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FAMILY BIOGAS PLANTS – A CASE STUDY

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Biogas Technology is being promoted in India on a mass scale to meet one of India's most important energy needs i e. cooking (it constitutes more than 70% of total rural India's energy needs). Biogas has received special attention because of the easy applicability. It also provides cheaper fuel for lighting and domestic purposes, provides cheaper and enriched field manure and improves the environment by keeping the kitchen clean and hygienic and decreasing the drudgery of women.

INTRODUCTION

The Government of India has launched the National Project on Biogas Development (NPBD) in 1981-82. Since 1982, the newly created Department of Non-Conventional Energy Sources (DNES) has been implementing the NPBD. During the period 1981-82 to 1986-87, over 7.4 lakh biogas units have been installed in the country. Basically two distinct types of biogas-technologies are being promoted in India, the floating-dome KVIC model and the fixed-dome Janata model. The popular response to biogas programme seems to be spectacular. While the biogas programme reached an encouraging take-off stage, there have often been reports of failures of plants, administrative and operational problems.

AIM OF THE STUDY

This study aimed to monitor the performance of the biogas programme of 1984-85 and 1985-86 in Bihar in relation to technology, administration, operation and various other infrastructural facilities. The objectives were :

- To determine the proportion of functional biogas plants and identify plants having structural and other problems.
- The report has also covered the problems faced by households in the operation of biogas plants and the benefits from biogas usage, the utilization of slurry as fertilizer and condition of soil after installation of biogas plants.
- To study the difference in demand of other fuels like firewood, kerosene and cowdung before and after utilization of biogas and to study the follow up action received by the plant owners for plant maintenance.

COVERAGE OF BIOGAS PLANTS

1. The sample consisted of 1671 biogas plants of which 1350 were of Janata type and 321 were of the KVIC type. These plants were located in 21 districts of Bihar. The distribution of plants according to model, year and functioning status is given in Table 1. It was observed that 18.79% of KVIC plants of the year 1984-85 were functioning while 70.32% of Janata 1984-85 plants were functioning. Of the total plants 89.11% were functioning. The capacity of biogas plants varied from 2 m^3 (cubic metre) to 20 m^3.

2. Table 2 shows the percentage of complete, complete but uncommissioned and incomplete plants. The percentage of completed Janata plants showed a distinct increase i.e. 74%, as compared to completed KVIC plants 64.5%.

Various causes were found for the complete but uncommissioned and incomplere plants. They are as follows :

(a) No more interest left in completion of plants once the subsidy is fully paid up.

(b) Family problems like illness in the family, housebuilding etc.

(c) Inspite of subsidy farmers did not have enough finance to invest their money.

(d) Accessories such as mantles, stoves, gas pipe not available from either the block office or locally.

(e) Plant was completed but not enough cowdung for initial feeding.

(f) Rain water had flooded the plant so initial feeding was not done.

SOCIO ECONOMIC BACKGROUND

Socio economic factors have played a major role in biogas technology. Previously biogas plant installation was the domain of rich farmers who possessed a large head of cattle. But in the last couple of years the scene has been changed. Introduction of government subsidy, land loan, levy cement has helped small and marginal farmers to install their own biogas plants. The new biogas technology has also helped installing plants of smaller sizes which

TABLE 1

NUMBERS & PERCENTAGE OF PLANTS YEAR-WISE, FUNCTION-WISE

MODEL & YEAR		FUNCTIONING	%	NON FUNCTIONING	%	TOTAL	%
JANATA	1984-85	276	16.52%	46	2.75%	322	19.27%
JANATA	1985-86	899	53.80%	129	7.72%	1028	61.52%
KVIC	1984-85	280	16.76%	7	0.42%	287	17.18%
KVIC	1985-86	34	2.03%	—	—	34	2.03%
TOTAL		1489	89.11%	182	10.89%	1671	100.00%

TABLE 2

NUMBERS & PERCENTAGE OF COMPLETE, COMPLETE & UNCOMMISSIONED, INCOMPLETE PLANTS

COMPLETION -WISE	JANATA 1984-1985	%	1985-1986	%	TOTAL JANATA PLANTS	%	KVIC 1984-1985	%	1985-1986	%	TOTAL KVIC PLANTS	%
COMPLETE	269	83.5%	730	71.0%	999	74.0%	197	68.6%	10	29.4%	207	64.5%
COMP & UNCOMM + INCOMPLETE	53	16.5%	298	29.0%	351	26.0%	90	31.4%	24	70.6%	114	35.5%
TOTAL	322	100.0%	1028	100.0%	1350	100.0%	287	100.0%	34	100.0%	321	100.0%

need only a few cattle. Despite the innovations of technology, socio-economic factors like family size, cattle size, land holding, caste, agro climatic conditions etc. do influence the adoption of biogas plants. The study showed that more than 90% of Janata and KVIC owners were from general category ; while less than 10% belonged to the scheduled castes and scheduled tribes.

1. The larger the family the greater amount of fuel required. Biogas can make a major contribution towards the fuel needs of a family. It was found that more than 50% of the plant owners had between 6 to 10 family members.

2. Generally the size of the plant to be installed is decided after taking into account the number of cattle head owned by the farmer and number of family members in the household. Number of cattle head is an important factor as the biogas plant is functional only after dung is fed into the plant. It was found that the cattle size varied from about 3-5 cattle for both Janata and KVIC plants.

3. Agro-climatic conditions also play a role in the installation of biogas plants. The survey revealed that majority of the plants were situated in plain areas.

THE GAP IN DELIVERY SYSTEMS

Quite a few farmers complained that the time between the application for biogas plants installation and completion is quite long. There is either some problem in getting the subsidy amount or delay in completing construction etc. It was found that the time gap between starting of construction and commissioning of plants was usually between 1-3 months. The same case was seen in obtaining subsidy from the implementing agencies.

OPERATING PROBLEMS IN PLANT FUNCTIONING

The causes for malfunctioning of plants mentioned here was not based on any thorough technical inspection of biogas plants but it mainly reflects the conclusions of the field investigators discussion with the biogas plant owners. There are various reasons for plant malfunctioning. A glance at Table 3 gives a list of several reasons which are attributed to the nonfunctioning of plants. 40% of Janata and 45.5% of KVIC plant owners list structural reasons for non-functioning of plants Irregular plant feeding comes a close second with 21.3% of Janata and 18.2% of KVIC respondents stating it to be the reason for plants not functioning.

PATTERN OF SLURRY DISPOSAL

1. The used slurry which comes out from the biogas plant is rich in manure. In terms of N, P, K (Nitrogen, Phosphorous and Potash) it is found that this slurry is superior to farm yard manure. The best method to use this slurry is by mixing it with irrigation water when it is still wet, as the dried slurry loses part of nitrogen content. It was found that about 90% of both Janata and KVIC plant owners used dry slurry in the field as manure. About 53% of respondents said that there was an increase in crop production due to slurry utilization while 47% said that the crop production remained the same.

2. It was seen that usually the farmers use either Firewood, Kerosene, Cowdung for their energy requirements. Biogas was used as an additional fuel apart from these three fuels. Therefore, there was not much difference or savings found in the monthly consumption of firewood, kerosene or cowdung found.

SEASONAL USE OF BIOGAS

Seasonal variation was observed in the consumption of biogas-both for cooking and lighting purposes. In Summer it was found 55% of households used biogas for cooking for 2-3 hours. 28% for less than 2 and only 17% used biogas for more than 4 hours.

TABLE 3

NUMBERS & PERCENTAGE OF REASONS ATTRIBURED TO NON-FUNCTIONING OF BIOGAS PLANTS

REASONS	JANATA	%	KVIC	%	TOTAL	%
1. STRUCTURAL	224	40.0%	35	45.5%	279	41.0%
2. LEAKAGE[1]	45	8.0%	6	5.0%	51	7.5%
3. LESS GAS PROD.[2]	4	0.7%	3	2.5%	7	1.0%
4. CLOGGING OF GAS PIPE	39	1.0%	7	5.8%	46	6.8%
5. DOME CRACKING (JANATA)	7	1.3%	—	—	7	1.0%
6. HOLES IN GAS HOLDER (KVIC)	—	—	3	2.5%	3	0.4%
7. CRACKS IN DIGESTER	—	—	—	—	—	—
8. LESS THAN REQD. AMT. OF FEEDING	50	8.9%	9	7.4%	59	8.7%
9. IRREGULAR FEEDING	119	21.3%	22	18.2%	141	20.7%
10. WRONG MIXTURE OF DUNG & WATER	51	9.1%	13	10.7%	64	9.4%
11. CRACKS IN INLET & OUTLET	21	3.8%	3	2.5%	24	3.5%
12. OTHERS	—	—	—	—	—	—
TOTAL	560	100..0%	121	100.0%	681	100.0%

*The data are based on multiple-responses and therefore do not correspond with the actual total of non-functioning plants.

1. Leakage problem in KVIC plants reported seen to be due to use of thinner gauge steel than recommended.

2. This reason is related to the functioning plants operating at less than rated capacity or partially functioning.

79% of the total households reported that they used biogas for less than 2 hours in winter for cooking purposes, while 21% of them used biogas for more than 2 hours.

The seasonal variation of biogas consumption for lighting purposes was not large. More than 90% of households used biogas for less than 2 hours in Summer and Winter. 29% of total respondents said that they needed less time for cooking food while 35% said that cooking had become easy after installing of biogas plants. 15% of respondents felt that it was more hygienic and 21% of them said that by using biogas less smoke was produced while cooking. On an average, 1-2 hours were reported to be saved by the respondents. This 1-2 hour time saving included activities like dung cake making, dung/firewood collection apart from actual cooking (time saved for actual cooking was about 30-40 minutes).

Almost all users agreed that the frequency of implementing agency's visit was very infrequent.

CONCLUSION

Appropriate Management Information System is required to ensure regular flow of information to the state level organisation, so that follow up action can be speeded up. Due to non availability of trained masons there was delay in construction or even defective constructions which led to non functioning or less than optimum functioning Mason training programme should be conducted to build biogas plants.

Proper care should be taken to see that regular and right proportion of feedstock is supplied to the plant for proper plant functioning. Regular follow up should be monitored by the agencies to find out the problems faced by the users and to rectify the faults.

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FACTORS AFFECTING THE ANAEROBIC PROCESS FOR BIOGAS PRODUCTION

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The paper discusses about the various factors affecting in the process of anaerobic fermentation for biogas production and their significance for the optimum gas production in a biogas plant. It also elaborates the limits of the various factors for proper functioning of the biogas plant. This paper is based on the experiences gained by technical experts working in the field of bio-energy.

In biogas plant the whole system is governed by a continuous process and anaerobic fermentation takes place for biogas production. The organic matter is fermented in the digester of biogas plant and is fed in semi-fluid form at one end (inlet) and the fermented spent slurry is discharged at the other end (outlet) without disturbing the whole system. The fermentation, if it is to proceed in the best possible manner, is being governed under certain specific parameters/factors. These parameters/factors can be enumerated as under :

1. Airtightness.
2. Temperature.
3. pH, Acidity and Alkalinity.
4. Solid content and volatile matter.
5. Water content (Moisture content).
6. Physical Characteristics of substrates.
7. Nutrients concentration.
8. Toxic Substances.
9. C/N (Carbon Nitrogen) Ratio.
10. Organic Loading Rate.
1 . Retention Time.

AIRTIGHTNESS

Micro-organisms can be either facultative or obligate. Facultative anaerobes are capable of shifting from a metabolism that uses free oxygen. Several of the Hydrolitic and Acetogenic bacteria are facultative ones. However, the methanogens are strictly obligate and hence can survive only in the absence of free oxygen. As a result, the digester for biogas production has to be made airtight.

TEMPERATURE

The temperature for fermentation will greatly affect the rate of biogas production. It is found that the process of the digestion and gasification proceeds at the highest rate when the temperature is around 35°C. Digestion and gas production can occur over a wide range of temperatures (4-60°C), if the temperature attained remains constant for a longer duration. There are two ranges of temperatures over which the anaerobic bacteria grow :

(a) Mesophilic Range of 21-45°C.

(b) Thermophilic range of 55-70°C.

Most of the anaerobes have an optimum activity at 35°C-40°C. However, certain strains of thermophilic methangens like M thermoacetotrophicum and Methano-thermus have recently been identified. They grow between 63°C-97°C.

Further the bacteria are found to be highly sensitive to temperature fluctuations. Once an effective temperature range is established, small fluctuations can result in process upset. For instance, sudden changes in temperature exceeding 3°C is found to affect the micro-organisms adversely. When the temperature falls, the anaerobie bacteria gradually becomes inactive and the process of digestion is retarded and below 15°C it is reduced so much that the gas plant produces very little gas ; that is why it is experienced that in "winter" the gas production is considerably depressed.

In thermophilic digestion one disadvantage is that the biogas generated will have more H_2S content. This increased H_2S production would give biogas an offensive smell, which might create problems in the use of biogas for certain purposes.

pH, ACIDITY AND ALKALINITY

pH is a term which denotes the acidity and alkalinity of the substrate. The anaerobic micro-organisms require a neutral environment for optimum functions. The hydrolytic and acetogenic bacteria can survive is as low a pH as 5.5, however the optimum pH for the methenogens is between 6.8 to 8.5. The slurry in the digester usually has a buffer system to balance the pH level. During start-up of a biogas plant the new slurry which has not developed the buffer system can be helped by the addition of sludge from plants already in operation.

It has been observed that the gas formation is optimum between pH of 7 and 8. If the pH drops below this the gas production will be reduced. When excessive loading, is resorted to the acid forming bacteria are far more active than the methane former bacteria, resulting in lowering the pH. It will be also noted that methane formers multiply slowly compared to the acid formers bacteria.

SOLID CONTENTS AND VOLATILE MATTER

The organic wastes, during anaerobic digestion, are decomposed into their constitutent elements like carbon, oxygen, hydrogen etc. The quantity and quality of biogas generated from an organic waste is decided by its total solid content, volatile and fixed solids.

The weight of the organic material left after an hour of drying or the weight that is unchanged after several drying is called its dry weight, dry matter or total solids (TS). Total solids comprise of total volatile solids and ash volatile solids (VS) represent the organic matter present and available for biological decomposition. The volatile solids are constituted by the Carbon, Nitrogen, Hydrogen, Oxygen etc. and are determined by burning the material at 600°C when elements like C, O, N, H etc. get evaporated. The left over ashes or the fixed solids are inorganic and hence not available for biological decomposition. However volatile solids is not a very accurate measure of the material biologically available to the micro-organisms. This is because the lignin content of the organic waste gives a high percentage of VS, and lignin hardly contributes to biogas production, VS and FS are generally given as percentage of TS to dry weight.

In general 7 to 9% concentration that is 7 to 9 parts of solid in 100 parts of the slurry is considered ideal for fermentation process for the production of biogas. If it is diluted further or if it is concentrated, the fermentation process is adversilly affected and retarded. That is why, it is recommended that 4 parts of the cattle dung to be mixed with 4 to 5 parts of water for better results. This brings the concentration to about 8% or little higher. The proportion of cattle dung and water should therefore be maintained for satisfactory fermentation takes place.

WATER CONTENT (MOISTURE CONTENT)

Moisture is required by all bacteria, but they are able to tolerate conditions ranging from slight amounts of moisture to dilute solutions of nutrients.

This mean that very wet wastes can be used without energy consuming drying. The effect of various moisture concentrations in solid waste on gas production has been studies varying from 36 to 99%. The optimum water content of the input material would be about 90% of the weight of the total contents. If the water content is too high, the rate of biogas production per unit volume in the digester will fall, whereas with too little water content acid accumulates, inhibiting the fermentation process.

PHYSICAL CHARACTERISTICS OF SUBSTRATES

It has been observed that the size of the solid waste particles effect on the rate of gas production. Decreasing the size by a factor of 10, increased the rate of gas production by a factor of 4.4 and increasing the density of solid wastes decreases the rate of gas production.

NUTRIENTS CONCENTRATION

A microbial cell contains a C : N : P : S ratio of approximately 100 : 10 : 1 : 1. Therefore, in order for microbial growth activity to occur, these elements must be present and available, and their absence or scarcity can, in fact, be rate limiting. C : N and C : P ratios of 25 : 1 and 20 : 1 respectively have been suggested of appropriate anaerobic process for biogas production. It is noticed that when amount of elements as suggested above, are available, fermentation proceeds very fast. It must be kept in mind that C : N and C : P ratios are of use only when referring to farmentable substances and available nitrogen and phosphorus. There are many organic compounds which may inhibit anaerobic digestion. These include organic solvents, alcohols and long chain fatty acids at high concentrations. Pesticides present in solid waste will also create problem for anaerobic digestion.

TOXIC SUBSTANCES

High concentration of ammonia, antibiotics, pesticides, detergents, heavy metals like chromium, copper, nickel, zinc etc. are toxic to the micro-organisms involved in biogas production. A low C/N ratio of the slurry leads to a high concentration of ammonia. Antibiotics used in animal feed or injected into the animals can cause difficulties in biogas production in plants using cattle dung as the input

C/N RATIO

The carbon to nitrogen ratio (C/N) represents the proportion of the two elements. Both the acid farming and methane farming bacteria require a C/N ratio ranging from 25 to 30 for optimum functioning From a biological point of view a digester is a culture of bacteria feeding upon and converting organic wastes. It is a symbiotic relationship involving food and energy. The elements of carbon (in the form of carbohydrates) and nitrogen (as protien, nitrates, ammonia etc.) are the main food for both type of anaerobic bacteria. Carbon is used for energy and nitrogen for building cell structures. These bacteria use up carbon about 25 to 30 times faster than they use up nitrogen.

Anaerobic digestion proceeds best when the organic materials fed to the bacteria contains a certain amount of carbon and nitrogen together. Other conditions like temperature, pH, etc being favourable, a C/N ratio of 25 to 30 will permit digestion to proceed at an optimum rate. If there is too much carbon (high C/N ratio e. g. 60) in the organic wastes, nitrogen will be used up first and carbon left over. This will make the digester slow down and come to a stop. On the other hand, if there is too much nitrogen (a low C/N say 2) the carbon soon becomes exhausted and fermentation stops. The remaining nitrogen will be lost as ammonia gas. This loss of nitrogen decreases the fertility of the digested slurry.

ORGANIC LOADING RATE

Loading rate is the weight of volatile solids loaded each day on the digester, divided by the volume of the digester. Loading rate is an important parameter especially in continous fed plants, since a high loading rate may affect the pH of the slurry, retention time and fermentation process. In biogas plant the loading rate is roughly 25 Kg per cubic meter of plant capacity. If this loading rate is changed there is possibility that the balance inside the digester will also be affected. Hence normally the rate should be kept constant.

RETENTION TIME

The retention time is the average number of days a unit volume of fermentable material resides inside the digester. In fact retention time is a design parameter and can be changed according to the size of the plant, temperature of fermentation, washout time etc. If the retention time is too low, the bacteria are washed out of the digester as fast as they can multiply, resulting as an unstable bacterial population. If the retention time is too high, bigger size of digester is required and the construction cost of the plant will go up and it will be not worth-while making larger investment. Ordinarily it is observed that maximum gas production takes place within the first 4 weeks and then it tapers off gradually. Retention time generally taken 45 to 55 days will be idle for optimum gas production and worthwhile.

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DEVELOPMENT OF BULLOCK DRAWN MULTI OPERATION TILLAGE IMPLEMENT FOR DRY FARMING

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The developed bullock drawn multi-operation tillage implement performs furrow opening, soil inversion, pulverisation and planking operations simultaneously. Draft of the implement was 71.3 kg. at 13 cm working depth. 7.1 percent moisture content (d. b.) at operating speed of 0.83 m/sec and has effective field capacity of 0.042 ha/hr at 70 percent field efficiency. Estimated cost of the implement was Rs. 350/ – and operational cost (fixed + variable) was Rs. 253/ha.

