchers, extension professionals and villagers of hilly areas of the country.

"Improved Water Mill", by S.A. Ahmad, Published by Information Division, CDRT, IERT, Allahabad., Pp 38, English, Rs. 50/-

★★★

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INSTITUTE OF ENGINEERING & RURAL TECHNOLOGY, ALLAHABAD

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★ Training & Promotion of rural entrepreneurs to undertake rural technology projects.
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Organised National Seminar on Rural Technology (1981), on behalf of Ministry of Rural Development, Govt. of India. State level workshops on technology transfer for state Govt. of Himachal Pradesh (1983) & Karnataka (1984), International Training Programme on Appropriate Technology sponsored by Unesco (1983), A.T. Orientation Programmes for senior officers of Science Policy Centre of Govt. of Iran etc.

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