

Energy Dynamics in Human Ecosystem : Energy Fixation

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Abstract

The study on energy fixation in human ecosystem revealed that the majority of the autotrophs (84%) were engaged in primary occupation ; whereas only 12% of the heterotrophs were in primary activities. The autotrophs also availed less number working days during the year as compared to that of the heterotrophs. This showed that the heterotrophs were in better position in employment opportunities as compared to that of the autotrophs. Accordingly the autotrophs spent more total and per capita energy in primary occupation ; while the heterotrophs provided much more total and per capita energy in secondary occupation. The heterotrophs also used greater amount of energy through manures and fertilizers as compared to the autotrophs. This showed greater diversity of energy fixation in human ecosystem at the trophic levels.

Key words : Energy dynamics, Human ecosystem, Energy fixation.

The study of energy dynamics in human ecosystem involves the identification and utilization of any form of energy or matter, all activities involved in the process of making the energy in the form of commodities and other activities which follow the consumption of that energy and finally disappearance outside the ecosystem (1). In human ecosystem, the disparities in energy fixation are reflected in the economic status and material belongings of the socially differentiated people at different trophic levels. In human ecosystem, the fixation of energy may be found as human energy input in agricultural pursuits (2). From the ecological standpoint, human energy input into an ecosystem has to be evaluated in terms of the nature and amount of work done by the different social classes each of which is analogous to a particular trophic level of a natural ecosystem. This can be done through an analysis of the occupational structure of the adult male and female population covered by the survey in each trophic level. In the present investigation an attempt was made to study the pattern of energy fixation among the social autotrophs and heterotrophs.

Methods

The study area comprises five settlement clusters such as Ballavpurdanga, Sarkardanga, Kheledanga, Khejurdanga and Ballavpurpara in the

revenue unit of Ballavpur mouza. Out of the five settlement clusters in Ballavpur Mouza four belong to the scheduled tribe population, while more than 90% of the households in only one settlement cluster belong to the general caste category comprising mainly the upper caste Hindu. The study included the survey of the nature and amount of work done by the various categories of people at different trophic levels, their employment opportunities in different fields and duration of engagement in works during the year. Similarly the amounts of manures and fertilizers used in agricultural activities at different trophic levels were also recorded. Then human energy expended in performing various activities of the production process along with energy used through manures and fertilizers were estimated following the energy equivalents reported by Fluck (3) and Binning et al. (4). and are presented in Table 1.

Table 1. Energy equivalents of different inputs in production process.

Sources	Unit	Equivalent energy	
Human labor	Adult men	Man hour	1.96 MJ/hour
	Adult women	Woman hour	1.57 MJ/hour
Fertilizers	Urea/DAP	kg	65 MJ/kg
	Phosphorus	kg	10 MJ/kg
	Potash	kg	4 MJ/kg
	Cow dung	kg	3.5 MJ/kg

Table 2. Percentage share of workers in each occupation.

Population	Autotrophs	Heterotrophs
Total adult population	256	168
Total workers	219 (85.5)	115 (69.4)
Agriculture workers	153 (69.9)	14 (12.2)
Construction workers	16 (7.3)	-
Brick making workers	14 (6.4)	-
Service	23 (10.5)	95 (82.6)
Other workers	13 (5.9)	6 (5.2)

Results and Discussion

Employment Opportunity Among the Trophic Levels

Table 2 shows that greater work participation among the autotrophs, where the share of total workers to total adult population was 85.5% as compared to 68.4% among the heterotrophs. The results showed that among the autotrophs 69.9% of the total workers were engaged in agricultural activities in the capacity of agricultural laborers ; besides 7.3% in construction activities and 6.4% in brick-making. In contrast to this among the heterotrophs only 12.2% of the total workers were engaged in agricultural pursuits. A comparison of the workforce in the service sector showed that 10.5% percent of the total workers among the autotrophs were engaged in the service compared to 82.6% among the heterotrophs. Diversification of occupation was seen only among the autotrophs but here again it was restricted within the primary occupation alone.

It was further noticed that greater number of female workers occupied the agricultural activities (81) and brick-making (12) as compared to that of the male workers (Table 3) among the autotrophs. In contrast,

Table 4. Working facilities available (days per annum).

Trophic level	No. of workers availing working facility (days per annum)				Total Workers
	Less than 100	100-200	200-300	More than 300	
autotrophs					
Ballavpurdanga	57	8	11	6	82
Sarkardanga	22	2	13	2	39
Kheledanga	57	4	3	-	64
Khejurdanga	32	1	1	-	34
Total	168 (76.7)	15 (6.8)	28 (12.8)	8 (3.6)	219
Heterotrophs					
Ballavpurpara	31 (26.9)	4 (3.5)	58 (50.4)	22 (19.1)	115

more number of male workers among the autotrophs preferred construction, service and other activities. Among the heterotrophs, maximum number of male workers enjoyed service as their occupation (64). Only few numbers (7 and 5) were engaged in agriculture and other activities respectively. The female workers of the heterotrophs also followed a similar trend, maximum (31) being in service followed by agricultural activities (7). While almost equal number of male and female workers among the autotrophs was engaged in different activities, less number of female members were included as working force.