INTRODUCTION

Dry farming is a farming system in which crop production in the drylands is dependent on rainfall as a source of water. About 70 percent of our cultivated area is without irrigation and it produces only 40 percent of the total all India grain yield. Dry farming can be effectively improved by adopting methods which help in conserving moisture while seedbed is prepared and sowing is being done.

In India most of the farmers are using conventional animal powered tillage operations to prepare the seed bed. In the improved method of tillage ploughing with mould board plough or cultivator is followed by planking. During these operations the field remains exposed for longer duration as farmer has to perform different operations one after the other. Open soil for longer duration before planking and sowing leads to more evaporation losses from the soil there by reducing the available moisture to the seeds to germinate and the germinated seedlings. Therefore, the soil moisture conservation during seedbed preparation is important, specially in the case of dry farming. Keeping above points in view a bullock drawn multi-operation tillage implement was developed.

MATERIALS AND METHODS

The developed implement consists of three units.

(a) Furrow opening unit : It consists of two tyne cultivator.

(b) Soil inversion and pulverisation units : It consists of mould board plough.

(c) Planking unit : It consists of wooden pata.

DESCRIPTION OF THE IMPLEMENT

Furrow opening of the soil is followed by soil inversion and pulverisation operation. Cultivator loses the soil and M. B. plough pulverises the loose soil and also works at an additional depth of about 4 cm thereby increasing the total working depth of the implement. Loose soil when worked with M. B. plough reduces the clod formation in the soil and also better degree of inversion and pulverisation of soil can be obtained at same draft values. Thus a better soil tilth can be obtained by using cultivators ahead of the M B. plough. Finally the planking operation is performed by wooden pata.

DESIGN ASPECTS

(a) Size of M. B. plough : Commercially available 16 cm bullock drawn M. B. plough which is commonly used as tillage implement.

(b) Spacing between tynes of furrow opening unit : Based on the size of M. B. plough the spacing between the two tynes was kept 10 cm This gives total working width of two tynes more than working width of M. B. plough.

(c) Size of pata : Wooden pata of 12.5 cm × 10 cm × 65 cm size, enough to cover the operation of cultivators and M B. plough for planking, was taken.

(d) Main frame : A square cross sectional beam 76 cm in length made of 4 cm × 4 cm × 0.8 cm mild steel angle iron was used to support all parts at required spacing by nuts and bolts.

(e) Position of the handle : The handle was fixed at the centre of gravity of the implement excluding the weight of pata (Table 1) so that implement can be lifted vertically upward with minimum possible force at turns.

(f) Draft calculations : Considering the bullock power assumptions made for calculating theoretical draft requirement of the implement is given in Table 2. Draft values were assumed on the basis of practical values observed for individual unit as a separate implement (Table 3).

(g) Position of hitch point : Hitch point of the implement was calculated on the basis of assumed draft values (Table 4).

Working of the implement

Working principle of the implement is shown in Fig. 1. During the operation of the implement in the first run cultivators open the furrow at the working depth of about 9 cm. In the second run the soil opened by cultivators is followed by M. B. plough at the additional working depth of about 4 cm. thereby increasing the total working depth of implement to about 13 cm. and at the same time cultivators open the new furrow. In the third run the pata levels the soil already worked by cultivators and M. B. plough while latter perform the same operation in the unploughed field. The process is repeated till the whole field is covered (Fig. 2).

Adjustments in the Implement

Following adjustments can be done in the implement to suit the field conditions by adjusting nuts and bolts.

(a) Hitching beam angle.

(b) Working depth of individual cultivator tyne.

(c) Working depth of M. B. plough.

(d) Position of hitching point on main frame by sliding mechanism.

(e) Position of handle on main frame.

RESULTS & DISCUSSIONS

The developed implement is shown in Fig. 3. It was tested at C. T. A. E. instructional farm (soil : sandy loam, previous crop : maize in kharif 88, initial bulk density : 1.48 gm/cc) and relicated trials were conducted in the month of November 1988.

The implement performs furrow opening, inversion and pulverisation of soil, and planking operations simultaneously. Average draft of 71.3 kg. was observed against the calculated draft of 72 kg. at

13 cm working depth, 7.1 percent (d. b.) moisture content and 0.83 m/sec. operating speed Draft was measured with spring dyanometer by measuring the pull along the beam and its angle with the horizontal.

After the operation bulk density of soil was 1.26 gm/CC thereby a reduction of 14.86 percent was observed. It can be easily pulled a pair of bullocks and has effective field capacity of 0.04 ha/hr at field efficiency of 70 percent. Slight tilting towards planking unit was observed during the turns at ends. This may be overcome by providing a support wheel at the planking unit. Estimated cost of the implement was Rs. 350/- and operational cost (fixed & variable) was Rs. 253/ha. It is low cost implement and can easily be afforded by the farmer.

CONCLUSIONS

(a) Developed multi-operation tillage implement is suitable for seedbed preparation.

(b) Draft of the implement was 71.3 kg at 13 cm working depth, 7.1 percent (d. b.) moisture content at 0.83 m/sec. operating speed and has 0.042 ha/hr effective field capacity at 70 percent field efficiency.

(c) Estimated cost of the implement was Rs. 350/- and operational cost was Rs. 253/ha.

Table 1 : Calculation of C.G. of the implement.

S. No.	Component	Weight Kg	Distance from left and, cm
1.	1st culivator	2.5	5
2.	2nd cultivator	2.5	15
3.	M. B. Plough	10.0	23
4.	Main frame	7.5	38

C. G. of the implement

$$= \frac{2.5 \times 5 + 2.5 \times 15 + 10 \times 23 + 7.5 \times 38}{22.5} = 25.11 \text{ cm}$$

Table 2 : Draft calculations of the implement.

Draft of the 1st cultivator at working depth of 9 cm	15 Kg
Draft of 2nd cultivator at working depth of 9 cm	15 Kg
Draft of M B. plough at working depth of 4 cm	35 Kg
Draft of pata	7 Kg
Total	72 Kg

Table 3 : Observed average draft values of individual implement under normal conditions (soil : sandy loam)

S. No.	Implement bullock drawn	Working width, cm	Working depth, cm	Draft Kg
1.	3-tyne cultivator	45	15	68
2.	M. B. Plough	16	15	66

Table 4 : Calculation of hitch point position.

S. No.	Component	Draft, Kg.	Distance from left end, cm.
1.	1st cultivator	15	5
2.	2nd cultivator	15	15
3.	M. B. Plough	35	23
4.	Pata	7	62

$$\text{Hitch point} = \frac{15 \times 5 + 15 \times 15 + 35 \times 23 + 7 \times 62}{72} = 21.37 \text{ cm.}$$

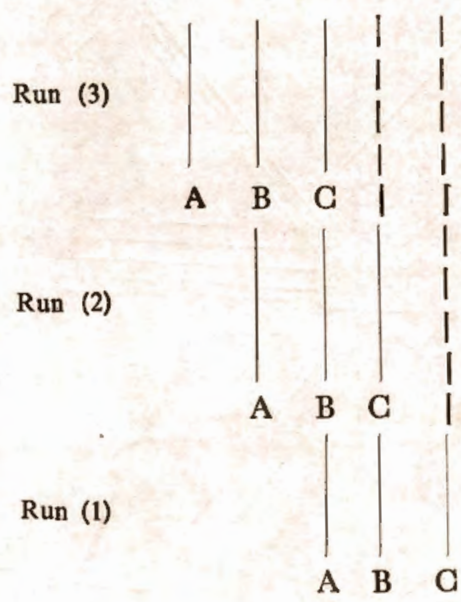

FIG. 1 WORKING PRINCIPLE

HERE :—

A — OPERATION OF CULTIVATORS.

B — OPERATION OF M. B. PLOUGH.

C — OPERATION OF PATA.

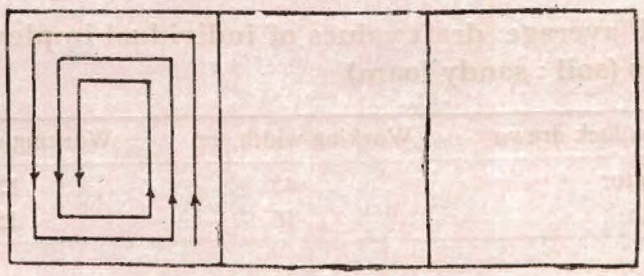

FIG. 2 PLOUGHING PATTERN

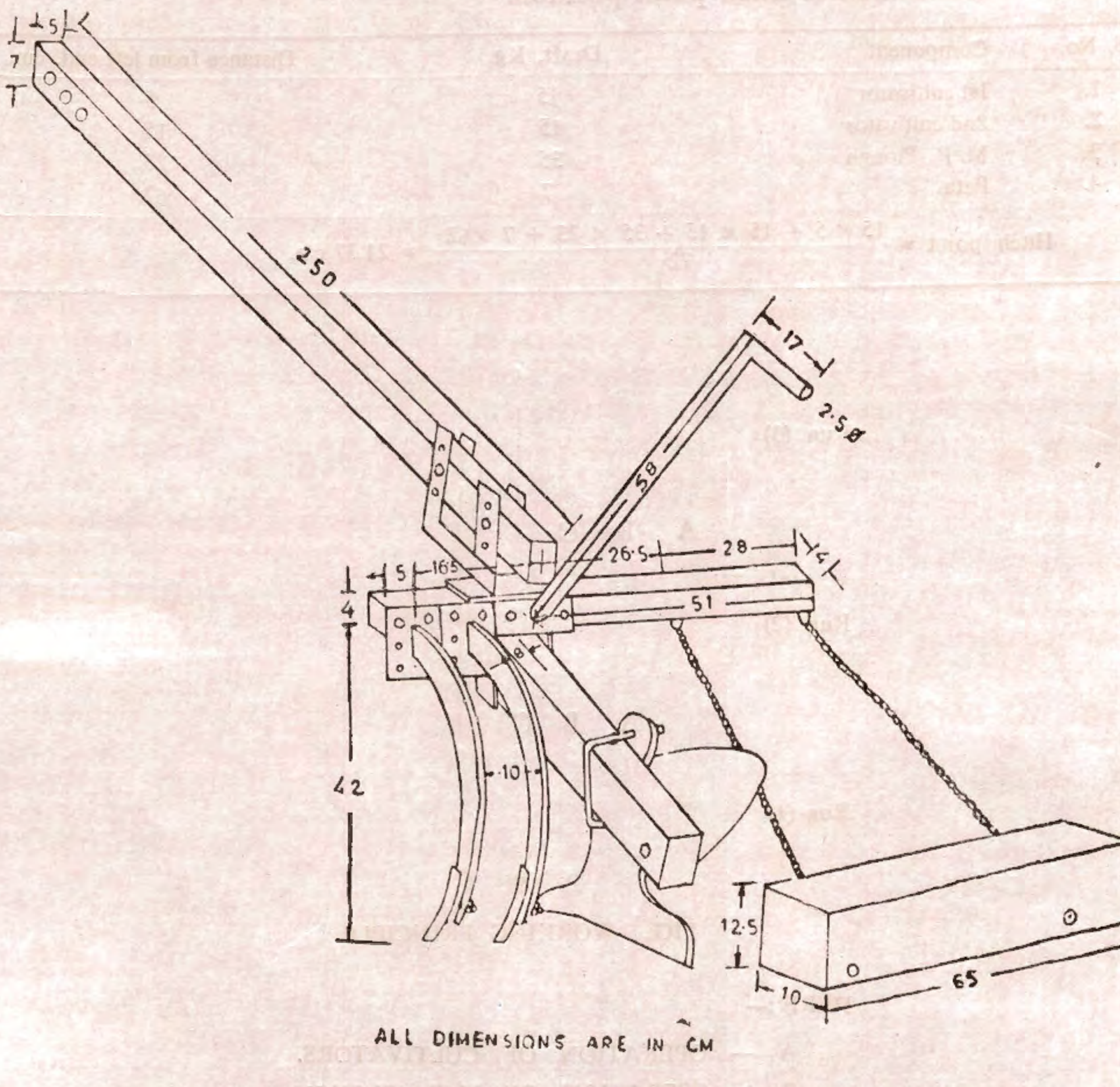

FIG. 3. ISOMETRIC VIEW OF MULTI - OPERATION TILLAGE IMPLEMENT.

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SMALL SOLAR PONDS FOR THE TROPICS

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The performance of a small solar pond at the Indian Institute of Science is discussed. It is argued that small solar ponds are suitable for the tropics to meet the process heat requirements of hatcheries, diaries and silk filatures. The use of a submerged copper heat exchanger is recommended because of its high effectiveness and low maintenance needs. A novel passive salt replenishment method is described and shown to work successfully in small solar ponds. The effect of size and shape of the pond on the performance of small solar ponds is discussed.

INTRODUCTION

The construction and operation of a 250,000 m^2 solar pond power plant in Israel has proved the technical and economic viability of solar ponds. This has, however, led to a general impression that solar ponds are technically and economically viable for a large scale applications only. Small solar ponds (bottom area less than 1000 m^2) have higher side heat losses. In temperate climates solar ponds cannot provide useful thermal output because of high heat losses during the winter period. In tropical climates, however, small solar ponds can provide useful thermal output throughout the year. There have been, however, no demonstration of technical and economical viabiliy of small solar ponds is the tropics.

CONSTRUCTION OF A SMALL SOLAR POND

A small solar pond (bottom area 240 m^2, 8m × 30m) was built at Indian Iustitute of Science in May 1984 (see fig. 1). One of the aims of this project was to assesss the technical and economical viability of small solar ponds for process heat and power generation. This pond used two low density polyethylene liners (0.3mm thick) to prevent seepage of salt. After the first layer of liner was placed, 5cm of powdered clay was put at the bottom before the second liner was placed. The clay was incorporated between the two layers of low density polyethylene liners to plug small leaks. 79 tones of common salt was used as initial salt inventory. The thickness of the storage zone was 40 cm. and the gradient zone 90 cm. The thickness of the upper mixed layer varied between 30 cm to 50 cm (see fig, 2). No heat was extracted during the first year of the operation of the pond. The temperature of the storage zone of the pond increased rapidly and attained a maximum value of 72°C during the post monsoon period. In the Second year heat was extracted using an external Titanium heat exchanger (see fig, 3). In the third year heat extraction was attempted by using first a submerged Poly Vinyl Chloride heat exchanger and then using a submerged copper heat exchanger. Algae control was achieved by using bleaching powder every two weeks.

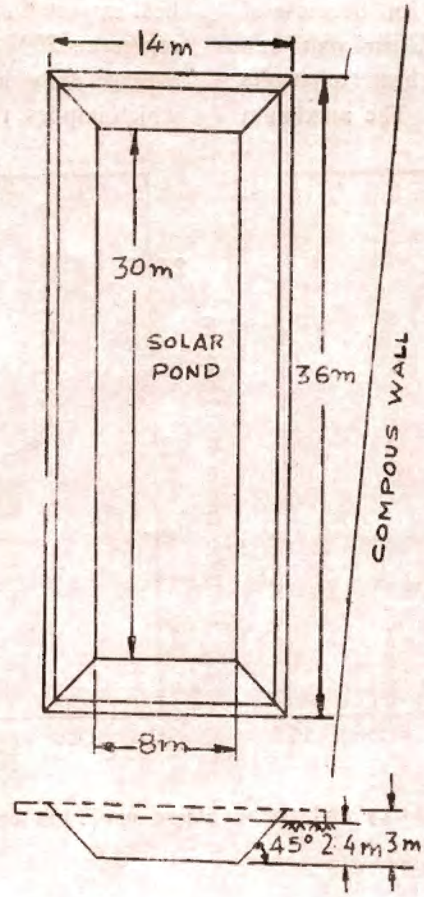

Fig. 1—Plan view of Solar Pond

HEAT EXTRACTION

Continuous heat extraction using, an external Titanium Plate Heat Exchanger was began in November 1985. The variation of temperature in the storage zone, and upper mixed zone, wind speed and amount of heat extracted is shown for the month of January 1986 in fig. 4. The brine pump which was used to pump hot salt water from the storage zone had frequent failure of seals. The Titanium plate heat exchanger became clogged after eight hours of continuous operation. Hence the heat exchanger had to be back-flushed with fresh water. The experience with the Titanium Heat Exchanger convinced us that it may not be suitable for small solar ponds because it needed frequent maintenance. We decided, therefore, to experiment with a submerged heat exchanger. We first used a heat exchanger made up of Polyvinyl chloride tubes. We found that the tubes became distorted on account of the high temperatures at the bottom of the pond. There was also a large temperature drop in the heat exchanger. We experimented next with a copper coil heat exchanger (see fig. 5). The copper heat exchanger was coiled tube 15 m long with tube outside diameter 16 mm. Polyethylene tubes were attached to this coiled tube at the inlet and outlet. The performance of this heat exchanger was excellent and its highest effectiveness was arround 80%. We measured the rate of corrosion of the copper tube by measuring the decrease in mass of a copper tube immersed in the storage zone. The decrease in mass of this copper tube is shown in fig. 6. The rate of decrease of the mass of copper is around 1% per year and hence the use of submerged copper heat exchangers in a solar pond is a viable solution. The maximum heat extracted in a day was about 1200 MJ, which represents 20% of the solar energy incident. The average daily heat extraction was around 800MJ which implies that the efficiency of the pond was

