UTILIZATION OF COMMON PROPERTY RESOURCES FOR MAKING A VILLAGE SELF-RELIANT - A CASE STUDY.

R.C. MAHESHWARI
ASSISTANT DIRECTOR GENERAL(CSC)
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
NEW DELHI

ABSTRACT

The increased population pressure has resulted in an increasing need for timber, fuel and fodder which has cused degradation of forest land by excessive tree lopping and overgrazing. An integrated approach has been made to develop a hillock wasteland falling under classes IIIes and VIes of land capability classification in watershed management plan, for achieving fuel and fodder security in an adopted village Islamnagar under Operational Research Project On Integrated Energy and Nutrient Supply System. An Energy Census and Resource Assessment Survey of this village (Maheshwari, et al, 1981) showed that village was in deficit of fuelwood by 98.8 tonnes (20.8%) and cattlefeed by 812 tonnes (30%).

The total area of the village is about 717.04 ha out of which 61.6 ha is forest land, more than half of the forest land comprised hilly terrain and completely denuded of its trees, the rootstocks of which still existed. In order to meet fuelwood and fodder demand of the village, 38 ha appropriate land identified on the bsis of land use planning, has been brought under silvipastural development with early growing tree species and high yielding varieties of the grasses. The soil and water conservation measures taken include contour survey, cut off trenches along the contour at 5-10 m vertical interval, vegetative waterways, drainage ditches, cattle protection trenches and kachha service road along the boundary of the area, temporary erosion control structures and micro-catchment water harvesting for insitu water conservation. In addition to meeting fuelwood and fodder demand and other intangible benefits, the silvipastural development of identified wasteland would generate 115421 man-days work during a life span of five years.

UTILIZATION OF COMMON PROPERTY RESOURCES FOR MAKING A VILLAGE SELF-RELIANT

A CASE STUDY

. . . . .

DR. R.C. MAHESHWARI
ASSISTANT DIRECTOR GENERAL (CSC)
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
NEW DELHI

* . * . *

BACKGROUND

In order to develop energy and plant nutrient supply systems and their management practices suiting to different sections of rural community in an identified village, an Operational Research Project on Integrated Energy and Nutrient Supply System was initiated at CIAE, Bhopal in March, 1984. An Energy Census and Resource Assessment Survey was carried out in 1981 to assess the energy use pattern by different categories of farmers for production agriculture, post-harvest operations, cattle raising and domestic activities (Maheshwari, RC et al, 1981). Fig-1 illustrates the total energy and material flow in the villagae Islamnagar ecosystem. The village had 224 households with a total human population of 1529 and total livestock population of 1436. Out of 16 TJ of total energy used in the village annually, the crop production accounted for 14.9%, post-harvest activities accounted for 0.49%, livestock raising accounted for 0.84% while the major share of 83.76% went to the domestic sector (mainly for cooking).

The village was surplus with regard to cereals, vegetable, sugarcane and milk. However, there were annual deficit with regard to fuelwood by 20% (98.8 tonnes), cattle feed by 30% (812 tonnes), oilseeds by 71% (23 tonnes) and pulses by 32% (7.2 tonnes).

