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# Editorial

Rural Technology per se is not a panaecia for problems demanding technological solutions. Government policies, social set up, and above all earnestness of policy planners and ad ninistrators is of utmost importance. There are instances where a proven appropriate technology, for income generation, is clearly utilised for profit accumulation by an individual. There is a case of person with adequate capital, owning a large number of pedal operated rope making machines and matting looms and running them with hired rural labours. The real operators of the machines-the daily wage earners receive a wage far too less than the prescribed minimum wages. Further, the machine owner, with his access to markets in urban centres, fetches handsome price of the products. Thus he gets twofold advantage at the the cost of poor rural artisans, rather by exploiting them, and yet claims to be a disseminator of rural technology and unfortunately accepted too as such by the society. This is a typical example to demonstrate that even a socialy, technically and economically appropriate technology will not be able to solve the problem of the rural poor unless there is a well knit plan to organise and implement transfer of technologies amidst the target population, and follow it up to ensure that the benefit percolates to the desired level. Besides this, such a plan will have to provide institutional spport in form of forward and backward linkages to complete the cycle, from raw material procurement, processing/utilisation, design, quality control to marketing. On the national level the paramount need is to identify the stock of proven rural technologies (technologies-on-the shelf), region/area-wise, identify capable NGO's/individuals/ concerned government departments/agencies and prepare an integrated transfer plan where target groups are individual rural families and the services are really provided at their doorstep. District could be appropriate level where such a plan is prepared however a block level plan will be even better. It would then be also necessary that the aforementioned stock of proven technologies, with complete details and economics of operation, is available at the level of planning. The next question is who initiates such an action plan. The answer is obvious an apex agency at the national level. Fortunately we do have such an agency-CAPART. It is to be seen that how dynamic will be the response of this agency to the above suggestion. At the least it can initiate a debate, rather hold a workshop, where the suggestion could be discussed refined, modified or altogather substituted by a better plan. But the point is that a national level agency on rural technology has to demonstrate quickly how a dent can be made in rural poverty by transferring on a massive scale appropriate rural technologies as a part of the overall development process.

# Publication List 1990

1. Rural technology : Report of National Seminar, 1981, 20 papers on Rural/Appropriate Technology.
   English pp 288 Rs. 200/-
2. Renewable Sources of Energy : Proceedings of Short Term in Service Training Programme, 1983,20 papers on Solar Cookers, Smokeless Cookstoves, Micro Hydro Power, Wind Energy, Biomass and Biogas etc.
   English pp 250 Rs. 200/-
3. Selection of Windmill and Agricultural Pumpsets : Course manual of Training Programme for Senior Officers of NABARD, 1984, 3 papers on Water Pumping Windmills, Special features : Paper on agronomic aspects of Windmill Irrigation.
   English pp 39 Rs. 30/-
4. Course Synopsis of ISTE : Summer School on Renewable Sources of Energy, 1984, 12 Papers on Biomass, Biogas, Wind Energy, Solar Energy and Micro Hydel sets etc. and 4 project reports on Solar Water Heater, Solar Cooker and Biogas plant.
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   English pp 196 Rs. 200/-
9. A case study on Smokeless Cookstove
   English pp 32 Rs. 25/-
10. Report of Sample Survey and Evaluation of the Smokeless Chulha Extension Programme of the Non-Conventional Energy Development Agency U. P., in the District of Varanasi, Faizabad, Nainital and Bijnaur.
    English pp 150 Rs. 200/-

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# ISSUES ON INVOLVEMENT OF WOMEN IN RURAL WATER SUPPLY AND SANITATION FOR 'HEALTH FOR ALL'

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*The article gives a broad overview of the key issues of S & T Mission on drinking water and the role of rural women in its implementation. It also gives a short narrative of the strategy and the pilot project formulated for action study. At the end it provides quite a comprehansive bibliography on women, water and sanitation in developing countries, which it is expected, will be of practial value to researchers, implementors and field workers alike.*

With growing experience of functioning of the National Drinking Water Mission, (NDWM), it was increasingly felt that the self-sustaining management of improved drinking water supply and environmental sanitation in rural areas is not taking firm roots. One of the significant reasons was slow pace of participation of rural community in general and women in particular who generally assume major responsibilities of domestic activities, family health and procurement of food, fuel, and drinking water for their families.

## THE WATER MISSION

Water Mission (NDWM) provided a timely opportunity for the advancement of modern system management of the multi disciplinary and inter-departmental approach for Rural Water Supply and Sanitation (RWSS) with the intervention of S & T. The rapid application technologies by the Mission expanded the provision of drinking water supplies with 'quality assurance' nearly to entire 'problem' villages.

## ROLE OF WOMEN

It was noted that when water supply schemes and sanitation facilities in rural areas were planned, the women were never taken into confidence and consulted. The community was also not made aware of strong linkage between safe water and health, water technologies, related assets and their cost, and health and hygeine education. Ghosh (1989) notes that the time has come to realise the role of rural population, particularly the women who can play if motivated and trained, a significant role in the operation and maintenance (O & M) of some of these assets.

Consideration of these needs, therefore, necessitated development of strategies designed to promote the involvement of women and their empowerment in planning, decision making, implementing and managing RWSS for 'Health for All',

## INDIA'S EFFORTS

The concept of involvement of women in the RWSS was discussed in India (during 1989-90) in the following forum :

1. Inter-department meeting to discuss integration of ICDS with Technology Missions on immunisation, literacy and drinking water (August, 1988) ;
2. DRD circular on involvement of women in panchayats (March, 1989) ;
3. DRD/UNICEF Inter-Agency Group on Women, Water and Sanitation : Concept paper (March, 1989) See : annexure 1 ;
4. Background note on the subject prepared by the author for the Department of Rural Development (DRD) (1989) ;
5. PROWWESS seminar on 'Women and Water' organised in collaboration with DRD at Udaipur and Calcutta (1989) ;
6. All India Coordinated Project on 'Women & Drinking Water', Department of Science & Technology (DST), Government of India (1989) ;
7. 'Women and Handpump' G. Ghosh, paper presented at Philippines (September, 1989) ;
8. Draft National Perspective Plan for Women (2000 AD) : Planning Commission (1989-90) ;
9. Role of Women as caretaker manager of handpump rural water supply : Dr J. C. Srivastava, paper presented at Barcelona. Spain (April, 1989) ;
10. Draft project proposal on the subject by UNDP/Word Bank (1990) ;
11. In addition PROWWESS/UNDP sponsored four studies at RCFWS, Bombay for Maharashtra (1985), CFDRT, Madras for Tamil Nadu (October, 1987), ORG. Bhubaneshwar for Orissa (October, 1987) and PRIA, Jaipur for Rajasthan and Orissa.

The author took the opportunity of discussing the subject with a cross-section of people (men and women) including water engineeers and managers (PHED) in some mini-mission districts of the Mission. The subject was also discussed in the DST forum (S & T for women) in the 'International Training Programme for women from Developing Countries', organised by the National Institute of Rural Development (NIRD), Hyderabad (1989) and in the International Conference on Water and Waste Water, Barcelona., Spain (1990). This interaction helped in the preparation of a project proposal on the subject (by the author) which was circulated to some experts in India and abroad for opinion (1990). With these emerging thoughts, a number of questions and issues surfaced. These issues have been compiled and presented here.

## LITERATURE SURVEY

A number of documents relating to rural womens' participation in development were scanned to search the principles and thoughts and the processes by which social mobilisation has been attempted. The documents exclusively aimed at the involvement of women in RWSS system were short-listed and given here (annexure 2). These documents draw our attention to the efforts and contributions made by PROWWESS/UNDP, UNDP/World Bank and other bilaterals. In these efforts made in South East Asia, viz. Nepal, Sri Lanka, Indonesia, Philippines, Thailand and Bangladesh could be of interest to India. The author has attempted to churn these to cull out the lessons which could be given trial in India's rural backdrop.

## ISSUES

1. Who wants that women should be involved in Rural Water Supply and Sanitation (RWSS) ;
2. Have we consulted women and their men (social sanction) in RWSS ;
3. What is the experience of those who are promoting this idea in villages, with what process and results ;

4. What are the needs, priorities and expectations of women specially of low education, low income groups and socially weak and where the safe drinking water ranks ;

5. What is the general labour-time-budget or women belonging to land owners, marginal/ small farmers, landless labours, artisans and service class staying in different agro-climatic zones and the time required for their participation in the RWSS sector ;

6. What do we mean by empowerment to women in RWSS ;

7. How to ensure access of all sections of rural society to pubric water supply points and water quality information ; who will ensure this previlege to weaker sections ;

8. Can priority be marginalised for fuel, food and fodder over drinking water or it could be an integrated programme together with income generation ;

9. How to balance conflict (avoidance) by the women caretaker-manager of RWSS during prevention/protections of public assets of RWSS ;

10. What should be the role of menfolk and the village institutions towards management of RWSS ;

11. How to institutionalise the operation and maintenance (O & M) of handpumps and water treatment plant ;

12. What should be the responsibility of NGO's, Panchayat, voluntary agencies, government functionaries including PHED engineers at village level ;

13. How to sensitise them (9) for involvement of women ; what are their constraints in mobilising womenfolk ;

14. What is the men's and mother-in-laws point of views about domestic water supply and sanitation and participation of their women ;

15. Do the people at micro level know about the water technologies being implemented (demystification) and related activities ; which of these should require women's attention and participation ;

16. What could be the role of universities, centres of women studies, scientific research laboratories, medical collages ; industries, and media people (all located in big cities, capital towns and urban areas) towards mobilisation of womenfolk for RWSS ;

17. What could motivate and convince women to act as caretaker-manager of RWSS assets (sources and hardware) and what could be the facilitators factor for women's participation ;

18. How can men and women be made aware of the positive gains of safe water, prevention from contamination (from source to storage at home) ;

19. How much time a women can save by doorstep facilities and how much proportionate increase income can be expected from this time saving and whether it would be a positive edge in terms of income augmentation and motivation ;

20. How to quantify and demystify the health and related productivity benefits by provision of safe, adequate and sustained water supply ;

21. Could there be code of practise for handling of drinking water and terms of prevention from contamination and wastage, maintenance of supply source and to some extent cost-sharing ;

22. For the rural women per-se, there are seventeen (17) development programmes from different departments, all impressing their priority and trying to compete with each other ; Who will decide the issue of integration and a common forum at the village level/ panchayat ; how to segregate the contribution of different functionaries if development inputs

are merged together and converge atleast at village ;

23. How to work for networking of various efforts aimed at the development of women within the conventional system of 'confidential report' writing of the bosses of different government functionaries ;

24. Could there be an incentive to the women caretaker-managers of RWSS, if so, in what form and modalities per standpost/handpump ; fluoride/ iron removal plants, SPV units ; and sanitation structures, etc. ;

25. How women could be motivated to form pressure group for more participatory action in RWSS ; how to ensure this action ;

26. What kind of communication aids should be developed which may attract men, women, and childrens' awareness and attention towards urgency and essentiality of safe water and health ;

27. How the women can be made more informed and also made change agent to extend water mission messages ; who will do the communication function i. e. women to women, women functionaries to women, men to women, voluntary agencies to women, panchayat to women, and school teacher to students ;

28. What could be the modalities for generating people's understanding in terms of awareness, sense of belongings, ownership and responsibilities towards valuable assets created in villages (what could be the criteria for this evaluation) ;

29. What could be the reporting system and role of engineers (who are mostly men) and how to fix responsibilities for rectification of defects in the RWSS assets ;

30. Do we know the cost of the RWSS assets, its break-up, standards, labour time and cost input required in installation (cost consciousness) and social cost-benefit of each asset ;

31. What should be the policy and support services for each asset in terms of handing over the ownership of RWSS assets to village panchayats and/or other village based institutions or the local water committee and sanitation committee ;

32. What should be monitoring system for participation of women in RWSS (clearly defining the output/input indicaters) ; criteria for measurement of women's involvement ; indicators for impact analysis; and MIS.

Ms. Siri, Melchior Programme Director, PROWWESS/UNDP New York while conveying new views on author's project proposal on the involvement of women in RWSS in India (op. cit.), drew attention to the following pointed issues :

(i) now the linkage with other socio-economic goals can be achieved and sustained at micro-level and exactly what benefits it would accrue ; and

(ii) while the micro-level implementation is the crux of the programme, how to rely entirely on local institution.

(iii) what could contain the benchmark (basic data).

## POST DECADE ACTION

There have been notable inputs of S & T through the Mission of which the most visible are source development, guineaworm eradication, installation of deep well handpump/VLOM pumps, low-cost water treatment plants (particularly the muscle powered) for removal of excess iron and fluoride, rainwater harvesting (roof catchment) SPV water pumping system ; introduction of water quality testing facilities and portable kits and provision of low-cost improved sanitation 'system'. The most significant achievement has been coverage of 'problem' villages through cost-effective solutions within the resource allocation and time-frame. The key to Post-Decade Action is to protect these ; sustain these ; maintain these : and sensitise the rural community including women to own these, use these effeetively and share its cost in some form or

the other. Cost effectiveness of entire ongoing, emerging and future programmes for health for all should be another necessity. There is also the urgent need to make the rural community aware of the direct relationship between water, health and productivity.

In this exercise of involvement of women in RWSS system and improvement of their health status productivity, and quality of life of the family should be kept in view vis a vis the community's active participation and how they propose to associate. What 'we' want we should perhaps not be imposed. Ghos notes (1990) what India has achieved in RWSS, how it has achieved and the proposed strategy should be the starting point for post-decade activities in RWSS. Mission crystalised some of these ideas and converted them into action-plan and practise and these things are actuly happening in the villages with visual display. Most of these have become women-friendly. In many places, women have boldly taken the leadership of operation and maintenance (O & M). Thus thinking process became the process of development. Selected Mission activities should be identified and grouped and strategies be developed for 'attitudinal change'. It is imperative to show through visual demonstrations the relationship of water with environmental sanitation. Soft-ware approaches specially designed and focussed to women which they accept need be thought. The quality aspect of water towards safety for health of young ones should be perhaps the crux of the womens' programme. Strategy to achieve change should be linked to achievements in terms of certain indicators like degree of participation and empowerment and not just the number of camps organised. The fear, however, still exists of multipilcity of agencies and approaches for the same one target-the women".

## STRATEGY

The strategy for involvement of women in RWSS should cover the following :

1. a national policy and socio-political commitment ;
2. terms of mission approach ;
3. full support in form of technical and technological input from national agenies, government departments and scientific organisations.
4. converting the programme into pilot-project for action research and then into a national mission ;
5. use of this programme as an 'instrument of change' ;
6. development of a required capacity and capability including a strong communication system ;
7. development of trained manpower for social mobilisation ;
8. programme aimed at serving the unserved and underserved (including rural poor and weak) ;
9. decentralisation (focus at micro-level/panchayat) ;
10. linkage of the programme with the minimum needs and accelarated rural water supyly programme of the Department of Rural Development, Government of India ;
11. development of village level committees with participation of panchayat, women and voluntary agencies ;
12. creation of awareness and health education and close coordination between drinking water personal hygiene, sanitation, and literacy programme ;
13. a time-bound programme with sharp output indicators ; and
14. a strong data base and MIS.

## PILOT PROJECT FOR ACTION STUDY

In view of above. a project proposal may be drawn for action study, defining the (i) objective (output indicators) ; (ii) modalities for baseline survey ; (iii) inputs required ; (iv) a sharply designed sche-

dule of action delineating the responsibilities ; (v) criteria for impact analysis ; and (vi) the MIS ;

1. This action study be initiated in pilot project districts selected from a cross section of geo-climatic zones (including mini missions and where women have already shown initiative and leadership in development programmes ;
2. This project be divided among PHED engineers, voluntary agencies both working in villages and those having established reputation and willing to work in social mobilisation in piiot project areas CAPART (Council for Advancement of Peoples Action and Rural Technologp could be associated in the selection of the voluntary agencies.
3. The nodal agency at far as RWSS system is concerned should be PHED (as in India).
4. Ms. Siri notes (op. cit.) that in such a pilot project area, a common factor should be local nodal/focal point chosen by the community itself.
5. Before starting the project all persons going to handle the project be got together for orientation .
6. The experience of this action-study for development of software model be pooled together for evaluation and multiplication.

## NETWORKING

The author has developed such a draft project proposal. This needs to be institutionalised and a 'network' from village to centre needs to be developed as done in the case of "Water Quality Monitoring and Surveillance" of India's Water Mission. In addition a draft MIS has also been developed (by the author) for pre- and post-interventions.

## CONCLUSION

The program for involvement of women in Rural water Supply and Sanitation system should, therefore, focus on

* problems of women, especially the poor and weak, in RWSS ;
* identification of women as the target audience for communication ;
* promotion of important role of women for planning, implementing and maintaining the water sources ; and
* development of an integrated approach on safe water, sanitation, personal hygeine and child care.

The cutting edge should be 'will to change' by all not only by the women.

## ACKNOWLEDGEMENT

The author is grateful to Mr, G. Ghosh, Joint secretary to Government of India and Mission Diector, National Drinking Water Mission (ND WM) Department of Rural Development for his encouragement and guidance. 'Ghosh' quoted in this paper denotes his this position.

# CSIR TECHNOLOGIES FOR RURAL DEVELOPMENT

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*The crux of rural development lies in raising the living standards of rural and tribal people. Development of India can be achieved, primarily by developing the lives of the above, by steering the economy and wealth of this country towards them. Looking towards an urgent need for steering the vehicle of technology for rural development to the rural areas and for the material benefit of the rural masses, CSIR has taken up very appreciatable step in this field. This paper is a brief introduction of CSIR's technologies and its trasnsfer to rural areas.*

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

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

itself so that farmer is able to add value to his produce, generate employment in rural areas Moreover, powder and husk is also retained in the village itself for use as cattle feed. I have seen farmers transporting cattle feed (husk etc) from cities to rural areas. Manufacture of these machines has started in M. P. with the help of PTC. CFTRI Mysore have developed a hand operated pulse milling machine (50 kg/hr cost Rs 5000/-) which can be set up ingrowing rural areas This can help in employment generation and reduce the cost of pulses to the consumer. With one machine we can generate employment for 3–4 persons. This "Small and beautiful" machine should be widely promoted under Technology Mission for oilseeds and pulses. Similarily, bakery flour mill having capacity of (100 kg/hr and costing Rs 85,000/-) should be set up in wheat producing pockets and where roller flourmill does not exist. Entrepreneurs can set up these plants for producing Maida, Suji, Atta etc. There is a need to develop a small hand/power operated flour mills although one design is available but it has not been found efficient. A unit has been set up in M. P. through PTC.

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

## SOYA MILK

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

## MUSHROOM CULTIVATION

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

## MEDICINAL AND AROMATIC PLANTS

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

## RABBIT FARMING

Rabbit farming has again been monoply of Jammu and Kashmir and Himachal Pradesh. PTC introduced very recently Rabbit Farming in M.P. in view of increasing demand of Furr. It has good export potential as well. Recently, a training programme was organised at Shivpuri (M. P.) in collaboration with a voluntary organisation. Another programme will be organised by M. P. Antyavasyee Nigam for tribals of M. P. It suits cold regions of Country where temperature does not ex-

ceed 35°C. Rabbit farming could be good rural Industry which can give raise to allied industry like 'Shawl and Sweaters'.

LEATHER PROCESSING BY RURAL TANNERS :

In M.P. about 80 million hides & skins are available annually and hardly 5% of this valuable wealth is processed within the State & rest is traded off to other provinces. It is our effort to increase its processing within the State. PTC organise training programmes in collaboration with CLRI Madras for improving the efficiency & quality of leather processed by rural tanners. M.P. Leather Development Corporation takes follow-up action and provides support to these tanners by way of supplying raw materials & chemicals required for tanning & buying the produce. Such programmes should be adopted in other areas also.

FOREST PRODUCE ;

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

HOUSING & SANITATION :

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

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

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

DRINKING WATER :

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

JAL SHAKTI :

It is worth mentioning the development of 'Jal Shakti' a polymer developed by NCL Pune & being manufactured by a Bombay firm. This polymer absorbs water up to 500 times its weight & keep the root/seed wet for 15-20 days. It is suitable for

cultivation in water scarce areas. Results' of trials have been very encouraging Higher yield to this tune of 30-40% has been achieved for many crops.

At present Technology delivery system involves :—

- Publicity of technologies through mass media, Journals.
- Lectures in seminars, workshops, training programmes, orientation programmes.
- Providing S & T inputs to DICs, DRDAs, Tribal welfare deptt., Bank Financial Instt. for incorporation in their plan of action.
- Interaction at Secretary level for incorporation of S & T inputs in State Plans.
- Direct intraction with entrepreneurs.
- Arranging Demonstration & Training programmes.

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

There are few ways in which a man can be more innocently employed than in getting money.

—**Samuel Johnson**

# FUEL CHARACTERISTICS OF AGRICULTURAL RESIDUES

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*The author has described fuel characteristics of rice husk IR-8. The fuel characteristics like calorific values proximate analysis, ultimate analysis, has been presented in tabular form. Various physical parameter which affects the burning rate of rice husk has also been considered. The behaviour of properties of fuels also has been presented graphically.*

## 1. INTRODUCTION :

One fifth of paddy by weight consist of rice husk and makes up the largest milling by-product of rice. Considering the annual production of paddy of about 80 million tonnes, the resulting quantity of husk is 16 million tonnes. Therefore, husk is an important heat source particularly for the industry where it is produced. In order to develop and test suitable husk-fired furnace, information on basic properties and burning characteristics of husk are necessary.

## 2. FUEL PROPERTIES :

### 2.1. Calorific Value :

The calorific value of three Indian varieties of husks is obtained with the bomb calorimeter and is given in Table 1. The difference between higher and lower calorific value is the heat in the water vapour produced in combustion.

### 2.2. Proximate Analysis :

Proximate analysis gives the percentages of volatile matter, fixed carbon and ash. The volatile matter is that portion of the husk which is driven off in gas or vapour form when subjected to a standardised temperature test. The fixed carbon represent that portion of the husks that must be burnt in solid state in the fuel bed. The ash is the non-combustible residue after complete combustion of the husks. Proximate analysis of husks is given in Table 2.

### 2.3. Ultimate Analysis :

Ultimate analysis is needed for the computation of air requirements. weights and percentages of products of combustion, and heat losses on furnace tests. The air requirements and the volumes of products of combustion are used in the determination of fan sizes. Ultimate analysis includes the determinations of total carbon. hydrogen, nitrogen and oxygen (Table 3). The total carbon includes both the carbon in the fixed carbon and in the volatile matter. All this carbon appears in the products of combustion as $CO_2$ when the fuel is completely burnt. All hydrogen in the fuel is burnt to water and. together with the moistures in fuel appears as water vapour. Nitrogen is of no importance as it is incombustible. The oxygen content of fuel is a guide to the rank of the fuel. The amount of oxygen is high in low heat-value fuels. On the basis of ultimate analysis, the percentages of products of combustion. and air requirements are given in Table 4 and Fig. 1. Further-

more, the Ostwald Chart and the monograph for determining the heat loss due to incomplete combustion and heat taken away by flue gases are presented in Figure 2 and Figure 3 for the LR-8 variety. The other varieties have similar value. The products of combustion and air requirement for perfect combustion of groundnut shell are given in Table 5. The chemical composition of various other kinds of agricultural residues is given in Table 6.

3. OSTWALD CHART FOR RICE HUSK :

Given the ultimate analysis of a fuel, the excess or defficiency of air during combustion can be computed from the flue-gas analysis. The computations may be avoided by the use of graphical charts such as were invented by Ostwald (Trunks, 1956). In the original Ostwald Charts, however, the assumption was made that all $H_2$ is burnt and the only combustible gas in the stack gases is carbon-monoxide. The charts were modified by Keller (Keller 1961) to take account of the experimentally determined fact that when CO appears an equal volume of $H_2$ is usually present. Figure 2 is the modified Ostwald chart for rice husks. This chart allows a very close estimate of the excess air from a flue-gas analysis.

Table 1. Calorific Value of Rice Husk obtained from bomb calorimeter.

| Sl. No. | Variety of husks | Higher calorific value, Kcal/kg | Power calorific value, Kcal/kg | Moisture Content (w.b) % | Moisture free High calorific value, Kcal/kg |
|---|---|---|---|---|---|
| 1. | IR-8 | 2937.29 | 2637.29 | 8.67 | 3216.13 |
| 2. | Patnai-23 | 3355.-3 | 3044.70 | 10.38 | 3744.06 |
| 3. | Padma | 3105.99 | 2828.96 | 6.62 | 3326.18 |

Table 2. Proximate Analysis of Different Varieties of Rice Husks.

| Sl. No. | Variety of husks | Percent volatile matter | Percent fixed carbon | Percent ash |
|---|---|---|---|---|
| 1. | IR-8 | 68.6 | 14.0 | 17.4 |
| 2. | Patnai-23 | 69.3 | 14.9 | 15.8 |
| 3. | Padma | 68.7 | 12.7 | 18.6 |

Table 3. Ultimate analysis of different varieties of rice husk from Elemental Analyser*

| Sl. No. | Variety of husks | Hydrogen % | Nitrogen % | Total carbon % | Sulphur % |
|---|---|---|---|---|---|
| 1. | IR-8 | 4.99 | 1.99 | 39.26 | 0.10 |
| 2. | Patnai-23 | 5.10 | 2.17 | 38.92 | 0.12 |
| 3. | Padma | 4.67 | 1.52 | 38.19 | 0.11 |

* The oven dried samples of rice husks had 3.57% moisture content at the time of analysis.

**Table 4—Determination of Theoretical Air Requirement and Products of Complete Combustion, 100 kg Rice Husk.**

| Component | Mole | Requirement Mole | | | Produced Mole | | |
|---|---|---|---|---|---|---|---|
| | | $O_2$ | $N_2$ | $CO_2$ | $H_2O$ | $SO_2$ | $N_2$ |
| C | 3.271 | 3.271 | 12.3095 | 3.271 | — | — | — |
| $H_2$ | 2.495 | 1.248 | 4.6949 | — | 2.495 | — | — |
| $O_2$ | 1.022 | −1.022 | −3.8447 | — | — | — | — |
| $N_2$ | 0.071 | — | — | — | — | — | 0.071 + 13.167 |
| S | 0.0031 | 0.003 | 0.0113 | — | — | 0.0031 | — |
| $H_2O$ | 0.193 | — | — | — | 0.198 | — | — |
| Total | | 3.500 | 13.167 | 3.271 | 2.693 | 0.0031 | 13.238 |

Air required :

$= 3.5 \times 32 + 13.167 \times 28 = 480.7$ kg of air/100 kg of husk

$= 373.3$ m³/100 kg of husk

Total quantity of combustion products

$= 3.271 + 2.693 + 0.0031 + 13.238 + 19.205$ mole/100 kg of husk

Hence, total value

$= 19.2051 \times 22.4 \div 100 = 4.3018$ m³/kg of husk

By multiplying their molecular weight of these gases

$= 143.924 + 48.470 + 370.664 + 0.1984 = 563.2564$/100 kg of husk

Thus the specific weight of flue gases

$= 563.2564/430.18 = 1.3093$ kg/m³ $= 1.31$ kg/m³

**Table 5—Theoretical Products of Combustion and Air Requirement for Perfect Combustion of Groundnut shell.**

| Constituents of Combustion of one kg of Goundnut shell | Volume $m^3$ | Weight kg | Percent by volume (WB) |
|---|---|---|---|
| $CO_2$ | 0.8570 | 1.683 | 17.27 |
| $H_2O$ | 0.6921 | 0.556 | 13.96 |
| $SO_2$ | 0.0007 | 0.002 | 0.01 |
| $N_2$ | 3.4112 | 4.264 | 68.76 |
| Total | 4.9610 | 6.505 | 100.00 |
| Theoretical Air Requirement for Perfect Combustion of one kg Groundnut Shell | 4.307 | 5.545 | |

**Table 6—Chemical Composition of Various Kinds of Fuel**

| Fuel | C | Percent by weight | | | | Ash | Moisture content |
|---|---|---|---|---|---|---|---|
| | | $H_2$ | $N_2$ | $O_2$ | S | | |
| Fire wood | 35.0 | 4.3 | 0.4 | 29.6 | 0.0 | 0.7 | 30.0 |
| Peat | 30.9 | 3.2 | 1.3 | 17.8 | 0.4 | 6.6 | 40.0 |
| Straw | 36.0 | 5.0 | 0.5 | 38.0 | 0.0 | 4.7 | 15.8 |
| Oat | 41.0 | 5.2 | 0.7 | 36.7 | 0.2 | 6.3 | 10.0 |
| Corn | 38.0 | 4.8 | 0.5 | 34.9 | 0.4 | 1.6 | 20.00 |
| Rice husk | 39.2 | 5.0 | 2.0 | 32.7 | 0.1 | 17.4 | 3.6 |
| Groundnut shell | 45.9 | 5.4 | 1.1 | 36.3 | 0.1 | 3.9 | 7.3 |
| Coal | 70.5 | 5.1 | 1.2 | 3.4 | 1.3 | 18.4* | ... |
| Liquid fuel | 84.8 | 12.7 | ... | 1.4 | 1.1 | ... | ... |
| Producer gas | $CH_4$ | CO | $CO_2$ | $N_2$ | $C_2H_2$ | $C_2$ | ... |
| | 15.2 | 20.0 | 8.0 | 54.0 | 1.3 | 0.5 | ... |

*Moisture + Ash.