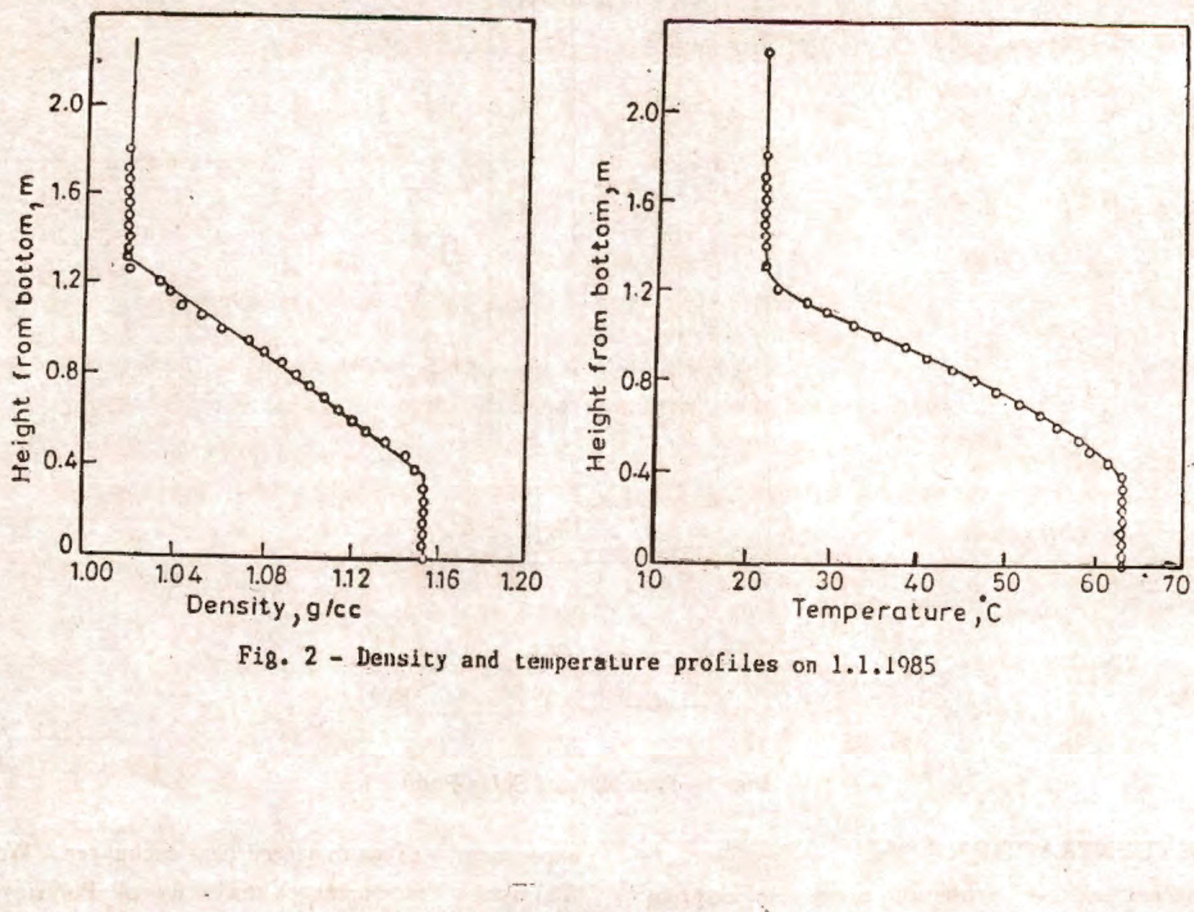

Fig. 2 - Density and temperature profiles on 1.1.1985

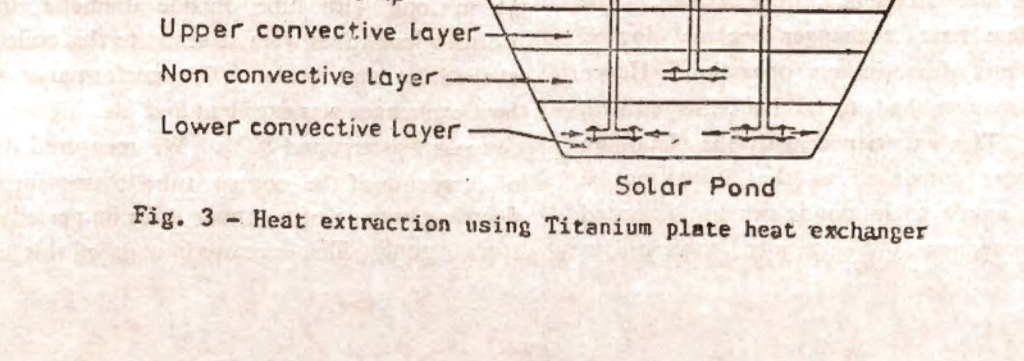

Fig. 3 - Heat extraction using Titanium plate heat exchanger

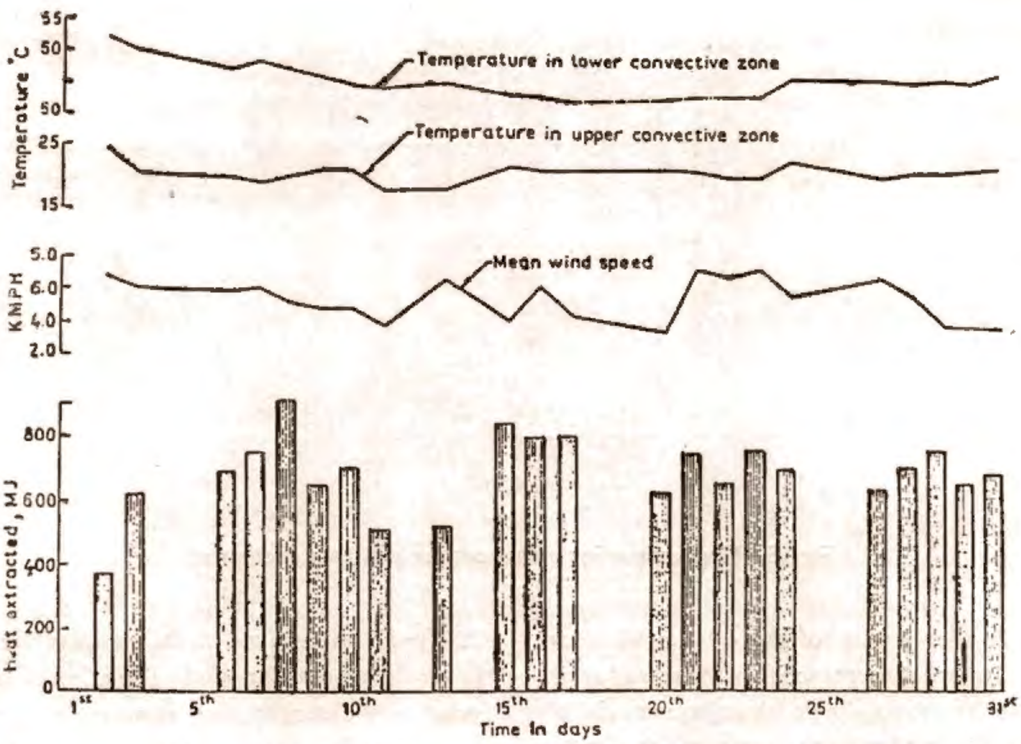

Fig. 4 - Performance of the pond, January - 1986

on an average about 13%. The submerged heat exchanger concept avoids the use of brine pump and is therefore more reliable. The performance of the pond with copper heat exchanger is shown in fig. 7.

EFFECT OF RAINFALL ON THE EROSION OF THE GRADIENT ZONE

The effect of rainfall on the erosion of gradient zone has not been studied so far. Heavy monsoonal rainfall can adversely affect the performance of a solar pond in the tropics. The effect of a rainfall of 30 mm per hour on the structure of the upper mixed layer of the IISc pond is shown in fig, 8. We see that the raindrops have penetrated a distance of 50 Cm from the surface. This implies that the thickness of the upper mixed layer must be maintained about 50 cm to ensure that raindrops do not enter the gradient zone.

EFFECT OF DIRT AND UNDISSOLVED SALT AT THE BOTTOM OF THE POND

The dirt accumulating at the bottom of the pond can reduce its ability to absorb solar radiation. The effect of dirt on the performance of a solar pond can be evaluated by a numerical model if the reflectivity of the dirt is known. Guha (1) has measured the reflectivity of dirt collected from the bottom of the IISc solar pond. He found the reflectivity of dirt accumulated at the bottom to be 0.1. Thus the solar pond absorptance of dirt is 0.9 while that of black low density polyethylene liner is 0.95. Hence the accumulation of dirt at the bottom of the solar pond will not have a great impact on its thermal performance. The presence of undissolved salt can, however, result in decrease of the thermal performance of a solar pond. Guha (1) has shown that the reflectivity of salt to solar radiation is between 0.4 to 0.6. If undissolved salt

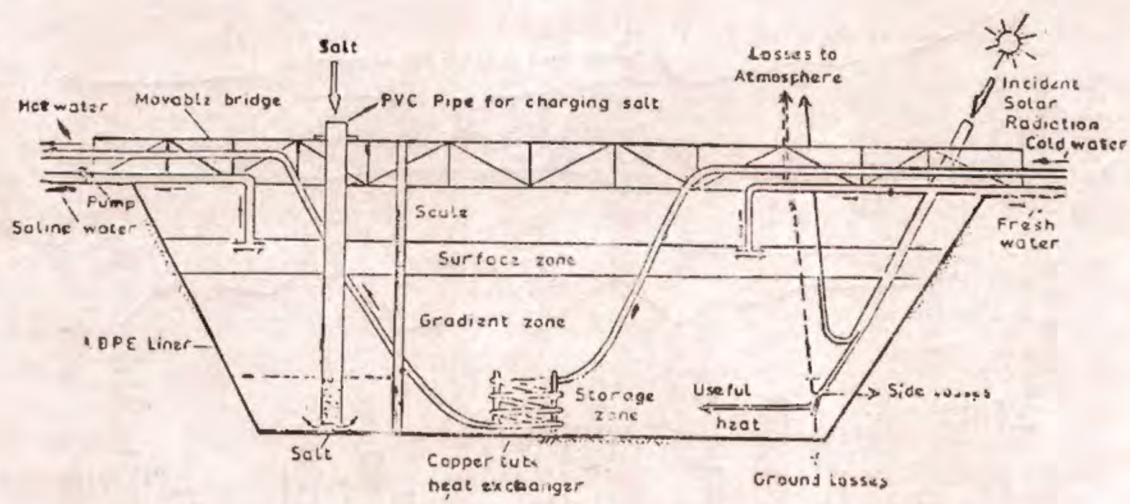

Fig. 5—Heat extruction using copper coil heat exchanger

is present at the bottom of the solar pond it can reduce its solar absorptance to a value as low as 0.4. Guha (1) used a simple three layer model of a solar pond to predict its performance for climatic conditions prevailing in Bangolore, India. (13°N). The effect of reflectivity of the bottom of the pond on the seasonal storage zone temperature (with no heat extraction) is shown in fig. 9. We observe that the presence of undissolved salt can reduce the storage zone temperature dramatically.

EFFECT OF SHAPE AND SIZE OF THE SOLAR POND

In small solar pond there are large side heat losses. Hence the size and shape of the pond can have profound influence on the temperature attained in the storage zone of the pond. The IISc solar pond never attained temperature above 76°C in the storage zone although the 250,000 m^2 solar pond in Israel attained temperatures as high as 95°. The role of shape and size has been demonstrated by Guha (1). In the model Guha (1) used the correlation for side heat losses proposed by Hull et a. (2). The seasonal variations of the temperature in the storage zone of a solar pond located in Bangalore as predicted by the 3 layer model is shown in fig. 10. We find that the nonoptimal shape of the IISc pond has resulted in its temperature being 7° lower than a circular pond. The effect of size of the pond on the storage zone temperature is shown in fig. 11. We find that if the size of the pond is below 1000 m^2 the temperature of the storage zone can be 20° lower than that in a very large, pond under the same climatic conditions. The effect of side slope of the pond is shown in fig. 12.

We find that the pond with vertical walls (Beta 0) has the highest side heat losses This is because in this case the heat flow path through the soil to the surface is the shortest.

PASSIVE SALT REPLENISHMENT

The IISc solar pond required the addition of 1.5 tonnes of common salt every month to make up for the loss by diffusion to the upper layer. In the initial stages the salt replenishment was achieved by pumping salt water from the storage zone through a salt bed and returning it to the storage zone through a diffuser (see fig. 13). This method was not completely satisfactory on account of frequent failure of brine pump. We decided, therefore. to experiment with passive salt replenishment. In this method a Polyvinylchloride tube (25 cm outer diameter) and 4m long was suspended vertically from the surface (see fig. 14), The bottom of the tube was 10 cm from the bottom of the pond. 8 holes. (5 cm diameter) were drilled along the circumference about 40 cm from the bottom 50 kilograms of salt was dumped every day into this tube. We found that the salt dumped in the tube dissolved within a day. The variation of density of the storage zone during passive salt replenishment is shown in fig. 15. Hence we have shown that passive salt replenishment is a simple and viable technique for small solar ponds.

INTERNAL CONVECTIVE ZONES

The IISc Solar pond has developed internal convective zones a couple of times. The analysis of temperature and concentration profiles showed that these profiles would not have triggered the formation of internal convective zones because they satisfied the stability criteria for one dimensional double-diffusive convection. Hence we are led to believe that these internal convective zones are triggered by intensive heating of the sloping side walls. Further studies on the onset of instability in small solar ponds is necessary.

ECONOMIC ANALYSIS

Solar ponds area attractive alternative for low temperature process heat because they are inexpensive and reliable source of heat for temperatures below 70°C. Based on the experience of the IISc solar pond, the following estimates can be made for the capital and running costs of a 250 m^2 solar pond (all costs in US dollars).

Capital cost (Digging, liner and salt inventory)	10,000
Maintenance cost (per year) (Salt & Bleaching Powder)	600
Electric power for brine pump	300
Manpower	1100
Running cost (per year)	
(a) Depreciation & interest on capital 25%	2500
(b) Maintenance cost	2000
Total cost	US Dollars - 4500

A 250 m^2 solar pond operating in climatic conditions similar to Bangalore will deliver 50,000 Kwh of thermal energy at 60°C. Hence the cost of thermal energy obtained from the solar pond will be around 0.10 Kwh. This cost is lower than the cost of thermal energy (obtained from coal or oil fired furnaces) in many developing countries.

APPLICATIONS

We can identify four industries (located in areas where land cost are not very high) where solar ponds will be economically viable. These industries are hatcheries, diaries, silk filatures, tobacco and dyeing. All these industries require some portion of their process heating below 70°C. Most of them use coal or oil fired furnaces or electric power to meet their heating loads. Among these, the requirement of hatcheries is most easy to satisfy. They need temperature around 37.2°C for incubating the eggs. For this purpose they are using, at present, electric heating. From a thermodynamic point of view, it is wasteful to use electric heating for such low temperature applications. On account of frequent power cuts they need to use diesel generators as a back-up. This increases the cost of incubating the eggs even further.

Based on the experience with IISc solar pond, we can confidently say that it can meet the needs of hatcheries throughout the year without any trouble. On account of large thermal storage in solar ponds there would be no need for a back up system. The only issue that needs additional technical work is the interfacing between solar ponds and incubator. The temperatures within these incubators need to be maintained within ± 0.25°C. This is fairly easy to attain with electric heaters. With hot water heating one needs to demonstrate that such a high accurate temperature control can be achieved. Silk filatures also require hot water between 45°C 55°C for reeling. Hence solar pond would be ideal since a small pond can meet these requirements very easily. For diaries located in rural areas water required for cleaning the vessels can be obtained from solar ponds. Small solar ponds may, however, be unsuitable for power generation. This is because the maximum temperature attained in these ponds may not exceed 75°C. Hence the Rankine cycle engine is used to convert thermal energy to electrical energy may not have efficiencies more than 5%. Hence the overall efficiency of a small solar pond power plant may not exceed 1%. Hence they cannot be competitive with solar cells.

CONCLUSIONS

The successful construction and operation of the 240 m² solar pond at IISc has demonstrated the technical and economical viability of small solar ponds. The use ofsmall soiar ponds for process heat requirement of hatcheries, diaries and silk filatures can be expected in the near future.

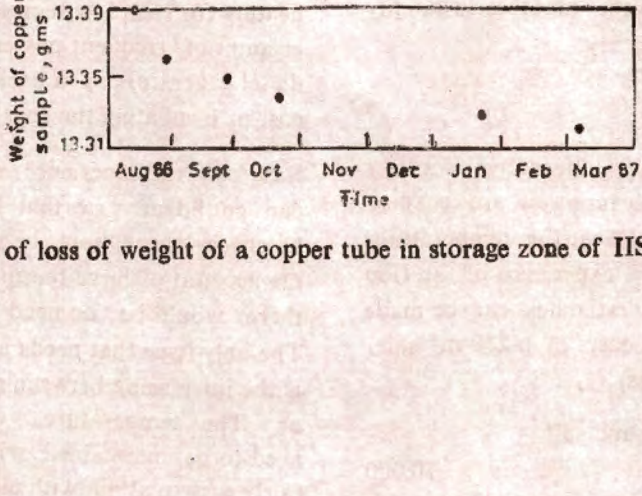

Fig. 6—Rate of loss of weight of a copper tube in storage zone of IISc Solar pond