Out of 46,000 TJ of solar energy received by the

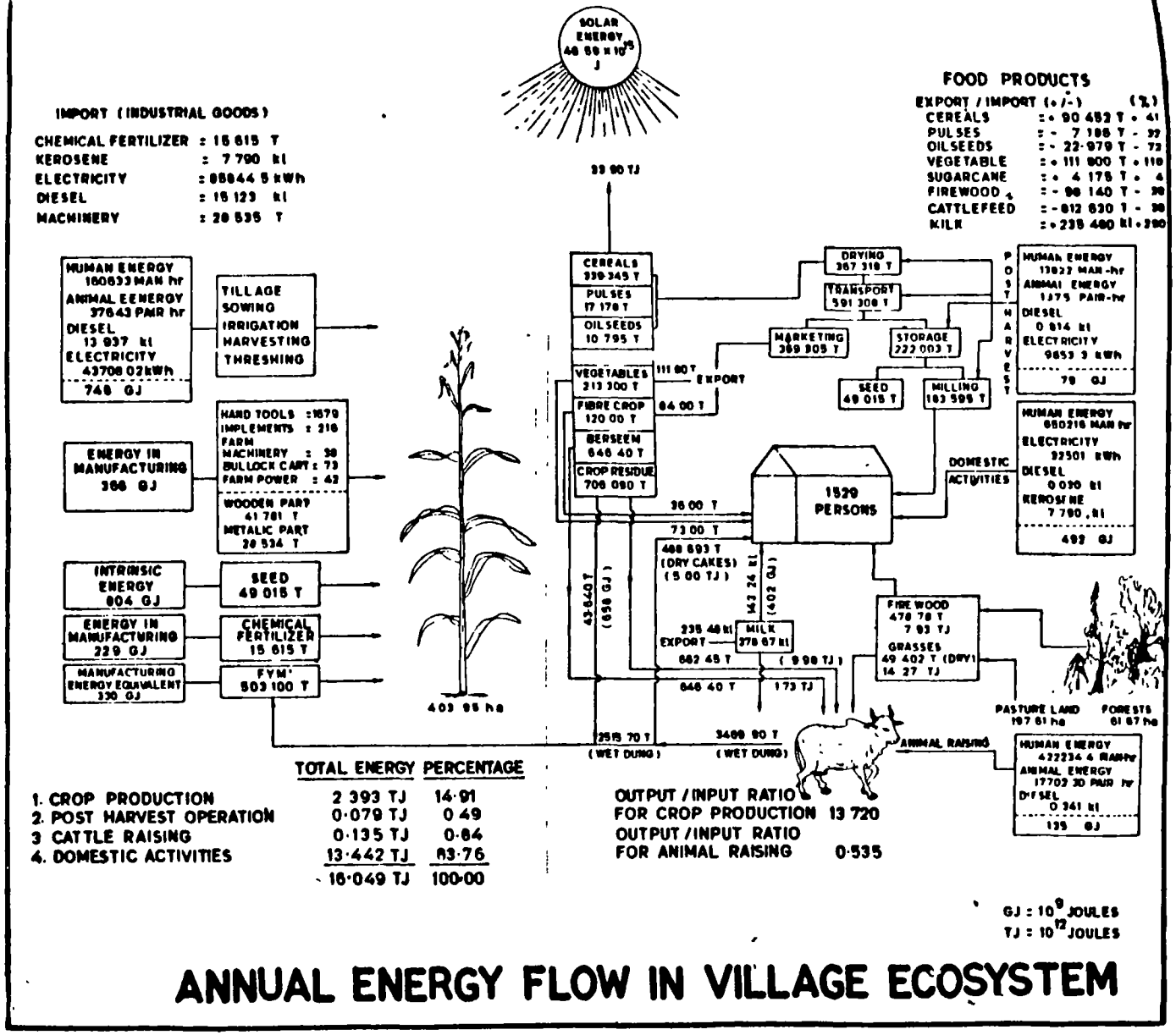


Fig. 1 Annual energy flow in village ecosystem

geographical landmass (717 ha) of the village, only 40.44 TJ is converted into food, feed, fuel and fibre. In order to achieve this conversion, 0.27 TJ from chemical fertilizer, 0.37 TJ from machinery, 0.46 TJ from diesel and 0.16 TJ from electricity are consumed as illustrated in Fig-2. The aforesaid energy census survey has become the basis for planning and implementation of the village development based on alternate and renewable energy sources for achieving the self-sufficiency in fuelwood, fodder, pulses and oilseeds production and its processing at village level. This was the Gandhian concept fifty years go.

The survey of resources availability and consumption patterns has identified the area of deficiencies and excesses in the village ecosystem. Even before independence, the Gandhian Philosophy had advocated to make the village self-reliant at the village level itself. Forty or fifty years back economic conditions were not ripe for its success, where as in today's economy and development in India, such efforts have much greater potentiality to bear fruits as demonstrated in this paper.