Working Facilities Available among the Trophic Levels

The number of working days per annum of the autotrophs and heterotrophs is shown in Table 4. The data showed that 76.7% of the population in the autotrophic layer was employed for less than hundred days in a year and only 12.8% of them were employed

Table 3. Occupational structure.

Trophic level	Employment opportunity												
	Adult population			Agriculture		Brick making		Construction		Service		Others	
	M	F	Total worker	M	F	M	F	M	F	M	F	M	F
autotrophs													
Ballavpurdanga	51	51	82	28	25	1	1	6	4	12	4	1	0
Sarkardanga	24	20	39	15	9	1	9	1	1	3	0	-	-
Kheledanga	35	34	64	16	30	0	2	4	0	0	0	10	2
Khejurdanga	17	24	34	13	17	-	-	0	0	4	0	-	-
Total	127	129	219	72	81	2	12	11	5	19	4	11	2
Heterotrophs													
Ballavpurpara	88	80	115	7	7	-	-	-	-	64	31	5	1

Table 5. Human energy input (MJ) used in different occupational activities.

Trophic levels occupation	Occupational energy inputs (MJ)					
	Total	Autotrophs Per capita		Total	Heterotrophs Per capita	
			Percent			Percent
Agriculture	183,994	719	51.0	16943	89	3.5
Construction	45,550	118	12.6	-	-	-
Brick making	27,312	107	7.6	-	-	-
Dairy	-	-	-	11446	60.2	2.4
Primary occupation	256,856	1,003		28,389	149	3.5
Service	98,396	384	27.3	456,696	2,403.7	94.1
Others	5,723	22	1.6	-	-	-
Total energy inputs	369,975	1,410		485,085	2,553	

for a period of 200 to 300 days per year. In sharp contrast to this, among the heterotrophs 50.4% of the total workers were gainfully employed for a period of 200—300 days in a year, while 19.1% of them were employed for more than 300 days in a year and only 26.9 percent of them had work for less than 100 days in a year. This made a great difference between the populations of the two trophic levels. Heterotrophs were in a much better position in employment than those of the autotrophs.

Human Energy Fixation

Plants fix light energy to produce food while human beings expend physical labor to produce food. Hence the other name of energy fixation by human autotrophs is the input of human energy. The discussion on fixation of human energy needs to concentrate on the comparison of human energy inputs of the agricultural laborers among the social autotrophs and heterotrophs. The human energy inputs used in different occupational activities are pre-

sented Table 5.

The results showed that the human energy input of the social autotrophs in primary occupation was significantly greater than those of the social heterotrophs, the corresponding per capita figures being 1003 MJ and 149 MJ respectively. Among the primary occupation, the largest amount of energy was fixed by the autotrophs in agricultural pursuits alone followed by construction activities and brick making, the corresponding per capita energy inputs being 719 MJ, 118 MJ and 107 MJ. In contrast to this, the per capita energy input of the heterotrophs in agriculture was 89 MJ only. There was no heterotrophic energy input into construction activities and brick making. These observations implied that the social autotrophs were the greatest energy fixers unlike their counterparts in a natural ecosystem. They were therefore the principal producers while the upper caste Hindus and the scheduled castes representing the higher and middle rungs of the society became the consumers. However, when the per capita energy input at the trophic levels as a whole was seen, it was found that

Table 6. Pattern of energy used through manures and fertilizers.

Trophic levels autotrophs	Total popu- lation	Households used nutrients		Energy value (MJ)			
		Manures	Fertilizers	Total Manures	Fertilizers	Per capita Manures	Fertilizers
Ballavpurdanga	181	14	12	12950	3055	71.5	16.9
Sarkardanga	93	6	8	10150	2600	109.1	27.9
Kheledanga	114	15	13	18550	3315	162.7	29.1
Khejurdanga	62	10	8	23100	9100	372.6	146.8
Total	450	45	41	64750	18070	143.9	40.1
Heterotrophs							
Ballavpurpara	245	30	28	67900	14235	277.1	58.1

the share of the autotrophs was less than those of the heterotrophs, the corresponding figures being 1410 MJ and 2,553 MJ respectively.

Energy from Manures and Fertilizers

The two main components of plant nutrients used in the area are cow dung manure and chemical fertilizers. The pattern of energy used from these two components of nutrient is shown in Table 6. The results showed that the per capita utilization of energy from both the sources of plant nutrients was lower among the autotrophs. Stout (5) also noticed similar trend of energy consumption in different trophic levels. When the pattern of energy utilization through plant nutrients was viewed at the trophic level as a whole, it was seen that both the autotrophs and the heterotrophs consumed almost equal amount of total energy, the corresponding figures being 82,820 MJ and 82,135 MJ. It was also found that about 80% of the energy was used through cow dung manure and only 20% of the remaining energy was applied through the chemical fertilizers. The cow dung manure was obtained locally, while the chemical fertilizers imported into the ecosystem from nearby areas.

This showed that there was little or negligible chemical load in the natural ecosystem of the area.

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