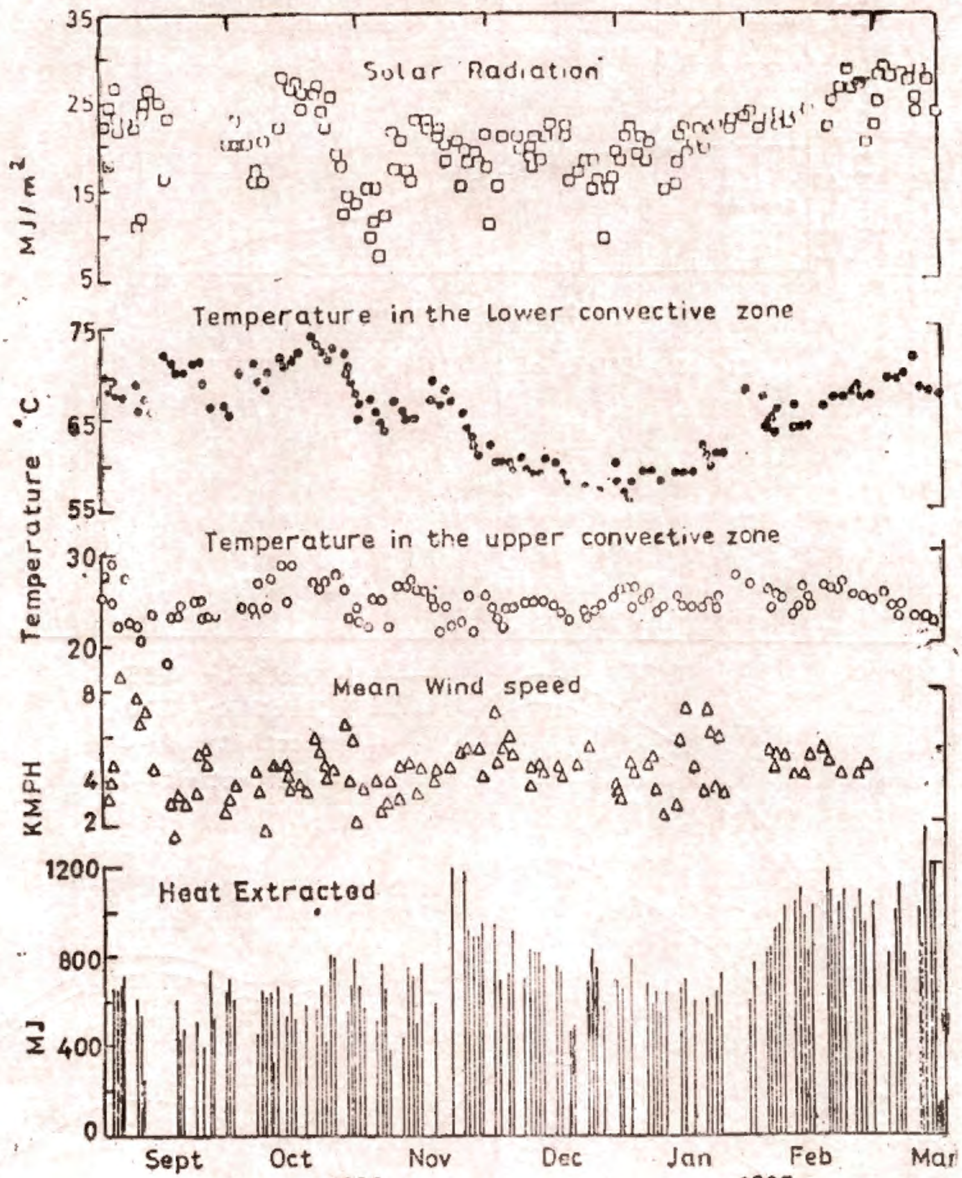

Fig. 7 - Performance of the pond

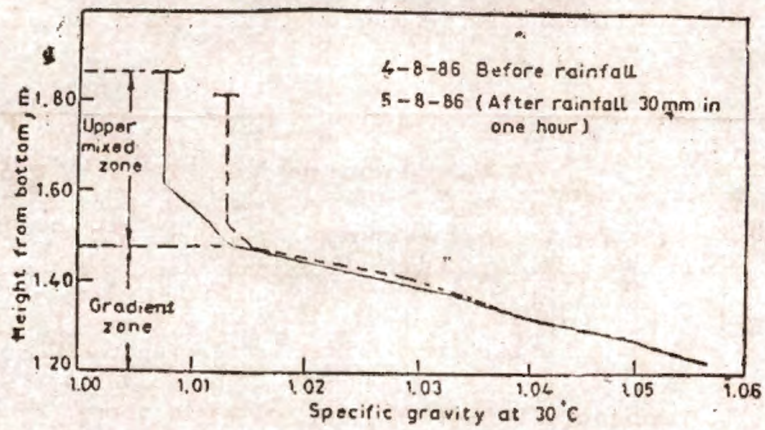

Fig 8 - Effect of rainfall on the density

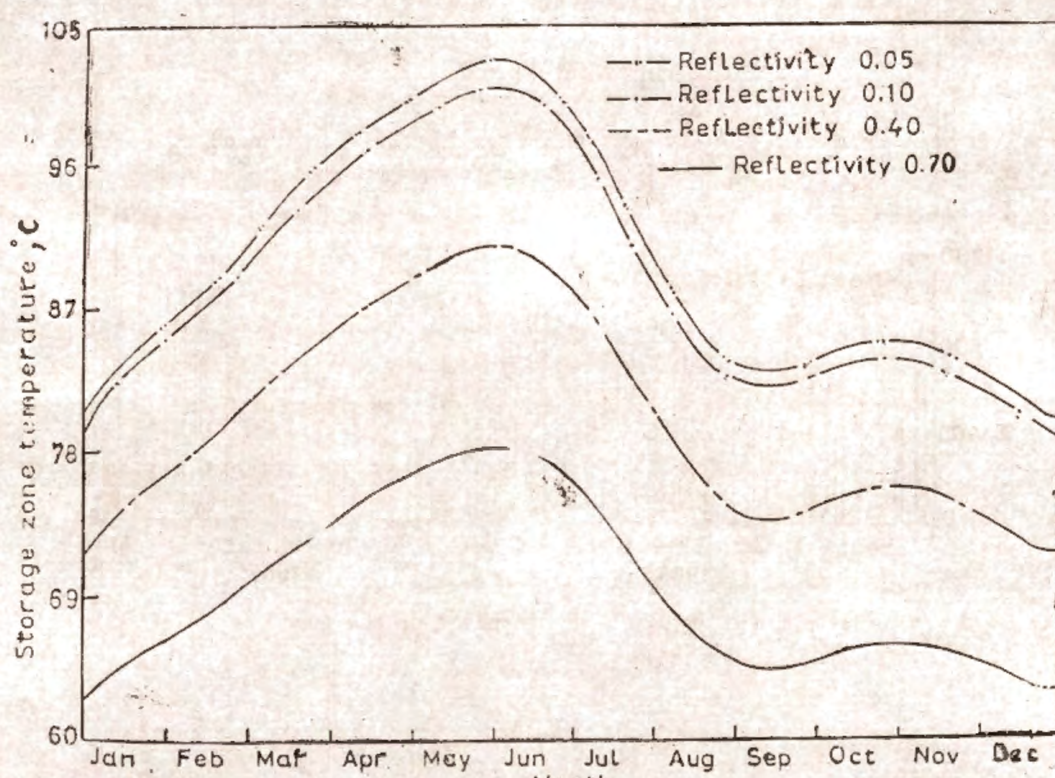

Fig. 9—Effect of bottom reflectivity on storage zone temperature.

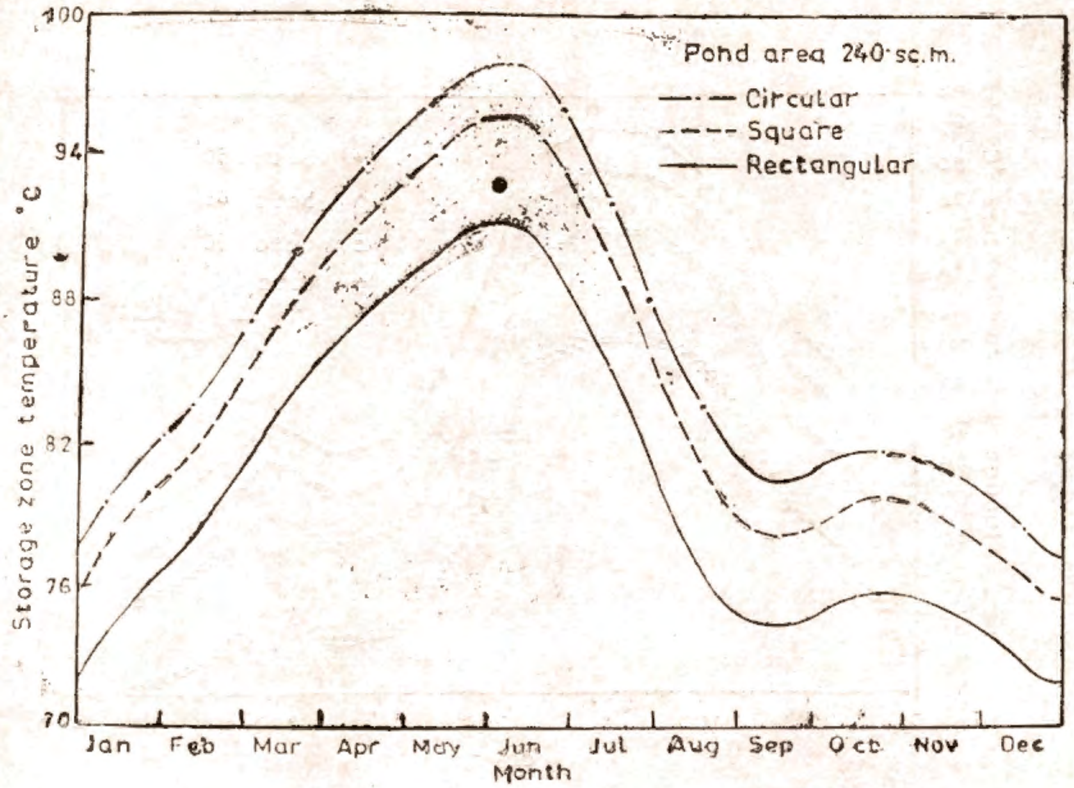

Fig. 10—Effect of shape of the pond on storage zone temperature.

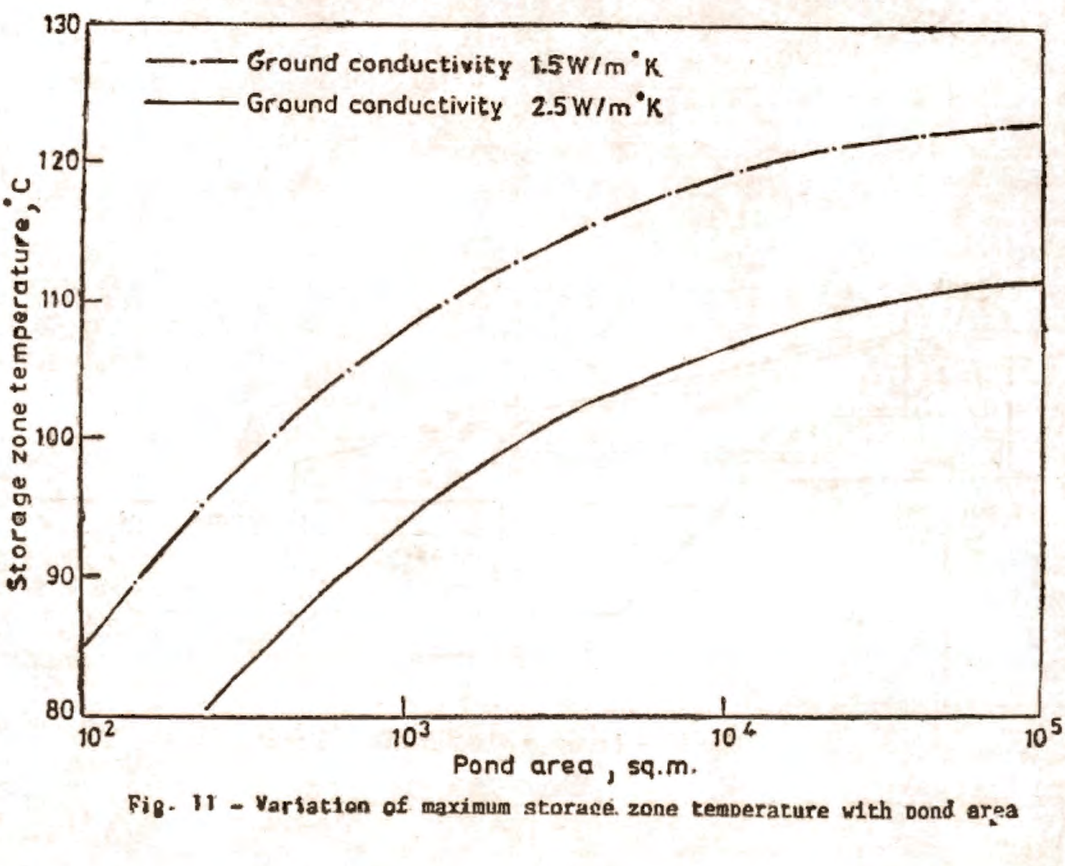

Fig. 11 - Variation of maximum storage zone temperature with pond area

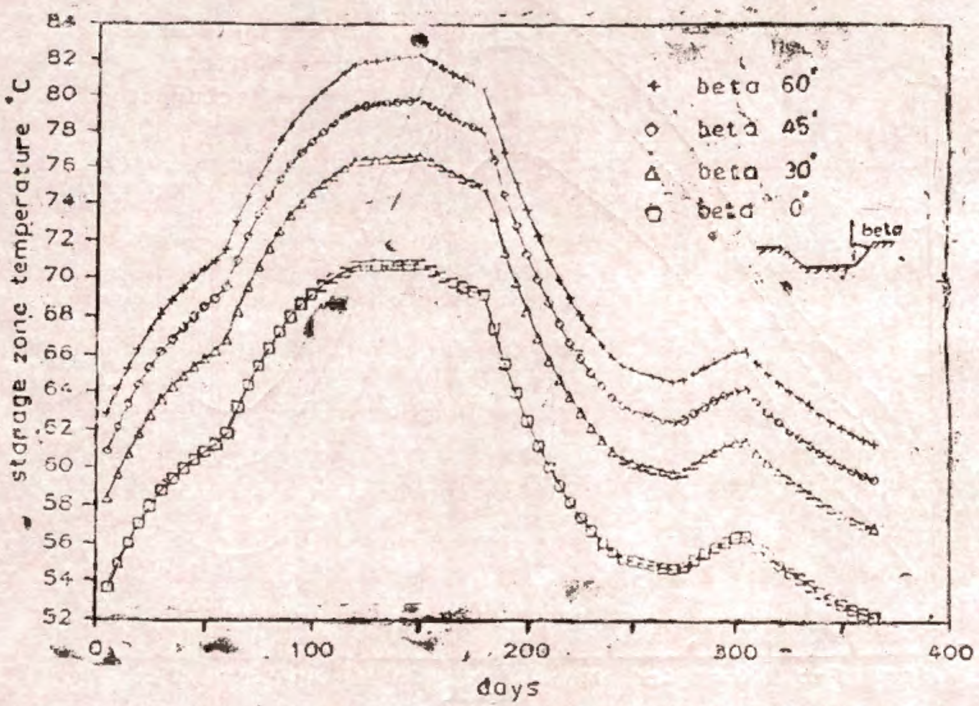

Fig. 12—Effect of beta on storage zone temperature.

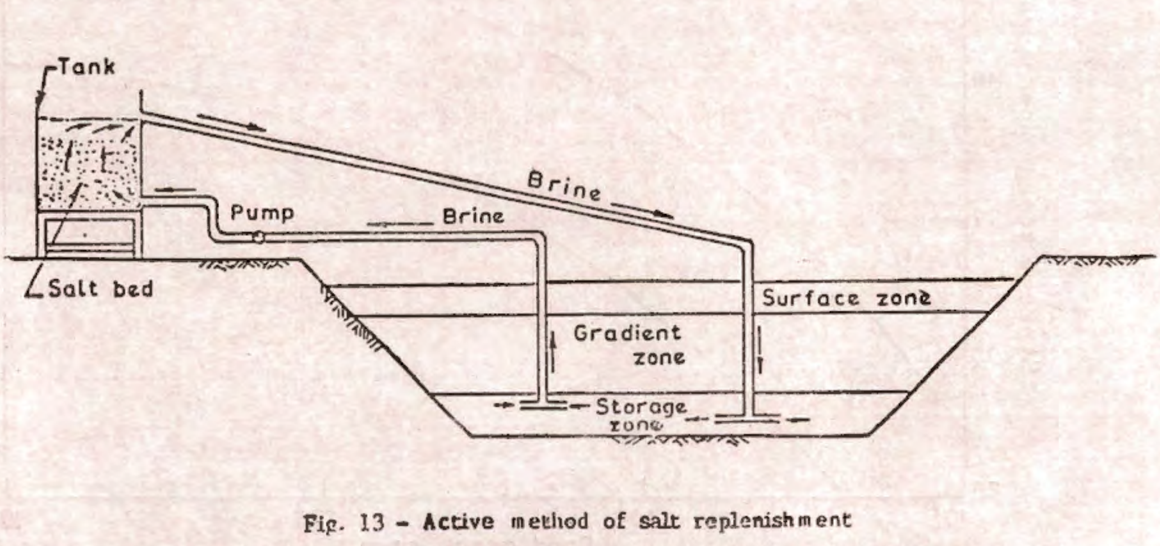

Fig. 13 - Active method of salt replenishment

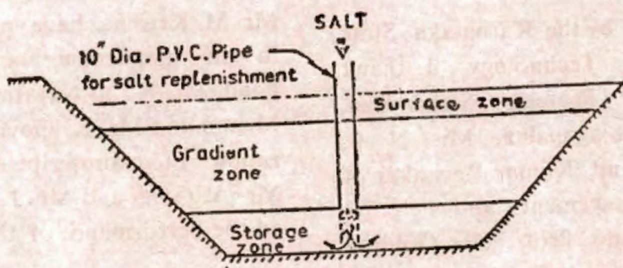

Fig. 14 – Passive method of salt replenishment

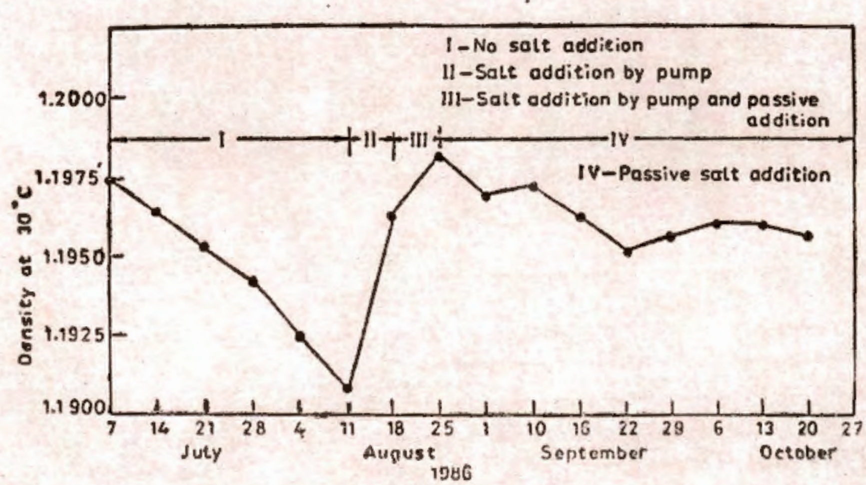

Fig. 15 – Density in the storage zone

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BIOGAS OUTPUT AND MICROBIAL PROPERTIES OF THE SOLID STATE AND AQUA DILUTED FERMENTATION OF A FEW VALUE ADDED BIOMASS

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This paper discusses the usefulness of some wastes like poultry droppings, poultry litter and spent mycostraw of biogas production in the form of solid state either alone used or with cattle-dung. In this paper the microbial properties of the solid state fermentation of wastes is also described. In this regard several experiments have been carried out to understand the nature of microbes involved in biogas production and exploration of the possibility of extending this type of technology in the areas where supply of water is limited.

Cattle-dung has hitherto been employed as a feed-stock for biogas production. In order to evaluate the usefulness of a few other wastes such as poultry droppings, (PD), poultry litter (PL) and spent mycostraw (MS), experiments were carried out with the above wastes either alone or in combination with each other along with cattledung. The normal farmers practice is to make use of water as a diluant (Aqua dilution) for preparing the slurry. However, in this study, the solid state fermentation of wastes (without adding water) was carried out and their performance in terms of gas output and microbiological properties, evaluated after comparing with the normal farmers practice of mixing with water (1:1 proportion on Wt/Wt basis). The experiments were allowed to progress as batch type for a period of seventy days, the details of which are discussed further.

An attempt has been made in this study to understand the nature of microbes involved in biogas production and explore the possibility of extending this technology in rural areas where supply of water is limited. Further, this may probably be the first report of its kind, where in fermentation of wastes were carried out with higher solids content and compared with that of farmers practice with lower total solids content. Elsewhere in several countries studies by Hills (1980) on dairy manure; *Ranade et al* (1987) on market residues and *Pietro et al* (1988) with municipal solid wastes, indicated the possibility of anaerobic digestion of wastes at higher solids content.

MATERIALS AND METHODS

The various wastes used in this study were collected locally and different treatments were designed, the details of which are as under.

FARMERS PRACTICE-BATCH TYPE EXPERIMENTS

A mixture by incorporating organic wastes with water were prepared as detailed below :—

Treatment Number	Materials used and their proportion (weight/weight basis)
T_1	Cowdung : Water (1000 : 1000 g 1 : 1 Wt/Wt)
T_2	Cowdung : Poultry droppings : Water (500 : 1000 : 500 g 1 : 2 : 1 Wt/Wt)
T_3	Cowdung : Mycostraw : Water (500 : 1000 : 500 g 1 : 2 : 1 Wt/Wt)
T_4	Cowdung : poultry litter : Water (500 : 500 : 1000 g 1 : 1 : 2 Wt/Wt)
T_5	Cowdung : Poultry litter : Poultry droppings : Water (333 : 333 : 333 : 1000 g 1 : 1 : 1 : 3 Wt/Wt)
T_6	Cowdung : Poultry litter : Mycostraw : Water (333 : 333 : 333 : 1000 g 1 : 1 : 1 : 3 Wt/Wt)
T_7	Cowdung : Poultry droppings : Poultry litter : Water (333 : 333 : 333 : 1000 g 1 : 1 : 1 : 3 Wt/Wt)
T_8	Cowdung : Poultry litter : Poultry litter : Water (250 : 250 : 250 : 1000 g 1 : 1 : 1 : 3 Wt/Wt)
T_9	Poultry litter : Water (1000 : 1000 g 1 : 1 Wt/Wt)
T_{10}	Poultry droppings : Water (1000 : 1000 g 1 : 1 Wt/Wt)
T_{11}	Mycostraw : Water (1000 : 1000 g : 1 : 1 Wt/Wt)

Biodigested slurry was added uniformly to serve as a source of microbial inoculum to all the treatments.

SOLID STATE FERMENTATION

The experimental set up was the same as that of farmers practice but here no water was used except ten percent biodigested slurry from the digester as inoculum.

The various treatments prepared were kept in amber coloured 2.5L. capacity bottles and sealed air tight. They were allowed to progress as batch type for a period of 10 weeks and the gas output was recorded daily by the water displacement method. (Mishra, 1954). The initial and final moisture content (Johnson and Ulrich, 1960), total and volatile solids, microbiological characteristics of the biodigested slurry for acid forming bacteria (Chynoweth and mah, 1977) ; cellulolytic bacteria (modified Hungate roll tube technique of Miller and Wolin (1974) with Hungate (1957 medium) ; and methanogenic bacteria (Miller and Wolin 1974) modified serum vial isolation technique using the Smith and Hungate (1958 culture medium) were also determined.

