

Energy Dynamics in Human Ecosystem : Energy Consumption

U. MAJUMDAR AND D. C. GHOSH¹

Department of Geography, Visva-Bharati, Santiniketan 731235, West Bengal, India

¹*Institute of Agriculture (Palli Siksha Bhavana), Visva-Bharati
 Sriniketan 731236, West Bengal, India*

Abstract

The results showed that energy intake from different sources varied widely at the trophic levels. The autotrophic villages consumed much less energy than that of the heterotrophic village. Again, total energy consumption from various sources differed markedly within the autotrophic villages. The per capita total energy consumption through different sources was much higher (112.3 MJ/day) among the heterotrophs as compared to those of the autotrophs (70.6 MJ/day). The autotrophic villages also differed markedly in per capita total energy consumption through different sources (55.3 MJ/day to 99.7 MJ/day). Taking per capita total energy consumption as the assessment of the economic status of the users, the study indicated better living standard of the heterotrophs than that of the autotrophs.

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

In a natural ecosystem, there are disparities in energy consumption at various forms of organisms. In a human ecosystem, these disparities are reflected in the economic status and material belongings of the socially differentiated people, otherwise known as caste hierarchy. Human beings consume energy principally from food, fuel and material belongings. Among these, the former two sources can be measured in calorie units (MJ) while the material belongings source is generally expressed in monetary terms. The present paper deals with the former two aspects of the energy consumption among the social autotrophs and heterotrophs. According to the principles of energy consumption, higher the social hierarchy higher is the intake of food items of greater nutritional value. Consequently differences in the composition of food consumed by the different caste categories (trophic levels) serves as one of the appropriate indicators of the inequality in the energy consumption among the human trophic levels. Energy consumption varies greatly among the trophic levels (1). Empirical evidence of this principle for the present study has been attempted through an estimation of the energy consumption of the two social trophic levels—the social autotrophs and the social heterotrophs.

Methods

The study was made in the five settlement clus-

ters (villages) such as Ballavpurdanga, Sarkardanga, Kheledanga, Khejurdanga and Ballavpurpara in the revenue unit of Ballavpur mouza. Out of the five settlement clusters four belong to the scheduled tribe population ; while, the other belongs to the general caste category comprising mainly the upper caste Hindu family. More than 90% of the households in that settlement cluster are the upper caste Hindu family. The study includes the survey of the nature and amount of food consumed by the various categories of people at different trophic levels along with

Table 1. Energy equivalents of different food and fuel items.

Food and fuel items	Unit	Equivalent energy (MJ/kg)
Plant products		
Rice	kg	14.04 MJ/kg
wheat	kg	9.20 MJ/kg
Pulses	kg	14.04 MJ/kg
Vegetables	kg	3.80 MJ/kg
Animal products		
Milk	kg	2.72 MJ/kg
Egg	kg	6.72 MJ/kg
Fish	kg	5.08 MJ/kg
Meat	kg	5.08 MJ/kg
Fuel		
dry leaves and twigs	kg	11.5 MJ/kg
Wood	kg	13.5 MJ/kg
Cow dung cake	kg	5.3 MJ/kg
Coal briquette	kg	14.7 MJ/kg

Table 2. Pattern of food energy consumption from plant products (MJ/day).

Trophic levels auto-trophs	Persons taking No. of households	Rice, pulses & vegetable	Wh-eat	Food consumption (kg/day)				Energy consumption (MJ/day)				Total energy (plant products) (MJ/day)	
				Rice	Wh-eat	Pul-ses	Vege-table	Rice	Wh-eat	Pul-ses	Vege-table	Total	Per capita
Ballavpur-danga	33	181	—	95	—	7.5	23.1	1333.8	—	105.3	87.8	1527	8.44
Sarkar-danga	12	93	—	48	—	2.4	8.4	673.9	—	33.7	31.9	739	7.95
Khele-danga	20	114	—	58	—	4.0	14.0	814.3	—	56.2	53.2	924	8.10
Khejur-danga	12	62	—	33	—	2.4	8.4	463.3	—	33.7	31.9	529	8.53
Total	77	450	—	234	—	16.3	53.9	3284.8	—	228.9	204.8	3719	8.26
Hetero-trophs Ballav-purpara	50	245	34	73.5	6.8	14.0	25.0	1031.9	62.6	196.6	95.0	1386.1	5.66

type and amount of fuel they are using in cooking food. The various data on food and fuel thus recorded from various categories of people living at different trophic levels were then used for conversion into energy equivalents with the help of equivalent energy values given by Fluck (2) and Binning et al. (3) as presented in the Table 1.