Presented in the present document are the planning, implementation and to some extent, monitoring of the above mentioned self-sufficiency plan with regard to fuelwood, fodder, puses and oilseeds based on renewable energy sources.

Planning for Self-sufficient in Fuelwood Supply System

The daily per capita consumption of fuelwood and dung cakes for cooking in the village amounts to0.85 kg and 0.88 kg, respectively. Thus, village consumes 474 tonnes of wood and 448 tonnes of cowdung annually for cooking. Besides augmenting the fuelwood supply, attempts have been made to reduce the demand of fuelwood and cowdung or cooking by (i) improving the thermal efficiency of wood stoves, (ii)

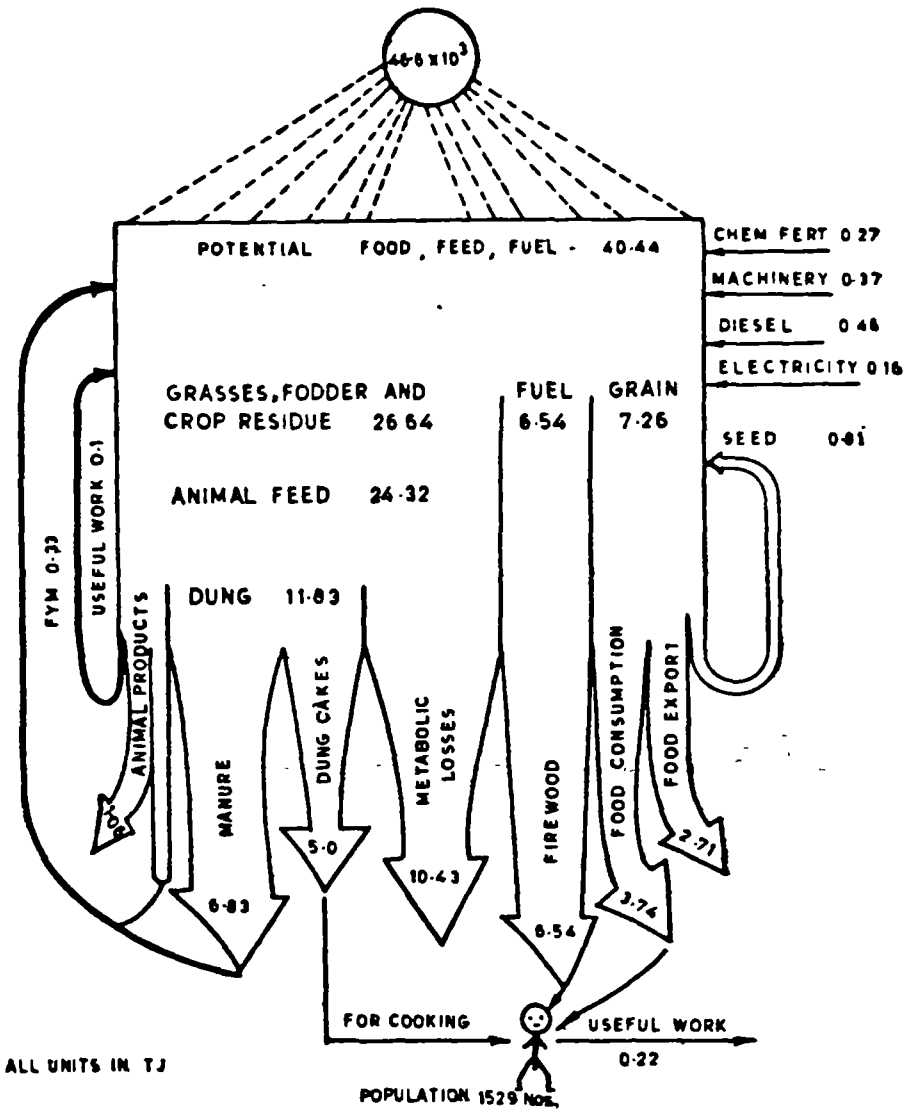


Fig 2. Sankey dia illustrating solar energy flow in the village ecosystem

installing the individual and community biogas plants. It has been estimated that 50 individual biogas plants (4 to 8 cum capacity) and three community biogas plants of 85, 35and 35 cum capacity would be able to meet the NPK requirements of crop production by 28% (so far, 42 individual and two community biogas plants have been commissioned in the village. Out of 224 households, 150 houses have been provided with smokeless stoves). In order to remove the twenty percent deficit of fuelwood the planning is as under :

i)	Total annual deficit	:	98 tonnes
ii)	Annual tree yield	:	4-6 kg/year
iii)	Number of tree required (assuming 5 kg/tree/year)	:	20,000 nos
iv)	Number of tree to be planted (assuming 50% mortality rate)	:	40,000 nos
v)	Number of tree to be planted/ha	:	1000/ha
vi)	Area required for plantation	:	40 ha
vii)	Area available for plantation	:	61 ha

Planning for Self-sufficiency in Fodder Supply System

The village ecosystem carries a total animal population of 1353 numbers (excluding poultry birds) and has a pasture land of 132 ha. The total fodder available on dry weight basis is 129.3 tonnes of berseem, 1186.3 tonnes of grasses and 662.4 tonnes of crop residue amounting to 1928 tonnes of fodder. However, the requirement of fodder on the basis of standard feed requirement works out to be 2740 tonnes (dry weight). Thus, there a shortfall of 29.65%. The above shortage can be overcome with the following planning :-

i)	Animal fodder deficit	:	812 tonnes
ii)	Available land for pasture development	:	132 ha
iii)	Potential of high yielding grasses 4 t/ha	:	528 tonnes

iv) Grasses from afforestation land : 80 tonnes
at the rate of 2 t/ha (40 ha)

Planning for Self-sufficiency in Pulses & Oilseed Production