RESULTS AND DISCUSSION

The proximate chemical constituents of various raw organic wastes showed wider variations because of their very nature of the material. (Table -I). The gas output, total as well as volatile solids destruction of both the solid state fermentation (without water) (Table-2) with normal farmers practice of biogas production (Table-3) are presented in Tables 2 and 3 respectively. The distribution of anaerobic organisms encountered during 20th, 40th and 60th day of biodigestion in both the experiments listed above are presented in Tables 4 and 5 respectively.

The weekly gas output recorded in the bench scale experiments of solid state fermentation and normal farmers practice are depicted in Figures 1 and 2 respectively.

Cellulose, which often offers resistance to bacterial attack, ranged in the raw materials used in this study, from 18.9 (poultry droppings-PD) to 38.0 percent (Poultry litter-PL).

In Cowdung, it was 24.32 percent whereas Hills and Roberts (1981) reported 24.9 percent. The total as well as volatile solids varied, depending upon the nature of the input materials employed in the experiments for biomethanation. The amount of biogas produced is primarly a function of the nature and type of wastes materials incorporated. All the treatments of experiment I and II showed significant variations in their gas production. In solid state fermentation-bench scale experiment, the maximum gas output of 16.91 was recorded in T_7 (CD : PD : MS). However, maximum gas output per g of TS and VS destroyed was 0.31 and 0.371 respectively, in yet another treatment (T_{10}) fed with PD alone. In solid state fermentation, the TS content ranged from 16.5 to 57.2 percent while in farmers practice experiments the same was to range from 8.3 to 29.2 percent. Pathak *et al* (1985) stated that the gas produced was nearly the same per g of TS destroyed when the TS content of the dung slurry was kept at 7.7 ; 10.2 or 14.8 percent. The Statistical analysis of the gas output in solid state fermentation showed that the gas output from T_1, T_{10} and T_3, T_5, T_2, T_9, T_2 : and T_8, T_6 and T_4 were on per with one another while T_7 and T_{11} differed significantly from other experiments. In the case of farmers practice, except T_{10} (PD alone), and T_6 (CD : PL : MS) all the other treatments were found to differ significantly from each other. The weekly mean gas output was also found to fluctuate very much in both the experiments. (Fig. 1 and Fig. 2). The results obtained (gas output data) were in agreement with the reports of Chen *et al* (1988) and Rajasekaran, (1986). Maximum amount of degradation of TS and VS were observed in T_7 (CD : PD : MS) of solid state fermentation, and farmers practice (barring T_1 of experiment of farmers practice) which gave 16.9 and 44.1 L. respectively. The maximum methanogenic population was recorded in T_7 (25.0×10^4/g) of solid state fermentation bench scale experiment (CD : PD : MS) while in farmers practice T_1 (CD) showed maximum followed by T_7 (CD : PD : MS). Comparatively higher microbial populations were observed in farmers practice of bench scale experiment. In addition maximum acid forming and cellulolytic activities were also observed in those treatments that recorded maximum gas production. Similar reports by Bryant (1976), Rajasekaran *et al* (1987), Rajasekaran and Nagarajan (1978) on biodigestion of wastes lend support to the above findings. Among the methanogens isolated, the characters were studied and found in agreement with Methanosarcina spp.

The study reveals that besides cowdung alone as feedstock, supplementation of mycostraw and poultry droppings in combination with CD will not only help in biogas productivity but also reduce the pressure on cowdung. Unless otherwise efficient organisms are identified and introduced that can anaerobically digest and produce more quantity of biogas, solid state fermentation of wastes may not be a profitable preposition at this stage, No doubt certain fundamental studies are needed in this direction to solve this critical problem.

Table 1. Proximate chemical constituents of various raw organic wastes

Waste material	Moisture (%)	TS (%)	VS (%)	% VS to TS	Cellulose (%)	HC (%)	TOC (%)	Total Nitrogen (%)	C : N ratio
Cowdung	83.5	16.5	13.8	83.6	24.32	19.4	33.98	1.24	27.4 : 1
Poultry droppings	64.0	36.0	19.2	53.3	18.90	87.3	85.60	3.19	26.5 : 1
Poultry litter	42.8	57.2	13.3	23.3	38.00	23.0	22.72	0.64	35.5 : 1
Mycostraw	79.5	20.5	15.0	73.1	32.20	18.4	30.24	0.72	42.0 : 1

TS—Total solids

VS—Volatile solids

HC—Hemicellulose

TOC—Total organic carbon

C : N—Carbon : Nitrogen ratio

Table 2. Physico-chemical properties and gas output of various wastes (Solid state fermentation— Bench scale experiment)

**Treatments		Moisture (%) ***I	Moisture (%) F	Total solids (%) I	Total solids (%) F	Volatile solids (%) I	Volatile solids (%) F	%VS to TS I	%VS to TS F	Total TS fed (g)	Total VS fed (g)	Total TS destroyed (g)	Total VS destroyed (g)	%TS* destroyed	%VS* destroyed	Total gas out put in (l)	Gas output in (l) Per g TS destroyed	Gas output in (l) Per g VS destroyed
CD	T_1	83.5	88.5	16.5	13.3	13.8	11.2	83.6	84.2	165.0	138.0	32.0	26.0	19.4	18.8	8.6	0.27	0.33
CD : PD	T_2	74.0	79.3	26.0	20.7	15.0	11.9	57.7	57.5	260.0	150.0	53.0	31.0	20.4	20.7	10.6	0.20	0,34
CD : MS	T_3	81.4	84.4	18.6	12.8	5.7	3.0	30.6	23.4	186.0	57.0	58.0	27.0	31.2	47.4	8.66	0.15	0.32
CD : PL	T_4	64.7	67.3	35.3	28.8	25.2	21.3	71.4	73.9	353.0	252.0	65.0	39.0	18.4	15.5	12.7	0.19	0.33
CD : PD : PL	T_5	62.2	69.8	37.8	33.2	16.0	13.2	42.3	39.8	378.0	160.0	46.0	28.0	12.2	17.5	10.0	0.22	0.36
CD : PL : MS	T_6	68.6	75 6	31.4	25.2	13.3	9.2	45.4	36.5	314 0	133 0	62.0	41.0	19.7	30.8	12.3	0.19	0.30
CD : PD : MS	T_7	73.9	71.4	36.1	28 6	22.9	17.4	63.4	60.8	261.0	229.0	75.0	55.0	28.7	24.0	16.6	0.22	0.31
CD:PD:PL:MS	T_8	66.1	69.8	33.9	28.1	25.3	21.1	74.6	56.4	339.0	253.0	58.0	42.0	17.1	16.6	11.1	0.19	0.27
PL	T_9	42.8	47.3	57.2	52.4	13.3	10.1	23.3	19.3	572.0	133.0	48.0	32.0	8.4	24.1	10.4	0.22	0.33
PD	T_{10}	64.0	68.7	36.0	33.2	19.2	16.9	53.3	50.9	360.0	192.0	28.0	23.0	7.8	11.9	8.6	0.31	0.37
MS	T_{11}	79.5	82.6	20.5	13.3	15.0	11.2	73.2	84.2	205.0	150.0	52.0	38.0	25.4	25.3	13.7	0.26	0.36

** CD—Cowdung

PD—Poultry droppings

PL—Poultry litter

MS—Mycostraw

* TS—Total solids

VS—Volatile solids

*** I —Initial

F —Final

Table 3. Physico-chemical properties and gas output of various wastes (Farmer's practice of Biogas production-Bench scale experiment)

**Treatments		Moisture (%)		Total solids (%)		Volatile solids (%)		%VS to TS		Total TS fed (g)	Total VS fed (g)	Total TS destroyed (g)	Total VS destroyed (g)	%TS* destroyed	%VS* destroyed	Total gas out put in (1)	Gas output in (1) Per g TS destroyed	Gas output in (1) Per g VS destroyed
		***I	F***	I	F	I	F	I	F									
CD	T_1	91.7	98.8	8.3	2.2	6.2	1.3	74.7	59.1	83.0	62.0	61.0	49.0	73.5	79.0	46.9	0.77	0.96
CD : PD	T_2	87.0	93.3	13.0	7.0	7.5	2.9	57.7	41.2	130.0	75.0	60.0	46.0	46.1	61.3	42.9	0.72	0.93
CD : MS	T_3	90.7	95.8	9.3	4.2	3.9	1.0	41.9	23.8	93.0	39.0	51.0	29.0	54.8	74.4	39.0	0.76	1.34
CD : PL	T_4	82.3	86.1	17.7	13.9	12.6	9.5	71.2	68.3	177.0	126.0	40.0	31.0	22.6	24.6	24.4	0.61	0.79
CD : PD : PL	T_5	81.1	86.4	18.9	13.6	8.5	6.0	44.9	44.1	189.0	85.0	53.0	25.0	28.0	29.4	27.7	0.52	1.10
CD : PL : MS	T_6	87.3	91.2	12.7	8.8	8.7	6.4	68.5	72.7	127.0	87.0	39.0	23.0	30.7	26.4	22.2	0.57	0.97
CD : PD : MS	T_7	83.9	89.8	16.1	10.2	6.8	3.2	42.2	31.7	161.0	68.0	59.0	36.0	36.6	52.9	44.1	0.75	1.25
CD:PD:PL:MS	T_8	82.9	88.5	17.1	12.5	12.0	7.75	70.2	62.0	171.0	79.0	46.0	28.0	26.9	35.4	19.8	0.43	0.71
PL	T_9	70.8	74.2	29.2	25.8	6.9	4.9	23.6	18.9	292.0	69.0	34.0	20.0	11.6	28.9	18.8	0.55	0.94
PD	T_{10}	81.5	84.8	18.5	15.2	9.8	7.6	52.9	50.0	185.0	98.0	33.0	22.0	17.8	22.4	22.0	0.67	1.00
MS	T_{11}	89.0	91.0	11.0	9.0	7.8	6.2	70.9	68.9	110.0	78.0	20.0	16.0	18.2	20.5	13.0	0.65	0.81

* TS—Total solids
VS—Volatile solids

** CD—Cowdung
PD—Poultry droppings
PL—Poultry litter
MS—Mycostraw

*** I—Initial
F—Final

Table 4. Distribution of anaerobic microorganisms in various wastes incorporated treatments at different time intervals (Solid state fermentation – Bench-scale experiment)

**Treatments		Bacterial population*** (expressed per g oven dry basis)								
		Cellulolytic (X10[4])			Acid forming (X10[4])			Methanogenic (X10[4])		
		20th	40th	60th	20th	40th (Period in days)	60th	20th	40th	60th
CD	T_1	13.1	5.0	13.9	7.5	4.5	5.7	9.8	3.9	11.8
CD : PD	T_2	14.7	6.1	17.0	9.8	15.0	9.7	15.2	4.9	16.5
CD : MS	T_3	13.6	5.2	14.7	7.5	4.7	6.4	12.1	4.3	14.7
CD : PL	T_4	16.0	6.4	21.8	12.4	5.7	11.3	16.2	5.4	19.7
CD : PD : PL	T_5	14.0	5.3	16.4	8.4	4.8	6.9	13.2	4.4	14.9
CD : PL : MS	T_6	15.0	6.3	20.8	11.8	5.6	10.9	15.5	5.2	18.0
CD : PD : MS	T_7	19.2	8.1	22.7	13.1	7.3	12.6	16.9	6.9	25.0
CD : PD : PL : MS	T_8	15.0	6.2	17.8	10.1	5.3	10.8	15.4	5.0	16.8
PL	T_9	14.5	5.4	16.4	9.7	4.8	7.5	13.7	4.4	16.5
PD	T_{10}	12.5	4.5	13.8	7.2	3.9	5.1	9.3	3.7	11.7
MS	T_{11}	16.8	6.7	22.5	12.8	6.4	11.7	16.8	5.7	21.3
CRD	SE_d	2.52	1.45	3.02	1.8	1.33	1.92	2.52	1.08	2.95
	CD	5.23NS	3.01NS	6.18*	3.72*	2.77NS	3.98*	5.23NS	2.25NS	6.13*
FRBD	SE_d		2.45			1.69			2.31	
	CD		4.89NS			3.37NS			4.61NS	

*** Population expressed is the mean values of three replications

NS Non significant

* Significant

** CD—Cowdung

PD—Poultry droppings

PL—Poultry litter

MS—Mycostraw

Table 5. Distribution of anaerobic microorganisms in various wastes incorporated treatments at different time intervals [Farmer's practice of biogas production–Bench-scale experiment]

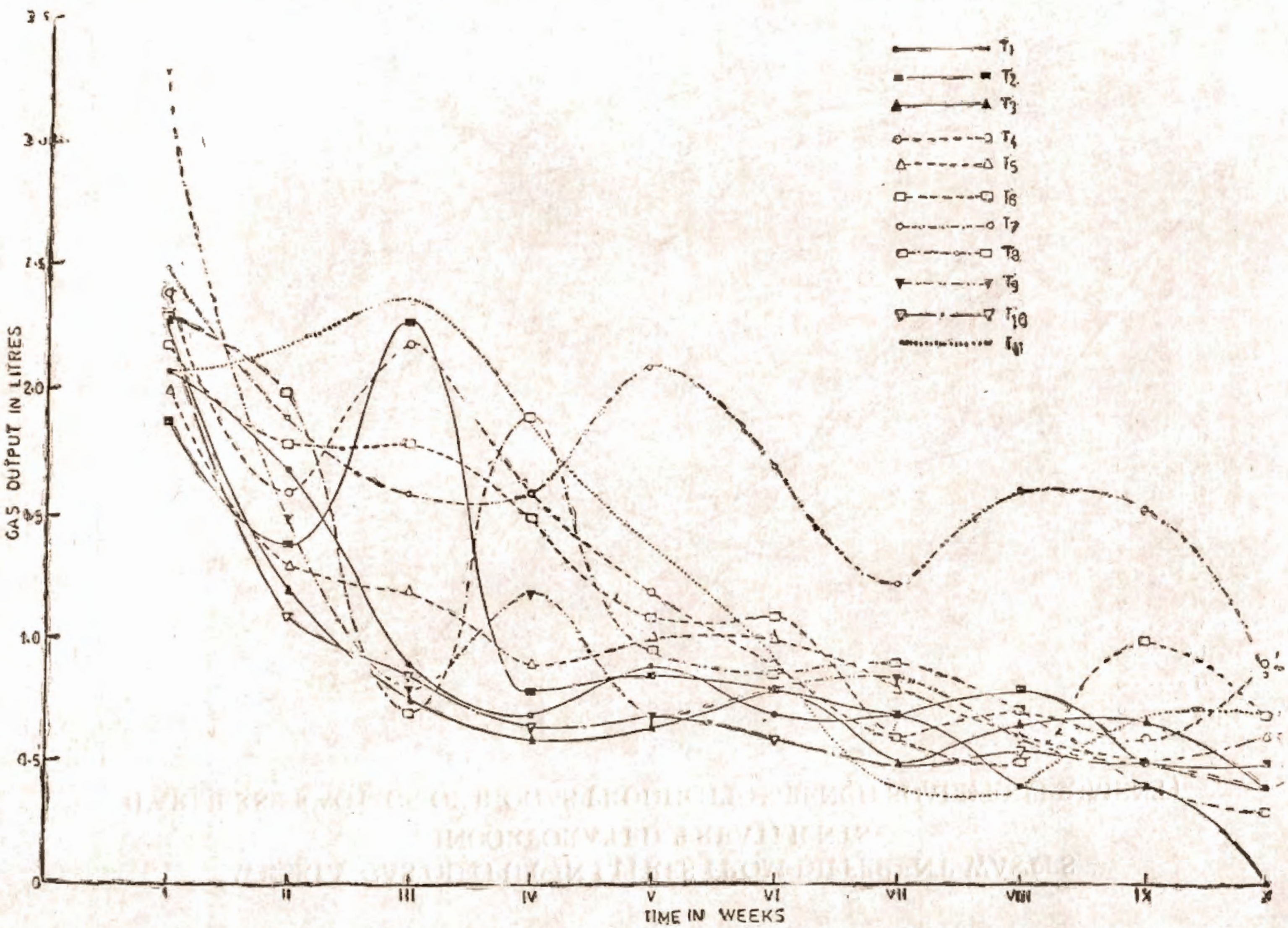
**Treatments		Bacterial population*** (expressed per g oven dry basis)								
		Cellulolytic ($\times 10^4$)			Acid forming ($\times 10^4$)			Methanogenic ($\times 10^4$)		
		20th	40th	60th	20th	40th	60th	20th	40th	60th
		Period in days)								
CD	T_1	56.7	66.0	58.6	25.0	30.0	35.0	23.7	32.0	39.3
CD : PD	T_2	50.0	53.3	50.0	21.7	26.6	30.6	20.7	29.6	34.0
CD : MS	T_3	47.3	51.3	48.0	19.7	25.3	26.3	19.3	27.6	31.0
CD : PL	T_4	38.7	41.0	40.0	18.3	23.3	24.3	17.7	23.6	26.3
CD : PD : PL	T_5	41.3	45.3	42.6	20.0	24.3	26.0	18.7	26.0	29.0
CD : PL : MS	T_6	32.0	38.0	34.0	15.3	20.6	22.3	16.7	21.3	24.3
CD : PD : MS	T_7	46 7	50.6	42.6	23.0	28.3	33.6	22.3	31.0	37.0
CD : PD : PL : MS	T_8	28.0	35.3	28.0	13.0	18.6	19.0	14.0	17.6	19.6
PL	T_9	24.0	27.0	22.0	12.0	17.6	17.0	11.7	15.0	17.0
PD	T_{10}	32.7	38.6	34.6	14.0	20.0	21.3	15.7	19.3	22.3
MS	T_{11}	18.7	22.6	20.6	9.7	16.0	15.3	11.0	13.3	15.0
CRD	SE_d	2.11	2.91	3.02	1.27	1.77	2.11	0.89	1 90	1.15
	CD	4.37*	6.03*	6.27*	2.64*	3.67*	4.37*	1.84*	3.93*	2.38*
2FRBD	SE_d		2.08			1.56			2.21	
	CD		4.15NS			3.12NS			4.41*	