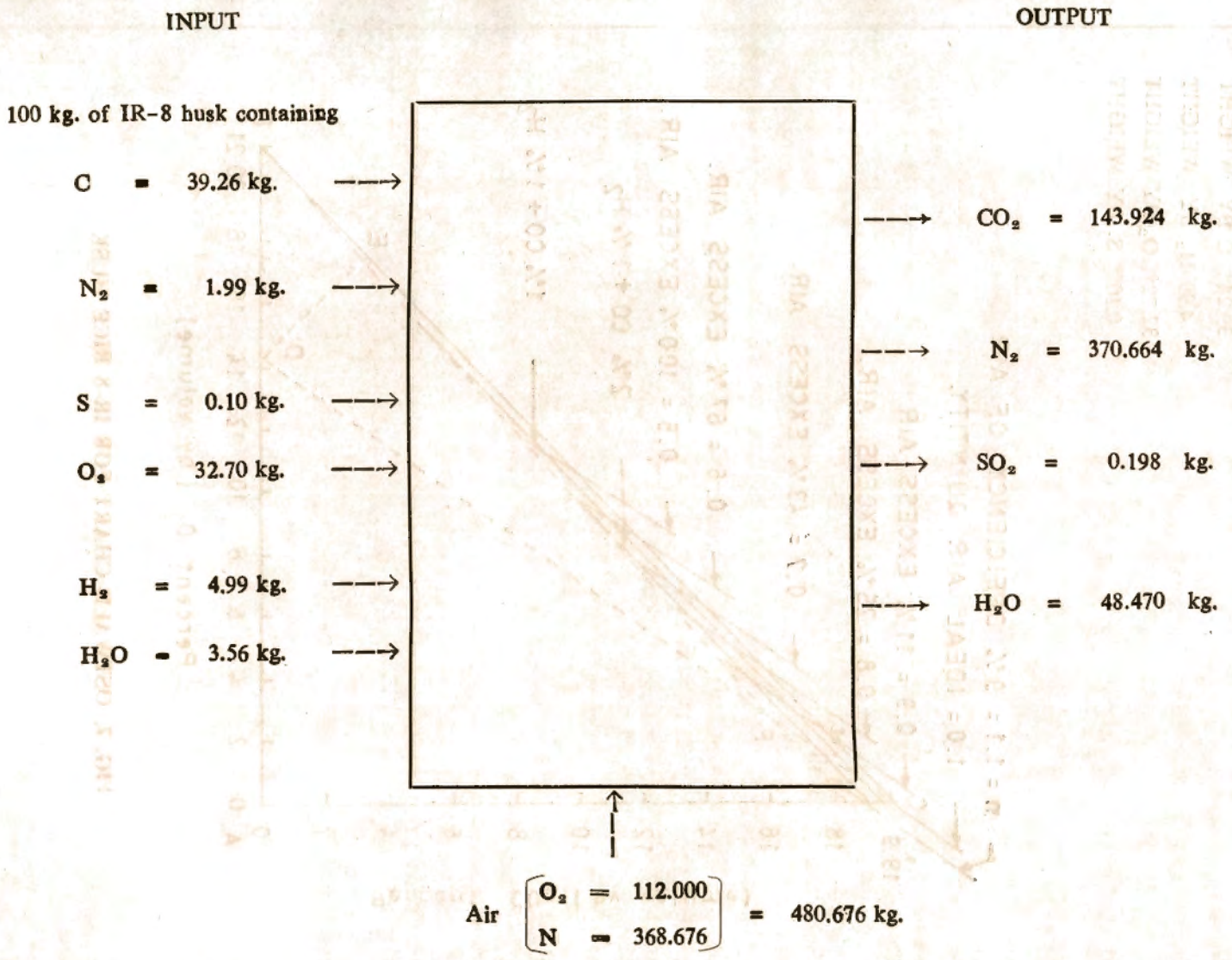


Fig. 1. Material balance of perfect combustion of IR-8 husk theoretically required air.

CHART FOR STOCK GAS ANALYSIS
VARIETY : IR-8
CONTAINING
39.24% C BY WEIGHT
4.99 $H_2$ BY WEIGHT
32.72% $O_2$ BY WEIGHT
0.10% S BY WEIGHT

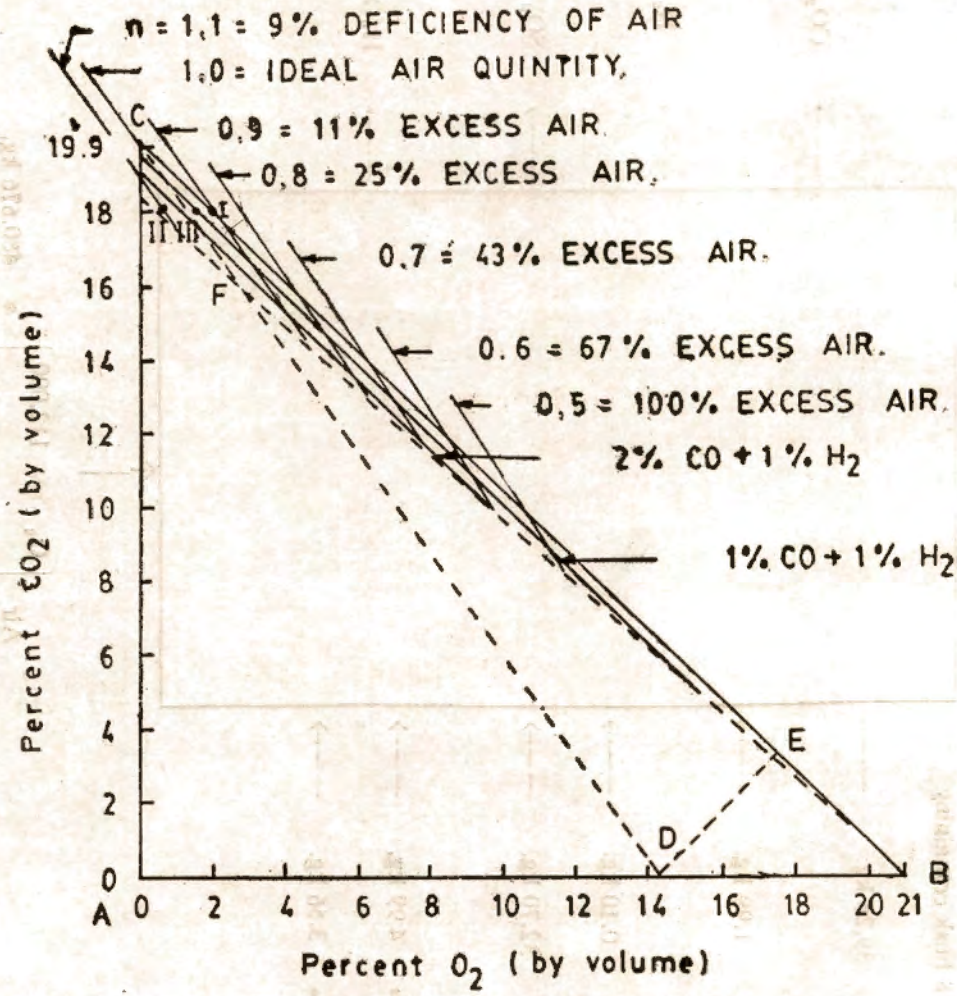


FIG. 2. OSTWALD CHART FOR IR-8 RICE HUSK

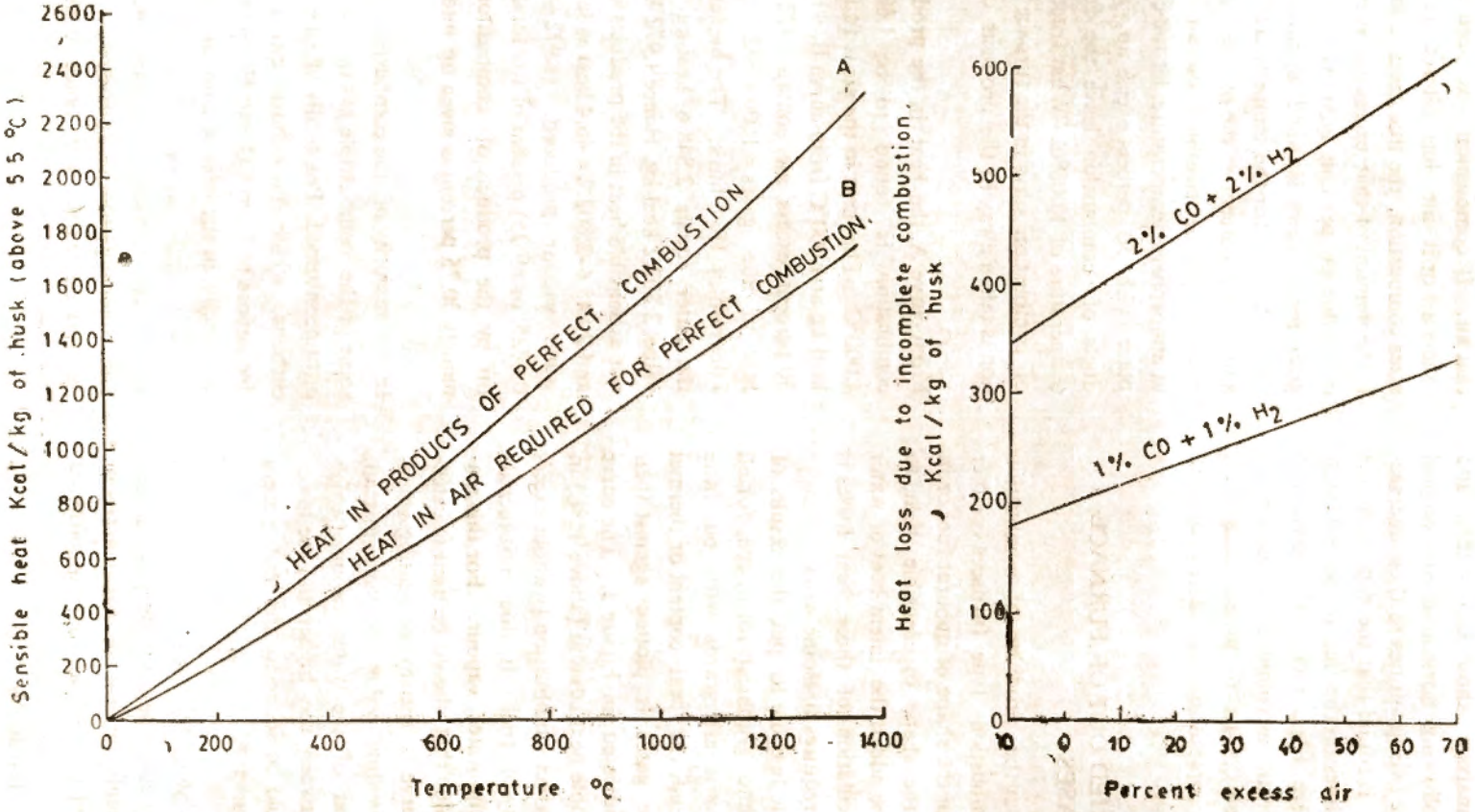


**FIG. 3. HEAT IN PRODUCTS OF COMBUSTION OF IR-8 RICE HUSKS**

One example will illustrate the use of the charts. Let a flue gas analysis show $CO_2 = 18\%$ and $O_2 = 2.25\%$ by following horizontal and vertical lines denoting these two quantities to their intersection at Point I, it is found that the representative point on the chart lines on the line of perfect combustion, so that there is no CO in the products of combustion. Air ratio, as found from the slightly inclined lines, equals 0.9, its reciprocal equal 1.11, which means that combustion was carried on with 11 percent excess air.

## 4. HEAT CARRIED OUT OF FURNACE BY FLUE GASES :

The heat energy that the products of combustion take out of the combustion type furnaces is either in potential form in the shape of unburnt fuel or in kinetic form in the shape of sensible heat, to which latter may be added the latent heat of water vapour. The calculation of those heat losses is often tedious and requires tiresome work.

It is, however, quite feasible to put the results of these calculations into graphical form, once for all and to use the charts afterwards with but little trouble. To this end, the heat content or thermal capacity of the flue gases is plotted against their temperature as indicated in Figure 3. The curve A furnish the sensible heat content (above 15°C) in the products of perfect combustion (without excess air) of unit quantity of fuel. It does not include the latent heat of the water vapour. For this reason the heating value that should be used in calculation with the curve is the lower heating value. If the higher heating value is used instead, then the latent heat of the water vapour (which is the difference between the higher and the lower heating value) should be added to the heat content as read from the curve A

The curve B, taken by itself, has no direct physical meaning, but is very convenient for purpose of calculation. It represents the heat in that quantity of air which is required to burnt an unit quantity of fuel, plotted as a function of the temperature of that air. If combustion has been carried on with excess air or if air has filtered into the furnace after combustion, the flue gases contain excess air. If the amount of that excess air is present, the heat in the flue gas per unit quantity of fuel and for a given temperature is found by taking the ordinate of the A curve for the temperature in question and adding to it percent of the ordinate of the B curve. For example, let rice husk and air enter a furnace at atmospheric temperature, let the combustion take place with 30 percent excess air, and let the products of combustion leave the furnace with a temperature of 1,000°C. What fraction of the heat of combustion stays in the furnace and what fraction is taken away by the products of combustion ?

From curve A, the heat in the products of perfect combustion is found to be 1,600 kcal/kg* at 1,000°C. The heat in the air is found to be 1,240 kcal/kg at 1,000°C from curve B, which means that 30 percent excess air contains 372 kcal/kg. The heat in flue gases = 1600+372 = 1,972 kcal per kilogram of IR-8 husk. The higher heat value of the latter equals 2,848 6 kcal/kg its lower heat value, 2.802.2 kcal/kg. Hence 1,972 kcal are carried out as sensible heat in the products of combustion, and 2,848.6–2,802.2 = 46.4 kcal as latent heat in the water vapour produced. (1,972 + 46.4/2,848.2 = 0.6925, or 69 25) percent of the total heat is carried off by the products of combustion and the rest, namely 30.75 percent is given up into the furnace.

In the majority of the combustion type furnaces, some of the combustible gas in the flue gases pass out unconsumed. Practically all fuel contain hydrocarbons, which may burn either completely or decompose to form CO and $H_2$ or they may break up directly, in the heat of combustion chamber, into hydrogen and carbon. The chief combustibles leaving the furnace, therefore, are CO and $H_2$. The determination of hydrogen content demands painstaking work and takes considerable time.

*1 kcal = 4,186 Joules.

Many investigators have established that CO and $H_2$ practically appear in equal ratio (volume percent) Lorenzi, 1951.

The percentage of CO in the flue gas is not a direct measure of the loss due to incomplete combustion. Instead, based on the fact that a given weight of carbon makes the same volume whether burnt to CO, $CO_2$ and that both gases are measured in flue gas analysis, the following expression for the loss due to incomplete combustion is given :

$$L\ (kcal/kg) = 5{,}693\ C\ \frac{\%CO}{\%CO + \%CO_2}$$

where 5,639 = difference in heat involved between 1 kg of carbon to $CO_2$ and to CO and where C= fraction (by weight) of carbon in the fuel which is burnt.

If as much $H_2$ as CO escape unburnt. the additional loss, based on the lower heating value of hydrogen (2,538 kcal/cubic meter compared with 2,898 kcal/cubic meter for CO), is 87percent of the above. The total loss due to incomplete combustion then is :

$$L\ (Kcal/kg) = 10{,}545\ C\ \frac{\%CO}{\%CO + \%CO_2}$$

The right hand curves on the Figure 2 represent the heat loss due to complete combustion at various of air supply.

## 5. EFFECT OF VARIOUS PHYSICAL PARAMETERS ON BURNING RATE OF RICE HUSK.

Physical factors that influence the burning rates of husk in a fuel bed are: variety of husk, moisture content of husk fire particle size and size .grading particularly with regard to the presence of fines, rate of air flow through the bed and height of fuel bed. Variety of husk is an inherent property of the husk and cannot be changed. Size and moisture content depend mainly on the method of milling of paddy, while height of fuel bed and air flow rate are related to combustion practices. The latter can be controlled for better combustion and higher furnace efficiency.

Combustion of solid fuels in fixed beds has for long been regarded as a mass transfer problem. The diffusional mass transfer through the gas film surrounding the burning solid fuel piece controls the overall rate of reaction in fuel beds, except during the later stages of the burning when the ash layer has grown sufficiently in thickness to become the rate controlling factor. The process of diffusional mass transport through the gas film depends upon the Reynolds number which defines the flow field, and the Schmidt number which is a property and a function of temperature and the composition of gas mixture. Thring developed the expression for partial presence of the gases $O_2$ ,$CO_2$ and CO at various heights of the bed.

On the basis of flue gas production by burning of carbon with air (23 percent oxygen by volume), the theoretical burning rate of husk can be deduced and is expressed below as :

Rate of burning carbon :

$$M_C = \frac{0.23\ m_a \times 12\ (P_{CO} + P_{CO_2})}{16\ (P_{CO} + P_{CO_2})}\ g/sec.$$

Whers, $m_a$ is mass rate of air flow and $M_c$ the burning rate of carbon and $P_{CO}$, $P_{CO_2}$ are the partial presence of carbon monoxide and carbon dioxide. Therefore, rate of combustion

$$= \frac{M_c}{(\text{mass fraction of caron in husk}) \times (\text{post furnace area})}\ \frac{g}{cm^2\ sec.}$$

The experimental studies on the actual burning rate of rice husk and actual air requirement for combustion were carried out with combustion pot techniques (Fig. 4). The results are discussed as under ;

### 5.1. Influence of Air Flow Rate :

Figure 5 shows the reduction in weight against combustion time. The temperature and relative humidity of the primary air for these experiments ranged between 28 to 32°C and 60 to 85 percent respectively. The slope at any point on the curves indicates the instantaneous burning rate which has been presented in Figure 6. The instantanious burning rates attained their peak value either at 3rd

or 4th minute after the fuel had been ignited. Thereafter, the rate decrease. This might be due to the growing ash layer thickness which gradually came to control the overall reaction rate. Rice husk has, to some extent, an inherent resistance to burning due to its high silica content (95% in silica). The silica is highly concentrated in the inner and outermost surface of the epidermal tissue, thereby developing the carbon and inhibiting its reaction with oxygen. Thus the rate of combustion of husk becomes very erratic and unpredictable towards the end of combustion as evident from Figure 6.

Average rate of combution for various air supplied were computed at the average slope of weight versus time curves. Similarly, the average bed temperature were also calculated. These results are plotted in Figure 7. The average combustion rates increase with the increase in air flow rate till a maximum value is reached. Further increase in the air supply resulted in lifting of fine husk particles from the bed thereby lowering the combustion rate. The maximum combustion rate of 81.26 kg/sq m-hr occured at the air flow rate of 532.42 kg/-m-hr. As the air flow increased, the average fuel bed temperature also increased and attained peak value much earlier than maximum rate of combustion (Fig. 7). Thereafter, the average bed temperature gradually decreased owing to the formation of larger volume of product of combustion which carried away increasing amount of heat from the fuel bed, thereby lowering the average fuel bed temperature.

### 5.2. Effect of Bed Thickness :

The progress of combustion for three different fuel bed heights i. e. 3.0, 4.5 and 7.0 cm. was also studied. The rate of combustion increase with the decrease in bed height. The maximum fuel bed temperature increased with the increase in bed height. However, in case of low bed heights, the bed temperature attained its peak early in combustions as the ignition plane moved upward faster with the liberation of the volatile matter.

### 5.3. Theoretical Aspects :

Figure 6 also demonstrates how the experimental burning rates of Patnai-23 husk compare with the theoretical values computed by Thring's method at different air flow rates Since the theory is concerned with carbon-air reaction only, considerable deviation is observed. In practice, a significant fraction of the total combustion time is used up in the evolution of volatile matter till the ignition plane reaches the top of the bed and combustion of fixed carbon starts. It is issued in Thring's theory that the diffusional mass transfer of the gases controls the overall reaction rate. This may not be the case throughout the combustion process of an actual fuel bed. As explained earlier, the silica content of husk-ash is about 95 percent.