The village has 224 households with a total population of 1529. Presently they consumes about 245 tonnes of cereals, 25 tonnes of pulses and about 14 tonnes of eduble oil annually. Considering the standard diet as per the National Institute of Nutrition, the production system is presently deficient in pulses by 32% and in oilseeds by 71% is surplus in cereals.

The reallocation of land in the village Islamnagar based on the land use planning prepared by the NBSS&LUP, Nagpur (Deshmukh, 1983) has been done by using systems engineering approach to make the village self-sufficient in pulses and oilseeds.

The survey of resources availability and their utilization has shown the scarcity of irrigation water in the village to the extent of 28 percent. To overcome this problem, installation of six units of hydram lift irrigation system on Patra river has been planned and the renovation of the existing water harvesting pond 11.33 ha-m capacity is being carried out. A package of energy efficient implements and tools has been worked out for the village as a whole to increase the yield through timeliness of operations.

IMPLEMENTATION AND MONITORING OF THE PROGRAMME

Installation of 50 individual biogas plants of 3.5 cum/day average capacity and three community biogas plants of 35, 35 and 85 cum/day capacity would produce 72270 cum of biogas and 578 tonnes of farm yard manure from the biogas slurry. The biogas generated would meet 58.2% of cooking energy requirement. On the other hand, 9.25 tonnes of

nitrogen, 1.73 tonnes of phosphorus (P_2O_5) and 2.45 tonnes of potash (K_2O) are required at the level of self-sufficiency in crop production (Fig-3). So far, two community and 43 individual biogas plants have been installed in the village and 150 houses have been provided with smokeless stoves. To cover 20% fuelwood deficit, energy plantation on 25 ha land at the hillock has been developed. This has led to the protection of more than 10,000 existing rootstocks of 20 species of trees. The village has 132.7 ha of pasture land and planting of high yielding grasses and fodder under social forestry programme will cover 70% of the deficit. During the first phase, an area of 10.72 ha was taken for seeding with cenchrus setigerus and chenchrus cilliaris grasses and an area of 0.98 ha was transplanted with cenchrus setigerus grass seedlings and adopted for silvipastural farming systems. 80,000 Napier grass slips were brought from BAIF, Urli-Kanchan (Maharashtra) and a nursery has been raised.