*** Population expressed is the mean values of three replications
NS Non-Significant
* Significant

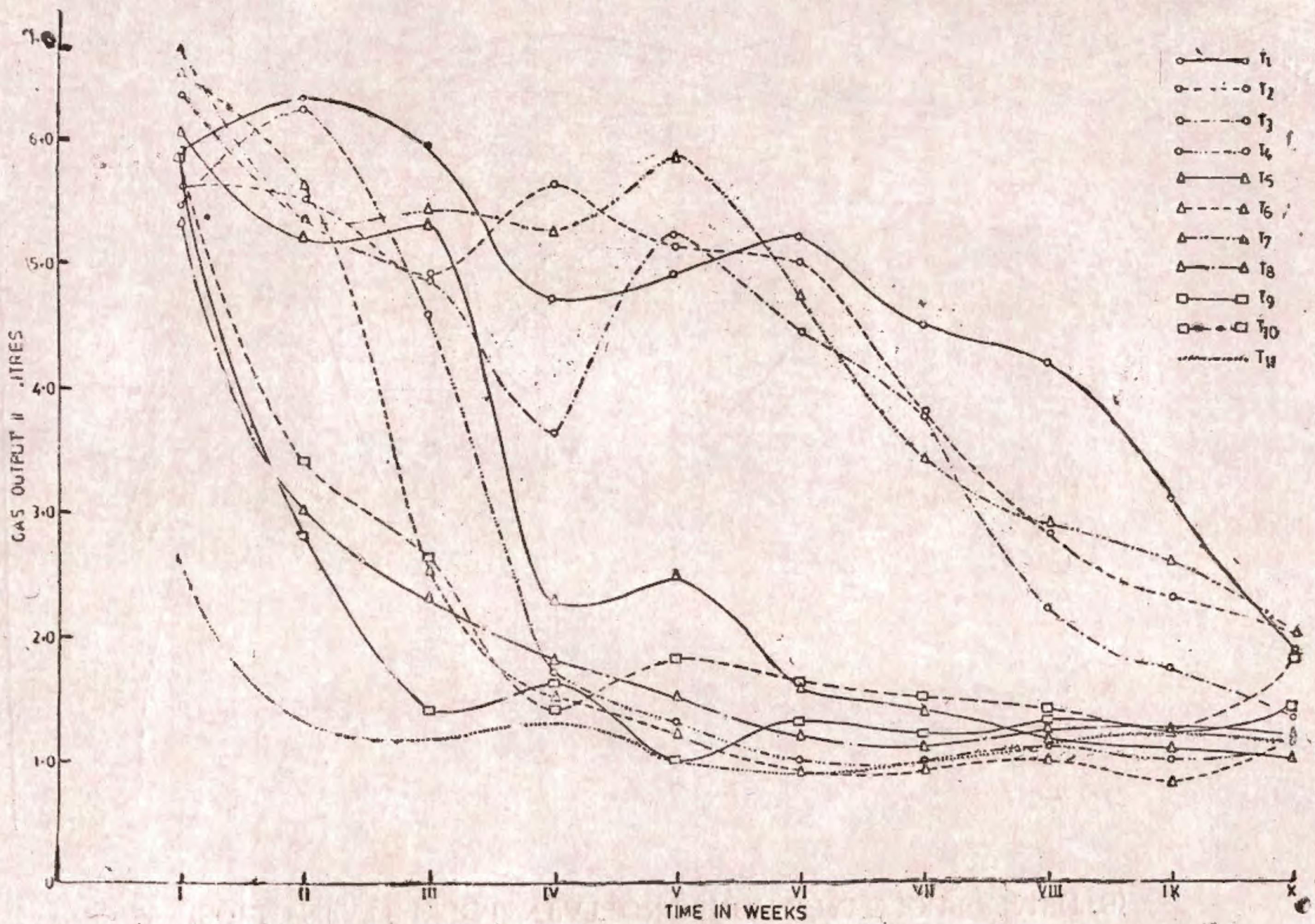
** CD—Cowdung
PD—Poultry droppings
PL—Poultry litter
MS—Mycostraw

FIG. 1, WEEKLY GAS OUTPUT IN LITRES FROM DIFFERENT WASTES INCORPORATED TREATMENTS

(SOLID STATE FERMENTATION-BENCH-SCALE EXPERIMENTS)



WEEKLY GAS OUTPUT IN LITRES FROM DIFFERENT WASTES
INCORPORATED TREATMENTS
(FARMERS PRACTICE OF BIOGAS PRODUCTION-BENCH SCALE EXPERIMENT)



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NEW GASIFIER PRODUCES COOKING GAS FROM KITCHEN WASTE

An inexpensive gasifier has been designed to produce cooking gas from kitchen waste of household.

The gasifier is easy to fabricate. Take three drums each of about 100 ltr. capacity and two drums of 5 ltr. capacity each. Weld the small drums inside the big ones and provide doors (shutters) at the bottom of two big drums (see sketch). Make the lid and bottom of the small drums revolve on a point axle. Now weld 6 cm gas out-go pipes near the upper rim of the big drums and connect them with 30 cm long bicycle tube bits. Attach to the revolving bottom of the small drums a thin rod, like an umbrella rib, and take the rod through a very small hole made in the side wall of the big drum. Fix tight rubber/leather washers on either side of the hole (one inside and one outside) to prevent leakage of gas. Make sure that the lids of the big Drums also fit tight. Finally weld a conical lid with an outlet pipe on the middle drum.

Fill the first and the third feeder drums with raw kitchen and cooked table waste. Rotten eggs and fruits, spoilt milk, curd, banana skins, rejected root crops, corn cobs, paddy straw, food grains, farm yard and chicken house manure, piggery and rabbitry sweepings, green leaves. cow dung, grass, weeds, etc. may all be added for more gas If cheap country brewed liquor is available add a pint of it to the charge once a month. Cheap vinegar or yeast may also be added to quicken gas formation. The volume of gas in the drum can be judged from the bulge and feel of the cycle tubes connecting the drums.

Connect the main outlet in the middle drum to a domestic cookstove. Tie a ribbon around one tube, arrest the flow of gas from it into the middle drum and use the gas only from the other drum. When this gas is used up, shift the knot to the other tube. Thus, gas from the two drums may be drawn alternatively and both the drums will accumulate much gas during idle period.

Before recharging a gasless drum, open its bottom door to remove the digested slurry for use as manure. Charging, recharging and slurry removing must be a continuous process If the gas obtained is inadequate for the family add one or two more feeder drums or set up another unit of three drums. Empty asphalt (tar) drums may be conveniently used for this purpose.

For convenience of transporting the second drum could be made 3 cm smaller than the first and the middle drum 3 cm smaller than the second so that they can be put one into other if the connecting rubber tubes are made longer and the middle drum is raised by about metre the leakage in the system will decrease.

The patented gasifier is designed by Felix Ryan, Ryan Foundation. No. 8. West Mada st. Srinagar Colony, Madras-600015.

Contact Agency :

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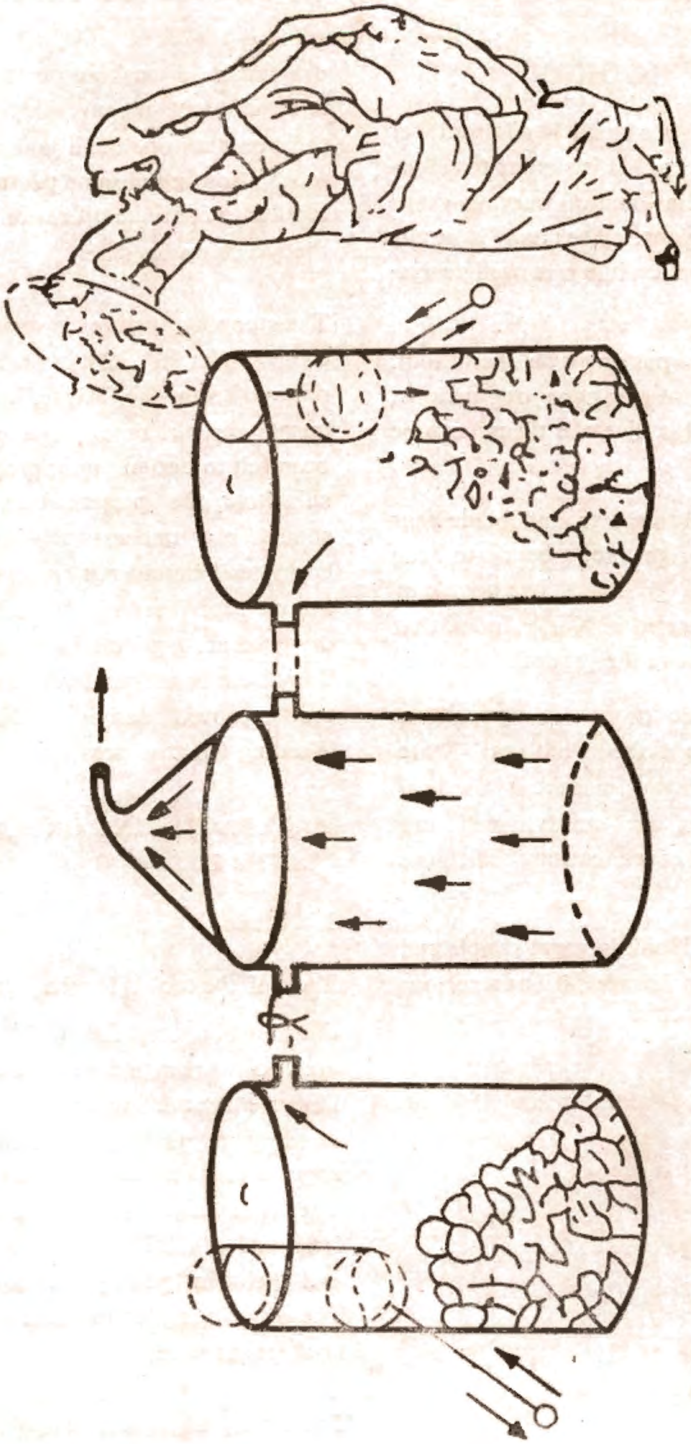
Madras—600015



(FIG. 1—COOKING GAS FROM KITCHEN WASTE)

HAND WEEDING HOOK, SICKLE & HAND RACK

HAND WEEDING HOOK

Hand Weeding Hook is a small hand tool for removing weeds from crops. It is similar to sickle-popular throughout India—and of varying shape and size in different regions. The tool is simply poke shaped in North India while it is well designed in South India.

Hand Weeding Hook is pushing type hand tool. Fingers start aching while working for long periods. If handle end of the tool is flat, the thrust can be taken on hand palm.

As the tool works parallel to the ground, blade near the handle is given two right angle bends to keep the fingers safe above the ground. The handle of the tool is so taper chieseled in North India, that the fingers remain well above the ground.

Weeding is an unavoidable process in agriculture. Any crop needs two to three weedings. More weeds come up when farmyard manure is used in crops. Sometimes weeds are sturdy, wild and faster growing than main crops, causing difficulties in cropping.

Though Hand Weeding Hook is very simple and inexpensive tool for Indian farmers, it has a serious drawback in working posture. The operator has to sit in very inconvenient stooping posture, hold the weeds in one hand and uproot them with the tool. And in the same posture one has to proceed further to continue operation. The operator stacks the weeds on his side.

Figure : 1 Hand Weeding Hook

The stooping posture is very inconvenient one and claims about 30% of the operator's energy. To get relieved from the fatigue, the operator needs frequent resting time. The need has continuously been felt to design an appropriate weeding tool to substitute the present one. The weeding tool should not unnecessarily waste the operator's energy and should not create mental fatigue. With this concept Weeding Hoe and Dutch Hoe has been designed at Agricultural Tools Research Centre. They have been found very useful. In this bulletin the improved design of the conventional Hand Weeding Hook is presented.

MANUFACTURING PROCESS (DESIGN PLATE : 1)

1. Blade

Blade of the tool is forged from $\frac{3}{4}'' \times \frac{3''}{16}$ (20×5) medium carbon steel flat of 7″ (176) length. There are two working edges of the blade as shown in Design Plate : 1. Outer curved edge, at front does weeding by pushing the tool while inner curved edge is used to cut big weeds-by pulling the tool. The inner edge is serrated for easy cutting. The front end of the blade is narrow and pointed. This end helps in pulling out roots of certain weeds. The blade being of medium carbon steel does not need frequent resharpening,

The cutting edges are well balanced from the centre line of the handle. As working edges are along the line of force one gets optimum return of the energy spent.

Another end of the blade is forged into tapered poke shape along the centre line of the blade and the handle as shown in the Design Plate : 1. The poke is kept little longer than the handle so that its tip projects out of the bigger end of the handle. The tip is bent over the handle end to prevent handle dismantling.

2. HANDLE

4″ (100) long round handle is made of hard wood. The handle is slightly tapered from $1\frac{1}{2}''$ (35) to 1″ (26) diameter along the length. Diameter of smaller end is still reduced slightly for $\frac{3''}{8}$ (10) length to accommodate a metal ring [3]. A hole is drilled up to half of the handle's length, poke end of the blade is made red hot and inserted through the hole till its tip projects from other end of the handle.

3. METAL RING

The metal ring of thin sheet metal fits on the smaller end of the wooden handle to provide firm grip to the blade and to prevent handle cracking.

SICKLE

USE

Sickle is a popular tool for harvesting crops and cutting fodder in almost all the parts of India. Its size and shape is changing from area to area according to cropping patterns and habits of the farmers.

Figure : 2 Sickle

Sometimes shape of the blade is customary also and farmers are not willing to accept any change. Thus Sickle specific tool and much popular than Hand Weeding Hook.

Blade of the sickle is given some curvature,-commonly in all regions. The curvature is designed according to the type of crops. Cutting edge of the blade is serrated to ease harvesting dry and hard crops. It has been heard from Japanese farmers that for green stems smooth cutting edge works very well and for dry stems serrated edge is more appropriate. This concept is worth adopting in designing sickles.

The Sickle is a pulling tool. Therefore frequent dismantling of the handle is observed however tight it is with the blade. In the sickle developed at Agricultural Tools Research Centre, the blade is inserted throughout length of the wooden handle and the blade tip is bent over the handle end. This small modification eliminates handle dismantling permanently.

The blade of sickle should be so shaped that the tool is well balanced while holding it in hand. If it is not properly balanced the operator has to spend some energy in keeping it balanced while working. The sickle being a pulling tool should be light in weight. A sickle made from proper quality of steel, well sharpened and light in weight is an appropriate hand tool for small and marginal farmers.

MANUFACTURING PROCESS (DESIGN PLATE : 2)

1. Blade

It is forged from $1'' \times \frac{3''}{16}$ (25 · 5) flat medium carbon steel piece of 5″ (125) lengh. One end of the steel piece is forged into narrow poke shape to be inserted into the handle [2] A small notch is provided at the upper end of the poke for hammering the blade into the handle. Rest part of the steel piece is forged into curved blade. Inner edge is sharpened and serrated to form a cutting edge. Upper end of the blade is forged into narrow tip. After forging the blade only the cutting edge is hardened to make it more durable. If the whole blade is hardened, it becomes brittle and can break with a blow.

In Japan bi-metal flat strips of high carbon steel and mild steel are available for tools like sickle. Carbon steel edge works as cutting edge and mild steel provides back support to the cutting edge. Such bi-metal strips are very appropriate for sickle.

2. HANDLE

Round 4." (110) long handle is made from a hard wood. It is also slight tapered along its length as in the case of Hand Weeding Hook.

3. METAL RING

It fits on smaller end of the handle to provide tight fitting of the handle and the blade and to prevent handle cracking.

As described in Hand Weeding Hook the Sickle also works parallel to the ground so the blade sometimes is given zigzag shape to keep the fingers safe above the ground. This needs separate shapes for left and right handers.

HAND RACK

USAGES

(1) Hand Rack is a tool for light digging in lawn or gardens. Farmers are making more uses of it also.

(2) For more airation in seedbed and lawn, the Hand Rack can be a good tool. Tines of the Hand Rack scrap top layer of the soil so that roots can breathe enough air. Scraping the top soil helps in retaining soil moisture also.

(3) Hand Rack is convenient tool for gathering left-over groundnuts after harvesting. By pressing the tines into the soil and pulling the tool the groundnuts get collected between the tines leaving the soil behind. At present the farmers do this process by turning over the soil with help of hand hoe.

Figure : 3 Hand Rack

(4) Weeding in paddy fields covered with water is not an easy job. By moving the Hand Rack all around the paddy shoots, the weeds come out with roots. Such use of the Hand Rack is known by the farmer's experience.

MANUFACTURING PROCESS (Design Plate : 3)

The Hand Rack has following five parts :

(1) Outer Tines
(2) Inner Tines
(3) Middle Tines
(4) Metal Ring
(5) Wooden Handle.

Outer tines, middle tine and inner tines all are forged from $\frac{3''}{8}$ (10) round mild steel bars. Outer tines and inner tines are first bent into required 'U' shape and then front tips are forged into pointed shape and shown in Design Plate : 3. One end of the middle tine is also forged into similar pointed shape and the other end is tapered to fit in the wooden handle [5]. Middle of the middle tine is given a bend to accommodate the outer and the inner tines. They are welded keeping all the tines in one plane. Then all the five tips are bent at right angles for about 2" (50) length.

4" (100) long handle is made from hard wood. It is also given a slight taper. At narrow end a metal ring [4] of $\frac{3'}{8}$(10) height fits as a cap to provide firm grip. A hole is drilled upto half of the length of the handle from the narrow end, for fitting the middle tine.

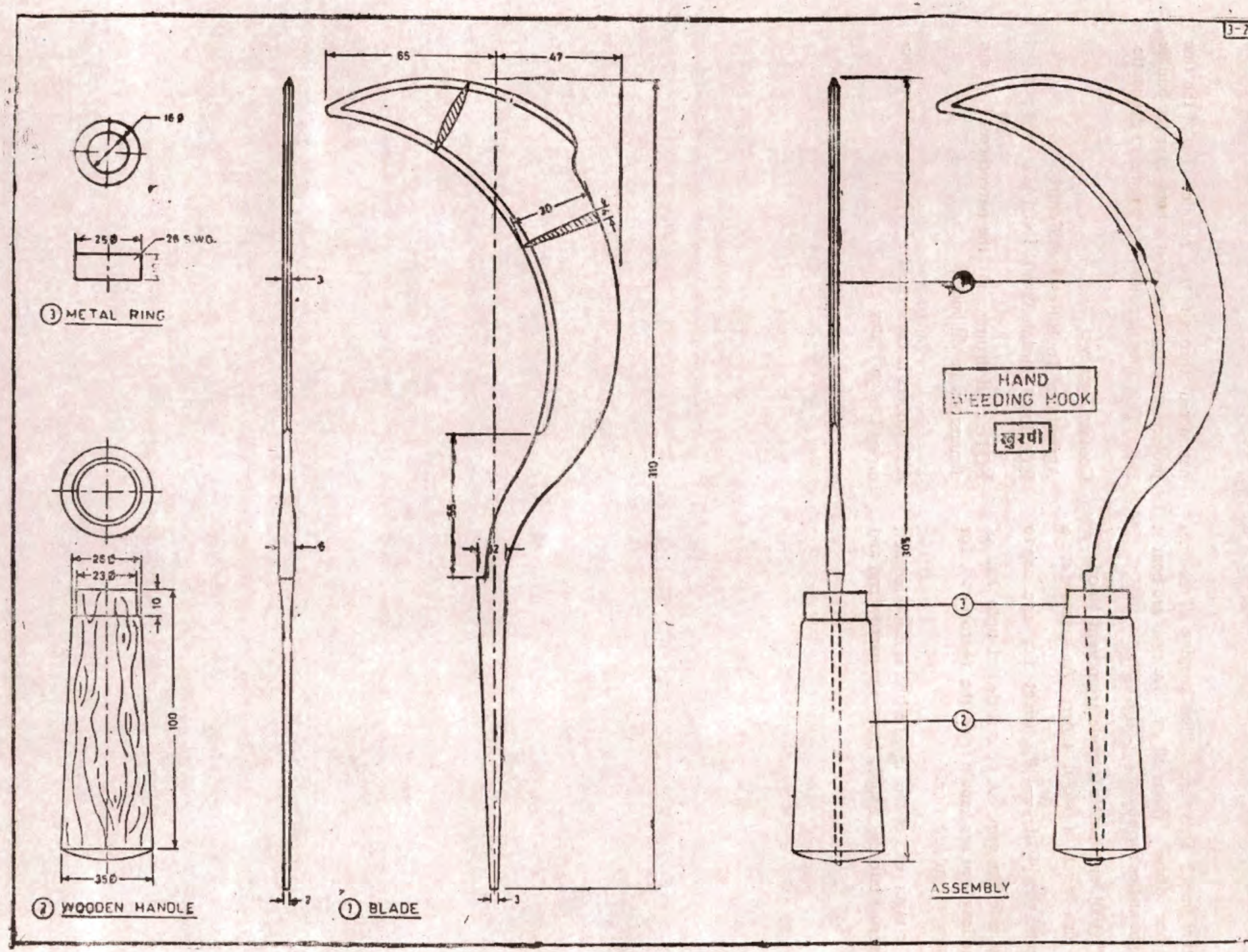
The taper end of the middle tine is made red hot, inserted into the handle from the narrow end and hammered through the handle. Tip of the tine projecting at the bigger end is bent over the handle end. This does not allow the handle to dismantle.