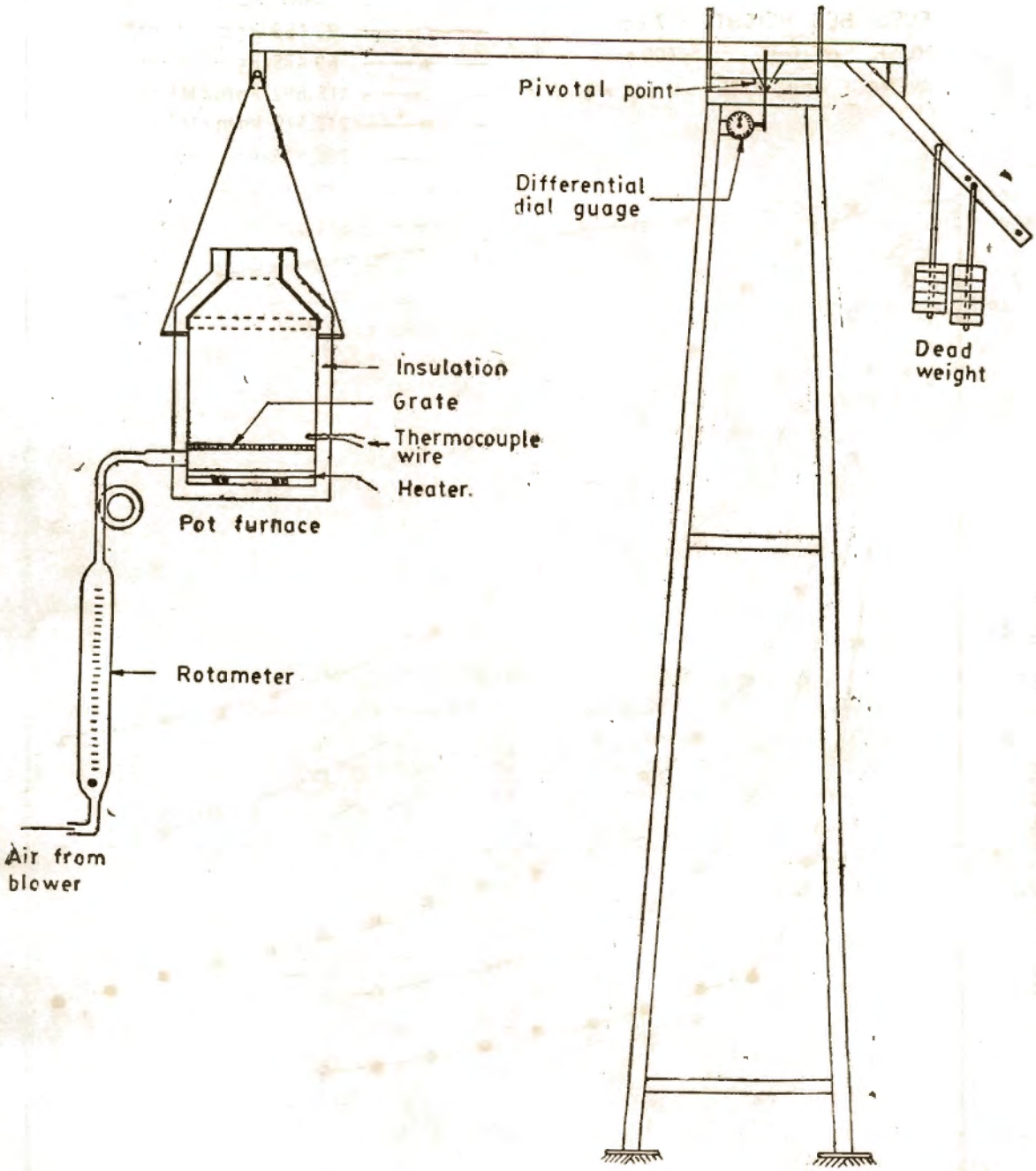


**FIG. 4. EXPERIMENTAL SET UP TO DETERMINE THE RATE OF COMBUSTION WITH COMBUSTION POT TECHNIQUE.**

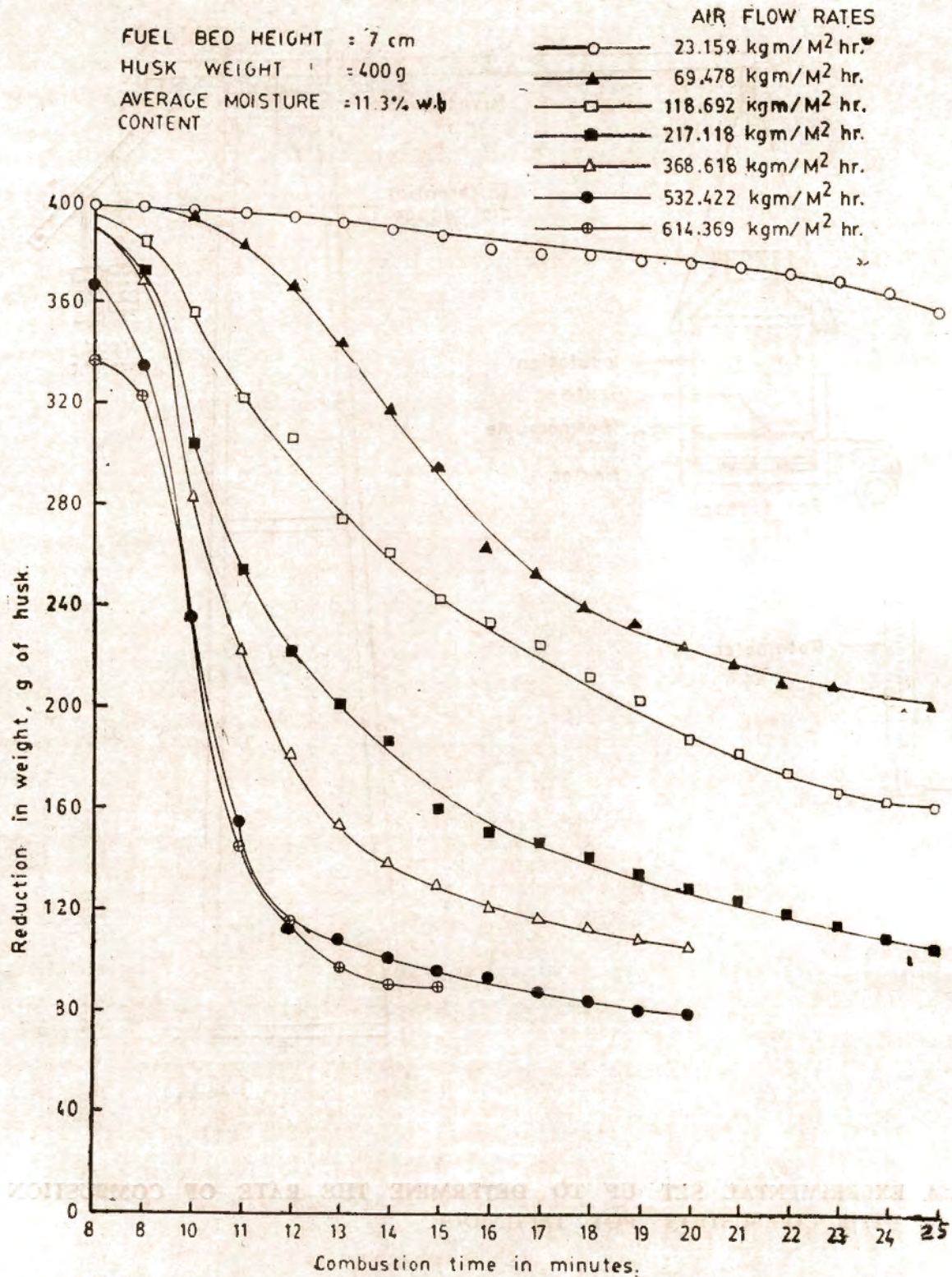


**Fig. 5—REDUCTION IN WEIGHT VS COMBUSTION TIME AT VARYING AIR FLOW RATES FOR IR-8 RICE HUSK.**

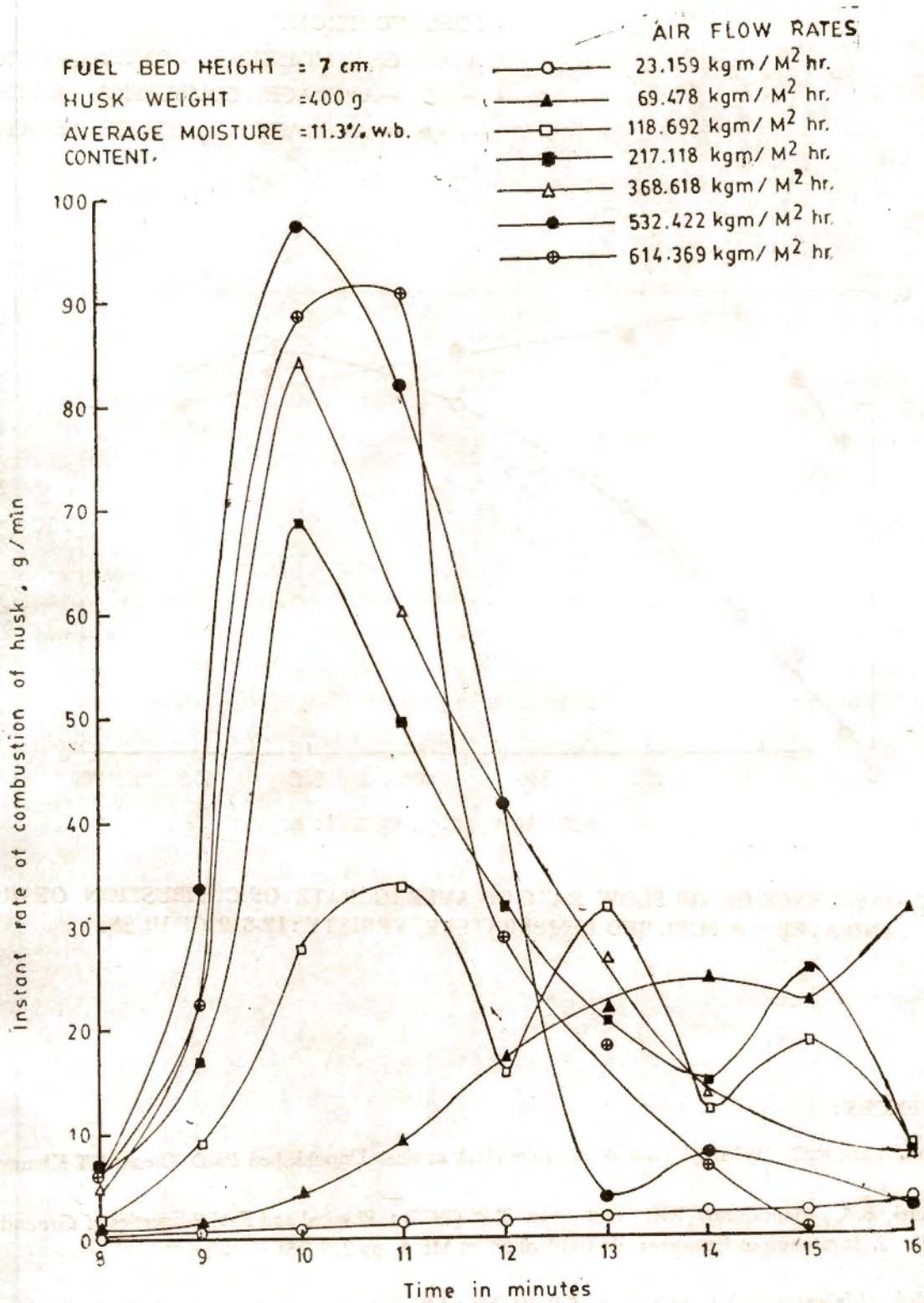


**Fig. 6—VARIATION OF INSTANT RATE COMBUSTION WITH PROGRESS OF COMBUSTION AT DIFFERENT AIR FLOW RATES FOR IR-8 RICE HUSK.**

FUEL BED HEIGHT = cm.
AVERAGE MOISTURE CONTENT = 11.3%
—o— AVFRAGE COMBUSTION RATE.
—●— AVERAGE FUEL BED TEMPERATURE.

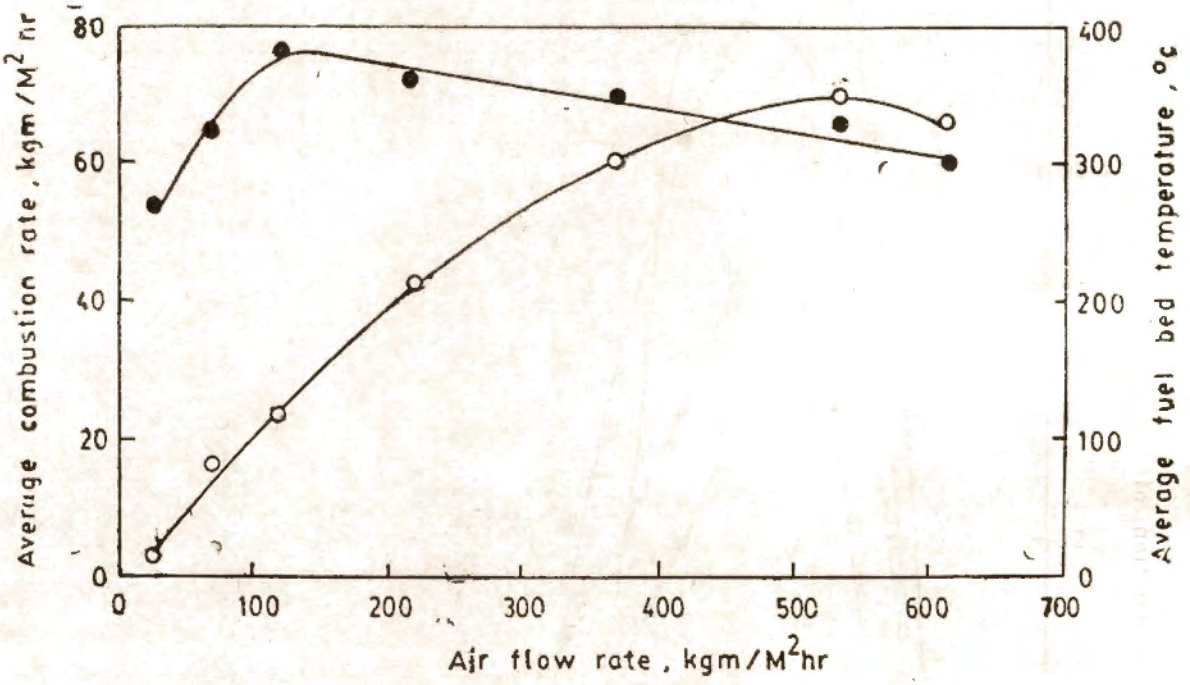


**Fig. 7—INFLUENCE OF AIR FLOW RATE ON AVERAG RATE OF COMBUSTION OF HUSK AND AVERAGE FUEL BED TEMPERATERE, VERIETY : IR-8 RICE HUSK.**

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# POTENTIAL OF CUT FLOWERS AND ORNAMENTAL PLANTS FOR INTERNAL AND EXTERNAL MARKETS

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*Commercial floriculture in India is still in developing phase. Considerable amount of work has been done in last decade and at present area under commercial floriculture is approximately 20,500 hectares with an annual transaction of Rs. 100.00 crores. Demand for cut flowers and live plants is increasing day by day. This paper throws some light on present position and future line of action of commercial floriculture alongwith its by products. A sincere, regulated and organized assests has to be made to make this industry a viable one.*

## INTRODUCTION

There is an increasing demand for floricultural products in India as well as in the world. Cut flowers and live plants are important items of internal as well as in International Trade to-day. According to a report of the Trade Development Authority of India, a survey conducted in New Delhi recently shows that the sale of cut flowers and live plants has increased ten fold over the last decade. The trend is the same in other metropolitan cities of India. As a result a business once dismissed as an indulgence of the affluent has blossomed into a Rs. 100.00 crore industry today.

According to a recent estimate, about 20,500 hectares are under flowers and the cut flower trade. The major flower growing states are Karnataka (6,846 ha), Tamil Nadu (6,420 ha), West Bengal (3,200 ha) and Andhra Pradesh (3,055 ha). In Karnataka, over 34,200 tonnes of cut flowers are produced annually.

Flowers like Rose, Jasmine, Crossandra, Chrysanthemum, Champak, Tuberose, Marigold and Aster are grown commercially. The total area under Jasmine in India is about 8,000 ha. and animal production is worth Rs. 8-10 crores. The important Jasmine growing areas are Coimbatore, Madras, Madurai, in Tamil Nadu, Bangalore, Kolar, Tunkur and Shimoga in Karnataka, Hyderabad in Andhra Pradesh and Ghazipur, Jaunpur in Uttar Pradesh.

The fragrant rose is cultivated in an area of 600 hectares in Hassayan, Aligarh. Hathras, Saharanpur, Kanpur, Sikanderpur, Ghazipur and Kannauj in Uttar Pradesh. It is also grown extensively in other states like Tamil Nadu, Karnataka, Rajasthan and Punjab.

The small flowered Chrysanthemum is grown largely in Madurai, Coimbatore and Chingleput, Chiekballpur, Devanhalli, Malur and Hosur, Ratlam, Indore and Ujjain in Madhya Pradesh, Madhupur

and Deogarh in Bihar, and Ajmer and Pushkar in Rajasthan.

Ranaghat and Kalaghat around Calcutta, Coimbatore, Madurai, Pune, Nasik, Chitradurga, Mysore, Shimoga and Bellary are famous for Tuberose cultivation. Crossandra is cultivated in Coimbatore, Madurai, Madras, Chitradurga, Kolar, Mysore, Shimoga and Belgaum.

Marigold is grown both in the northern and southern States with a large area in the former. It is cultivated in Kolar, Mysore, Belgaum, Bijapur, Bellary and Chitradurga in Karnataka, Salem and Madras in Tamil Nadu. The other states which grow marigold are Uttar Pradesh, Punjab, Haryana, Rajasthan, Gujarat, West Bengal and Delhi. Important aster growing areas are Pune, Nasik and Ahmednagar in Maharashtra, Bangalore, Chitradurga, Kolar, Tumkur and South Kanara in Karnataka. Besides these flowers, lotus and Champak are sold in flower markets in West Bengal and Karnataka respectively.

## INTERNAL MARKET :

### Cut flower

Florist shops in cities which are located mainly in hotels and sophisticated markets, deal in arostrocrat flowers, like the long-stemmed Hybrid Tea and Floribunda rose, Orchids, gladiolus, tuberose, large-stemmed chrysanthemum, carnation, lilies, narcissus, gerbera, antirrhinum, gyposophila and others. But in small towns it is handled by a fewer merchants. Flowers, live plants, bulbs, seeds etc. are sold in local market. Flowers like rose, gladiolus and tube rose as cut flower are flown to distant markets from their production centres. For example, gladiolus and rose from Kashmir to Delhi, tuberose from Calcutta to Delhi or Bombay. Loose flower like marigold, Jasmine, aster, gallairdia, Kaner, malti etc. are frequently taken to big cities from distant places. The large stemmed chrysanthemum are supplied to markets from Calcutta, 24-Parganas, Kalyani, Hoogli (West Bengal), Lucknow, Bareilly Uttar Pradesh) and Delhi. Pot mums (chrysanthemum plants in small pots) is supplied to Delhi and Bombay from chail near Shimla. Lilies, Poeonies, frassia and narcissus are supplied from Srinagar. Orchids are supplied from Kalimpong, Darjeeling, Sikkim, Shillong, Arunachal Pradesh and Trivandrum.

In internal markets, the price of cut flowers fluctuates according to the varieties, quality, demand and supply. The long-stemmed rose bloom fetch the highest price of Rs. 12 to 18 a dozen during December in Delhi while at other time it is Rs. 2 to 6. The price of the large flowered gladiolus is Rs. 36—48 a dozen during June to August but in winter it comes down by almost 50 percent. Jasmine flower sold at Rs. 15—25 per kg., small flower chrysanthemum at Rs. 4—12 per kg., marigold at Rs. 3—4 per kg., aster at Rs. 10—12 per kg., gaillardia at Rs. 2—3 per kg. The cost of one dozen tube rose stick is about Rs. 5-6 and loose flower at Rs. 20 per kg. and long stemmed chrysanthemum at Rs 4—6 per dozen.

## ECONOMICAL PRODUCTS :

The products like gulkand of rose, rose water, rose otto and perfumes of other flowers like tuberose, Keora, molsari, Juhi, chameli etc. are made and sold in the market. These essential oils are used in soap and cosmetici ndustries. The essential oils from Jasmine, rose and tuberose are sold at prohibitive prices. For examples, 1 kg. of Jasmine concrete may cost as high as Rs. 10,000 and one acre of Jasmine can yield up to 6 kg. of concrete. At present, most of our essential oil requirements for the perfume and soap industries are being met by import. With a little help this industry can develop not only to meet the internal demand but also to feed the export market. It will also bring substantial income to the farmers. For extraction of essential oil, the places like Kannauj and Hathras (U. P.) Coimbatore (Tamil Nadu), Haldighati (Rajsthan), Amritsar (Punjab) are well known in the country.

## ORNAMENTAL NURSERY :

There is unlimited scope for increasing the sale of nursery stock such as budded roses, indoor plants,

bulbs and seeds, provided the customers are assured of good quality materials. Successful nurserymen are making handsome money. Now-a-days, $F_1$ hybrids due to uniformity, earliness, bigger flowers and profuse flowering, are becoming popular. In many flowers like petunia, pansy, marigold, antirrhinum, nicotiana carnation etc. $F_1$ hybrids are common. The production cost of these $F_1$ hybrid is a little more but they fetch good price.

BONSAI

Bonsai are mini plants which have great importance in modern decoration of homes, restaurants, hotels etc. plants like bougainvillea, rubber plant, Pomegranate, *Ficus benghalensis*, *Ficus infectoria*, *Ficus religiosa*, *Erythrina indica* etc. can be used for making bonsai and sold in local market.

EXTERNAL MARKETS :

**Cut flowers**

Among the top three cut flowers in the international imports, carnation ranks first ( 212.7 m dollars ) followed by rose (178.6 m dollars) and chrysanthemum ( 126.3 m dollars ). The Netherland is the leading exporter of rose (102.8 m dollars) followed by Colombia ( 36.6 m dollars ) and Israel ( 15.0 m dollars). The four largest exporters of carnation are Colombia (70.6 m dollars), Netherland (65.7 m dollars), Israel (27.0 m dollars) and Italy (18.3 m dollars). Chrysanthemums are supplied mainly by Netherland (74.7 m dollars) and Colombia (42.1 m dollars). Colombia sends its mostly to U. S. A. and some to European countries. The maximum imports is by West Germany, about 36 percent of the total world imports, while the U. S. A., France, United Kingdom, Switzerland are the other important importing countries. The biggest exporter is the Netherland having 65 percent share in the total world exports. The other leading suppliers are Colombia (12 percent), Israel (5.7 percent). Among the main orchid suppliers, Thailand is next to the Netherland and it exports mainly Dendrobium. Kenya ranks eighth among the exporter countries and its exports rose, carnation chrysanthemum, statice, Singapore and Malaysia export orchids and Mauritius supplies anthurium. The South American countries (Peru, Maxico, Costa Rice and Brazil ) exports roses, chrysanthemum, carnation and other flowers. During winter Netherland imports roses and gladiolus from Zimbabwe while gladiolus is also obtained from Ethiopia in winter. From above analysis it has been observed that carnation, orchids and chrysanthemum from developing countries may have favourable markets in Europe. France is a good market for exporting roses, chrysanthemum, carnation in winter and orchids, particularly new varieties and species.

LIVE PLANTS

The world imports and exports include a large varieties of ornamental foliage and flowering plants. Most important foliage plants are Dieffenbachia, Dracaena, Aglaonema, Maranta, Philodendron, Ficus, Begonia, Croton, Yucca, Cordyline, Kalanchoe, Pelargonium, Syngonium, Palms, Bromeliads etc.

The total world imports of live plants is 1035.29 US dollars. The largest buyer is the Federal Republic of Germany ( 23.6 percent ) followed by France, United Kingdom, Italy and Netherland. The leading exporter is the Netherland (45.3 percent). The other exporters are Denmark, Belgium, West Germany, France and U. S. A.

EXPORTS FROM INDIA

The first trial consignments of rose (cut flowers) were sent to Paris, Rotterdam and Frankfurt in 1969 by the floriculture scientists of Indian Agricultural Research Institute with the assistance of the State Trading Corporation of India. The successful venture paved the way for the export of floricultural product from the country. Unfortunately during the last 20 years there has not been any significant progress in the export trade of ornamentals. The exports of floricultural products from India is almost negligible. It was Rs. 54 lakhs in 1985-86. Almost half of the quantity exported comprised of foliage plants. However during this

period, some encouragement and support came from the Government of India agencies, like the Ministry of Commerce, the Agricultural and Processed Food Products Export Development Authority, State Trading Corporation and Trade Development Authority.

## CONSTRAINTS IN EXPORT

There are several constraints in export trade of ornamental from India.

(i) Poor production of flowers, both from the points of view of quality and quantity, lack of plant material, high air freight rate, inadequate incentives and financial assistance for export and absence of organised marketing channels and monitoring system.

(ii) Market prefers specific varieties and high quality with standard specifications. However, in India large quantities of planting materials of export varieties of most of the flowers are not available.

(iii) With the existing meagre facilities of infrastructure for floricultural research.

(iv) Packaging of cut flowers and live plants for export which is specific for each kind of flower and plant is not fully developed in our country.

(v) Cut flowers are given cold treatment before packing them. The packed cartons are transported to airport in airconditioned vans and kept in cool place before loading in the aircraft. Such facilities do not exist here at present.

(vi) Flowers and live plants are not grown in large areas in the country. Hence small grows of flowers for export may require assistance in marketing their products.

**Suggestions for promotion of export of ornamentals :**

(i) It is necessary to have specific information on the present level of production, area and locations of flowers and ornamental plants in the country.

(ii) Green house or glass-house production of major flower for quality products.

(iii) It is suggested that the air freight to destination in Europe may be reduced from the current rate to make it more competitive and thus encourage exporters to send flowers and live plants to European countries.

(iv) Since floriculture industry is capital intensive, provision of bank loan on a lower rate of interest may assits floriculturists to take up production of flowers and plants for export.

(v) Collection of flowers and live plants from small growers may be arranged through a consortium of federation of growers or by any export house.

(vi) Research on flower crops for export should be intensified so that it may assist in establishing and promoting export trade of ornamentals.

(vii) There is an acute shortage of qualified and trained staff in floriculture, especially those having experience of growing flowers and live plants for export. The Central and State Governments and agricultural Universities may consider deputing floriculture staff for training abroad for this purpose.

## CONCLUSION :

There is an immense potential for export of floricultural products. The present situation of the foreign markets indicates that there is a good scope for export of carnations, chrysanthemum and orchids preferably during winter months. Rose grown in green house or under partial cover may have a possibility for export. Efforts should be made to develop export trade of orchild plants and cut flowers at Kalimpong, Darjeeling, Sikkim and Arunachal Pradesh for temperate Orchids and in Trivandrum, Cochin, Western Ghats for tropical orchids.

The export of live particularly foliage plants can be developed in Bengalore, Pune, Calcutta, Trivendrum and Cochin.

For acceleration the growth of the floriculture industries three types of inter related agencies have been suggested. The development agency will be related to the activities of research institutions, market intellegence for export, experiment for demonstration farms, centres of training and education and horticultural, floricultural societies. The Regulatory Agency is necessary for handling the matters pertaining to airlines, plant quarantins, import and export and financing. The Servicing agency may be closely linked with the development and Regulatory agencies and it will provide assistance to the farmers, cooperatives of farmers or export houses.

## DID YOU KNOW ?

In the United States each year consumers throw away : 18 billion one-use diapers, 25 billion styrofoam cups, 2 billion disposable razors, 200 milion tyres, 7.5 million TVs' and enough wood and paper to heat 5 million homes for 200 years.

**—GARBIT from GARBAGE magazine**

# VOLUNTARY ORGANISATION IN PROMOTING SCIENCE AND TECHNOLOGY IN RURAL DEVELOPMENT

R. N. Kapoor

General Secretary, Deen Dayal Research Institute, New Delhi

*Unemployment, rural poverty and ecological disbalance have assumed ominous dimensions all over the world. Of course the government has taken up the responsibility of solving the major problems like poverty, unemployment and inequalities. So far as India is concerned the direction of growth is as important as the rate of growth. But, experience tells us that a purely bureaucratic approach is not going to achieve the growth of required order. Perhaps only voluntary agencies can do a recommendable job in certain areas because the strength of Voluntry Agencies lies in their capacity to understand local needs, problems and resources; to involve local people and secure their cooperation and participation ; and their desire to experiment with new programmes with their experience of their rich heritage as highlighted by the enlightened author. The paper very efficiently advocates the need of "Land to Lab" innovation process to overcome the growing range of problems.*

Rural development and eradication of unemployment and poverty is a global problem and particularly for developing countries. Several rich countries in the middle east and Africa are still underdeveloped even when their population is small and highly industrialised nations in Europe, USA, USSR and even Japan and Australia are in the grip of rising unemployment, pollution, sucides, divorces and insanity etc. All this poses a great challenge before planners and governments and indicates that plans for more economic development are not going to provide an answer to our burning problems. Recent developments in USSR and China have proved the inefficacy of Government controls in the development process. Governments in most democratic countries are to-day governed by a few houses and people there are looking for newer political combinations.

Science and Technology is developing at a fantastic rate. The developments in the decade have been far more than what we had achieved in earlier decades. Rate of obsolesence is also fantastic and all of us to-day live in a highly competetive world and in rat race where only a few survive and succeed at the cost of many others. This has developed a highly consumeristic society and an exploitative culture where the poor and under developed is just an orphan and has none to look after. This self centred elite has a very narrow vision and presently all our Scientific and Technological developments are geared to meet their specific requirements. Most of us to-day do not care even for our own children what to say of future generations and in this viscious circle the present process of development has not spared our limited natural non-renewable resources or the all

pervading balanced Nature so essential for our existence. We have to work for a society in which the rich cares for poor, educated for the illiterate, strong for the weak and all caring for all Mighty and his meticulous network of perfectly balanced Nature. With this objective we must plan our future developments in Science and Technology and devise delivery systems to benefit others.

India with 800 million people had been looking for solutions from the problematic West and many of us now find that all that glitters is not gold and we should have had faith a sense of pride in our own heritage and culture and on that base we should have designed and developed the future of India. Ever since the civilisation started, developments have been going on, but earlier the goal was to provide more and more happiness to the man-kind and live in harmony with the nature. We understood self and gave due importance to it and continuously developed ways and means to improve self. We thought of integrated development of human beings through the development of body, mind, intellect and soul. It was well understood that proper development of human beings could only bring more happiness and develop a healthy society. Human being is an integral part of society and nature and with this concept in mind our earlier system had been designed. We worshipped sun, river, earth, plants and cows etc. instead of exploiting them and thereby developed a culture to live in harmony with the nature and be complimentary to it. Harvesting rain water without bringing down the water table or creating water logging was planned in keeping with the need through ponds and small earthen dams. Housing technology was supplimenting water management as silt was regularly taken out from ponds in summers to maintain rural mudhouses as well as ponds. Organic fertilisers were used and that enriched soil and its fertility increased and natural harmless pesticides were well known. In Bengal alone there were 86000 makhtabs and Madarsas (Small Schools) in 17th Century and the use of herbs and local medicines was common in all houses. We have failed to build up on what we had already developed and lost faith in our rich heritage. Education, health, industry, legal redressal, self reliance even at the village level was taken care and, the whole living pattern had been decentralised and developed most scientifically in keeping with the nature. People's involvement at the village level was high and the urban-rural relationships were complimentary to each other. Our rulers had destroyed the whole fabric of the Indian culture and we have not cared to revive it and plan the future development on our strong indegenous foundation. The roots however, have been so deep and strong that the ancient India and traditions are still visible in villages despite all damaging efforts by foreign rulers and our series of mistakes committed after the independence.

The present process of industrialisation and centralisation has developed a peculiar culture of dependence amongst people at all levels. We look towards the government for every type of development and the involvement of people in the development projects or process is neither sought nor designed. We must take a lesson from the faliures of the government controlled efforts in USSR and China etc. and plan for the revival of our ancient decentralised management system and increase the involvement of people at all levels. Contribution of voluntary sector in identification, formulation, development and implimentation of projects through peoples involvement has been off and on appreciated even in our highly beaurocratised and centralised goverment system. This realisation however does not find expression in practice and we inadvertantly continue with practices which have already failed miserably. We continue to prepare plans and impose them on villagers without devising a system of involving them and inspiring their confidence in their own development. We identify technologies ourselves and work in them in the laboratories or get some from the west and try to impose them on villagers through the existing rural development machinary of the Government. Not one out of six lacs villages can today be shown as a model for replication and the problems are increasing every-

day. We thought of "Lab to Land" programmes for transfer of technologies and never thought of land to lab process for identification and development of traditional and local technologies. We had green revolution, white revolution and many innovations and achievements for a small percentage of people and still large number of villages even to-day do not have drinking water or basic necessities of life. Involvement of people and their voluntary contributions for the development of society must get a fillip at all levels and based on some successful experiences of voluntary groups in different pockets of our country a system needs to be evolved through which all our infrastructure could become responsive to community's needs and our future is developed on the deep and strong foundation already available here.