Land in Islamnagar has been reallocated on the basis of the land use planning done by the NBSS&LUP, Nagpur, by adopting systems engineering approach to make the village self-sufficient in the pulses and oilseeds production. Efficient soil and water management planning forms the basis for increasing production and productivity. In addition, a package of improved tools and implements has been adopted for the village as a whole.

The survey of resources availability and their utilization has shown scarcity of irrigation water in the village. Only 48.5% cultivable land is under irrigationat present from the existing sources of water. To overcome this problem installation of hydram lift irrigation system on Patra river has been planned and installation of three units of 12 x 2.5 in size double pipe hydram has been initiated. Renovation of the existingwater harvesting pond of 7.14 ha-m capacity and installation of additional tubewells have been planned and measures have been taken.

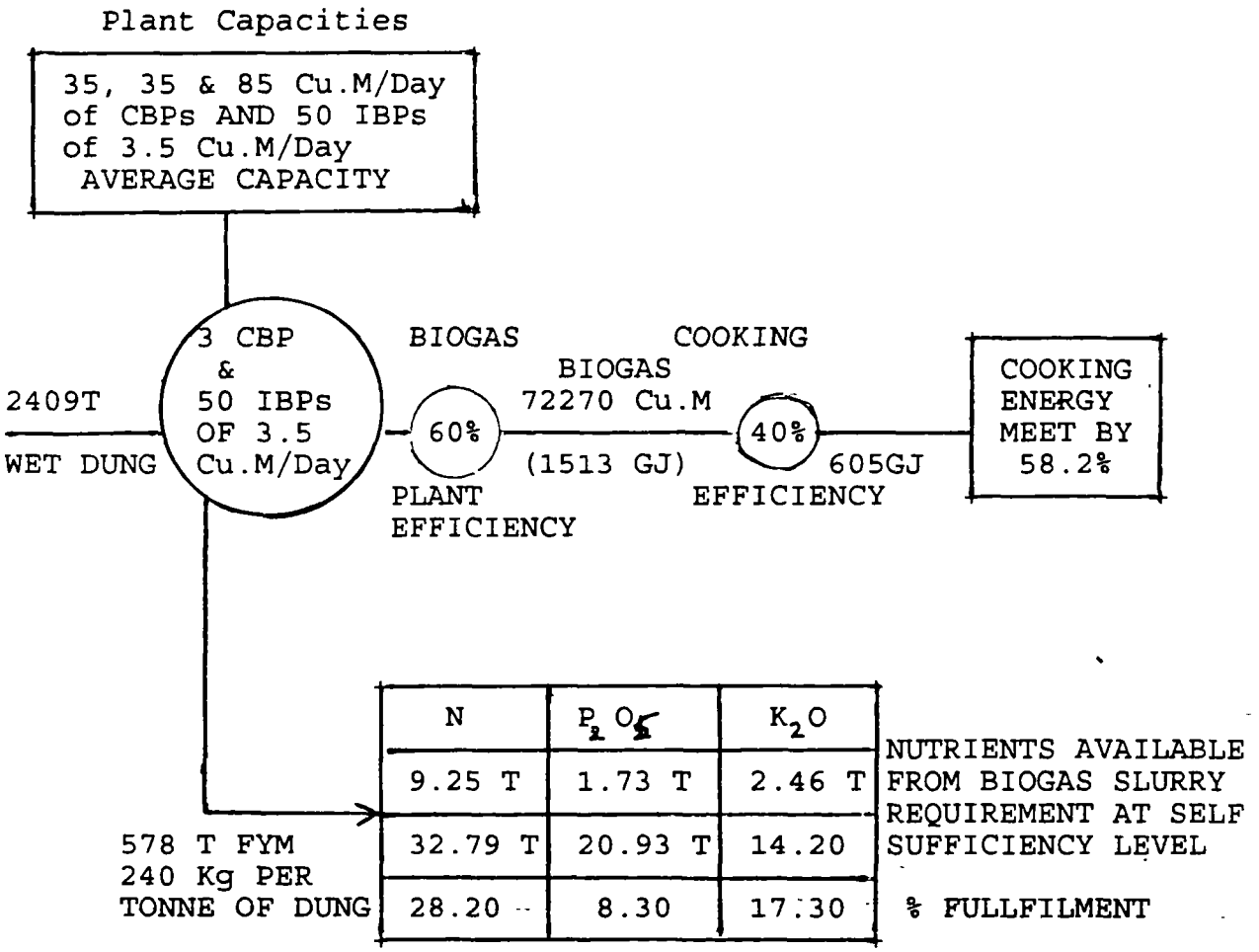


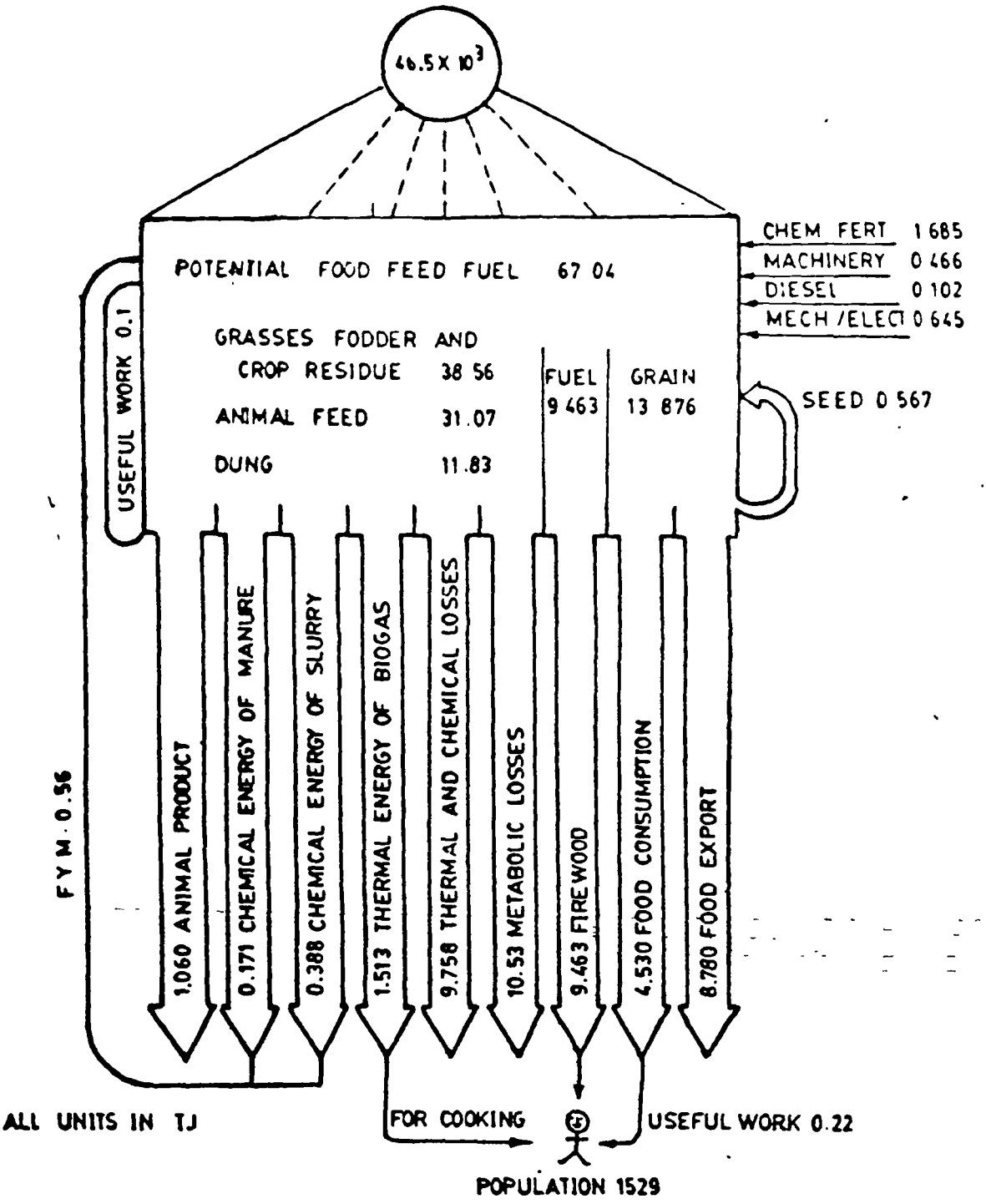
FIG.3 *REALLISTIC PLANNING OF BIOGAS TECHNOLOGY IN VILLAGE ISLAMNAGAR TO MEET COOKING ENERGY AND FERTILIZER REQUIREMENT.*