Contact Agency :

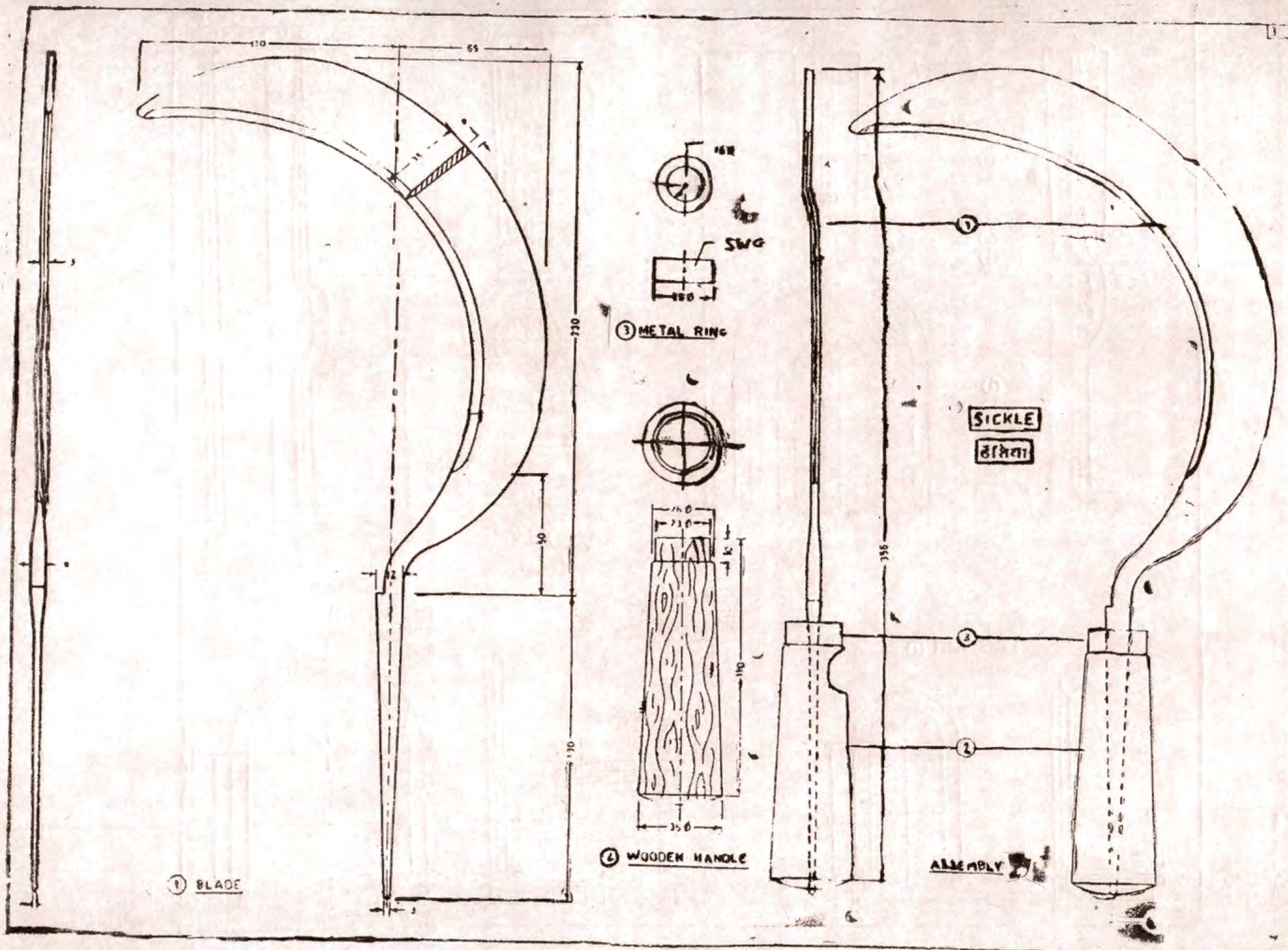
Agricultural Tools Research Centre
P.O. Box 4 Bardoli 394601 INDIA.

NOTE : All figures in the parentheses ( ) are dimensions in Millimeter.

All numbers in the brackets [ ] refer to Manufacturing Design Plates.

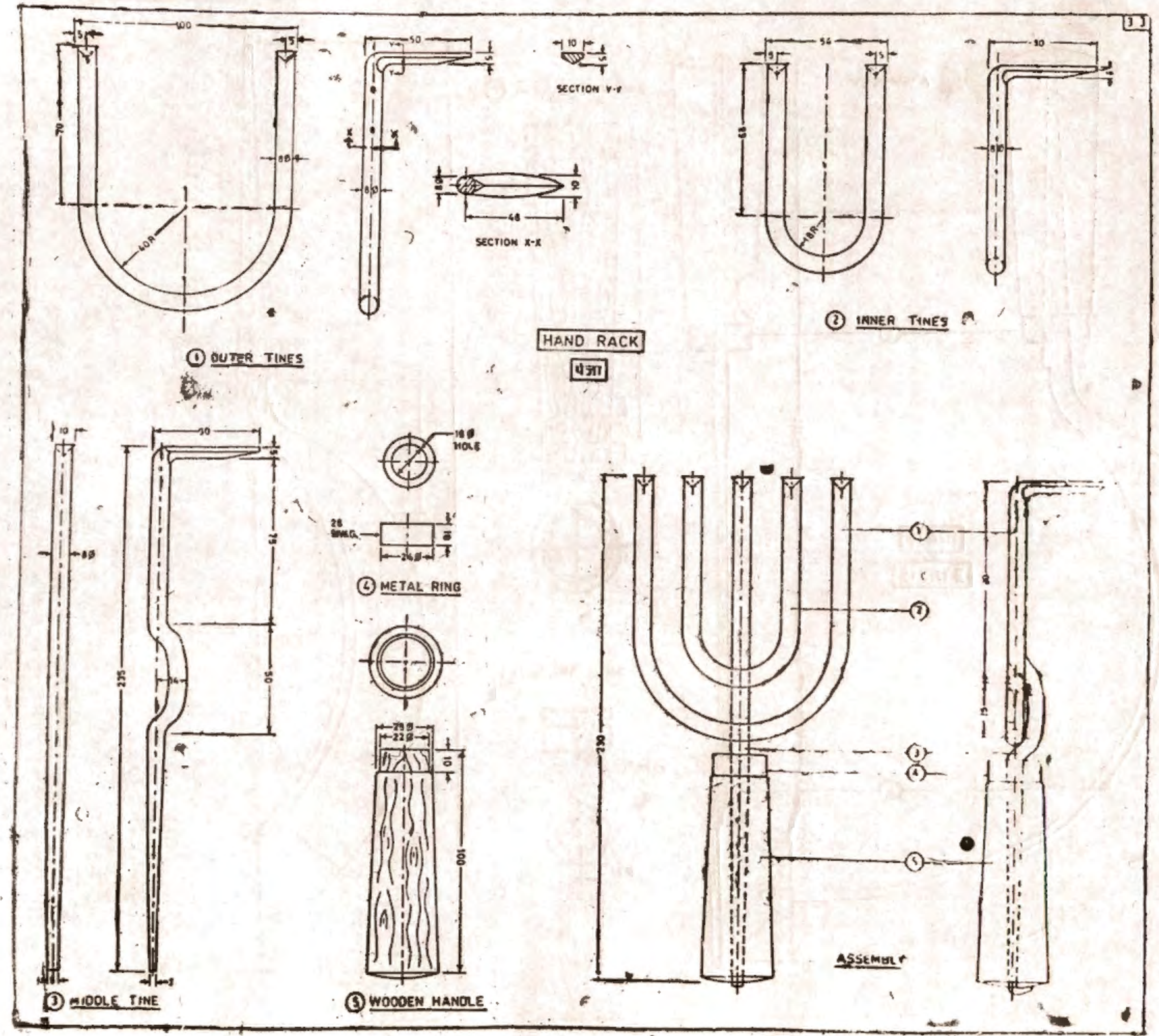

3-7
16 Ø
25 Ø
26 S.W.G.
③ METAL RING
25 Ø
23 Ø
10
100
35 Ø
② WOODEN HANDLE
3
6
① BLADE
65
47
20
55
310
3
305
HAND
WEEDING HOOK
खुरपी
ASSEMBLY
③
②

De..gn Plate : 1



Design - Plate : 2

Design ...e : 3



OUTER TINES
SECTION Y-Y
SECTION X-X
INNER TINES
HAND RACK
MIDDLE TINE
METAL RING
WOODEN HANDLE
ASSEMBLY

SPOT LIGHT

U.S. AGENCY CLEARS TOMCO'S NEEM–BASED PESTICIDE

THE ENVIRONMENT Protection Agency (EPA) of the United States has approved a neem-based biological pesticide developed by Tata Oil Mills Company Ltd. (TOMCO) for use on a wide range of food crops.

The natural pesticide based on neem extracts underwent extensive field trials in the United States. It has been cleared for use on outdoor and greenhouse crops. TOMCO has plans to set up a plant to manufacture the product on a commercial scale.

In the category of small fruits, the TOMCO product has been cleared for use on caneberry (raspberry, dewberry etc.), bushberry (grape. kiwi fruit etc.), strawberry, pome fruit (apple pear etc). stone fruit (peach, cherry etc.), nut crops, trees as well as shrubs, and other temperate fruits like persimmon and papaw.

Among tropical and subtropical fruits, the pesticide has been approved for use on citrus, banana and plantain, palm fruits like date and coconut. Among beverage crops, it has been cleared for use on cocoa, coffee, tea, chicory and mint.

In the case of flavouring and spice crops, it has been cleared for use on leaves, stem, root. seed, and pods of various plants. In the case of vegetables like tomato, beans and asparagus, the TOMCO product can be used on leaf, stem, root, seed and pod.

It has also been cleared for use on grasses like Sudan grass, Brome grass, corn and sorghum, small grains for forage such as rye and legumes such as crotalaria and soybeans.

Under the classification 'grain and edible seed crops' the product has been cleared for use on corn, rice, wheat, barley. oats, alfalfa, sesame, peanut, sunflower, and non-grains such as squash and pumpkins.

It has also been approved for use on oil crops. Neem extracts produced by various firms in India are being investigated in agricultural institutes in several Western countries as well as the Soviet Union.

Many agricultural universities in the United States have conducted studies on neem compounds and have established the efficacy of azadirchtin, the active ingredient in neem, in fighting pests attacking a wide variety of vegetation. But this is the first occasion when a neem compound has been cleared by EPA.

The stage is now set for use of the natural pesticide by farmers themselves.

HEATING TAP WATER WITHOUT HEAT LOSS

Any water tap can deliver hot water instantly without any loss of heat through the use of an ingenious system developed in Britain.

Dubbed *Hottrace*, it works by fixing a length of electric heater tape along a hot-water pipe. Heat is applied directly to the pipe and is maintained at a constant temperature, avoiding any heat loss along the length of the pipe. Insulation enveloping both the tracer tape and the pipe conserves the energy and makes the system economical to run.

The system is easily fitted. It is suitable for installation in new systems when there is a considerable reduction in plumbing requirements. It eliminates the need for a hot-water recirculatory system with its associated return pipework which, in turn, saves valuable space. It can also be fitted to existing hot-water systems.

Water and energy costs are further reduced since there is no wastage while the user drains water from the system waiting for hot water to reach the tap. Moreover, by maintaining a constant high temperature in the pipe, *Hotrace* prevents the growth of potentially dangerous bacteria such as *Legionella*.

Hotrace is offered in zone parallel *Meterheat* or self-limiting versions and can be used in conjunction with any type of pipe work or water heating system currently in use. These allow the system to be activated section by section and/or by time control. The system is particularly useful for hospitals, hotels, factories, etc.

The hotrace is the development of Jimi-Heat Ltd, 200 Rickmansworth Road. Watford, Hertfordshire. WD1 7JS England.

SMALL GREEK ISLAND GETS WARMER LIFE WITH SOLAR ENERGY PLANT

Athens—The Greek island of Gavdos, a five square mile triangle covered with juniper bushes, is the only place in Europe to rely completely on solar energy all year round.

A photovoltaic power plant set up by Siemens of West Germany in co-operation with the state, owned Public Power Corporation (PPC) produces 20 kilowatts at peak operating periods, supplying the 60 islanders with electricity for lighting refrigerators, televisions and a telephone network.

Although the PPC is committed to electrifying all inhabited Greek islands. Gavdos remained a low priority. It lies in the Libyan Sea, 24 miles south of Crete, and is often cut off in stormy weather. Its population was diminshing steadily as families moved away.

However, since the photovoltaic plants started up in 1987, migration has halted and a small summer flow of tourists is gradually increasing. "Govdos was a classic case for the application of solar power, but it had to be a plant of extremely simple design, requiring almost no maintenance," says Hilmar Kadella of Siemens Solar, the company's solar energy subsidiary.

The central generator which serves two small villages, consists of 160 solar modules arranged in eight parallel rows on a south facing hillside. Another six isolated homes are equipped with independent solar panels. Among them are the island's two tavernas, each with a 700 watt peak output, enough to keep tourists supplied with cold drinks.

A derelict windmill was restored to house a specially designed four-quadrant solar inverter to convert direct to alternating current for operating low-consumption domestic appliances. It is claimed to be 94% efficient. A small computer monitors the system, transferring information automatically to a floppy disc which is sent to Athens every month for the PPC to analyse.

The 144 circular solar cells, which convert sunlight directly into electricity, are made of monocrystalline silicon sliced to a thickness of half a millimetre. They have a 10 cm diameter and an output of 130 watts each Mounted on the modules beneath highly transparent tempered glass, their expected life span is about 10 years.

Lead-acid storage batteries are housed in an adjoining dry stone building similar to the islanders' houses. The 250 units can store a five-day power supply, the maximum length of time that Gavdos, the southernmost, of Europe point is likely to be without sun-shine.

The plant, designed by a Greek architect who specialises in solar projects, was constructed with a view to fitting in with the landscape. It cost $432,000, one third of which was covered by the European Community.

One the central generator stared each family was presented with a refrigerator, television and lighting fixtures designed to consume at least 50% less energy than to usual household appliances. The 11 watt light bulbs burn as brightly as a normal 75-watt bulb, while the television uses 38 instead of 120 watts and the refrigerator 70 instead of 150. An islander checks the plant every week and a PPC technician visits occasionally to regulate the batteries. Short circuits in the grid caused problems at first, but last winter the power supply was maintained without a break.

Other remote regions of Greece are unlikely to become fully dependent on photovoltaics, however. The limitations are already clear on Gavdos, for there is not enough power available for appliances like cookers, washing machines and air-conditioners which consume larger amounts of electricity.

Expanding the solar generator would be costly since expensive monocrystalline cells are still preferred for large-scale power generation. Solar cells made from amorphous silicon, which is thinner, less pure and considerably cheaper, are widely used for calculators and watches but it will be some time before they can replace the sturdier, more light absorbent monocrystalline variety.

The PPC wants to put a wind generator on Gavdos. "Wind is the obvious way to meet increasing demand. It's cheaper than photovoltaics in Greece, and it's complementary because it's abundant in the winter," says George Betzios of the PPC's alternative energy department.

A pilot wind-solar project by Siemens and the PPC on the island of Kythnos, near Athens, has proved successful. Five 35 kW wind generators and a large photovoltaic unit peak output of 100 kW both feed into the local grid, backing up a diesel powered system serving 2,000 residents.

The most cost-effective use of photovoltaics in Greece may be for the more than 1,000 light-houses and beacons scattered around the mainland coast and the islands. A demonstration project by Siemens at the Sapientza light-house in south-western Greece, on the main sea lane from the Aegean to the western. Mediterranean mixes photovoltaics and a small wind generator to operate a rotating flashing light.

A new rotary beacon, powered by 10 solar modules with peak output of 1.3 kW replaced an old oil-fired beacon and a rotation mechanism that had to be rewound manually every two hours by the lighthouse keepers. The storage batteries can keep the lighthouse operating for 12 sunless days. It is now unmanned a digisponder monitors the system and automatically telephones the local coastuard if something goes wrong.

GLOBAL WARMING, OIL CRISIS PUT FOCUS ON WIND ENERGY UTILITY

Palm Springs, California (UPI)--California's wind-energy, industry, often viewed with scorn as a tax-supported pie-in-the-sky idea that didn't work very well, has been polishing up its maverick image.

Helping, too, wind-energy companies say, is the current Gulf crisis, which has fuelled a dramatic run-up in oil prices and focused attention on alternative energy sources.

"We're still trying to get out from under the tag of being a tax shelter". Said Miles Barrett, co-owner of Wintec Ltd., which operates several wind-farms near the desert resort town of Palm Springs, one of the three major wind energy sites in California.

"But I think we're changing a lot of perceptions, a lot of the myths". said Barrett, who also is president of a trade group, the Desert Wind Energy Association. With 4,000 turbines in the Coachella Valley, wind energy generated about the same amount of electricity—540 million kilowatt-hours—as used by the 93,000 homes in Palm Springs area last year.

Palm Springs, about 100 miles (180 km) east of Los Angeles, prides itself on being an elegant winter vacation spot, with the finest shopping and restaurants. It has a highly conservative political outlook and did not take kindly to the presence of thousands of windmills north of town which sprang up a decade ago in the wake of $ 40-a barrel oil.

The presence of alternative energy tax credits, at both the federal and state level, led to 3,000 turbines being erected locally by 1985, when the credits expired. Two other California areas—the Altamont Pass east of San Francisco and the Tehachapi Pass east of Bakersfield—saw a boom in wind turbines.

The result was that wind energy from the state's 14,000 turbines supplies more than 2 billion kilowatt-hours per year. That's well over 1% of the state's electrical demand.

But Palm Springs was not impressed. The city twice filed suit over placement of the machines.

The suite resulted in settlements that limited where windmills could be placed and concessions on the height and colour of the machines. Residents living near the windmills complained that the machines were noisy.

But those attitudes appear to be changing.

"There has been a strong turnaround in the city's relationship with the wind industry". Said Douglas Evans, assistant planning director Palm Springs. Increasing concern over the environment is part of the reason for the change in attitude, Barrett said.

"We've been suggesting to Palm Springs that the Windmills can help it position itself as an environmentally concious resort destination", he said.

Locals also complained the wind turbines often didn't work.

Barrett admits that in its early years, the wind industry often erected machines that broke down.

"The loads that these machines are subjected to turned out to be much heavier than what had been expected", Barrett said.

As a result, state-of-the-art turbines tend to be much bulkier than the earlier models, built by American, Danish and Japanese companies. Mitsubishi has made a splash in the business by offering a turbine with a warrantly of an unprecedented length—eight year.

Randy Swisher, executive director of the American Wind Energy Association, said that as a result of technical improvements, the availability factor for operating turbines has gone from 60% in 1990 to 95% today.

"There was really nothing like the wind farms even a decade ago". Swisher said. "And now there are some fundamental questions—does it work, is it reliable—that have been settled, for anyone who's knowledgeable about the industry".

The wind power generated near Palm Springs at the San Gorgonio Pass is fed into power lines that lead to Southern California Edison's Devers substation and then directly in to the Edison power grid, which serves nearly 4 million Southern California customers.