Based on the experiments and action researches conducted by the Institute of Engineering and Rural Technology, Allahabad, Allahabad Gram Swarajya Samiti, Rural Craft and Technology Centre and Allahabad Rural Development Society in Allahabad District and the successful experiences of Deendayal Research Institute in Gonda, Singhbhoom, Beed etc. it is suggested that for voluntary participation and people's involvement programmes and identification of local technologies and problems a network of Rural Development Centres should be organised in every cluster of 10—12 villages or each Nyaya Panchayat. The Rural Development Centre ( R. D. C. ) will have its arms in it's associated villages variety of management models should develop in the country so that all our infrastructure gets involved and oriented towards rural needs and their development and gradually rural urban conflict is transformed into a rural-urban mutually supporting network.

Rural Develoment Centre—Objective of the RDCs will be to—

(i) involve local people and encourage their participation in planning and development process ;

(ii) take the development machinary close to the beneficiary;

(iii) involve villagers in identification and solution of their own problems;

(iv) identify traditions and technologies practised in the local area and develop them for improved performance with the help of infrastructure and knowledge available any where ;

(v) develop technologies based on local resources;

(vi) supplement the shortages and gaps in variety of technologies and resources and develop self reliant villages;

(vii) utilise renewable natural resources already available in the area.

FUNCTIONING OF RDCs :

The RDC should be established in every cluster of 10 to 12 villages and their management should be through a "Managing Committee" registered under Cooperative or Society's Act of 1860. The managing committee should comprise of local representatives, government nominees, professionals etc. To begin with such RDCs should be sponsored through selected Voluntary Organisations, Agricultural Universities, Krishi Vigyan Kendras, Community Polytechnics, Universities, Technical Institutions or similar organisations having arms in rural areas and interest in such development activities. Gradually RDCs should be established in all clusters of the country and they should be developed to manage complete affairs of the cluster. In times to come, they should be able induct the desired culture in blocks and district institutions, colleges, universities and all public institutions etc. and make each of them responsive to the local needs.

RDCs should help in preparation of development plans and identification of local problems and practices and involve the local community by constituting hamlet development committees in the hamlets of its associated villages and establish their close network. Detailed information about land, animals, resources, families and local problems etc. shouid be readily available in the RDC. Infor-

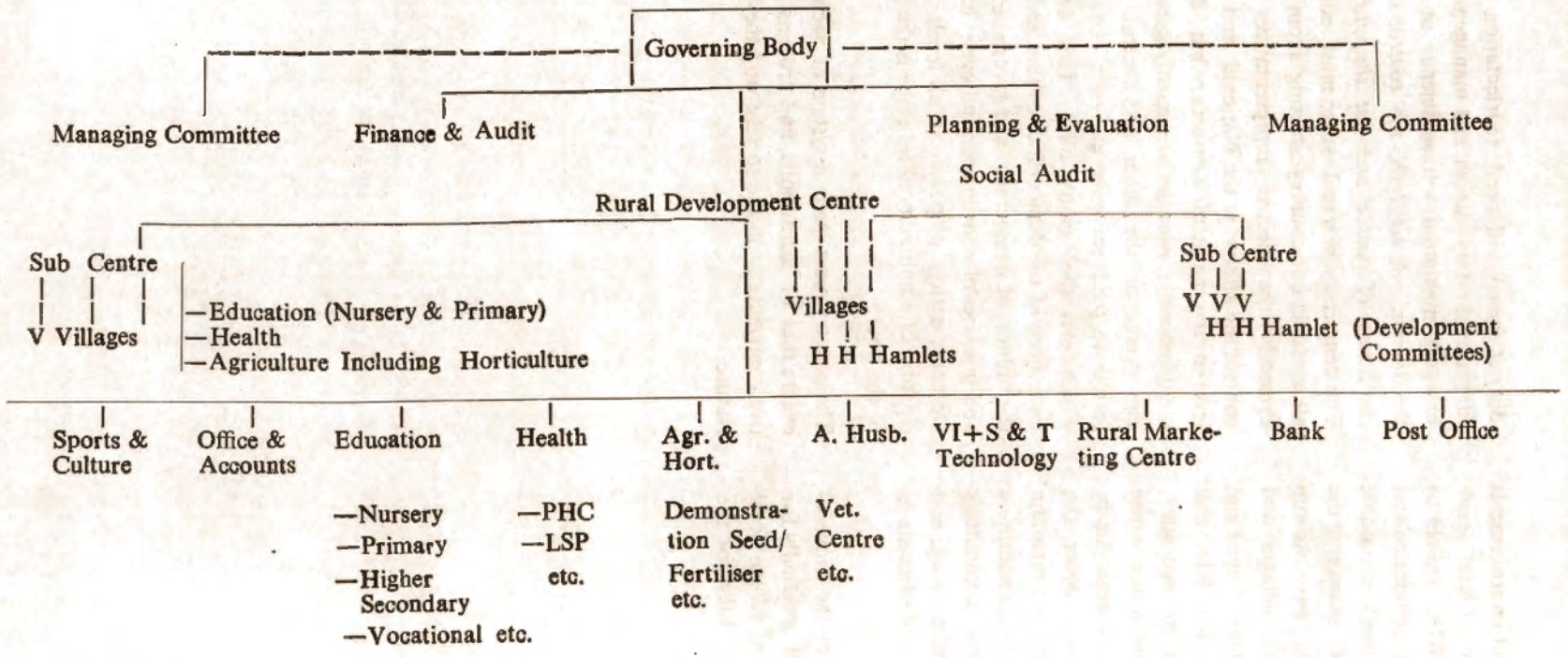
mation about practices followed and improvements demanded should also be available at RDC level. Employees and volunteers of the RDC should be under the control of the managing committee and local participation and voluntary work should be encouraged at all stages. The RDC managing the cluster of 10—12 villages should have its sub centres, each covering two to three villages and providing services to children. women, aged and invalids at an accessible distance. The RDC and its sub centres should be managed by managing/ executive committees which should be in due sourse of time registered under Charitable Society's Act or as a cooperative society. RDC will cover the whole spectrum of rural development and maintain linkages with block and district agencies/committees and institutions. The management committees should draw its members from hamlet, village and sub centre committees and include professionals as and when they require.

Existing block level agencies set up by the Government shall have to be reorganised gradually for encouraging the voluntary culture at village level and supplement RDCs in their area. Likewise the district agency will need reorientation for giving a fillip to voluntary action and management and for bringing maximum self sufficiency at all levels in the district. *At all levels the control should be in the hands of people and not the paid employees.* The democracy in a real sense must come down to all levels in our country starting from the village. Presently the elected representatives of people control the affairs at the National and Provinicial level in the name of democracy but down below the democratic agencies are mostly superceeded on one pretext or the other and control gets transferred to paid servants and not the community which forts their salary bills. This damages the basic fibre of the democratic culture and results in the failure of democracy and gives rise to politics and practices of convenience and even exploitation. Decentralisation of power at all levels and participation of community at all stage is the prime need of the hour.

The country must have a system of Social Audit to ensure that all institutions and projects have positive contribution to the society and they enrich the Nature.

# RURAL DEVELOPMENT CENTRES

## (Established in Allahabad District)




**Abreviations :**

| | | |
|---|---|---|
| V | : | Village |
| H | : | Hamlets ; |
| Agr. | : | Agriculture |
| Dev | : | Development |
| A.H | t | Animal Husbandry |
| VI | : | Village Industries |
| S & T | : | Science & Technology |
| PHC | : | Primary Health Centre |
| L.S P. | : | Lok Swasths Parampara Development |
| Hort. | : | Horticulture |

Model of RDCs sponsored by :

Institute of Engineering & Rural Iechnology Allahabad

# JTRL JUTE FIBRE EXTRACTOR

**Function :**

Extracting fibre from jute plant

**Developed at** : Jute Technological Research Laboratory, Calcutta

**Specifications**

| | | |
|---|---|---|
| Type | : | Power operated fluted roller type extractor |
| Overall dimensions | : | 1,350 mm × 450 mm × 1,500 mm |

**Test Results**

| | | |
|---|---|---|
| Suitability for crops | : | Jute |
| Capacity | : | 9 kg/h (jute fibre) |
| Power requirement | : | 1 hp electric motor |
| Labour requirement | : | One |

**Economics**

| | | |
|---|---|---|
| Cost of equipment | : | Rs. 4,000 (US $ 320) |
| Cost of operation | : | Rs. 8.30/q of jute plant |

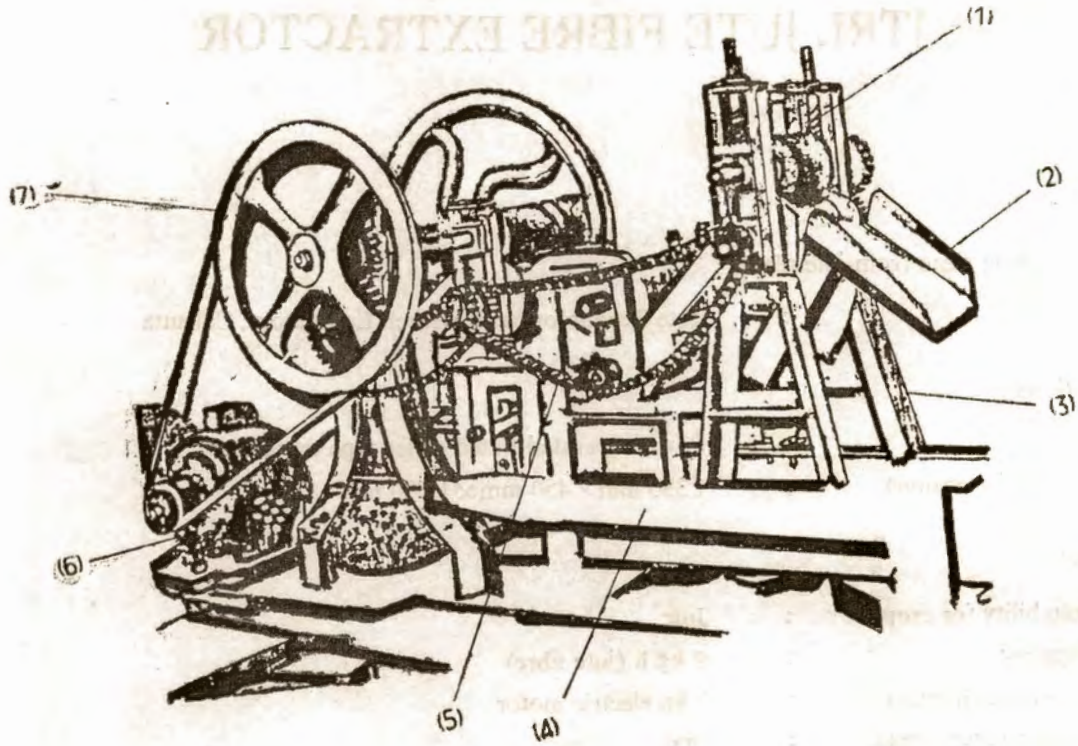
**Salient Features :**

The machine applies heavy pressure on the plant through its three pairs of fluted rollers to detach the bark containing the fibre from pith. It reduces the retting time by about 30.50%. Efforts needed to process the fibre and also the quantity of water is reduced. The fibre thus obtained is practically free from rooty portion.

**Stage of Exploitation :** Equipment released for field trials

**Contact Agency :**

Jute Technological Research Laboratory
12, Regent Park
Calcutta—700040 (WB).




(1) EXTRACTOR
(2) OUTLET
(3) STAND
(4) BASE
(5) CHAIN DRIVE
(6) MOTOR
(6) PULLEY

**FIG 1. JTRL JUTE FIBRE EXTRACTOR**

# SUGARCANE CRUSHER

FUNCTION :

Extraction of juice from sugarcane

DEVELOPED AT : Tamil Nadu Agricultural University, Coimbatore

SPECIFICATIONS

Type : Horizontal type 4 roller crusher

TEST RESULTS

Suitability for crops : Sugarcane
Capacity : 185 kg/h
Power requirement : 5 hp electric motor
Labour requirement : Two
Shelling extraction efficiency : 65%

ECONOMICS

Cost of equipment : Rs. 11,000 (US $ 880)

| Economic Parameter | OPERATIONAL CONDITION | | | |
|---|---|---|---|---|
| | 100% custom hire | 50 % custom hire and 50% sale | 100% sale | Self use |
| Working capital, Rs. | 750 | 1,638 | 2,526 | 750 |
| Cost of operation. Rs /q Sugar cane | 7.05 | 7.05 | 7.10 | 7.05 |
| Break-even-point, q/y | 735 | 727 | 720 | 394 |
| Annual net profits, Rs | 3,511 | 3,623 | 3,734 | n. a |
| Return-on-investment, % | 31 | 31 | 32 | n. a |
| Employment generated, man-days/y/ Rs. 10,000 of capital investment | 178 | 174 | 170 | n. a |

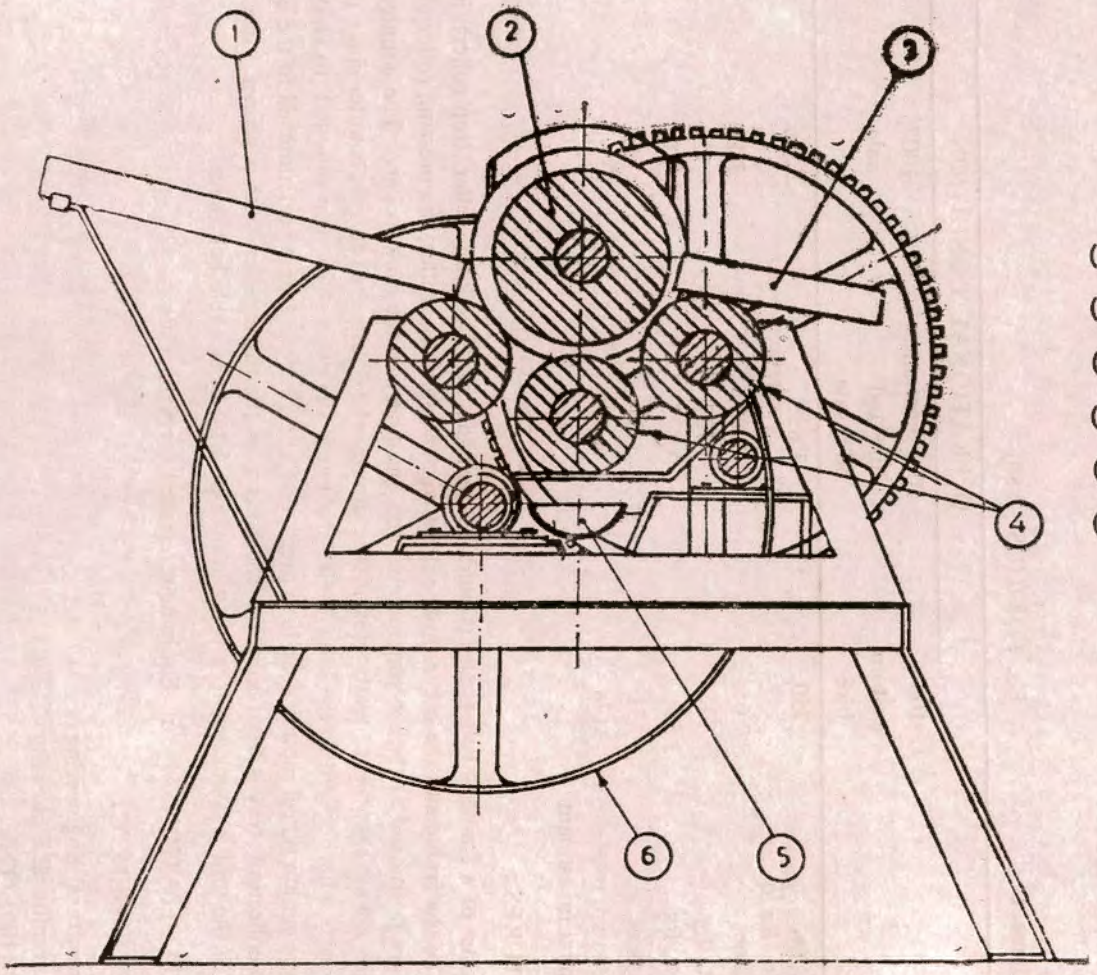
SALIENT FEATURES :

The crusher consists of a frame, 4 rollers shafts and counter shafts. The king roller (top roller) is positioned at the top of the frame and the other three rollers, viz; the splitting roller, the pressing roller and the extraction roller are positioned at the bottom, around the periphery of the king roller. The counter shaft is arranged in such a way that the 12 teeth closed type pinion wheel attached to the counter shaft meshes with the 50 teeth gear wheel keyed to the king roller shaft and the main shaft is positioned to enable the 12 teeth closed type pinion wheel mounted on it to mesh with the 71 teeth gear wheel attached to the counter shaft. The juice collection tray is fixed covering the bottom of the three roller with a proper juice outlet. The drive wheel of the unit is connected to a prime mover of 5 hp by suitable belt drive.

STAGE OF EXPLOITATION : Equipment released for field trials.

CONTACT AGENCY :

College of Agricultural Engineering
Tamil Nadu Agricultural University
Coimbatore—641003 (TN)




(1) FEED HOPPER

(2) KING ROLLER

(3) BAGASSE

(4) SPLITTING & CRUSHING ROLLERS

(5) JUICE OUTLET

(6) FLY WHEEL

FIG 1 : SUGARCANE CRUSHER

# SPOT LIGHT



## RURAL REMEDY, CURDS, MAY HELP BURN WOUND HEALING

Hot on the heels of potato peals have emerged two more simple Indian remedies to hasten burn wound healing a tree extract used in cremation rites and curds.

A doctor from rural Maharashtra. who attended the recent Eighth International Burns Congress in New Delhi reported good results after using an extract called "ral" obtained from the 'sal' tree as a dressing for born wounds.

The extract from sal, botanically known as Shorea robusta has been used since ages in rural India to treat burn wounds.

Reluctance of the residents of Barsi in Sholapur district in Maharashtra to visit the local hospital for treatment of burns and their preference for the ancientral remedy prompted Dr. B. M. Nene from the Barsi Maternity and General Hospital to test the efficiency of ral.

Ral is available in kilogram packets in many grocery shops as it is widely used in cremation rites, fireworks displays and by goldsmiths.

It is obtained as a pale cream gummy substance from the bark of Shorea robusta a large sub-deciduous tree found in central and eastern recover from any damage by fires. when all other trees in their vicinity have died.

Indigenous production of ral is not sufficient to meet domestic requirements, and a large portion is imported from Thailand at present.

Following a time-tested procedure, Dr. Nene powdered the extract from 'Sal' bark and mixed it with an equal amount of coconut oil and a little camphor.

A gauze piece dipped in the mixture was used as a dressing in 50 consecutive burns patients admitted to the Barsi Hospital between February 1988 and January 1989. Dr. Nene compared the results with those from 50 patients admitted to his hospital between February 1986 to January 1988 and treated with normal topical applications.

The 'ral' dressing proved to be safe, effective and economical, and decreased the number of antibiotic injections, intravenous fluids and plasma products needed for recovery.

An added advantage is that it can be easily adopted at primary health care centres with few hitech facilities like skin grafts and skin banks, and is therefore suitable for developing countries.

"Coming from remote rural hospital in India, data presented by Dr. Nene is one of the best and the 'ral' treatment appears very interesting", commented Dr. Andrew Munster from the United States, who chaired the special session on topical applications at the Burns Congress.

A second promising remedy is potato peels smeared with curds which helps to remove the dead tissue on a wound faster so that new skin tissue can form again.

Curds serves as a useful marinating agent that softens the dead tissue and removes it faster, reported Dr. Akanksha Patil from the burns research unit B. J. Wadia Hospital for Children, Bombay. It offers a non-surgical way to excise the dead tissue.

## ALTERNATIVE HEAT INSULATING TREATMENT

An alternative heat insulating treatment of roofs by embedding them with white glazed tiles has been developed at the Central Buildings Research Institute (CBRI), Roorkee.

The treatment is cost-effective and long-lasting says a newsletter of the organization.

Studies at the institute have shown that when white glazed tiles are embedded on 10-cms-thick light weight cement concrete roof, the temperature of the roof, ceiling and indoor air could be reduced to 16, 12.5 and 3 degrees celsius respectively. The surface temperature compares favourable with other conventional heat insulation treatments.

Light weight materials reduce appreciably the dead load on roofs, while the white glazed tiles do not absorb dust particles and can be cleaned easily by brushing without losing their shine.

During rains, the tiles get cleaned automatically and continue to maitain their glassy appearance.

Preliminary trails were carried out on 25 roof panels and on a roof of 4×3 square metres room. The tiles were also applied on 2.5 cms thick light weight polymer concrete roof, with a surface area of 100 square cms of a newly constructed house. Studies on the application of these tiles are in progress on 380 square metres of another building at Roorkee.

The cost of the tiles is negligible, and with a trained mason and a labourer one can lay about 5 square metres surface area every day at a cost of Rs. 50/- per square metre, including the prices of cement, tiles, sand and labour.

## ALTERNATIVE FUELS

The use of alternative transportation fuels is neither new nor is the automotive technology they require exotic. Some 500,000 natural gas vehicles are in use worldwide, as are about 800 methanol vehicles. While alternative fuel use is not a panacea for the world's air pollution problems or for the depletion of nonrenewable energy sources, these fuels offer the advantage of working well and cleanly in automobiles. Moreover, in many applications they cost less than gasoline.

Use of natural gas and methanol can reduce emissions of reactive hydrocarbons, the key ingredients in urban smogs formation, by about 50 percent compared with pollution discharged from the tailpipes of conventional automobiles. Advanced technology offers hope of reductions of greater than 90 percent. Both alternative fuels virtually eliminate noxious soot and smoke from diesel engine exhausts and natural gas has the added benefit of dramatically reducing carbon monoxide emissions by over 95 percent in some cases.

Several countries, notably Italy, New Zealand, Canada and the United States, have undertaken programmes to encourage the use of natural gas vehicles. About 300,000 cars in Italy and about 11 percent of the cars in New Zealand have been converted to run on natural gas. The US is also promoting the use of pure methanol as an automotive fuel. About 600 of the world's 800 methanol vehicles operate in the US.

## BATING THE TSETSE TRAP

Kenyan Scientists have developed a tsetse fly trap which is reported to be 99 percent effective. At a meeting of the International Centre for Insect Physiology and Ecology (ICIPE) in Nairobi recently, the Kenyan Minister for Livestock Development, Elijah Mwangale, said the device was developed by ICIPE after six years of research.

The trap, known as NG 2 B, baits flies with a mixture of acetone and urine and traps them in polythene bag cage where they quickly die from heat stress.

"The trap is a cheaper and safer alternative to chemical pesticides which cause hazards such as environmental pollution, indiscriminate killing of non-target insects and resistance to pesticides in insects", the minister said.

Mwangale explained that the trap had been successfully tested in Kenya and was increasingly being employed by local farmers. The technology was also in US in the Kagera River Basin bordering Rwanda, Burundi, Uganda and Tanzania.

Outlining the gravity of the tsetse menace, he said 23 species of the insect infest over 10 million square kilometres in over 37 countries in Africa, exposing 350 million people to sleeping sickness (trypanosomiasis), as well as 100 million cattle.

## GREAT BOX OF FIRE

In rural Somalia, it is not uncommon to see women trudging across the sweltering countryside bent beneath heavy loads of firewood. Somalia has no oil, and its fuel resources of wood and charcoal are rapidly running out. At present rates of consumption, there may be no trees left in as little as six years.

For Somalia, hope has come in the shape of a small cardboard box. Solar box cookers, cheaply built from cardboard, tape and window glass, can take Somalia's abundant sunlight and put it to work cooking. On a clear day, a solar box cooker can easily reach 325 degrees F within an hour.

Solar box cookers, now being promoted worldwide by the United Nations' Food and Agriculture Organization, were created in 1976 by Barbara Kerr and Sherry Cole from Arizona, a state in the dry southwest of the United States. The Kerr-Cole "Eco-cooker" was patented to prevent any corporation from trying to control the technology for profit. As a result solar boxes are now being built and sold in Kenya, Haiti, Zimbabwe and Lesotho.

Bob Metcalf, co-founder of Solar Box Cookers International ( SBCI ), believes solar cooking "has more potential to improve the lives of people in developing countries than most other single technologies". As much as 90 percent of the fuel consumed in developing countries is used to cook food and to heat water, Metcralf notes. Now, with a set of SBCI instructions, anyone with $15 of supplies, a knife and one day's labour can construct a solar oven capable of cooking 15 pounds of food. Boxes can be made from plywood or recycled cardboard boxes. Insulating material may be provided by goose down, rice hulls, wood, straw, crushed newspapers or broken Styrofoam.

Solar cooking typically takes twice as long as conventional cooking, which means that chopped vegetables are ready in 45 minutes, bread in 90 minutes, chicken in two hours. The advantage is that solar ovens do not require constant vigilance, thus freeing women from their "bondage to the camfire". Solar ovens can be used year-round in the tropics and for eight months out for the year in temperate zones.

Solar box cooking has now been introduced in Somalia, Egypt. Djibouti, Slerra Leone, Zambia, Zimbabwe, Indonesia, Guatemala, Bolivia, Belize, Mexico, Yemen and the Navajo Nation. SBCI's goal for the next decade is to introduce 2.4 billion people to the economics of solar box cooking.

## SWEETER BEES

Tanzania recently developed an efficient honey extractor, opening new opportunities for the bee keeping industry. The country, with a potential for producing 1,38,000 tons of honey and 9,200 tons of beeswax a year, exploits only 3.5 percent of the resource. Poor harvesting methods are in large part responsible for this shortfall.

The centrifugal honey extractor was designed and produced by a young Agricultural Engineer, Valery Ng'atigwa, who recently gave a demonstration at the Soloine University of Agriculture in Morogoro. The honeycomb is placed in a perforated cage enclosed by an outer container before the cage is swirled at 200 revolutions per minute by hand. The honey is thrown out to the sides of the container, collecting at the bottom, from where it is drained

The combs, which are attached to wooden frames, remain intact after the honey has been extracted so they can later be returned to the beehives for reuse by the bees.

"In this way it is possible to harvest honey every three to four weeks", says Ng'atigwa. He has used

locally available materials to make the machine appropriate for rural areas where most beekeepers live and where there is no electricity.

## NEW ENGINE RUNS ON VEGETABLE OIL

A Dutch company plans to produce a new car engine that could revolutionize motor traffic through the use of vegetable oils for fuel, an invention which could be of great importance to Third World countries.

To many car manufacturers, the idea of running engines purely on vegetable oils is utopian. But the makers of the "Elsbett Environmental Engine" believe they can make this particular dream a reality.

Tests have shown that the thermodynamic efficiency of the Elsbett combustion engine for cars is much higher than that of traditional car engines.

According to spokesperson J. Behrens of Moeken's Montage Bedrijif (MMB), the company which plans to manufacture the engine, the combined costs of production and manufacture of the vegetable oil fuel are lower than the total costs of fossil fuels, making the mileage rate lower than that for gasoline and diesel, even without price subsidies for vegetable oils.

And unlike fossil fuels, vegetable oil is free of sulphur and heavy metals, making the Elsbett engine a potential solution to some of the environmental problems linked with road traffic.

The oil is environmentally safe and can be used as foodstuff or fertilizer. If vegetable oil was to be released into rivers or seas because of a tanker leak the fish would feast on it.

Depending upon the market MMB aims to produce 5,000 engines in the first year, to be raised to 30,000 in the fourth year.

"In the foreseeable future, easily exploitable mineral oil reserves will be exhausted and mineral oil prices will go up", said Behrens. "Morever, damage caused to the environment due to the use of the fossil fuel is on the rise. It is time to look for an alternative fuel, free from environmental hazards, before the finite fossil fuel is exhausted." The company has been unable to start production because it lacks the money to set up a production line, and so far government financing bodies have been unwilling to provide the necessary capital.