The drainage system has been designed and its execution is underway.

Implementation of various programmes for making the village self-sufficient has led to better resources utilization and increased harnessing of solar energy for its conversion to food, feed, fuel and fibre. The original and changed scenarios with regard to solar energy flow in the village ecosystem are depicted in Figs-2 and 4.

The solar energy conversion goes up from 40.4 TJ to 67 TJ and the overall photosynthetic efficiency goes up from an average of 0.0868 to 0.144%. It hass been ascertained that when the ecosystem becomes a surplus one in terms of food, feed and fuel, the actual energy requirement goes down from 16 TJ to 15.5 TJ. This has become possible through (i) reduction in wasteful use of thermal energy with traditional stoves and achieving higher thermal efficiency with the use of gas burners for the biogas, and (ii) harnessing of solar energy for additional fuelwood and grass production.

The employment potential in making the village self-reliant through production agriculture, post-harvest operations and animal raising activities goes up by about 1,00,000 man-hours (12,500 man-days) (Table-1). In addition to removal of drudgery in the domestic sector to the extent of 1,45,500 man-hours there is an increased activity in afforestation (1,15,000 man-hours) and grasses (79,000 man-hours) development programmes. Thus, there is additional generation of 12,500 man-days in a yar in the village. To manage the renewable energy technologies, a housewives society, named as, **"Ekikrat Urja, Poshak Tatva Evam Gramin Vikas Mahila Samiti"** has been organized in the village and registered with the Registrar of Cooperatives. The Samiti has raised an amount of Rs 10,000 to repair and maintain



OVERALL EFFICIENCY OF THE VILLAGE ECOSYSTEM	0.1438 %
OVERALL EFFICIENCY OF THE VILLAGE ECOSYSTEM, AT 1981 LEVEL	0.0868 %
INCREASE IN OVERALL EFFICIENCY	0.0570 %
INCREASE IN OVERALL EFFICIENCY W.R.T. 1981 LEVEL	65.70 %

Fig. Sankey Diagram Illustrating Solar Energy Flow into Village Ecosystem at The Level of Self-Sufficiency

Table 4.- Annual Man Power Requirement and Employment Generation at Self-sufficiency Level

Sl. No.	Operation	Manual energy at 1981 level		Manual energy at self sufficiency level		Additional manual energy Generation/reduction (±)	
		Man-hrs	GJ	Man-hrs	GJ	Man-hrs	(±) GJ
1.	Crop production	1,60,633	28.76	1,85,020	33.12	+ 24,387	+ 4.37
2.	Post harvest activities	13,822	2.47	23,321	4.17	+ 9,499	+ 1.701
3.	Domestic Activities	6,50,216	116.89	5,04,946	90.34	— 1,45,510	— 26.05
4.	Cattle raising	4,22,234	75.58	4,39,664	78.70	+ 17,430	+ 3.12
5.	Energy Plantation	—	—	1,15,307	20.64	+ 1,15,307	+ 20.64
6.	Grassland management	—	—	78,944	14.13	+ 78,944	+ 14.13
7.	Milk marketing	24,984	4.47	24,984	4.47	Nil	Nil

Overall increase in man-hrs = 1,00,057

Hence, total man-days generated = $\frac{100057}{8}$ = 12,507 man-days/yr

the biogas plants.