Edison pays the wind farms according to contracts set in the early 1980s at a rate that was based on the equivalent of $30 a barrel for oil.

Opponents of wind power have argued that when oil prices were resting comfortably at less than $20 a barrel before the current Gulf crisis Edison was paying twice as much—about 7 cents a kilowatt-hour—for wind power than it would have for energy from a conventional gas, or oil-fired plant. That translates to higher rates for customers.

Negative Costs

But proponents point out that such an assertion fails to take into the negative costs of fossil fuel plants.

Edison also has similar contracts with Tehachapi wind farms, which makes it the world's largest buyer of wind power. Ran Luxa, supervisor of power contracts at the utility, said Edison has no plans to seek more wind power.

"We have no need for any more capacity right now", he said. "We probably won't until 1996".

In northern California, Pacific Gas and Electric buys the power from the operators in the Altamont Pass area. It is working on a $16 million project with the Electric Power Research Institute and industry leader US Windpower of San Francisco to build a "utility grade" turbine with a 33-metre blade.

The machine would be about twice the size of conventional turbines and use variable speeds. Most turbines operate at a single speed and cannot spin as fast as the wind blows.

California currently produced about 85% of the world's wind power and Hawaii has some significant development. Denmark now is producing about 2% of its power with wind, and developments are going up in Britain, India and Spain.

Nick Lennson, a research at the Worldwatch Institute in Washington, D. C., said the prospect of global warming, combined with the Gulf crisis, is likely to spur wind power growth in the short-term, with an acceleration over the long term.

"It's not a technology that's a long way off", Lennson said. "It's here today and being refined".

IMPROVED MUD CHULHAS WITH CERAMIC LINERS

New improved mud "chulhas" with ceramic liners, which are more durable and can retain their shape and heat after repeated use, have been developed by the Technical Backup Support Unit of the Central Glass and Ceramic Research Institute's Khurja centre in Uttar Pradesh.

The prefabricated ceramic liners have considerably high mechanical strength, low thermal mass, low conductivity and high thermal shock resistance.

These liners can withstand the severe and continuous thermal loading during cooking for several hours.

CGCRI, which has standardised the raw material composition, design and fabrication techniques for commercial production of the ceramic liners, has disseminated the technology package to rural potters through 14 training-cum-demonstration programmes during 1989-90.

The scientists used raw materials like common clays, plastic fireclays and ball clays which are easily available and cheap, as well as additive such as red clay grog, fireclay grog, low-grade talc, silica and agrowastes like rice husk.

Two types of energy-efficient wood-fired kilns, which were superior to and safer than traditional kilns were used to fire the ceramic liners at a moderately high temperature and low cost.

The technology would go a long way in eliminating human drudgery and improving the economic standards and quality of life of rural potters, reports a newsletter of the Council for Scientific and Industrial Research.

ISRAELIS SEE WIND AS VALID SOURCE OF ENERGY

"SHIMSHONE ! Take a rest at 20 metres and let the basket down slowly. "Dr. Eli Ben Dov shouts up orders as his assistant climbs the 60-metre tower to change the warning lights at the top. It is a bright, sunny, windless, morning and the nearby turbine is still.

Israel has been exploring alternative sources of energy to decrease its dependence on imported oil and coal since the energy crisis of 1973. While most investigations focussed on the exploitation of solar power, a major project involving power from the wind was also undertaken.

The site, near Moshav Yodfat, is in area of 28 small settlements called Misgav, midway between Haifa and Tiberias. This particular spot was chosen because it has the strongest average wind in Galilee-seven metres a second.

Dr. Ben Dov studied electrical engineering at the Technion in Haifa where the subject of his master's thesis was wind power. Following completion of his studies he went to work for the Israel Electric Corporation and tried to spread his enthusiasm about wind power to his superiors. "When I first suggested the idea to them". he says. 'They looked at me as if I were a Don Quixote. It was very difficult to convince people to see wind as a valid source of energy".

"In January 1986', he continues, "chossing a particularly sophisticated Belgian model. The turbine has been working for almost four years and production is outstanding. There hasn't been a single serious breakdown. I call this a success rate of 117% since it puts out 17% more electricity than we through it would".

The 22-metre high turbine supplies 225 kw of electricity at wind speed of 14 metres a second. The pole is hollow, housing the computer system and a ladder for climbing up to repair the blades, which weigh 500 kg each and have a diameter of 25 metres. Sensors constantly check wind conditions, while the blades rotate for maximum utilisation of the wind, no matter which direction is comes from.

The experiment has been so successful that the Israel Electric Corporation is now planning a farm of 25 turbines along a chain of hills running east from Yodfat to a settlement called Hararit. The $6 million project is expected to supply electricity to all the settlements of the region as well as to part of the nearby city of Carmel.

Much attention is paid to the ecological factor. "We will be very careful", says Dr. Ben Dov. "This is a lovely area and we work with ecological groups in order to keep in beautiful".

In the United State some 12,000 turbines are already at work harnessing energy from wind. Israel's first project is just getting underway and will have to overcome the suspicion of local inhabitants, some of whom see the turbine as an intruder. "It it doesn't give us free electricity, why should we have it here ?" one resident asked sourly.

As a meek breeze starts. the turbine rotates its blades, grouping for the wind. It starts to turn sluggishly, picking up speed as the breeze gets stronger, eventually spinning like a pin-wheel in the hills. The image dazzling.

WATERSAW CUTS, TRIMS, SLITS MOST MATERIALS

The "Marvel'. watersaw uses a high pressure stream of water to cut through titanium, high alloy steels, aluminium, rubber, stainless steel, lead, ceramics, glass, Kevlar and other metals and composites.

Under pressure up to 1867 kg/cm², the water is forced through a nozzle at speeds up to 869 m/sec. Nozzle diameters range from 0.30 mm to 0.61 mm. Adding an abrasive like silica, sand or garnet into the jet-stream enables the watersaw to make deep cuts into materials like titanium. The device features omnidirectional cutting capabilities and kerfs from 0.13 to 0.28 mm : Armstrong Blum Manufacturing Co. 5800 W. Bloomingdale Ave, Chicago IL. 60639, USA.

SAWDUST BECOMES FUEL

Briquettes made from sawdust could offer a very economical substitute fuel for Ghana's 16 brick and tile factories.

Each year, these factories burn 72,000 tons of wood for fuel while 90 per cent of the sawdust produced by Ghana's 100 sawmills goes to waste. Simply converting half of this sawdust into fuel briquettes would satisfy all the energy needs of the factories. The sawdust briquette factory in Akim Oda is currently the only one supplying this kind of product. Recently, production has tripled, to 3,000 tons per year.

The National Energy Bureau envisages using the sawdust briquettes as a weapon against deforestation. Some 112,000 hectares of orest are destroyed each year to supply wood for fuel.

PLASTIC TREES FOR DESERT FORESTS

Spanish inventor Antonio Ibanez Alba claims to have developed an artificial tree which, he says, is capable of making deserts turn green within 10 years if used in sufficient numbers alongside natural trees. Several North African nations are committed to trying out the device, including Libya which is planning a pilot scheme of 30.000 to 40,000 trees.

Ibanez Alba, an electronic engineer from Barcelona, says his invention, coupled with reforestation programmes of natural trees, will turn deseart areas green by changing the meteorological patterns in the desired zones, principally through the increase of precipitation, "If rain is caused by the meeting of cold and warm air, all you need to do is create a source of low temperatures to spark precipitation", says Ibanez Alba "That", he adds, "in a nutshell, is what this tree is all about".

The tree creates cooler air by absorbing the moisture that condenses onto its surface during the cold desert nights and retaining it in the body of the tree. In the heat of the day the moisture is slowly released, cooling the air. The tree—between 7 and 10 metres tall—is the product of four years of research and laboratory tests. It is made from inexpensive, fire-resistant polyurethane and phenolic foam, and imitates the stages of evaporation and condensation of a natural tree but does not require artificial or natural irrigation.

Similar to its natural counterpart, the tree is divided into three parts ; roots, trunk and leaves. The stiff tubular trunk is filled with a polyurethane material which is riddled with channels which absorb water by capillary action. Several layers of polyurethane of different densities were designed to retain water and release it slowly during the course of the day. At the base of the trunk, the density of polyurethane is 6 kilograms per cubic metre, while at the top it is 4.5 kilogroms per cubic metre.

Because of the high winds in desert areas—sometimes as high as 140 kilometres per hour—the trees need strong roots. These consist of three hollow tubes with holes along their sides arranged like a tripod at the base of the tree. After planting, polyurethane injected into the tubes at high pressure oozes out into the soil to form long extrusions of polyurethane. These cool after 30 minutes and can extend up to 20 metres from the tree to give a strong anchorage.

"If we could build and plant artificial woods with millions of these trees and then sow natural trees in the same number and percentage once the cycle of rain patterns has begun to take place, within a 10-year period the deserts could be reforested", says Ibanez Alba.

The inventor believes the main advantage of his tree is that it requires no maintenance, and he cites the recent case of reforestation programme in Nigeria that failed because of lack of irrigation and skilled labour.

ENVIRONMENTAL AND MANAGEMENT ASPECTS OF AIR AND WATER POLLUTION FROM INDUSTRY

Industrial Human Resource Development Branch (DIO) of United Nations Industrial Development Organization (UNIDO) will organise a six weeks Training on "Environmental and Management Aspects of Air and Water Pollution from Industry", at Belgium in August-September '91.

For further information contact :

Industrial Human Resource Development

Branch, (DIO)

United Nation Industrial Development

Organization (UNIDO)

P. O. Box 300, A-1400

Vienna, Austria.

MICRO-HYDRO POWER TRAINING COURSE

Intermediate Technology Development group, Colombo, Sri Lanka, will organise a "Training Course on Micro-Hydro Power" from 3rd to 22nd September '91 at Sri Lanka.

For further information Contact :

Course Co-ordinator

Micro-Hydro International Course

ITDG, 33-1/1

Queen's Road,

Colombo

Sri Lanka

BIOGAS COURSE AND STUDY TOURS

Biogas Research and Training Centre for Asia and the Pacific (BRTC) China will organise a "Short-term Biogas Course and Study Tours" from Ist to 20th November '91 at Sichuan, China.

For further information contact :

Secretary of Foreign Affairs,

Biogas Research and Training Centre

for Asia and the Pacific, No. 13,

4th Block, People's South Street Chengdu

Sichuan,

P. R. of China.

RURAL WOMEN IN POST HARVEST LOSS PREVENTION

CIRDAP's Link Institution will hold a Regional Workshop on "Training of Rural Women in Post Harvest Loss Prevention", at Sri Lanka in September '91.

For further information contact :

Centre on Integrated Rural Development

For Asia and the Pacific (CIRDAP)

Chameli House, 17 Topkhana Road

GPO BOX 2883

Dhaka-1000

Bangladesh.

SOLAR ENERGY FOR THE 21ST CENTURY

American Solar Energy Society USA will organise a conference on "Solar Energy for the 21st Century" from August 17th to 24th '91 at USA.

For further information contact :

American Solar Energy Society

2400 Central Ave. B-1

Boulder Co. 80301 USA

(303) 443-3130,

AGRICULTURE SYSTEM MANAGEMENT COURSE

The National Institute of Public Administration (INTAN) Malaysia will conduct a five weeks International Training Course on Agricultural Development titled 'Agriculture System Management Course' at Malaysia from 9th September to 12th October '91.

The course will cover commercial agricultural development approach, establishment of relevant agricultural development system based on marketing technology and managerial level, management technique systems, review management aspects on successful systems and their experiences, case study and workshop.

For further information contact :

The Director

Institute Tadbiran Awam Negara

(INTAN), Peti Surat 1154,

Jalan Pantai Baru

59700 Kuala Lumpur, Malaysia

MONITORING AND EVALUATION METHODS AND TECHNIQUES IN RURAL DEVELOPMENT

CIRDAP will conduct a three weeks "Third Regular Regional Course on Monitoring and Evaluation Methods and Techniques in Rural Development" during November '91. The course is intended for middle level to top level officials engaged in planning, implementing, monitoring and evaluating IRD Programmes.

For further information Contact :

Centre on Integrated Rural Development

for Asia and the Pacific (CIRDAP)

Chameli House, 17 Topkhana Road

G. P. O. Box, 2883

Dhaka 1000

Bangladesh

ENVIRONMENT AND DEVELOPMENT

United Nations will conduct an U. N · Conference on Environment and Development (UNCED) in June '92.

For further information contact :

UNCED Office United Nations

New York, NY 10017 USA

OR

Centre for Our Common Future

52 rue des Paquis

CH-1201 Geneva

Switzerland

VERTEBRATE PEST PROBLEMS AND SOLUTIONS IN DC's

Department of Fishery Wildlife Biology, Colorado State University USA, will conduct "Third International Short Course on Vertebrate Pest Problems and Solutions in Developing Countries from 4th to 22nd August 1991, at Colorado State University.

The Course is for individuals working or planning to work with vertebrate pest control projects, students of agriculture, forestry, wildlife biology and related subjects are also invited. After the short course, there will be an opportunity for participants to visit the Denver wildlife Research Centre and/or its field stations or other vertebrate pest management programmes in the United States.

For further information contact :

Dr. Julius G. Nagy,
Emeritus Professor,
Dept. of Fishery and Wildlife Biology
Colorado State University
Fort Collins,
CO 80523, USA.

ENERGY AND ENVIRONMENT

Centre of Energy Technology, Helsinki University of Technology, Espoo, will organise "1991 International Symposium on Energy and Environment" at Espoo, Finland, from 25th to 28th August '1991.

For further information contact :

ISEE Symposium on Energy and Environment,
Helsinki University of Technology,
Centre of Energy Technology
Otakari 4
02150 Espoo
FINLAND

WATER POLLUTION

Wessex Institute of Technology, England, will organise "First International Conference on Water Pollution" from 3rd to 5th September '91 at Southampton, U. K.

For further information contact :

Ms Liz Newman
Computational Mechanics Institute
Eessex Institute of Technology
Ashurst Lodge, Ashurst
Southempton 5042 A A
ENGLAND, UK.

BOOK BAG

News and Notes on Books & Publications

ENVIRONMENTAL POLLUTION : CONSERVATION & PLANNING :

Environmental disturbance such as water, air and surface pollution has become a global phenomenon, and also the main abuse of human civilisation. Incineration of rejected waste has added fuel to the fire. Negligence, mismanagement and technological snags to environmental outlook has deteroriated the ozone layer of the earth. Urban solid wastes which comprise bio-degradable and nondegradable refuse and human excreta is assuming notoriety.

The two volumes of book deals with all these problems in details. First volume of the book deals with introduction, and various aspects of Marine Pollution, with special focus on Ganga Water Pollution. A seperate chapter deals with legislative awareness against environmental pollution. In India and in other countries of the world.

Second volume of the book deals with the problem of waste land. This volume has been divided into three parts. First part deals with atmospheric pollution, environmental degradation, preventions, environmental pollution caused by nuclear explosion and obnoxious gases.

Second part of the book deals with the problem of surface pollution, forest conservation, wasteland development etc. to reflect the views to meet out the fruitful result.

Some case studies has been also discussed in the third part of this volume. Over all book is useful for researchers who are working in the field of environmental pollution covering many aspects and problems of the same.

"Environmental Pollution : Conservation and Planning" (in two volumes) by Pashupati Nath and Siddh Nath, Pub : Chugh Publications, Allahabad, Rs. 500/- .

SCIENCE & TECHNOLOGY FOR RURAL DEVELOPMENT :

Rural Development as a concept is overall development of Rural Areas with a view to improve the quality of life of rural people. In this sense, it is comprehensive and multi-dimensional concept and encompasses the development of agriculture and allied activities—village and cottage industries and crafts, Socio-economic infrastructure, Community Services and facilities, and above all the human resources in Rural Areas. This rural development means development of the rural areas in such a way that each component of rural life changes in a desired direction and in sympathy with the other components. Science and technology is a key factor for development in developing countries. The experience of the developed countries is a pointer to the fact that technology is an important factor of production in addition to land labour and capital. Physical natural resources are limited but they through science and technology assume new uses, to become more effective and are economically more easily exploited because of the easy transport and new equipment.

In the context of rural development it has been seen what parts of innovations are likely to play how science and technology can improve the productivity of the masses living in the rural areas.

The present study examines the various aspects of rural areas, such as rural poverty, poverty eradication programmes and place of Science and Technology in the development of rural areas. The problem of rural people and the problems regarding the implementation of the various programmes of the Government have been discussed.

The author presents his views that development in Science and Technology can be fruitfully utilised for the development of the rural poor through increase in productive efficiency of investment resources as well as that of the rural labour, conservations of resources used by them improvement in their living conditions. health and sanitation. There is need, however to improve the efficiency of the information delivery system for better dissemination of knowledge and technology.

'Science and Technology for Rural Development' by Upendra Kumar, Pub : Deep and Deep Publications, New Delhi, Rs. 150/- .

ENVIRONMENTAL & INDUSTRIAL SAFETY :

Modern Society is sick of the Industrial Pollution. Industrialization is spreading so fast in the entire world that we have to urgently devise ways and means to keep our environment clean and safe.

Environmental and industrial safety will pose some of the most critical and difficult challenges to the process of industrialization in the developing countries as well as to the pace of progress in the advanced Countries. Policy strategy, systematic approach are needed to cope with problems from higher accident rates, occupational diseases, and environmental hazards.

In this book the author has tried to answer so many questions regarding environmental and industrial safety, how can an industrial manager provide a safety policy and programme ? How can an Industrial Manager provide a safety programme with least cost and little expenses ? How can an industrial manager implement and manage a safety policy and programme ? etc.

The book is divided into fourteen chapters including the importance of Engineering Management, Economics, Industrial Psychology, Medical Science, Sociology, Environment, Government and Politics in the study of Industrial and occupational safety, Health and hygiene.

"Environmental and Industrial Safety", by Dr. A.H. Houmadi, Pub : Indian Bibliographies Bureau, Delhi, Rs. 250/-.

ENVIRONMENTAL RESOURCES : THE CRISIS OF DEVELOPMENT :

Man's interaction with environment and physical resources, which had started millions of years back. Ever since the advent of human species upon the planet, has increased in magnitude today with the meteoric growth of population and the industrialisation of human society.

The aim of this volume is to present a systematic account of the various aspects of resource development in their geographical perspectives. All chapter of the book covers a wide spectrum of human responses to resource utilization of the environment. Having not been structured within any single approach they present a compressed and selective account of various facts of man-environment relationship in a tropical countries like India.

All research papers of the book provide the diversified aspect of resource development. The field of environmental studies integrates the natural Sciences with environmental ethics, environmental economics and planning in the broad spectrum of relationship between people and environment. With the unprecedented growth in population and its consequential effects on the exploitation of natural resources, man is at cross roads today to consider the economic and social development process to be in harmony with natural environment.

The book expounds upon the central theme whether the positive benefits of technology and resource development outweight the negative ones of degradation of environment.

"Environmental Resources" : The Crisis of Development, by H. S. Mathur, Pub : RBSA Publishers, Jaipur. Rs. 190/-.

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RURAL TECHNOLOGY JOURNAL

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 :—

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

Note for the guidance of authors :

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1. The complete manuscript should be written in English and the desired order contents of Title, Abstract, List of symbols, Main Text, Acknowledgement, Reference and Appendices. The Standard International System of Units (SI) should be used.
2. The manuscript should be typed on one side of the paper only (preferably 8"×11" bond paper) with double spacing between lines and 1½" margin on the left.
3. Two copies of the manuscript and illustrations (one set original) should be sent to the Editor.
4. The title should be brief (maximum of 150 characters including blank in between words or other non-alphabetical characters) and followed by the author's name, affiliation and address.
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