Behrens hinted that MMB might shift the project to Ireland if the Dutch authorities refuse to show interest "Ireland wants to have environment-friendly industry and they are willing to put up a lot of money for it. However, we are now working in the private sector to see how people can finance us. We have met so much private enthusiasm, that we may need no more help from the government", he said.

There is a potential market abroad for the engine, particularly in tropical and developing countries. Such countries facing serious ecological threats can be an ideal market for the engine, that would be beneficial to them both economically and environmentally. Indonesia for example has already shown a keen interest in he Elsbett engine and has approached MMB.

Says Behrens, "Taking into consideration the overall energy, health, economic and enviror mental aspects, vegetable oil can be the fuel of the future".

## REDUCE PESTS BY INTERCROPPING

African farmers have long known that intercropping maize with beans helps preserve nutrients in the soil and increase yield. Agricultural researchers has also discovered that growing these two crops together decreases the number of army worms, leaf hoppers and leaf beatles by 25 to 40%. The crops seem to act as berrers for each other, making it more difficult for pests that attack just one kind of crop to spread from plant to plant.

Leaf hoppers and leaf bettles can also be curtailed by intercropping maize with sweet potatoes. Growing maize with ground nuts discourages com borers, while intercropping maize with cotton controls com earworms.

Another effective intercropping plant is cowpea. When grown with sorghum it prevents leaf-beetles from spreading and greatly reduces weed growth. When intercropped with cotton it decreases the number of boll weevils. And when intercropped with miller it deters thrips, small insects that attack cowpeas planted alone.

A tool is but the extension of man's hand, and a machine is but a complex tool. He that invents a machine, augments the power of a man and the well being of mankind.

**Henry Ward Beecher**

## MHP TRAINING COURSES

Intermediate Technology Development Group (ITDG), Great Britain Offers following Micro-Hydro Power (MHP) Training Courses for operators, engineers and manufacturers in the fields of maintenance design and manufacturing techniques, These courses put emphasis on the participation of trainees, practical work and demonstrations, site visits, case studies and use of worked examples.

1. MICRO HYDRO DESIGN AND IMPLEMENTATION

This course covers all aspects, from Hydrology to turbine purchasing economics, selection of synchronous and induction generators, regulation, transmission, demand-supply matching etc.
The next venue for this course will be Sri Lanka in November '91.

2. OPERATION AND MAINTENANCE

Intended for site operators and site managers, this course covers fault diagnosis of electrical and mechanical equipment, maintenance procedures and schedules.

3. PELTON TURBINE MANUFACTURE

Intended for manufacturers of Micro-hydro equipment this course teaches participants through practical work how to construct simple foundries and cast pelton wheels suitable for high head/Low flow sites.

4. ELECTRONIC LOAD CONTROLLER

This course covers the wiring-in and commissioning of ELCs and also assembly in local workshops of of the ELC panel, components and ballast tanks.

5. INDUCTION GENERATORS AND CONTROLLER

Training is available in motor selection, installation and assembly of electronic circuits. At present training is available on a one-to one basis usually by virtue of a visit by manufacturer to Britain.

For further information contact :

Intermediate Technology
Development Group (ITDG)
Myson House, Railway Terrace
Rug by CV 21 3 HT/
GREAT BRITAIN.

## AGRIMACH '91

Regional Network for Agricultural Machinery (RNAM) in collaboration with Department of Agriculture, the Department of Trade and Industry and the University of the Philippines will be organised on "Agricultural Machinery Exhibition and Symposium" during May 25th to 28th' 91.

Exhibition will cover various machinery for food and Poultry Production, horticulture and Agro-industry/processing.

Symposium will emphasise on business opportunities in agricultural machinery manufacture, agricultural mechanization technologies and marketing trends in agricultural machinery.

For further information contact :

The Secretariat
**AGRIMACH '91**
C/O RNAM
UNDP, PO Box 7285 DAPO
1300 Domestic Road,
Pasay City
Metro Manila,
PHILIPPINES.

## WORLD FORESTRY CONGRESS

"The Forest, Our Furture Heritage" is the theme of the World Forestry Conference, to be held in Paris, 17-26 September, 1991.

Organized jointly, on this occasion, by FAO and France, the Congress Convenes every six years to provide an opportunity for forestry experts to evai-

luate the global situation and discuss forest development prospects. The Agenda will include 25 themes, grouped in six sections :

1. The Forest, protector of nature,
2. Forest preservation and protection.
3. Trees and forests in regional development.
4. Management of world forestry resources.
5. The forest : a vital economic asset,
6. Forestry policy and institutions.

For further information contact :

Food & Agriculture Organization,
Via delle Terme di Characalla,
100100 Rome,
ITALY.

## CONFERENCE ON MASONRY

CI-Premier Conference Singapore will organize an Asia-Pacific Conference on Masonry from March 14-15, 1991 at Singapore.

The Conference will cover the following Areas : Materials manufacture, Properties, durability, etc. Architechtural developments. Load bearing brick work design. Brick work cladding in framed structures. Brick walling and paving. Reinforced and Prestressed brick work. Masonry subjected to seismic loading. New constructional techniques. Research and Development.

For further information contact :

John S. Y. Tan,
Conference Director,
150 Orchard Road 07.14
SINGAPORE — 0923.

## COMMUNITY HEALTH AND COMMUNITY DEVELOPMENT

The THREAD Training Centre. Puri (Orissa) will conduct a six Months Course on "Community Health and Community Development" from February 1991 to July 1991 at their Centre.

The course will cover the contents : Inter/Intra-personal relationship, group dynamics, society analysis, different approaches to Community Development, communication, leadership styles, planning and implementation, observation techniques, causes and prevention of common diseases, mother and child care, immunization, health education methodology and materials, health in the context of Indian situations, alternative approaches to community health and Community Development, drug etc.

For the participation in the course the candidate should have a working knowledge of English ; should be willing to travel to different parts of India and live in difficult conditions in rural tribal areas and should be above age 23 years.

For further information Contact :

The Programme Officer,
THREAD, Siddharth Village,
Badatota, Jatni,
Puri (Distt). 752050,
ORISSA (INDIA).




## URBAN ENVIRONMENTAL CONSERVATION

Urban Environmental Conservation is not a new phenomenon. It has been in the minds of geographers, economists, sociologists, planners and environmentalists since long back. The conservation does not mean to conserve the things as it is but to protect and preserve the old things of importance and simultaneously to provide development of the area.

The major objectives of the book is to create a reasonable awareness about the present status of the cities ; to advance responsible and serious investigation of today and tomorrow ; to promote the development and improvement of the methodologies ; to increase public understanding and to provide a thought to the individuals and planners, to put emphasis on empirical studies of Allahabad. The city of Kumbh has been taken into conservation.

The volume is divided into 6 chapters viz Introduction, Socio-cultural Environment, Educational Environment, Judicial Environment, Environmental Pollution and Ecology of Transportation and Communication.

This volume will help the educationist, planners, bureaucrats and technocrats to reorient their thoughts in implementing the urban plans because the upheaval and peculiar ecological crisis in Indian cities has made the problems so complex that without the participation of various organisations related to these problems a correct picture of the situation cannot be formed.

Urban Environmental Conservation by Dr. Pramod Singh, Pub : Ashish Publishing House, New Delhi Price Rs. 350.

## AFRICAN FARMER :

African farmer is a quarterly publication of the Hunger Project, an international not for profit organisation committed to the end of the persistence of world hunger. It was launched by the Hunger Project in 1988 to foster the growing dialogue between the farmers and leadership position holders of African continent with a great inclination to popularise participation development.

The magazine has a view that the people of Africa must be empowered to be the agents for the economic and social transformation. Every issue of African Farmer features, profiles of the women and men who, in the face of enormous challenges, grow most of the food and many of the commercial crops on which Africa depends, calls for African people to have a real voice in their own development. It invites readers to send reactions, comments and opinion. For more details and specimen copy please contact.

Editor 'African Farmer'.
One Madison Avenue
New Yark NY 10010
USA

## ENVIRONMENTAL CHANGES AND DEVELOPMENT

Presently the growing environment have focussed attention of both the scientist and the citizen, and of many national and international organisations. It is now known as an 'ecological crisis' or more precisely an 'Environment Development-Crisis' The varied associations of society with the environment tend to change its properties both spatially and temporally, and thus man is exposed to varied environmental influences. Land as the one of the most important resources of the earth are developed by man and his influence tends to grow with the use of science and technology. The various developmental activities like mining and quarying, establishment of new industries particularly cement

and power industries, construction of Rihand Dam etc., in South Mirzapur resulted deforestation due to the rehabilitation of inhabitants in new areas particularly in forest tracts have caused the ecological imbalance in this tribal dominating area.

In any programme of resource conservation and preserving the environment with reference to national planning, the changing rural environment caused by the utilizing and increasing demands forms a major item and thus specially so in the South Mirzapur where the primitive culture and civilization is still preserved amongst the people regarded as aboriginals or tribals now adays. In this book an attempt by the author to present a comparative picture of the past and present land-uses and suggesting a planned programme for future on the basis, of the empirical evidences and trends and changing cultural landscape of the area with relation to the natural environment. To have a systematic comprehension the present work-includes a substantial account of physical aspects, the relationship of man with land, changing patterns, characteristics and importance of different types of landuse categories etc. with a support of sample studies-Adoption of agricultural innovations in tribal society ; though it is very-very negligible in the area is also dealt with fully in separate chapter. All these studies have been followed by the changing rural environment caused by the various recent developmental activities with special reference to urbanization and industrialization. The work has been concluded with proposal for the total upliftment and balanced development of the area maintaining cultural heritage of the inhabitants All the facts and findings have been illustrated by diagrams. It is expected that this work proves to be useful to the students and researchers of geography as well as the associated disciplines like environmental studies, rural development etc.

Environmental changes and Development by M. K. Singh, Pub. by Chugh Publications, Allahabad.

## FUEL FROM WASTES AND WEEDS :

Among biomass sources, wastes and weeds are available in bulk and, in most cases, at free of cost. The such wasted resources include agricultural and agroindustrial residues, animal wastes forestry residues, industrial wastes, kitchen wastes, municipal wastes, terestrial hardy weeds petroleum weeds, and aquatic weeds. By a number of technologies, wastes and weeds can be converted into solid, liquid and gaseous fuels. Such fuels can be used for cooking, heating, lighting, water pumping, in boilers and furnaces, as industrial fuels and for electricity generation. For rural, agricultural and Industrial sectors fuel production from wastes and weeds generates employment, minimises pollution and improves living standards of workers, farmers and rural poor. The present publication is an exhaustive review of wastes and weeds with latest data comprising 74 tables. It is aimed at serving, as reference book for scientists, students, policy makers, administrators, entrepreneurs, and all those engaged in the utilisation ofwastes and weeds in particular and renewable energy in general.

Fuel from Wastes and Weeds by P. D. Tyagi, Pub. Batra Book Service 1/5 Bhagat Singh Lane New Delhi, Price Rs. 175/-

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

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Article/Paper

# IMPLEMENT DEVELOPMENT FOR SAT ALFISOLS

R. K. Bansal, N. K. Awadhwal and V. M. Mayande

International Crops Research Institute for the Semi-Arid Tropics Center India, Patancheru, A. P. India

*Field operations in Alfisols and related soils require timeliness and precision of the early establishment of a crop in the rainy season. Animal drawn, multipurpose wheeled tool carriers (WTCs) have been found to be the most appropriate machinery for this purpose. Three designs discussed in this paper covered 1 ha in 3–4 hours for different tillage operations, and could be drawn by a pair of oxen of average size. A WTC fitted with a planter-and-fertilizer applicator, consisting of an inclined plate for seed metering and oscillating mechanisms for fertilizer metering and a double-shoe furrow opener, gave excellent results in sowing various crops, and covered 1 ha in 4-5 hours with an average draft of 1530 N (156 kgf) for four rows. A rolling crust breaker, developed to enhance seedling emergence through the surface crust, gave good results. Intensive primary tillage of Alfisols showed advantages in the early stages of crop growth, but they tended to disappear late in the season. Results of tillage studies conducted for 4 years indicate a need for further research to find out the comparative advantages intensities of primary tillage during the cropping season and off-season.*

## INTRODUCTION

As discussed elsewhere, in this volume, Alfisols and related soils in the semi-arid tropics have earned inherent characteristics, such as low water-holding capacity, high erodibility, and a potential for excessive runoff, that are constraints in crop production under rainfed conditions. Alfisols are often very shallow and posses a subsurface layer of compacted soil that inhibits root development and water percolation. The loamy sand texture of the topsoil and predominance of kaolinite among the clay minerals make these soils structurally "inert" (Charreau 1977). Thus the noncracking topsoil becomes very hard when dry, making primary tillage possible only after good showers before the rainy season. Structural instability of these soils often causes crusting of the surface when rain alternates with dry periods. The formation of a crust subsequent to sowing can be a serious problem for the establishment of a crop with required plant density.

Alfisols therefore offer a considerable challenge regarding the development of farm machinery required for tillage and seedbed preparation operations that make possible the early sowing of crops; the improvement of metering and placement of seed and fertilizer; the enhancement of seedling emergence in the event of crust formation; and the

effective control of interrow weeds. The need to evaluate alternative tillage practice and to study the reaction of the soil to tillage tools, plant and soil interaction during plant establishment and early growth, and seedbed requirements were also recognized. This paper summarizes farm machinery development, and the results of selected experiments conducted on Alfisols, at ICRISAT Centre.

## MACHINERY DEVELOPMENT

### Multipurpose wheeled tool carriers (WTCs)

In the SAT, farmers mostly depend on human labour and draft animals (usually oxen) in their farm operations. In India a range of ox-drawn implements, such as a country plow ; a blade harrow, a seeder with hand metering for two or three rows, and an interrow weeding hoe are common everywhere. These implements are attractive to farmers because of their low purchase and maintenance costs, easy availability, from local artisans, and minimal repair requirements. But they are slow in operation, are tiring to use and often fail to give the precision required for intensive cropping.

After initial experience with traditional ox-drawn implements in farming systems research at ICRISAT Center, efforts were directed towards the development of multipurpose wheeled tool carriers. As the name implies. such a tool carrier, drawn by oxen, asses, or mules, is capable of performing various field operations by the attachment of appropriate implements. The frame and linkages on the WTC have provisions for making vertical and lateral adjustments in the position of the implement with respect to the soil surface or the crop. An implement mounted on the WTC can be raised into a transport position, or lowered to operate in the soil, with a lever. A WTC provides stability in operation, comfort for the operator, and is designed to maintain the correct direction of travel in the field.

The first design of a WTC found to be promising was the Tropicultor, already in use in some parts of West Africa. The Tropicultor was evaluated at ICRISAT Center and modified. Later, more work was done on matching implements to meet the operational requirements without undue stress on the oxen. The Tropicultor has a set of pneumatic wheels supporting a tubular frame, with a beam at the front and a square toolbar 1.7 m long at the rear. The toolbar is attached to the lifting linkages with removable pins such that its height from the ground can be varied All implements are mounted on the toolbar with simple U-clamps. The Tropicultor can also be converted into a two-wheeled cart by mounting a cart attachment over the frame.

The Tropicultor was found to be very effective and useful for field operations in watershed areas at ICRISAT Centre and in farmers' fields. However, its high purchase price has been a major constraint in its acceptance by Indian farmers. Subsequently, development of relatively low-cost tool carriers with comparable versatility and utility was initiated. The first low-cost design, the Akola Cart, was derived from an ox-drawn small cart popular in the Akola region of Maharashtra State in India. Its frame and wheels are made of wood, and a hollow, rectangular steel toolbar is attached to the frame. A lifting mechanism operated by a lever placed in the center raises or lowers the implement mounted on the toolbar. The arrangement for mounting implements on the toolbar is similar to that for the Tropicultor.

The second low-cost design is the Agribar . It is made of steel and has a 1.7-m long square toolbar to which a beam is attached at right angles. The toolbar is supported on two wheels of 30 cm diameter. Implements mounted on the toolbar can be raised or lowered by operating a lever at each end of the toolbar one by one. Implements for the Agribar are the same as those used with the Tropicultor, and the manner of mounting is identical.

To compare the performance of these three WTCs, we measured the actual field capacity (the area covered in 1 hour), and the draft requirements for different operations. To enlarge the scope of the experiment, a 20.9 kW (28 hp) TE-type Bouyer

tractor was also included in the study. Plot sizes varied from 271 to 688 $m^2$, because of the shape of the field.

For all field operations, the Tropicultor had greatest reliability (ICRISAT 1982), With the Akola Cart there were problems of frequent breakdowns because of failure of the wooden components. Similarly, the Agribar, at that stage in its development, was not strong enough to withstand the load of two normal-sized 225-mm wide moldboard plows or ridgers. Accordingly, smaller plows and ridgers were used on the Cart and the Agribar. Results obtained for the time required per ha for different operations (Table 1) showed that the Tropicultor was the most efficient, Because of the smaller plows used with the Akola Cart and the Agribar, plowing was done twice in the respective plots. For other operations the difference between the treatment in terms of time saving was very small, often statistically nonsignificant ($P<0.05$). The tractor did not show any advantage over the animal-drawn machinery.

The tractor time required was influenced by such factors as the skill of the operator, implements used length of run, and turning time. It was observed that the tractor required more turning time than a WTC. In straight runs, the advantage that could have been obtained in the tractor treatment was lost partly because of the requirement to operate slowly to avoid damage to the implements, which were designed for use with a WTC, and partly because of the small plot size.

Table 2 gives the range and average figures for pull force (draft) measured by a dynamometer placed in the beams of the WTCs. The data showed that it is the type of operation and not the type of WTC that determines the pull requirement, because over 90% of the pull is attributed to the implement used. Plowing and ridging are heavy operations. Regardless of pull in the range of 1600-2250 N (163-230 kgf), oxen were able to perform these operations and work continuously for 6 hours a day with normal rest periods, Similarly, the effect of the machinery system was not found to be significan t on plant population and yield of sorghum and pigeonpea crops (Table 3). Further testing of the Tropicultor. Akola Cart, and Agribar revealed poor viability and transferability of the Akola Cart design. Inappropriate dimensional control and seasonal swelling and shrinking of the wooden components called for too much attention every year. As a result of this, no further design work with the Akola Cart was done.

**Table 1.** Average machine-hours per ha required for various operations with different machinery systems used in an Alfisol watershed, ICRISAT Centre, 1979-80.

| Operations | Machinery systems | | | |
|---|---|---|---|---|
| | Animal-drawn WTC | | | Tractor |
| | Akola Cart | Agribar | Tropicultor | |
| Plowing I | 1.8 | 1.8 | 1.8 | 3.2 |
| Cultivation | 2.7 | 2.8 | 2.6 | 3.0 |
| Plowing II | 3.2 | 3.6 | NR | NR |
| Ridging | 3.2 | 3.6 | 2.7 | 3.4 |
| Bed-shaping | 3.4 | 3.4 | 2.4 | 2.6 |
| Fertilizer application | 3.3 | 3.2 | 3.0 | 2.7 |
| Planting | 1.9 | 2.7 | 2.0 | 2.8 |
| Interrow cultivation I | 3.1 | 2.7 | 2.5 | 3.0 |
| Interrow cultivation II | 3.7 | 3.7 | 2.9 | 3.0 |
| Total | 26.3 | 27.5 | 19.9 | 23.7 |

NR = Not required

Table 2. Average and range of pull (N) observed for various operations with different machinery systems in an Alfisol watersheds, ICRISAT Centre, 1979-80.

| Operation | Machinery system | | | | | |
|---|---|---|---|---|---|---|
| | Akola Cart | | Agribar | | Tropicultor | |
| | Range | Average | Range | Average | Range | Average |
| Plowing | 1600-2250 | 2000 | 1700-2000 | 1950 | 1800-2000 | 1900 |
| Cultivation | 1500-1650 | 1550 | 1300-2000 | 1600 | 1400-1700 | 1550 |
| Ridging | 1750-1850 | 1800 | 1700-1800 | 1750 | 1700-1800 | 1750 |
| Bed-shaping | 1250-1600 | 1500 | 1200-1600 | 1450 | 1450.1550 | 1500 |
| Fertilizer application | 1100-1400 | 1300 | 1400-1600 | 1500 | 1400-1450 | 1450 |
| Planting | 1150-1200 | 1150 | 1100-1250 | 1200 | 1350-1400 | 1400 |
| Interrow cultivation I | 1300-1400 | 1350 | 1400-1500 | 1450 | 1400-1700 | 1600 |
| Interrow cultivation II | 1350-1650 | 1450 | 1050-1600 | 1350 | 1150-1600 | 1400 |

Table 3. Plant stand end grain yield obtained using different machinery systems in an Alfisol watershed, ICRISAT Center, 1979-80.

| Crop | Factor | Machinery system | | | | |
|---|---|---|---|---|---|---|
| | | Animal-drawn WTC | | | | |
| | | Akola Cart | Agribar | Tropicultor | Tractor | SE (±) |
| Sorghum | Plant stand $ha^{-1}$ | 168000 | 185000 | 155000 | 166000 | 10760 |
| | Yield (t $ha^{-1}$) | 4.0 | 3.5 | 3.4 | 3.6 | 0.49 |
| Pigeonpea | Plant stand $ha^{-1}$ | 68000 | 62000 | 69000 | 67000 | 4733 |
| | Yield (t $ha^{-1}$) | 0.44 | 0.45 | 0.45 | 0.44 | 0.065 |

## SOWING AND FERTILIZER APPLICATION

Traditionally, sowing in India is done by the hand-metering of seed into a furrow opened by a country plow. A multirow wooden seed drill, called a "gorru" or "tippen", is also widely used for sowing. The use of inorganic fertilizer is relatively new among dryland farmers in India, and the sowing techniques they currently use are inadequate to meet the operational requirements if fertilizer is to be drilled at the same time as seed. Some multirow hand-metering seed drills have been modified for placing a basal dose of fertilizer along with the seed, e g., the Royal gorru and Eenati gorru (Venkata Nadachary and Kidd 1981).

The traditional systems have several limitations that result in poor plant stands, even though the normal rate of seed application is 3 or 4 times more than that recommended (Soman et al. 1981). Traditional systems give uneven distribution of seed, which means crowding of plants at different locations in the same row and gaps elsewhere. Another limitation of this system is inappropriate placement of the seed, and delay in covering it. In Alfisols, with low soil-moisture retention capacities, any delay between opening and closing a furrow can adversely affect germination and emergence. Finally, ground coverage is slow, and traditional operations require at least two or three people. Thus for com-

pletion of sowing of crops early in the rainy season, traditional sowing equipment is not adequate.

For moisture conservation in Alfisols, minimum soil disturbance, quick furrow closing, and proper compaction are essential for seeding. When more than 10 kg $ha^{-1}$ of nitrogen fertilizer needs to be applied at seeding, it should be placed in a band away from the seed to avoid salt injury (Sanghi et al, 1982). The separation of seed and fertilizer appears to be more important in Alfisols and related soils than in clayey soils such as Vertisols, probably because of lower availability of moisture around germinating seeds in the former case.

During the early phase of farming systems research at ICRISAT Center, fertilizer application preceded sowing as a separate operation in both Alfisols and Vertisols. A narrow shoe-furrow opener (Fig 1 (a) was developed for planning on the lines where fertilizer was already banded. With the development of a combined planter-and-fertilizer applicator a change in the furrow-opener design became necessary.

Fig. 1(b) shows a two-chamber single-shoe furrow opener designed to cut a narrow slit for minimizing draft and soil disturbance. With this furrow opener, fertilizer was placed on one side of the seed and at the same level. Two main shortcomings of this design were found to be inadequate separation of seed and fertilizer, and clogging of the furrow opener with soil when lowered into the working position.

Another design [Fig. 1(c)] attempted to overcome these problems. It required fertilizer to be placed about 40 mm directly below the seed row. The furrow opener was closed at the bottom and had exits for seed and fertilizer at the rear. While this design got over the problem of clogging, seed and fertilizer separation varied from 0 to 20 mm owing to the poor flow of moist soil.

In the third modification [Fig. 1(d)] the furrow opener was made wide and had exits at different levels. Fertilizer was expected to fall in a band about 40 mm below and 30 mm to the side of the seed row, separated by a layer of soil. The performance of this design was also unsatisfactory because of insufficient seed and fertilizer separation. The seed tended to roll down on to the fertilizer band because the soil layer between them was thin. Covering a 60 mm wide furrow was also found to be a problem.

Finally, a double-shoe furrow opener [Fig. 1(e)] that keeps seed and fertilizer well separated was developed. It has two identical, narrow shoes bolted to an inverted T-frame that permits fertilizer to be placed 40-50 mm to the side and below the seed. Furrows opened by the fertilizer shoe are partially closed by the seed shoe. The seed row is covered and compacted by floating arms and a press wheel. The double-shoe furrow opener design gave adequate separation between seed and fertilizer and performed without any problem of blockage in both Vertisols and Alfisols (ICRISAT 1984).

A four-row planter-and-fertilizer applicator developed at ICRISAT Centre permits seed and fertilizer to be metered mechanically and to be placed at required depth. This planter is suitable for a wide range of crops grown in the SAT. Seed is metered by an inclined-plate mechanism. Metering plates, made in aluminium, can be changed easily to suit a particular crop. The fertilizer application rate is controlled by an oscillatory mechanism fitted to the bottom of the hopper. Both mechanisms are driven from the left wheel of the Tropicultor on which the planter is mounted. Test results from an ICRISAT. Alfisol watershed showed that the machine can cover 1 ha in 4-5 hours depending on plot size, shape, and other operational factors (Table 4). Pull forces required for sowing on Vertisols and Alfisols are given in Table 5. Sowing of four rows of any crop on Alfisols was never found to be difficult because the pull requirement was not excessive and the oxen could sustain the load for normal working hours.

**Development of a rolling soil-crust breaker**

Soil crusts on Alfisols impede seedling emergence. Once a crust forms over a seeded row, it needs to be

wetted frequently or broken mechanically for satisfactory seedling emergence.

During rainless periods, application of water in the SAT is impractical, however, because of its limited availability; labour requirements and equipment cost are the other constraints. Farmers have no traditional equipment for breaking soil crusts. Therefore, a rolling crust breaker was developed that can be used on seeded rows (Awadhwal and Thierstein 1983). The manually-operated rolling crust breaker which can also be attached to a WTC, has two 150-mm diameter rollers with 16 rows of spikes 25 mm long. Spacing between the rows and the length of spike were selected to ensure that no crust was left undisturbed. The crust breaker covers a 180-mm wide strip over the seed row.

**Table 4. Actual field capacity for planting and fertilizer application in different land-management practices on Alfisols, ICRISAT Centre, 1980-81.**

| Watershed no. | Land treatment | Crop | Actual field capacity (ha $h^{-1}$) |
|---|---|---|---|
| RW-3D | BBF | Sorghum/pigeonpea | 0.25 |
| RW-3D | BBF | Pearl millet/pigeonpea | 0.21 |
| RW-3D | BBF | Castor/green gram | 0 26 |
| RW-3D | Flat | Sorghum/pigeonpea | 0.21 |
| RW-3D | Flat | Pearl millet/pigeonpea | 0.20 |
| RW-3D | Flat | Castor/green gram | 0.26 |
| | | Average | 0.22 |

BBF = Broadbeds and furrows.

Performance of the rolling crust breaker was evaluated on Alfisol fields with sandy, sandy loam, and sandy clay soils. We examined the effect of breaking surface crusts on different pearl millet and sorghum genotypes. The pearl millet and sorghum genotypes were planted manually, about 35 mm of water was applied, by sprinkler from a height of 2 m, to produce a reasonably uniform and hard crust. A day before expected emergence, the crust surface was dry and its strength, measured with a pocket penetrometer, was in the range of 196 to 245 k Pa (2 0 to 2.5 kg $cm^{-2}$).