The impact of all the technologies introduced on the productivity of the land and income of the farmers has also been assessed and is presented in Table 2.

REFERENCES

Bhandarkar, D.M. (1986). Efficient soil and water conservation planning for village Islamnagar. CIAE Tech. Bulletin No. CIAE/CPE/86/48. CIAE, Bhopla, India.

Deshmukh, S.N. et al, (1983). Soil Survey & land use planning for village Islamnagar. NBSS Report No.453 CIAE, Bhopal, India.

Maheshwari, R.C. et al, (1981). Energy census and resource assessment of village Islamnagar in Distt. of Bhopal. CIAE Tech. Bulletin No. CIAE/81/28.

Maheshwari, R.C. et al, (1988). Planning and implementation of an integrated energy and nutritional security system for village Islamnagar. CIAE Tech. Bulletin no. CIAE/RES/88/83.

Table 2. Impact on Productivity, Socio-economic Conditions & Employment Generation in the Village Islamnagar

Sl. No.	Item	Technological & Economic Changes		
		1981 Scenario	1986/90 Scenario	% Change
1	2	3	4	5
I.	Changes in Village Ecosystem			
1.	Total villagers	1,529	1,726	12.9
2.	No. of households	224	253	11.5
3.	No. of farming households	131	121	-(4.5)
4.	No. of landless households	93	132	17.4
5.	No. of catles	1,427	1,648	13.4
II.	Changes in Agricultural System			
1.	Net cultivated land (ha)	403.88	430.76	6.7
2.	Total cropped area (ha)	402.00	583.43	44.5
3.	Cropping intensity (%)	99.50	135.40	36 1
4.	Total irrigated area (ha)	196.27	267.28	36.0
5.	Use of chemical fertilizers (kg/ha)	39.00	110.72	183.9
6.	Productivity (tonnes/ha)	0.986	1.43	45.0
7.	Storage capacity of water harvesting pond (ha-m)	3.53	7.14	102.3
8.	Total deiesel consumption (Litres)	13,938	22,694	66.8
9.	Toral electricity Consumption (kwh)	43,708	75,399	72.5
III.	Change in Environment and Ecology			
1.	No. of trees possessed by the farmers	1,200	2,285	90.4
2.	Original rootstock regenerated due to protection	...	10,886	...
3.	Total trees in the ecosystem (No.)	1,200	25,897	2141.4
4.	Tree species in the ecosystem (No.)	20	44	120.0

1	2	3	4	5
V.	Status of Biogas Technology			
	1. Individual biogas plants installed (Nos) ...		44	
	2. Community biogas plants installed(Nos)-		3	
	3. Biogas generated (cum/yr) ..		40 647	
	(Potential)		64,824	
	4. Cooking energy met throgh biogos ...		32%	
	technology (Potential)		52%	
	5. Annual availability of slurry (tonne)		326,8	
	(Potential)		518 6	
	6. Plant nutrient (N) met through sulrry		16%	
	(Potential)		28%	
V.	Employment generated & Drudgery Removed			
	1. No. of man-days used for			
	a] Crop production activities	20,079	23,127	15.2
	b] Post harvest acti vities	1,628	2,915	68.7
	c] Cattle raising	52,779	54,950	22.
	d] Energy plantation	---	14,412	..
	2. Drudgery reduced (women days) in domestic activities	81,277	63,188	-22
VI.	Chaneg in Economic Indicators			
	1. Net return/ha (Rs./ha) (base year 1988-89)	1,769	3,310	91
	2. Net return per farmer, Rs. (base year 1988-89)	737	2,125	188
	3. Benefit cost ratio	1.583	1.895	19