The rolling crust breaker was used to break the soil crust on the seeded rows 1 day prior to the day of expected emergence. The emergence count was taken 1 week after the breaking of crust. Seedling emergence under crusted conditions was very poor, and the use of the crust breaker increased the emergence significantly when soil moisture was not a limiting factor (Awadhwal and Thierstein 1983).

### Tillage Studies on Alfisols

Tillage experiments were conducted on Alfisols for 4 years from 1978 (Klaij 1983, Awadhwal and Thierstein 1984). The objectives of the studies were to evaluate alternative primary tillage practices and their effect on crop production, in terms of soil reaction to tillage tools, plant and soil interaction during plant establishment and early growth, and to evaluate seedbed requirements.

**Table 5, Pull requirement for planting and fertilizer application.**

| Soil | Crop | No. of rows per pass | Pull (N) | | CV (%) | SE (±) |
|---|---|---|---|---|---|---|
| | | | Range | Mean | | |
| Vertisol | Maize | 2 | 900-1400 | 1080 | 11 | 24 |
| Vertisol | Sorghum/pigeonpea | 3 | 1400-1700 | 1470 | 6 | 18 |
| Alfisol | Pearl millet | 3 | 1000-1400 | 1240 | 13 | 33 |
| Alfisol | Cowpea | 4 | 1300-1700 | 1530 | 8 | 25 |

Tillage operations consume a large proportion of the total energy exoenditure in all field operations. Hence the study also aimed to provide an understanding of the factors that can lead to the saving of energy. The experiments were conducted on a broadbed-and-furrow configuration where the traffic zone (furrow) is clearly separated from the cropping zone (broadbed). Four primary-tillage treatments evaluated, shown in figure 2, were split-strip tillage covering the entire width of the broadbed in three successive passes of the WTC ; strip plowing with right-and left-hand moldboard plows; chiseling to 120 mm depth at locations where crop rows were to follow; and shallow cultivation by duckfoot sweeps. The treatments were performed by using respective implements in conjuction with a WTC.

Variation in the rainfall pattern from one year to another, which affected moisture availability, had a greater effect on crop growth that the intensity of primary tillage. Intensive tillage by the split-strip method tended to make better seedbeds by turning and mixing the soil across the entire width of the broadbed, thus covering weeds properly. When compared with other treatments, weed intensity in split strip tillage plots was less up to 22 days after planting, even though data were significant only at the 10% probability level (Klaij 1983). Tillage treatment did not affect weed development late in the season.

The major effect of tillage treatments was expected to be on availability of soil moisture during crop growth. Table 6 shows trends of soil moisture depletion in the top 20-cm layer during the early growth of the sorghum crop. Split-strip tillage holds marginally more of water, but moisture depletion during stress is faster. Consequently, at the end of dry spells moisture in intensive tillage is less than in shallow-tillage treatments.

There can be two hypotheses to explain differences in soil moisture in different tillage, plots. First, the intensive-tillage treatment provided a better environment for plant growth and root development resulting in higher rates of transpiration that led to faster depletion of soil moisture. Secondly, in shallow tillage the soil is stratified in two layers : a toptilled layer and a subsurface-untilled layer. This stratification caused discontinuity of pores, resulting in increased resistance to moisture migration. In the case of moldboard-plowed soil the entire plowed zone was in one layer with better continuity of pores, which, coupled with higher porosity, enhanced moisture loss through evaporation. These hypotheses require validation by further research (Awadhwal and Thierstein 1984).

Table 6. Effect of tillage methods on soilmoisture on an Alfisol during no-train periods, ICRISAT Center, rainy season 1981.

| No. of dry days | Tillage methods | | | | Mean | SE(±) |
|---|---|---|---|---|---|---|
| | Split-strip plowing | Strip plowing | Chiseling | Shallow cultivation | | |
| | ————Soil moisture (mm) in top 20-cm layer———— | | | | | |
| 0 | 45 | 43 | 44 | 43 | 44 | 0.6 |
| 2 | 31 | 29 | 34 | 35 | 32 | 0.7 |
| 4 | 28 | 29 | 30 | 33 | 30 | 0.5 |
| 9 | 22 | 25 | 28 | 32 | 27 | 0.5 |

Source : Awadhwal and Thierstein 1984.

Effect of tillage treatments on crop yield was not consistent (Table 7) and thus there is no conclusive evidence to suggest that any one treatment was better. However, split-strip tillage gave significantly ($P < 0.05$) more yield (2460 kg $ha^{-1}$) in a year of low rainfall (1979) than in field RA-14 which contains a fair proportion of gravel in the top layer (1120 kg $ha^{-1}$). Apparently soil moisture was greater only in RA-14 where the crop responded well to the increased tillage because of enhanced infiltration. In the following year the same field gave much lower yields accross all treatments. Sorghum grain yield varied considerably from year to year in RW-2B, where the clay content was greater. The results did not have significant differences.

Energy expenditure in primary tillage was estimated by measuring the draft and the travel distance required to cover 1 hectare. As expected split-strip plowing consumed a much higher level of energy (28.2 MJ $ha^{-1}$), as compared with strip plowing (11 MJ $ha^{-1}$), chiseling (9.6 MJ $ha^{-1}$), and shallow cultivation (7.7 MJ $ha^{-1}$). Part of the excessive amount of energy used in the first case could be compensated for by saving one secondary tillage operation for seedbed preparation, which was otherwise necessary for effective weed control.

**Table 7.** Effect of primary tillage on sorghum grain yield (kg $ha^{-1}$) in Alfisol fields, ICRISAT Centre, 1979-81.

| | Field identification and year | | | | |
|---|---|---|---|---|---|
| | RA-14 | | RW-28 | | |
| Treatment | 1979 | 1980 | 1979 | 1980 | 1981 |
| Split-strip plowing | 2460 | 1130 | 2970 | 1800 | 3080 |
| Strip plowing | 2140 | 1120 | 3080 | 1750 | 3010 |
| Chiseling | 1970 | 910 | 2870 | 1450 | 2680 |
| Shallow cultivation | 1950 | 1060 | 3040 | 1910 | 2870 |
| Mean | 2130 | 1050 | 2990 | 1740 | 2910 |
| SE(±) | 90 | 116 | 111 | 120 | 260 |

Source : Klaij 1983 ; Awadhwal and Thierstein 1984

## CONCLUSIONS

Improved, ox-drawn wheeled tool carriers and implements developed so far have shown considerable advantages in terms of the timeliness and quality of operations. The highest draft requirement was recorded for plowing with a set of left and righthand mold board plows operating on a broadbed in the range of 1600 to 2250 N, with an average of 2000 N. For a single right-hand moldboard plow operation on flat land the draft values were in the range of 1180-1670 N. with an average of 1470 N. For other operations the draft values recorded were far less. An average pair of oxen was able to sustain these loads for a usual working period in a day. For sowing all common crops in Alfisols and Vertisols a planter-and-fertilizer applicator gave good results. It could sow sole crops as well as intercrops, and place seed and fertilizer with required precision. All these machines were drawn by a pair of oxen of average size.

A crust breaker, used either as an attachment to a WTC or as a hand-pushed implement, facilitated the emergence of seedlings and improved the stands of sorghum and pearl millet in fields where a surface crust was formed by natural drying processes. Primary tillage studies on Alfisols conducted for 4 years revealied that intensive tillage improved the pore-space and water-retention capacites of these soils, and reduced weed infestation in the early stages of crop growth. It also enhanced the risk of soil erosion in the absence of adequate crop cover. Advantages accuring from intensive tillage can therefore be realized only conjunction with soil-conservation practices In the years of normal and better-than-avererage rainfull, shallow tillage treatments gave comparable yields. It is thus clear that defining the best tillage techniques for Alfiso.s is a subject for further studies.

**Acknowledgement**

The authers make grateful acknowledgement to M C. Klaij because the section on tillage studies is largely based on his work and Ph.D. thesis. Thanks are also due to G. E. Thierstein who led or participated in much of the research work reported.

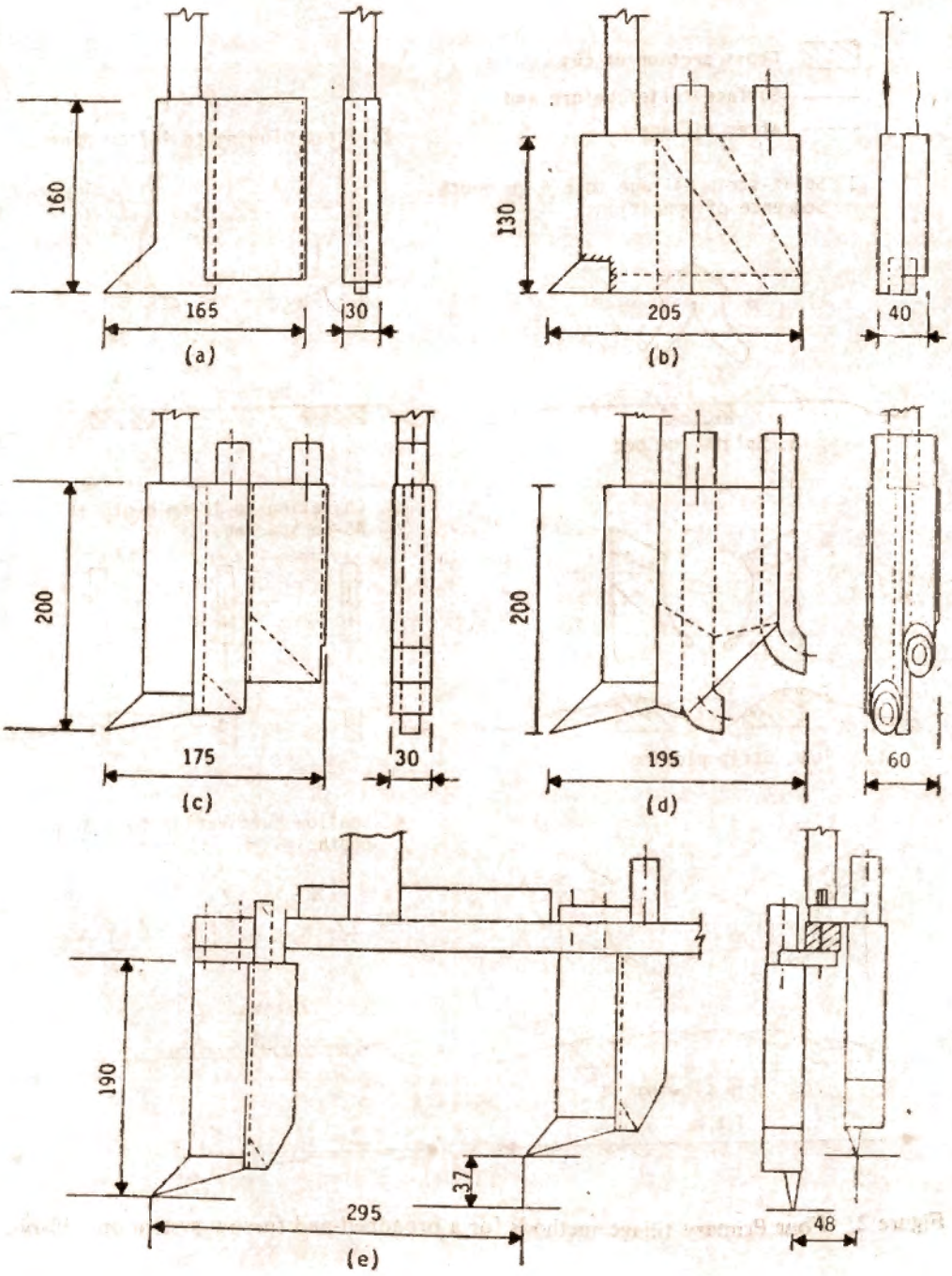


**Figure 1. Furrow openers. (Measurements in mm.)**

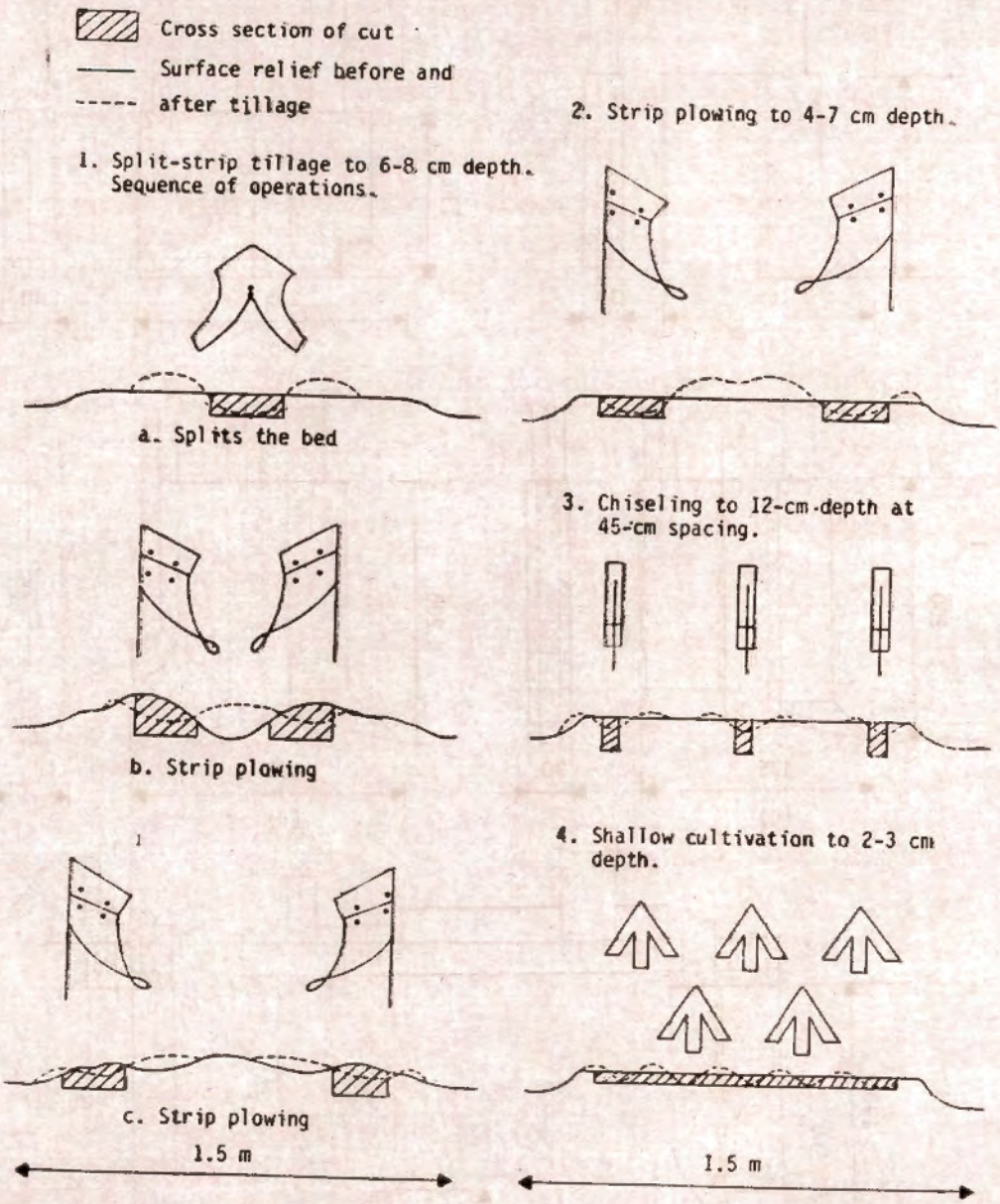


**Figure 2.** Four Primary tillage methods for a broadbed-and furrow system on Alfisols.

# WATER RESOURCES DEVELOPMENT AND MANAGEMENT

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*The paper reveals about the present water resources and how the inefficient management leads to drought in some areas and floods in other areas. An experimental study about village Sukhomajiri has also been discussed. It also elaborates a strategy for proper management of soil and water resources.*

Land and water are most precious gifts of nature. Throughout the ages man has been an exploiter of the land its resources. History contains many examples of civilization which flourished as long as the land and its resources supplied their needs, but which eventually vanished as water supplies declined.

The magnitude and complexity of water resources development and management problems in the early days were not complex. Population was small, per capita demand was low and water was plentiful. This scenario started to change with the unchecked population growth.

Current estimates indicate that the total volume of water on earth is $1.4 \times 10^9$ km$^3$, 97.3% of which is ocean water, therefore cannot be used by man except for fisheries and navigation. Only 2.7% is fresh water, 7.2% of which is stored in polar ice-caps and glaciers, 22.4% as ground water and soil moisture (about two-third lies deeper than 750 metres below the surface), 0.35% in lakes and swamps, 0.04% in the atmosphere and less than 0.01% is in streams. In other words, nearly 99% of the fresh water is not easily available. For all practical purposes, it is surface water in rivers, streams and lakes, amounting to less than half a percent of available fresh water that constitutes the basic available supply for man.

## ANNUAL RAINFALL BUDGETING OF INDIA:

India receives an average annual rainfall of 112 cm or 370 million hectare metres (m ha m). Of this amount, it is estimated that about 120 m ha m is lost as evaporation, 80 m ha m seeps into the soil and about 170 m ha m flows into the rivers. Out of 80 m ha m water that seeps down annually into the soil, about 43 m ha m remain in the top layers and contribute to soil moisture which is essential for growth of vegetation. The remaining 37 m ha m seeps down into the soil and enriches ground water. Out of this 37 m ha m, about 11.25 m ha m is being utilized for irrigation and about 15.5 m ha m can be utilized in future.

It has been estimated that out of 170 m ha m of river flow only 59.7 m ha m (35%) can be utilized for irrigation because of the limitations imposed by topography, flow characteristics, climate and soil condition At present about 32 m ha m is being utilized for irrigation. The remaining 27.7 m ha m is available for future use.

The available water resources are ill-distributed, resulting in seasonal abundance and devastating floods in some areas while large tracts in other regions are frequently affected due to drought. The Shiwalik foothill region spreading in the states of Punjab, Haryana and Himachal Pradesh and covering about 2 million hectare area, experience

frequent droughts and crop failures due to erratic distribution and uncertainty of rainfall. Though the region receives an average rainfall of 112 cm, most of it not only goes as waste but causes the problems of soil erosion, floods and sedimentation. Rain water harvesting during the surplus months and utilization of stored rainwater for supplemental irrigation appears to be the only plausible way to increase and stablize agricultural production in this region and reduce the menace of floods and sedimentation.

## THE SUKHOMAJRI EXPERIMENT :

The above approach was adopted at a small foothill village called Sukhomajri, where 5.63 ha m runoff water from 9.2 h hilly catchment was collected behined a 12 metre high earthen dam. The irrigation water is conveyed to agricultural fields through underground pipe line by gravity. Since water is available in limited quantity only two irrigation to rabi crops are assured. Application of one presowing irrigation to wheat increased wheat yield from 670 to 2000 kg/ha (198%) with two irrigations yield increase was from 670 to 2470 kg/ha (269%) and with three irrigations from 670 to 3550 kg/ha (430%). With the availability of supplemental irrigation total grain production in the village has increased from 450 quintals in 1975 to 1850 quintals in 1988.

With the visible benefits from water resource development, the people have started protecting the hilly watersheds from grazing and illicit cutting of vegetation. The grass production from hills has gone up from less than one quintal to 25 quintals per hectare. Availability of more fodder from agricultural fields and grass grom hilly area has given a fillip to the milk industry in the village. The number of buffaloes has increased from 79 to 313 and milk production has gone up from 248 to 1200 litres per day during the period 1975 to 1988.

## MANAGEMENT OF THE PROJECT

The entire management of the project has been handed over to a village based Hill Resource Management Society. The main responsibilities of the Society are : (i) Protection of hills from grazing and illicit cutting of vegetation (ii) Distribution of water and other common resources among its members (iii) Maintenance of dam and water conveyance system.

Water resource development and its management has provided safety against drought, minimized hazards of soil erosion, floods and sedimentation, helped in augmenting ground water and proved a boon for improving the eco-system and the environment.

The overall impact of Sukhomajri experiment was reflected in reduction of sediment load in Sukhna Lake from 141 to 15 tonnes per hectare per year over a period of eight years.

If the socio-economic condition of the people living in Shiwalik foothill villages is to be improved, there should be large scale replication of Sukhomajri type projects. The departments of Forests, Soil Conservation and Agricultural must join hands in developing and utilizing water resources for the mutual benefit of the people on the one hand and the forests on the other.

Design details of Earthen dams.

| Particulars | Sukhomajri | Nada | Bunga | Una |
|---|---|---|---|---|
| Catchment (ha) | 9.1 | 25 | 127 | 41 |
| Height of dam (m) | 10 | 14 | 16 | 16 |
| Spillway level (m) | 8 | 12 | 14 | 14 |
| Storage capacity ($ha_m$) | 5.6 | 7.9 | 59.6 | 9.65 |
| Command area (ha) | 24 | 34 | 243 | 60 |

Note :—Water conveyance is through underground pipelines by gravity in all the projects.

# DEVELOPMENT OF A LOW COST EXTRUDER FOR SOYPRODUCTS

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*A low cost single screw forming extruder costing about Rs. 15000.00 has been developed to produce soy cereal blended snack foods. It has a capacity of 25 kg/h and can extrude soy cereal blends at a moisture content of 30% wet basis. The product is well mixed, porous and in strands form which is further dried and flaked. The product thus obtained is deep fried and consumed with sprinkling spices and salt as per taste. The soy cereal blended flakes (30:70) had protein content of 21.37, 20.18 and 20.67% for wheat, sorghum and maize flakes. The bulk density were 259.94, 283.28 and 256.76 gm/cc for soyblended flakes from wheat, sorghum and maize. Cost of operation worked out to Rs. 40/q of product. The nutritional value and physical properties of the snacks were found to be satisfactory.*

## INTRODUCTION

Soybean is a protein rich material having scope for developing various nutritious snack foods. Extrusion has become an important processing technique in a variety of food processes. Traditionally also extrusion has been employed to make ready to eat snacks from wheat, rice and pulses called *Kurdai*, *Chakli*, etc. Variety of extruders are available to manufacture different types of food products but mostly these machines are imported and are suitable for large through puts. Soybean due to its high protein content is better to be consumed along with other cereals. The soy cereal combination also improves the amino acid profile.

Many soft moist foods are prepared on extruders which have moderate shear and high compression. Heat is applied to the barrel as little viscous dissipation of heat occurs due to relatively low viscosity of the material (Harper, 1979), with an objective to make available a low capacity low-cost indigenous unit a single screw extruder has been developed at CIAE to work with moistened soy cereal blends.

## MATERIALS AND METHOD

Extruder : The extruder consisted of main components as (i) Extrusion stand, (ii) Drive mechanism, (iii) Thrust bearing, (iv) Feed hopper, (v) Barrel, (vi) The screw and die plate.

(i) Extrusion Stand : was a base of MS angle which supported drive, bearings, extrusion barrel and screw assembly.

(ii) Drive mechanism : The extruder was driven with an electrical motor of 7.5 hp, with variable speed dyno drive system.

(iii) Thrust bearing : Two thrust bearings were provided at the driven end of the screw. The rear-

ward thrust at absorbed is the bearings to compensate for the force imparted on extruded material.

(iv) Feed hopper : It was provided near the driven end through which soy cereal dough was pushed through the screw by manual feeding.

(v) Barrel : The barrel was manufactured from MS pipe of 75 mm internal diameters. To get larger surface area for heating L/D ratio was kept to 10:1 to get longer residence time.

(vi) The screw : The screw was made from MS bar and later plated with nickel based chromium. It was a metering type screw with three geometrical sections viz. deep feed section, tapered compression section and relatively shallower metering section. The screw was supported by a sealed ball bearing at exit end. The length of the screw was 70 mm and dia of screw was 70 mm. The clearance between screw and barrel was kept at 2.5 mm. The compression ratio was 3:1, with channel depth at inlet and exit being 15 mm and 5 mm respectively. The helix angle was 11° with square pitch of 48 mm.

(vii) The die plate : A die plate was fitted on the barrel at exit end on the flange by nut bolts. This plate in the centre houses a sealed bearings at centre and the radial distance was provided with 6 holes of 5 mm dia.

The tape heater of 1,000 watts was lined over the barrel to get initial heating of the barrel when required. The schematic drawing of the extruder is shown in Fig. 1.

The extruder was put on and allowed to run idle for a few minutes. The small quantity of moistened material was passed 3—4 times to heat the barrel. The barrel was also heated externally by rope heater. When the extrudate temperature of above 100°C was achieved, the moist soy cereal blends at 10, 20 and 30% soyflour having moisture content of 30% were fed to the extruder at speed of 300 rpm. The material when came out was in the slightly expanded strands Fig. 2. The strands were cut into small pieces and after partial drying. were flaked in a low capacity CIAE flaking machine (PATIL & Shukla, 1988). Flakes were further dried and consumed after deep frying, like potato chips with salt and spices Fig. 3. The process thus followed for making the soyfortified extruded flakes from cereals was as given in Fig. 4.

The nutritional value of the flakes was determined by Standard analytical procedures ( Anon, 1970 ) and the energy value was estimated as per composition. The physical properties of these flakes were determined as per the method given by Boison etal. (Boison etal, 1983) for extruded products.

## RESULTS AND DISCUSSION

Maize, sorghum and wheat flour with mixing of full fat soyflour at 10, 20 and 30% level was extruded at 30% moisture content, wet basis. The flake thickness was maintained less than 1 mm. The flakes were further dried to about 8—10% moisture content. The protein content of the product increases with increase in soyflour in the blend. The fat content was also found to increase as the soyflour content in the blend was increased, obviously due to higher protein and fat available in soybean. However, the carbohydrate content was reduced as blending level of soybean was increased. The calorific value of the products was above 350 calorie/ 100 gram The protein content of the soyfortified flakes ranged from 14.3 to 15.20 at 10% blending whereas it was 20.10% to 21.37% blending (Table 1).

The physical properties i. e. bulk density and water absorption capacity which indicate the degree of expansion were determined for dried flakes. The moisture content of the flakes for these values has also been reported (Table 2). The bulk density was higher in sorghum flakes at all levels of blending, followed by wheat and maize flakes. This may be due to the fact that maize starch require gelatinization before puffing. The water absorption capacity was higher in maize flakes at 10% blending but it was higher for sorghum and wheat flakes at

20 and 30% blending. The subjective organoleptic evaluation of the fried flakes at 30% soy indicated that soy sorghum and soy wheat flakes gave crispy taste whereas soymaize flakes were little hard. The taste of fried flakes was similar to fried SORGHUM PAPAD conventionally produced in Sorghum growing areas.

The cost of the extruder works out to Rs 15,000.00 and operating cost comes to Rs. 40/q of the flour extruded.

Table 1 : Nutritional value of soy fortified cereal flakes.

| Sl. No. | Composition | Soy blending at 10% | | | Soy blending at 20% | | | Soy blending at 30% | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Wheat | Sorghum | Maize | Wheat | Sorghum | Maize | Wheat | Sorghum | Maize |
| 1. | Protein | 15.20 | 13.67 | 14.30 | 18.30 | 16.94 | 17.50 | 21.37 | 20.18 | 20.67 |
| 2. | Carbohydrate | 64.53 | 67.41 | 61.75 | 59.67 | 62.23 | 57.11 | 54.81 | 57.85 | 52.57 |
| 3. | Fat | 3.47 | 3.65 | 5.18 | 5.25 | 5.41 | 6.88 | 7.04 | 7.18 | 8.37 |
| 4. | Calorific value/100 gm (estimated) | 350 | 356.3 | 359 | 364.6 | 359.8 | 368.1 | 368.1 | 372.00 | 368.80 |

Table 2 : Physical Properties of soy-fortified extruded flakes

| Sl. No. | Property | Soy blending at 10% | | | Soy blending at 20% | | | Soy blending at 30% | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Wheat | Sorghum | Maize | Wheat | Sorghum | Maize | Wheat | Sorghum | Maize |
| 1. | Moisture content of flakes %, wb | 7.60 | 7.28 | 8.97 | 10.56 | 10.54 | 9.25 | 10.03 | 7.37 | 8.66 |
| 2. | Bulk density | 275.54 | 313.42 | 235.43 | 260.70 | 302.27 | 242.36 | 259.94 | 283.28 | 256.76 |
| 3. | Water absorption capacity % | 314.68 | 329.87 | 336.47 | 299.27 | 293.13 | 289.06 | 369.35 | 354.96 | 292.32 |

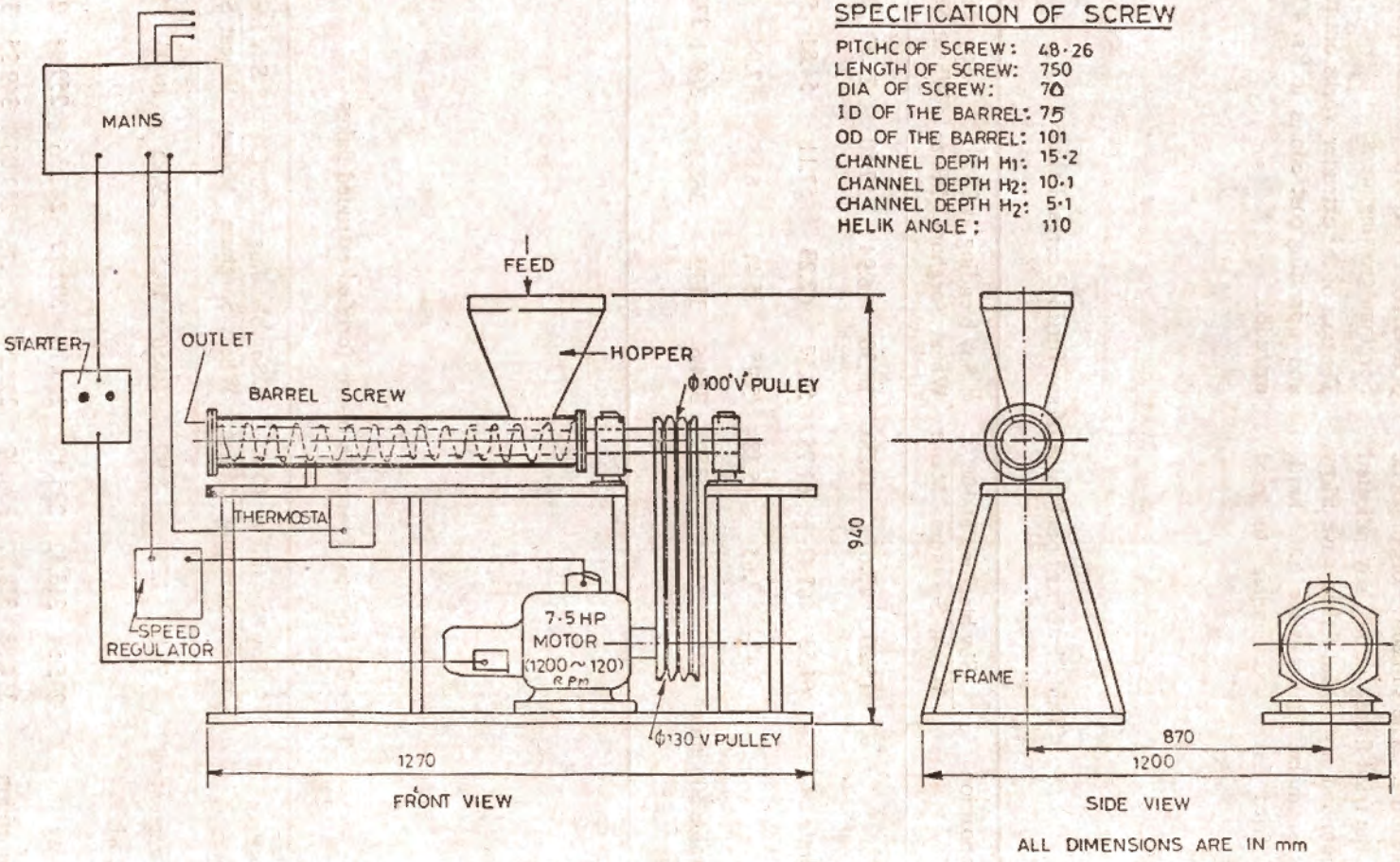


**FIG 1 : SCHEMATIC DIAGRAM OF EXTRUDER**

FIG 2. EXPANDED STRANDS OBTAINED AFTER EXTRUSION

FIG. 3. FLAKES FROM EXTRUDED STRANDS

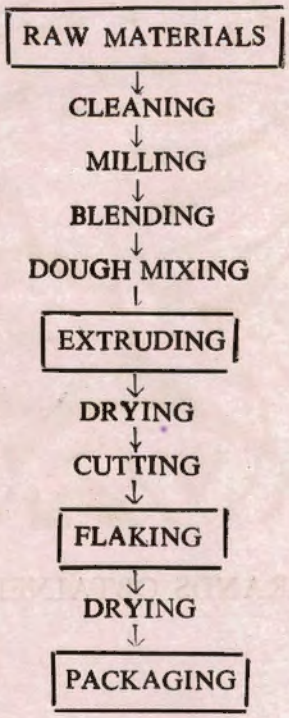


Fig. 4. PROCESS FOR MAKING SOYFORTIFIED CEREAL FLAKES USING FORMING EXTRUDER

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# DEVELOPMENT OF AN ANIMAL-DRAWN, INCLINED-ROLLER CRUST BREAKER

N. K. Awadhwal

International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh

*An animal-drawn, inclined-roller crust breaker was designed, developed and evaluated in the Alfisol field. It completely breaks the soil crust, causes negligible injury to seedlings, and promotes emergence of pearlmillet [Pennisetum typhoides (Burm. f.) Stapf and C. E. Hubb., syn. P. americanum (Linn.) Leeke] and sorghum [Sorghum bicolor (Linn ) Moench] to the level expected in the absence of crusting. It covers a 1 m wide strip, and its average fieldcapacity is 0.35 ha/hr. The design is simple and it can be made locally.*

Poor emergence of seedlings because of soil crusting reduces plant density and prevents the establishment of a uniform plant stand under a wide range of soil and climatic conditions. Awadhwal and Thierstein (1985) reviewed the problem of crusting and its impact on crop establishment. To ensure proper emergence, even when crusts have formed, the soil surface should either be frequently wetted or mechanically broken. Breaking the crust with hand-tools such as sickle is excessively tedious and requires as much as 200 man-hr/ha. In the past, rotary hoes, finger-type weeders and tooth harrows have been tried as crust breakers. These implements tend to remove soil and may seriously damage the seedlings. A cultipacker crushes the surface and breaks the soil crust, but it also injures seedlings (Kemper and Miller, 1974). A wooden roller, with spikes projecting 60 mm above its surface that punches holes in the crust to facilitate seedling emergence, could be useful but there is lack of quantitative information about its effectiveness and injury caused to the seedlings (UAS, Bangalore, 1984).

Awadhwal and Thierstein (1983) developed an implement that broke soil crusts over rows of germinated seeds to improve seedling emergence. It consisted of 2 spiked rollers placed in a tandem arrangement in a frame, with their axles perpendicular to the direction of travel. This tandem-roller crust breaker covered a 15 cm wide strip and effectively broke crusts without injuring the emerging seedlings. It is easy to use as a manually operated single-row implement. However to use it as a multi-row implement it is necessary to attach the required number of crust-breaker units to a wheeled tool carrier or a tractor. Moreover, the working width of a tandem-roller crust breaker is equal to only 1 roller width, though each unit employs 2 rollers. To overcome these limitations, and to achieve a wider coverage in a single pass, an animal-drawn implement was designed, developed and evaluated in field at the ICRISAT centre, Hyderabad. In this paper the design and performance of the inclined-roller crust breaker are described.

## MATERIALS AND METHODS

### Design criteria

The tip of a nail fixed on a roller follows a cycloidal path and staves a cavity into the soil surface when the roller moves freely on a flat soil surface with its axis perpendicular to the direction

of travel. The inter-row spacing that provides continuity between the cavities produced by spikes in successive rows is a function of the roller radius and spike length. It can be calculated by an equation reported by Awadhwal and Thierstein (1983). The design of the tandem-roller crust breaker (Awadhwal and Thierstein, 1983) was based on this principle. However, it required 2 rollers in tandem because a single roller could not effectively break crusts.

If the angle between the axes of the spiked roller and the direction of travel deviates from 90°, the plane of spike rotation no longer coincides with the direction of travel and the spikes exert an additional shear force on the soil, that results in a better break-up of the soil crust. This concept was studied with spiked rollers. The roller axes were inclined at angles 0—15° from the perpendicu lar to the direction of travel. At 0° the spikes merely punched holes, whereas at and beyond 15° the roller stopped rolling. A complete break-up of the soil crust without any apparent injury to the seedlings was achieved with a single roller when its axis was inclined to 5—10°. It provided the basis for the design of the inclined-roller crust breaker.

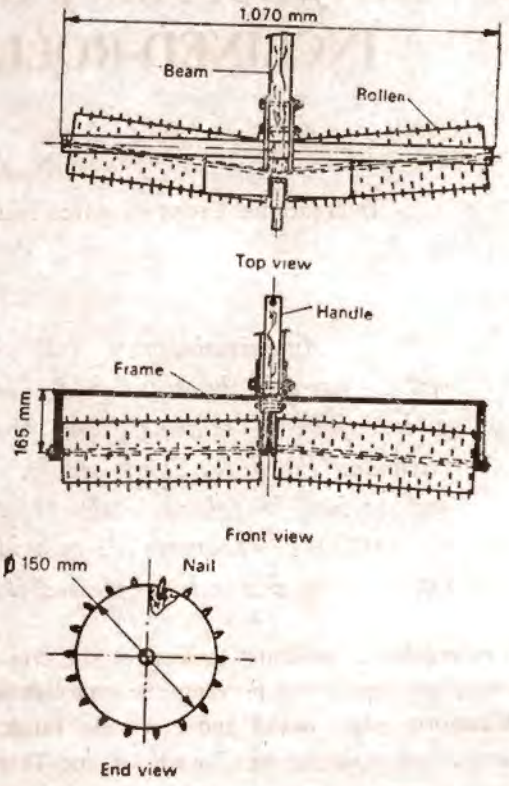


Fig 1. Animal-drawn inclined-roller crust breaker.

## Construction

The inclined-roller crust breaker consists of 2 wooden rollers, each 500 mm long and 150 mm in diameter (Fig. 1). Nails are fixed on to the rollers, projecting 25 mm above the surface, in rows 25 mm apart running along the roller axis. The rollers are arranged side by side in a U-frame made of mild-steel flats, such that their axles make a 170° included angle at the centre of the frame. The axle of each roller is inclined at an angle of 5° from the perpendicular to the direction of travel. This arrangement permits a coverage almost equal to the combined length of 2 rollers. It also counter-balances the side forces arising from the inclination of the rollers. The axle housings are 20 mm shorter at the centre of the frame than at the outer ends, so that the entire length of the rollers comes in contact with the soil surface when the implement is brought in operating position by raising its beam to an angle of about 30° with the horizontal. It can be pulled by a pair of oxen, either as an independent unit (Fig. 2, *top*) or as an attachment to an indigenous blade harrow (*bakhar*) or a plank (Fig. 2, *bottom*). It covers a 1 m wide strip, and its average actual field capacity is 0.35 ha/hr. It weights about 50 kg (without beam) and costs about Rs 250.

## Performance

The ability of the inclined-roller crust breaker to enhance the emergence of pearlmillet [*Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubb., syn P. *americanum* (Linn.) Leeke] and sorghum [*Sorghum bicolor* (Linn.) Moench] was evaluated. A trial was conducted in an Alfisol field with sandy-loam soil in the summer of 1986 and was repeated in the

Table 1. Seedling emergence (%) through unbroken and broken soil crusts, in summer and rainy seasons 1986.

| Treatment | Sorghum | | Pearlmillet | |
|---|---|---|---|---|
| | Mean (%) | SE | Mean (%) | SE |
| Soil crust unbroken* | 16.4 | ± 2.75 | 1.4 | ± 0.26 |
| Soil crust broken with inclined roller crust breaker* | 73.1 | ± 0.84 | 55.1 | ± 2.53 |
| Soil crust broken with tandem-roller crust breaker** | 73.7 | ± 1.52 | 35.7 | ± 7.43 |
| Soil crust broken manually with a sickle*** | 71.0 | ± 0.96 | 52.8 | ± 1.83 |

*Based on the data of 2 seasons, **based on summer-season data, ***based on rainy-season data.

rainy season. Both the trials were conducted in randomized block design with 4 replications. The treatments were unbroken crust and broken crust with an inclined-roller crust breaker, a tandem-roller crust breaker or a sickle (manually). In each plot 100 seeds were sown at a depth of 30 mm for pearl-millet and 50 mm for sorghum in 2 rows of 5 m each. Water (40 mm) was applied the same day by a sprinkler and a crust of reasonably uniform strength of 200—250 kPa ( 2-2.5 kg/cm$^2$) was obtained on the fourth day after irrigation. The crust strength was measured with a pocket penetrometer. Crust breakers were used on the fourth day after sowing, and seedling emergence was recorded 5 days after breaking the crust.

## RESULTS AND DISCUSSION

The inclined-roller crust breaker effectively broke the crust, causing negligible (<1%) injury to the seedlings. In both the trials emergence was significantly ($P < 0.01$) higher in the plots with broken crust than in those with unbroken crust (Table 1). However, the differences in the methods of breaking the crust had no significant influence on seedling emergence. Thus all the 3 methods used for breaking crusts are equally effective. The work capacity per hour of the inclined-roller crust breaker was 3—4 times higher than that of a tandem-roller unit attached to an animal-drawn toolbar. The inclined roller crust breaker required 2.8 hr (SE±0.12) to cover 1 ha area compared with 200 man-hr (SE±7.35) required for breaking the crust manually.

Thus the animal-drawn, inclined-roller crust breaker is an effective, efficient and a low-cost implement for breaking soil crust and improving seedling emergence. It is superior to the tandem-roller crust breaker because it breaks the crust of a wider strip in 1 pass and requires less time per hectare for the same quality of crust breaking. It is simple to fabricate and can be built with easily available materials.

## ACKNOWLEDGEMENTS

I am thankful to Mr. R. K. Bansal, Dr. T. Takenaga. Dr. K. B. Laryea and Dr. P. Soman for suggestions and help.

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No national development will be meaningful and thorough without the full involvement of women in the development process.

**—IBRAHIM BABANGIDA**

# RCC RING BIN

**Function** : Safe storage of agricultural produce such as food grains

**Developed at** : Indian Grain Storage Institute, Hapur

**Specifications**

| | | |
|---|---|---|
| Type | : | Precasted RCC ring made outdoor bins |
| Overall diameter | : | 1,920 mm |
| Overall height | : | 2,000 mm |
| Wall thickness | : | 50 mm |
| Height of each ring | : | 455 mm |

**Test Results**

| | | |
|---|---|---|
| Suitability for crops | : | Wheat and other food grains |
| Capacity | : | 40 q of wheat |
| Safe storage period | : | Up to one year |

**Economics**

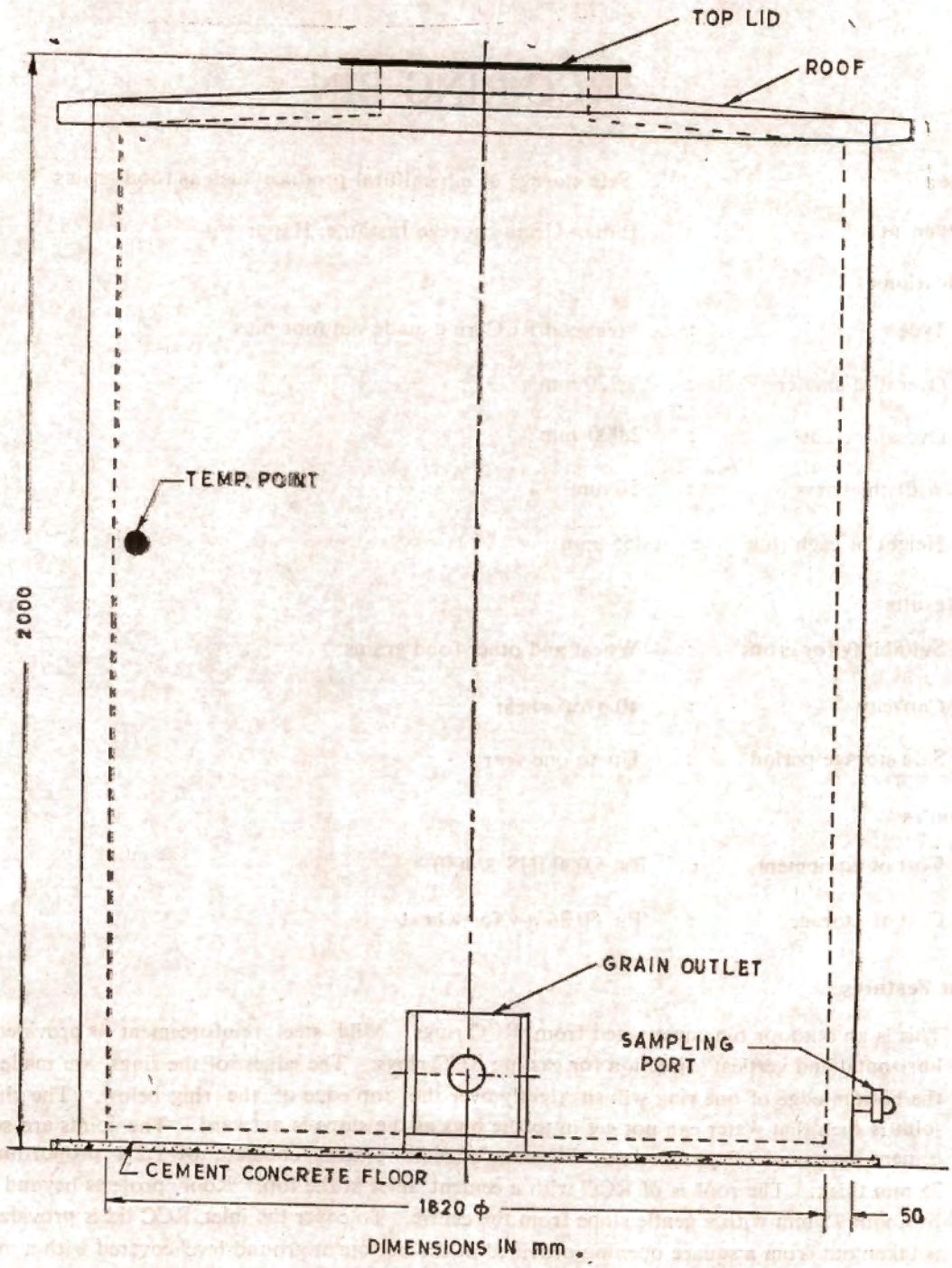
| | | |
|---|---|---|
| Cost of equipment | : | Rs. 5,000 (US $ 400) |
| Cost of storage | : | Rs. 50.26/q-y for wheat |

**Salient Features :**

This is an outdoor bin constructed from RCC rings. Mild steel reinforcement is provided both in horizontal and vertical direction for casting RCC rings. The edges of the rings are made such that the bottom edge of one ring will sit tightly over the top edge of the ring below. The shape of the joint is such that water can not get in to the bins as the slope is outward. The joints are sealed with cement mortar of 1:2 proportion. Floor is of plain cement concrete of 1:2:4 proportion and it is 75 mm thick. The roof is of RCC with a cement inlet at the top. Roof projects beyond the walls by about 75 mm with a gentle slope from the centre. To cover the inlet, RCC lid is provided. Grain is taken out from a square opening provided at the bottom at ground level covered with a metal sheet.

**Stage of Exploitation** : Equipment awaiting commercial production.

**Source of Availability** : Indian Grain Storage Institute, Hapur (UP)


TOP LID
ROOF
TEMP. POINT
2000
GRAIN OUTLET
SAMPLING PORT
CEMENT CONCRETE FLOOR
1820 ϕ
50
DIMENSIONS IN mm.

**R.C.C. RING BIN**

# SOLAR MILK PASTEURIZER

**Function** : Pasteurization of milk

**Developed at** : Institute of Technology, Kharagpur

**Specifications :**

Type : Parabolic cylindrical reflector type pasteurizer

Overall dimensions : 1,500 mm × 1,000 mm × 250 mm (solar collector)

Total weight : 100 kg

**Test Results**

Suitability for products : Milk

Capacity : 20 Lit./h

Power requirement : Solar energy and electric pump (0.025 hp)

Labour requirement : One

**Economics**

Cost of equipment : Rs. 1,500 (US $ 120)

| Economic Parameter | Operational condition | | | |
|---|---|---|---|---|
| | 100% custom hire | 50% custom hire and 50% sale | 100% sale | Self use |
| Working capital, Rs. | 109 | 1,357 | 2,605 | 109 |
| Cost of operation, Rs./q | | | | |
| Milk | 15.40 | 15.80 | 16.20 | 15.40 |
| Break-even-point q/y | 103 | 93 | 87 | 102 |
| Annual net profit, Rs. | 1,181 | 1,616 | 2,051 | n.a |
| Return-on-investment, % | 77 | 85 | 90 | n.a |
| Employment generated, man-days/y/ Rs. 10,000 of capital investment | 1.305 | 1,049 | 877 | n.a |

**Salient Features :**

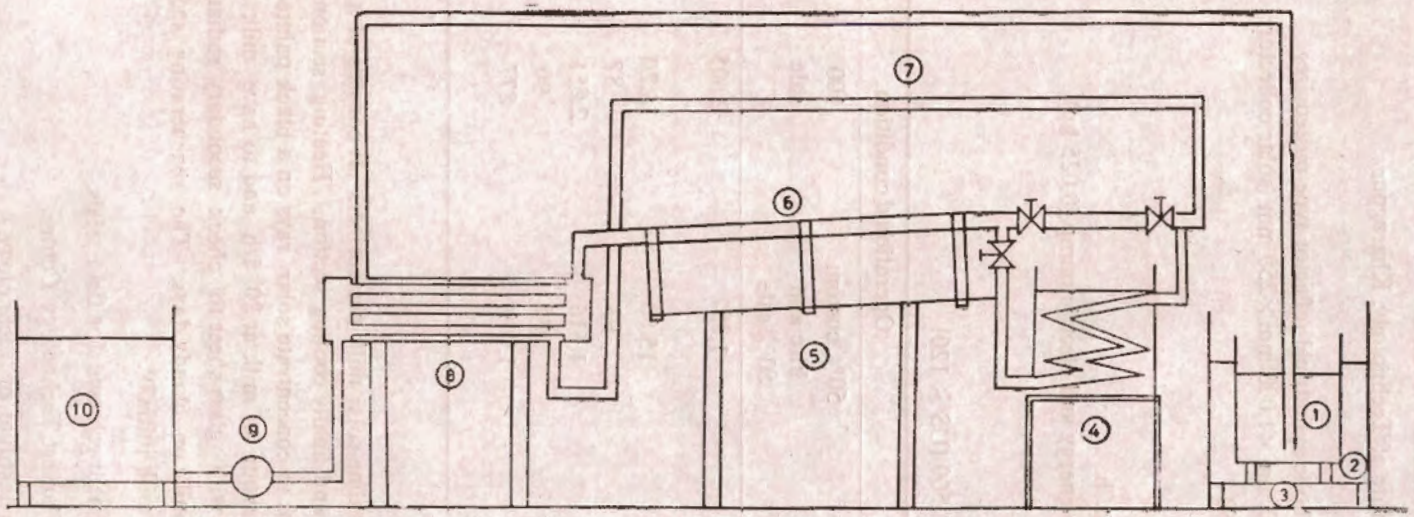
The unit is called high temperature short time solar milk pasteurizer. It consists of a heating section, a holding section, a regeneration section and finally cooling section. Heating section is a parabolic cylinder solar collector with mirror strips to concentrate solar rays on a black painted absorber pipe of 5 cm diameter with adjustment for flavour of milk at 20 1/h and to have milk temperature of 75°C. The whole assembly is covered with glass sheet to check secondary radiation losses. An auxiliary heater is provided for heating milk on cloudy days. The regenerating section utilises the heat of pasteurized milk to heat the raw milk initially.

**Stage of Exploitation** : Equipment released for field trials.

**Source of Availability** : Post Harvest Technology Centre,

: Indian Institute of Technology,

: Kharagpur—721302 (WB)




(1) PASTEURIZED MILK
(2) ICE WATER
(3) COOLING SECTION
(4) AUXILIARY SECTION
(5) SOLAR COLLECTOR
(6) ABSORBER PIPE
(7) HOLDING SECTION
(8) REGENERATION SECTION
(9) PUMP
(10) RAW MILK CONTAINER

**SOLAR MILK PASTEURIZER**

# PANTNAGAR DHAL MILL

**Function :**

Dhal making (dehulling and splitting) of arhar grains

**Developed at** : GB Pant University of Agriculture and Technology, Pantnagar

**Specifications**

| | | |
|---|---|---|
| Type | : | Continuous |
| Overall dimensions | : | 6,000 mm × 4,000 mm × 3,000 mm |

**Test Results**

| | | |
|---|---|---|
| Suitability for crops | : | Pigeon pea |
| Capacity | : | 4 q/h |
| Power requirement | : | 5 hp |
| Labour requirement | : | Two |

**Economics**

| | | |
|---|---|---|
| Cost of equipment | : | Rs.25,000 (US $ 2,000) |

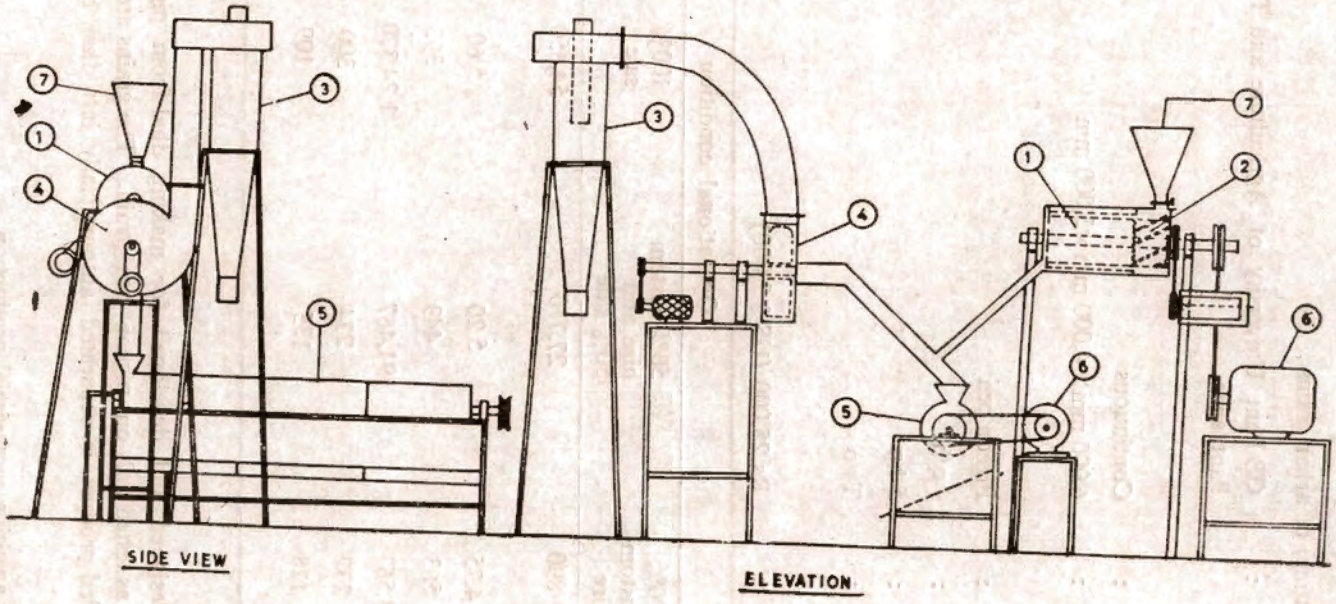
| Economic Parameter | Operational condition | | | |
|---|---|---|---|---|
| | 100% custom hire | 50% custom hire and 50% sale | 100% sale | Self use |
| Working capital Rs | 890 | 27,770 | 54,650 | 890 |
| Cost of operation, Rs/q | | | | |
| Pigeon pea | 4.75 | 5.20 | 5.60 | 4.75 |
| Break-even point q/y | 563 | 449 | 393 | 259 |
| Annual net profits, Rs | 58,563 | 91,467 | 1,24,370 | n.a. |
| Return-on-investment % | 232 | 274 | 300 | n.a. |
| Employment generated man-days/y/ Rs 10,000 of capital investment | 178 | 135 | 109 | n.a. |

**Salient Features :**

Pantnagar dhal mill has been designed and developed for making dhal from pigeon pea, green gram, and lentil. However, it was tested only on pigeon pea grain. The grains are treated to 6% moisture content (db). The milled product is separated automatically into dhal, broken, powder and husk.

**Stage of Exploitation :** Equipment awaiting commercial production.

**Source of Availability :** College of Technology,
GB Pant University of Agriculture and Technology,
Pantnagar—263 145 (UP)




(1) EMERY CYLINDER
(2) CONVEYOR
(3) CYCLONE SEPARATOR
(4) BLOWER
(5) GRADER
(6) MOTOR
(7) HOPPER

**PANTNAGAR DHAL MILL**

# SPOT LIGHT



## AIR-WATER VAPOUR COMPRESSION HEAT PUMPS

The Central Power Research Institute, ( CPRI ), Bangalore, has developed a 1.5 kiloWatt heat pump which provides heat in the useful temperature range of 40 to 65 degrees celsius to warm water and air.

Heat pumps have a bright future in India as alternative energy saving devices as they are three times more energy efficient than electrical resistance heaters and one-eighth as capital intensive as solar heaters.

A heat pump extracts heat from a low temperature source and delivers it at a high temperature with the aid of an electric input. It delivers three times more thermal energy than the electrical energy input. and the remaining energy is absorbed from the environment.

Heat pumps find applications in the useful temperature range of 40 to 65 degrees celsius for central domestic water and air heating and air conditioning for apartments, industrial air and water heaters for dairies, bakeries, curing barns and textile mills. They are in wide use in western countries and Japan for room heating.

In India the design of the heat pumps is different from that in western countries because of higher ambient temperatures and the greater stress on water heating than air heating in the country.

The heat pump cycle is similar to a refrigeration cycle and consists of four basic processes: low pressure evaporation, mechanical compression, high pressure condensation and enthalpic throttling.

The working fluid is reduced to such a pressure that it evaporates from a "free" energy source such as ambient air water. The vapour is next compressed to a high pressure and then condensed. The heat condensation (which is the useful heat) is transferred to the medium to be heated and lastly, the condensed liquid is throttled to a low pressure to enable its evaporation.

The essential components in a heat pump include an evaporator, a compressor, a condenser and an expansion device.

The CPRI heat pump has an output of 1.5 kW when operating on ambient air as the heat source. The design is flexible and can be adopted for any size of the system. Systems with a power output of 50 kW and higher have a payback period of less than three years. The cost per kW of installed power output drops from Rs. 8.500 per kW for 1.5 kW output to Rs 3.000 per kW for 50 kW output.

## INSTANT POLLUTION TEST TO BECOME POSSIBLE

Scientist at Australia's University of Wollongong are on the brink of developing an instant method of testing environmental pollution. Dr. Gordon Wallace of the University said that given sufficient funding a simple hand-held sensor could be on the market in a few months.

Sydney beaches, like those of many heavily populated centres around the world, are subject to pollution from sewage and industrial discharge. The present testing methods for pollution are time consuming and provide only retrospective data. Samples taken today can provide information about the quality of the air you breathed or the condition of the water you may have swum a day earlier. There is no test available that can tell today itself what bacteria or viruses are lurking in the surf today.

But Dr. Wallace believes the solution is almost at hand. "Equipment for detection in water of heavy metal pollutants such as cadmium, lead and mercury already exists," he said, "My group is working

on the development of new and much improved chemical and biological monitoring deviecs that can instantly detect pollutants in the air and water".

Dr. Wallace in the director of Polymer Systems. Technology, a company formed at the university to explore the commercials possibilities and of 'intelligent materials that can detect and respond to changes in the environment.

## SPOILING THE SOIL

India's soil is becoming unarable at a rapid pace. In search of food, fodder, and fuel, India's 800 million people and 400 million livestock have exhausted more than 100 million ha of once-productive land.

Another 160 million ha of land are under cultivation, left only marginally productive and in various stages of degradation.

To combat the problem, the Indian Council of Agricultural Research is integrating agroforestry methods into farming. They hope the restore fertility to much of the land.

The IDRC-sponsored project, "Agroforestry in India", is designed to reduce the erosion that results when agricultural land is degraded. Erosion often leads to siltation and floods.

The project was started in 1989 through the National Research Centre in Agroforestry in Jhansi, India.

## SIMPLE WATER TESTS

Drinking water sources in most rural areas of the world remain untested because of the cost of conventional methods for assessing water quality. But, for the past 6 years, IDRC has supported research in the development of simpler and cheaper tests. Researchers from Brazil, Chile, Egypt, Malaysia, Morocco, Peru, Singapore, and Thailand have examined a number of promising nontraditional microbiological water tests and have adapted them to their particular needs.

A final report of this research is available from IDRC's Communications Division. It is called *"Use of Simple, inexpensive Microbial Water Quality Test : Results of a Three-Continent, Eight Country Research Project"*. Its research number is MR-247e. (IDRC Reports, Oct. '90).

## MACHINE SPEEDS UP 'SINGHARA' DECORTICATION

A new machine developed by Shri D. K. Jain (Scientist PHT Scheme, College of Agricultural Engineering. JNKVV, Jabalpur 82004) promises to eliminate the drudgery involved in the manual decortication of singharas.

The water chestnut (trapabispinosa roxburgh) locally known as singhara is an aquatic fruit crop grown in the ponds d ring August to November many States of India. In green form its kernels are consumed directly or by boiling after decortication. It is estimated that 80% of this crop is sun dried and later on decorticated manually to produce 'singhara goti' which is milled to make flour.

During Hindu festivals siughara flour is mainly consumad in the form of several delicious preparation.

In singhara cottage industry the present method of manual decortication is a labour intensive practice.

This manually operated machine is simple and cheap and could be easily operated.

The machine consists of a fixed, perforated, semicircular concave and a reciprocating comb operated manually by a lever. Dried singhara when fed gets decorticated simply by operating the lever. The husk and decorticated kernels (goti) are discharged through the perforations of the concave. This machine is operated by a single person at a decortication speed of 30 kg/hr with an efficiency of 98%. The current estimated cost of the machine is Rs. 1000, which can be reduced when mass produced.

## EVERYBODY'S SOLAR WATER HEATER

It is indeed true that Solar Water heaters are the most common form of Solar Technology now in use around the world with over two million installed in Japan, 600,000 Israel homes and in well over 30,000 homes in the U. S. A. They are in regular use throughout northern Australia, where fules are expensive, and in Greece and Cyprus. Several developing countries in Asia, Africa and Latin-America having great solar heat available have yet to benefit from Solar water heating systems with any great impact, since few sectors of these countries populations can afford solar systems. For Example : In India the average cost of a family size Solar Water Heating system is a bout Rs. 9000 (about US $ 550), Even though some subsidy is being given by the Government, the Solar Water Heating Systems are still a rarity.

To overcome the above impediments, based on rich traditional wisdom and utilising locally available resources a low-cost Solar Water Heater has been fabricated and tested by Dr. A. Jagadeesh, of 'Society of Science for the People' in Nellore using the insulating efficiency of mud pots and rice straw.

In this design four oil tins (each of capacity 15 litres) are connected together through a 3 cm diameter metal pipe for transfer of water. The Tin in the end is fitted with a tap. All the Tins are coated outside and inside with the black paint. A mud jar of capacity of 70 litres is coated inside with a thin layer of Cement to block the pores. The jar is fitted with tap at the bottom to draw Hot water. The outer layer of the mud jar is covered with a 10 cm thick straw and over with a black polythene sheet so that the whole system is air-tight. Above clay lid a bamboo basket covered with thick straw and blackpoythene sheet is placed so that it will minimise heat losses at the opening. A similar arrangement is provided to cover the tap at the bottom of the jar after use. A rubber pipe is provided to transfer the hot water from tins to the Mud jar.

## WHAT ARE KILLER BEES ?

So-called "killer-bees" are descendants of insects taken from Africa to Brazil by scientists in 1956. No honeybees are native to the Americas, and the bees already in Brazil when the African strains arrived were themselves the progeny of European races introduced by Portuguese and other early settlers, Originally from temperate climates, they were relatively easy to handle.

The scientists who introduced the African bees hoped that, being from tropical areas, they would be better adopted to Brazil's climate—and they were right. The newcomers thrived and have since spread throughout most of South and Central America. They are likely to reach the southern United States this year.

The 15 years following the release of what are now referred to as "Africanized" bees into Brazil were disastrous for the country's beekeepers, who had no available literature or technology to help them cope. People were previously accustomed to keeping bees in large apiaries, often near home and close to both human activity and farm animals. Keeping African bees under such conditions inevitably resulted in the kinds of attacks that gave raise to the "killer" myth.

Eventually, however, beekeepers organized themselves and began in earnest to devise new management methods. Some of this knowledge could surely be of value in Africa. For example, Brazilian apiaries are now sited at least 100 metres human habitation, preferably in thick, bushy vegetation. Copious amounts of smoke are used to subdue the bees during harvest, and—since the Africanized bees reach swarming condition faster than European bees—great attention is paid to swarm control.

These techniques are continually improving, and Brazil ranks among the major honey-producing countries with annual production of honey exceeding 30,000 tonnes.

## BACKING INTO A CORNER

Uncontrolled sewage and waste-water, environmental degradation and scarce water resources also confront Argentina's capital of Buenos Aires. But there is another problem.

The city's groundwater reserves, which account for almost 40% of the drinking water, are at risk of contamination by saline instrusion—the infiltration of salt water. As a result of unrestricted underground pumping, the saline water has reached one of the region's largest reservoirs, the Puelche aquifer. A number of wells have been forced to close.

Poor water management has only heightened the problem. The outflow of large sewers and waste water goes largely unchecked into the River Plate, another major source of water for the region. An IDRC-sponsored project began to examine the threat of contamination and mismanagement to Buenos Aires' groundwater in 1988. Scientists from Argentina and Canada are currently trying to find a successful way of meeting the city's demand without damaging its fragile resources. (IDRC Reports, Oct' 90)

## ALCOHOL FROM FUNGUS AND INSECT INFECTED MAIZE

Spoilt maize which is unfit for human consumption is emerging asapotential source of alcohol, report researchers from Gulbarga University in Karnataka.

Usually, maize that has become spoilt due to improper harvesting, poor storage conditions and attacks by a number of fungi and insects is used as animal feed or manure.

The new finding that fungus-or insect-infested maize can be better utilised as a substrate for ethanol production paves the way for a more economical method of using the waste, report R. C. Kanta and Y. F. Neelgund in "Current Science".

The two scientists successfully fermented alcohol from spoilt grains using two yeast enzymes, one from Zymomonas mobilis. Samples of the spoilt grains were randomly collected from different warehouses, storehouses and grain shops.

The Gulbarga team first prepared a slurry of the grain fluor, using water, bacterial alpha-amylase, and small amounts of calcium chloride and sodium chloride. The hydrolysed slurry was saccharified and treated with fungal amyloglucoside (glucozyme) enzyme. Finally, the fermentation was carried out using Saccharomyces cerevisiae and Zymomonas mobilis.

The study reveals that S cerevsiae var ellipsoideus is more efficient than Z mobilis in bioconversion of spoilt maize grains to alcohol.

The fermentation efficiency ranged from 97.08 to 97.58% when using S cerevisiae and 92.31 to 92.44 percent for Z mobilis. The fermentation efficiency for unspoilt, healthy grains is only slightly higher, recording 97.73 percent in the case of S cerevisiae and 93.87 percent in the case of Z mobilis.

Describing their observations as "encouraging", the scientists said using spoiled grains for alcohol production rather than animal feed or manure in developing countries would be a "wiser concept".

## RE-ESTABLISHING VEGETATION

in arid and semi-arid regions should get a boost thanks to an invention of Daniel Gerber, a Swiss agronomist. His intensive research has led to development of pellets containing seeds, nutrients and the necessary amount of moisture to prevent the seeds from drying out. The seeds are also treated with insecticides. The porocity of the pellets enables them to absorb atmospheric moisture. Under dry conditions the pores of the pellets close up, keeping the moisture inside, thus preserving germinability over long periods until more favo-

urable conditions obtain. The main advantages of this method, protected by international patents, are optimum germination and growth under difficult conditions and direct introduction of appropriate plants shrubs, trees, grasses, legumes. cereals, etc. into expansive areas. For more information: (i) Swiss Green, Bertschi and Partner, Arbonerstr 23, CH-8580 Amriswil, Switzerland; (ii) Tamil Nadu Agricultural University, Coimbatore 641003.

## CASTOR LEAF KEEPS OFF MOSQUITOES

Scientists of the Centre for rural development and Appropriate Technology, Hauz Khas, New Delhi have found that castor leaf extracts are very effective against eggs and larvae of mosquitoes at fairly low concentrations. Castor leaves contain a protein, ricinin which is highly toxic.

An extract of leaves is to be made and used to check the mosquitoes. The results of the experiment show that these extracts at a concentration of of 110 ppsn (on the basis of ricinin content) in ovicidal. At 47.6 ppsn (ricinin) concentration the extracts caused 100 percent mortality of the first instar larvae of a AEGYPTI. The third instar-larvae of all three species died within 24 hours at 119ppsn (ricinin) concentration.

## THE 'FERTILIZER TREE'—FIXES NITROGEN ABOVE GROUND

Yvon Dommergues, a French researcher, has just discovered in the Reunion Island a tree possessing nitrogen fixating aerial nodules.

It is common knowledge that plants above the ground are unable to use the nitrogen in the air to synthesize the acids necessary for their growth They have to find these resources in mineral from in the soil or obtain additional nutrition from nitrogen-rich fertilizers. However, an over-consumption of these fertilizers leads to ground water pollution by the nitrates.

Some plants have been able, very astutely, to overcome this difficulty by living in symbiosis, most of the time at root-level, with bacteria which transform the nitrogen in the atmosphere for them, into ions absorbable by the plant. That is the case of most leguminous plants which associate themselves with rhyzobium. It is also true of Casuarina cunninghamiana's association with a filamentous bacteria, an actinomycet, known as Frankia. It is on *Casuarina cunninghamiana*, this non-leguminous ligneous plant resembling a pine, that Yvon Dommergues has just discovered nodules placed at 1 or 2 m from the ground, and these possess the same structure as the root nodules induced by Frankia.

The discovery is an important one for if the plants' sub-soil nodules use the nitrogen in the atmosphere while the soil in which they are growing is poor in nitrogen, the nitrogen fixating process stabilizes quite rapidly by auto-regulation once the soil becomes richer in nitrogen. The aerial nodules are not limited by this factor and continue to fixate nitrogen during most of their life, thus accumulating a considerable stock. To this day, one knew of only some leguminous plants' aerial nodules such as *Sesbania rostrata*, a yearly plant (which flowers once a year) which has doubled rice production in some regions. This time, it is a tree of which the growth is spread over a number of years.

One may use this discovery to enrich the soil like a green fertilizer to grow later other crops by rotation or to introduce an associative system of fields and trees. The interest elicited by this discovery is easy to understand. Especially so, if it leads scientists to master the artificial induction of aerial nodules.

Furter information about this plant can be had from the Office for Scientific and Technical Research Overseas (ORSTOM), 213 rue la Fayette, 75480s Pari cedex 10, France.

## SOLAR ENERGY TO DESTROY TOXIC WASTES

Soon solar energy could be used to destroy toxic wastes leaving behind fewer by-products. The

Solar Energy Research Institute (SERI) in Golden Colorado and Sandia National Laboratories in Albuquerque, New Mexico, are working separately on solar powered techniques for this purpose, SERI's test showed that sunlight concentrated 1000 times above its normal intensity could destroy 99.9999% of dioxin. The heat destroyed 10 mg of dioxin in 10 minutes, as vapours of the chemical flowed through the chamber. And this was achieved at lower temperatures than conventional incineration with fewer by-products.

Sandia has used solar energy together with catalysts to destroy concentrated organic liquids and organic compounds in water. The process uses ultraviolet part of sunlight to activate $TiO_2$, a catalyst which is mixed in with the contaminated water as it flows through glass pipes.

## SYNTHETIC LURE FOR HONEY-BEES

Scientistsat the Maharashtra Association for the Cultivation of Science (MACS), Pune, have artificially synthesised a pheromone released by honey-bees is which expected to give a major boost to the bee-keeping industry.

The pheromone, released by the bees's Nasonov glands after the worker bees draw nectar from flowers, helps lure the next batch of worker bees from the hive to flower. Different species of bees produce different pheromones.

Now the pheromone produced by the Indian honey-bee Apis indica has been artificially synthesised by scientists at MACS and the Central Bee Research and Training Institute (CBRTI), Pune. The bee is also found in Burma, Bangladesh, Sri Lanka and Malaysia among other south-east Asian countries.

The collection of honey by bees in a hive is governed by a unique relationship between the Queen bee, worker bees and the scout bees.

After locating an ample source of nectar, scout bees return to the hive and perform a characteristic dance to indicate the direction of the source to the worker bees.

While sucking out the nectar from the flowers, the workers emit a natural pheromone which acts as a lure to the next batch of workers.

A second pheromone developed by MACS scientists is the one which is emitted by the Queen bee to attract the workers to its hive. If the Queen bee dies, the hive becomes deserted as the workers no longer smell the pheromone.

In an experiment, the MACS scientists replaced the Queen bee with a small plastic ball coated with the synthetic pheromone. The bees continued to function normally untill another Queen bee raised under controlled conditions was established there.

The scientists are also working on a third pheromone given out by bees as a danger signal on sensing one hazard. This helps the bees to keep away from the danger zone.

## NEW MOSQUITO REPELLANT

Scientists in Sweden have developed a new mosquito repellant based on mandelic acid amide which is to be launched in the marketplace this year.

The repellant developed after nearly two decades of research by researchers at the Swedish Defence Research Institute (FOA) has proved to be highly effective against mosquitoes and other biting and stinging arthropods.

The FOA scientists found that mandelic acid, best known as a means of treatment for dogs suffering from kidney problems seemed to be the best aromatic acid with which to prepare a repellant. The mandelic acid amide developed at FOA was called DEM.

The repellant was initially tested in fields around FOSA and the results with what scientists call were excellent results. Other blood sucking and disease

transferring arthropods such as lice and ticks were also repelled by the substance, reports the journal New Scandinavian Technology.

The substance was tested on different species of mosquitoes, among them yellow fever mosquitoes with good results. The scientists simultaneously synthesized 30 different new compounds to identify better compounds if any. But the repellant with the mandelic acid base seemed to have the best effect.

In 1989, the mosquito repellant was approved by the Swedish Chemicals Inspectorate and its biological effect have been tested in Sweden, the United Kingdom and France. This year, the repellant will be launched in the Swedish market in the form of moist tissues. Next year it will be sold in the form of a stick and a bottled solution and sold in Europe.

## GREATEST GOOD OF ALL

I do not believe in the doctrine of the greatest good of the greatest number. It means in its nakedness that in order to achieve the supposed good of 51 percent, the interest of 49 percent only can be, or rather should be sacrificed. It is heart less doctrine and has done harm to humanity. The only real dignified human doctrine in the greatest good of all, and this can only be achieved by uttermost self sacrifice.

—GANDHI

## BIOMASS ENERGY DEVELOPMENT

KENGO in collaboration with Regional Wood Energy Programme for Africa (RWEPA) will hold again a Regional Training Course on Biomass Energy Development on 2-28 June '91. This year's theme is on "Management of Community Biomass Energy Programmes". This will include practical sessions, field visits, workshops and seminars.

The objectives of the course have been to expose participants to a wide range of proven and mature renewable energy technologies, to equip participants with up-to-date technical and theoretical skills in renewable energy technologies, to offer a professional forum for sharing ideas, skills, knowledge and experiences from different regions of the developing world.

For further information contact :
KENGO/RWEPA
P.O. Box, 48197
Nairobi
Kenya

## SUSTAINABLE INDUSTRIALIZATION

Drawing up the first comprehensive approach to curb the third World's industrial pollution will be the goal of a high level assembly 'International Conference on Sustainable Industrialization' to be organised by United Nations Industrial Development Organisation (UNIDO) in next October at Copenhagen.

Discussion will centre on four key areas : clarification of the issues involved in sustainable industrial development ; the roles of government, industry and the public in promoting ecologically sustainable industrialisation ; the contribution of UNIDO to this goal ; and recommendations for the 1992 United Nations Conference on Environment and Development.

For further information Contact :
United Nations Industrial
Development Organisation
P. O. Box 300
A-1400 Vieuna
Austria

## CONFERENCE ON HUMAN ECOLOGY

Department of Human Ecology, University of Goteborg, will conduct an 'International Conference on Human Ecology', at Goteborg from June 9 to 14, 1991.

For further information contact :
Moj-Lis-Foller,
Department of Human Ecology,
University of Goteborg,
Viktoriagatan 13
S-411 25 Goteborg,
SWEDEN.

## NINE MONTHS TRAINING COURSE

Emersion College, Sussex offers every year a "Nine month Training Course in Agriculture". The course is structured in Content-block varying from one to several weeks, in order to accomodate people who cannot attend the full year. The course is devided into eight blocks covering philosophy, Socio-cultural, historical, biodynamic agriculture, anthropological and rural development studies, Soils, Crops, Animals, integrated systems the "Farm Organism", Quality, and Socio-Economics and Community Development.

For further information contact :
Emerson College
Rural Development Programme,
Forest Row
SUSSEX RH 18 SJX.




## WOMEN IN RURAL SOCIETY (SOCIO-ECONOMIC IMPACT OF GOBAR GAS PLANT ON RURAL HOUSE-WIVES)

It is felt that the number of biogas plants can be successfully increased if Socio-economic debilities hindering the adoption of gobar gas plants are properly overcome. These debilities can be revealed by studying the socio-economic impact of gobar gas plants. Such studies will pin point the existing gaps in technology and socio-economic factors which are leading to non-adoption/causing resistance to the adoption of biogas technology. Suitable measures will be then required to be evolved by Technologist and Sociologist for making the adoption of renewable energy, great success.

The present publication examines the Socio-economic impact of gobar gas plants on rural housewives focussing on their socio-economic character is fics, time utilization pattern, problems during and after the installation of gobar gas plant and the reason for non-adoption of Gobar Gas Plant. As it provides smokeless, safe and instantly usable cooking fuel aimed at improving the quality of rural women. It has been observed in this study that the clean fuelwood provided by biogas has contributed to better hygenic conditions, improvement in mental and physical health, home environment and a better life style for rural housewives.

Biogas plant technology has reduce the time spent by the rural housewives in Kitchen, collection of fuel wood and preparation of dung cakes which is now being devoted by them towards their children and other productive activities. The study also suggests that adoption of gobar gas plant can be further improved.

Apart from academic interest to the Scholars researchers and the students of such disciplines as sociology, social work, extension education etc. this study would be of immense interest to planners, administrators and those engaged in promoting the bio-gas technology in rural areas.

Women in Rural Society (Socio-economic impact of Gobar Gas Plants on Rural Housewives), by Anju Agarwal nnd Dr. D. R. Arora. Pub : Vohra Publishers and Distributors, Allahabad, Rs 75/-.

## ENERGY CRISIS IN INDIA :

Energy is the basic natural resource without which existence of mankind is almost next to impossible. It plays a vital role in human welfare as all important economic activities of the present development are dependent on the use of energy. In other words, energy is an important parameter of overall economic development of any country.

This book high lights various aspects of the energy problem. It also provides comprehensive picture of energy resources, consumption. Production/ generation and oil imports of India. The impact of likes in oil prices on India's energy consumption, production, oil imports and total exports has been evaluated in this study. It attempts to locate the causes of energy crisis in general and oil crisis in particular. It also deals with various problems and government policies in respect of various energy sources in India. As such this stndy is useful in planning and execution of the Government's in policies respect of energy production, generation, consumption on eating energy conservation consciousness in the society and to researches in allied areas.

Energy Crisis in India by M. G. Mehrotra, Pub : Chugh publications. Allahabad, Price Rs. 250.

## INDIA'S ENVIRONMENT : CRISIS AND RESPONSES

Development policy in the third world had focussed exclusively on planning for economic Growth, since




it was assumed to be syno yous with economic development. Increasingly however, it is being experienced that economic growth cannot lead to development if it is destructive to the environment.

This book is a collection of papers selected from a series of six seminars on various aspects OP environmental crisis held in various parts of India.

The first part of the book is an attempt by leading professionals to analyse the processes by which the power of sustained productively of nature and natural resources are being eroded. The second part of the book provides detailed insight into the responses of India's environmental crisis. Those responses include cultural shift in Science, Technology, values and fife/styles. They also include the emergence of expressions of the democratic process in the form of ecology movements, like the chipko, which are redefining policies and laws. The book is essential reading for those concerned with environmental crisis and movements, third world development, alternative strategies for development, appropriate science and technology, environmental legislation, forestry agriculture, pollution control etc.

India's Environment : Crisis and Responses, Edited by J. Bandyopadhyay et. al. Pub : Natraj Publishers, Dehradun, Rs 150.

## ENERGY SCOPE :

In recent years, energy has acquired great important due to world-wide energy crisis. It effects both the industrialized and the developing countries, but the latter would be hit harder. We, in India will have to go through the process of economic development and modernization with much higher energy costs. With growing population and people's needs, out demand for energy would rise exponentially. The oil crisis resulting in steep price hike of p troleum products and our importing are thirds of our requirements of this product, with no near chance of reducing the gap, should lead us to think and plan seriously about conservation of energy, developing altarnative sources and making more energy available, if possible.

This book deals with energy audit, waste-heal recovery and other connected topics which result in immediate financial benefits on application. Other topics-which yield benefits in long term, such as conservation and efficient use of energy, development of alternate sources, particularly non-pollutant, non conventional energy sources like solar, wind and tidal, are also dealt with in details.

Energy Scope by Durgesh Chandra and P. R. Srinivasan. Pub : South Asian Publishers, New Delhi, Rs. 140.

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**Aims and Scope :**

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

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| 3. | Spot Light | — | (News and Views) |
| 4. | Futurama | — | (Forthcoming Events : Training Programmes, Seminars, Symposium, Workshop etc.) |
| 5. | Book Bag | — | (News on Books and Publications) |

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