Results and Discussion

Food Energy

The food energy constituents have been discussed under two broad categories such as plant products (rice, wheat, pulses and vegetables) and animals products (milk, egg, fish, and meat).

Plant Products. The individual food items derived from plant products consumed at the village level and at the trophic levels as a whole are presented in Table 2. The results showed that rice, vegetables and pulses were consumed by all the families covered by the survey. The households among the autotrophs did not consume wheat and among the heterotrophs only 34 members of 7 families out of 50 families consumed wheat. Thus, wheat was found to be a rare intake item under this study. This was obvious because these items were the staple diet items of the people of this area.

The results showed the distribution of energy consumption through rice, pulses and vegetables among the trophic levels and it was evident that rice took the major share in all the clusters at both the trophic levels. The energy consumption derived from rice among the autotrophs ranged from 463.3 MJ/day to 1333.8 MJ/day as compared to the values of 1031.9 MJ/day in the heterotrophic village. This shows that the distribution of the rice energy varied widely at the trophic levels and the autotrophs consumed much higher rice energy than that of the heterotrophs. Pulses took second position in energy consumption at the trophic levels. Again, its consumption varied greatly (33.7 MJ/day to 105.3 MJ/day) among the autotrophs, the highest consumption being at cluster of Ballavpurdanga. The energy consumption through pulses in the heterotrophic village was 196.6 MJ/day indicating that the heterotrophs consumed higher amount of pulses than that of the autotrophs. The vegetable consumption at the trophic levels under the study area was low. Here again the heterotrophs consumed relatively higher amount vegetables than that of the autotrophs ; where greater variation in energy consumption (31.9 MJ/day to 87.8 MJ/day) through vegetables existed among the villages. The total plant energy consumption also varied markedly at the trophic levels in which the autotrophs consumed higher energy as compared to the heterotro-

Table 3. Pattern of food energy consumption from animal products (MJ/day).

Trophic levels autotrophs	Total population	Persons taking					Milk	
		Milk	Egg	Fish	Meat	Total	Per capita	
Ballavpurdanga	181	–	55	33	11	–	–	
Sarkardanga	93	–	23	85	23	–	–	
Kheledanga	114	6	51	51	6	3.6	0.03	
Khejurdanga	62	5	52	41	–	1.3	0.02	
Total	450	11	181	210	40	4.9	0.01	
Heterotrophs								
Ballavpurpara	245	16	201	78	132	37.8	0.15	

Table 3. Continued.

Trophic levels autotrophs	Total population	Energy consumption (MJ/day)						Total energy (animal products) (MJ/day)	
		Egg		Fish		Meat		Total	Per capita
		Total	Per capita	Total	Per capita	Total	Per capita		
Ballavpurdanga	181	23.7	0.13	4643.4	25.65	22.5	0.12	4689.6	25.91
Sarkardanga	93	7.2	0.08	5516.9	59.32	43.5	0.47	5567.6	59.87
Kheledanga	114	16.8	0.15	2298.7	2.16	2.4	0.02	2321.5	20.36
Khejurdanga	62	16.2	0.26	2206.7	35.59	–	–	2224.2	35.87
Total	450	63.9	0.14	14665.8	32.59	68.4	0.15	14803.0	32.90
Heterotrophs									
Ballavpurpara	245	117.1	0.48	19125.6	78.06	277.5	1.13	19558.0	79.83

phs. The per capita plant energy consumption also followed a similar trend, but its variation among the autotrophic villages was negligible. The results corroborate the findings of Sharma (4).

Animal Products. Detailed information on the pattern of individual consumption of animal products has been presented in Table 3. The data showed the distribution of milk energy among the trophic levels and it was evident that among the autotrophs milk is consumed in only two clusters (Kheledanga and Khajurdanga) that too only 5 and 8% of the inhab-

itants of the respective villages consumed milk. In sharp contrast to this, most of the families of the heterotrophs consumed milk. The per capita energy value derived from milk consumed by the autotrophs ranged from 0.02 MJ/day to 0.03 MJ/day as compared to the values of 0.15 MJ/day among the heterotrophs. This shows wide variation in the distribution of the energy value derived from milk among the autotrophs.

The distribution of the energy obtained from egg among the trophic levels showed that egg was consumed in all the villages ; but the percentage of people

Table 4. Total energy consumption at different trophic levels.

Trophic level autotrophs	Total population	Plant products	Animal products	Total consumption of energy (MJ/day)				
				Total food energy	Per capita	Fuel	Total (MJ/day)	Per capita
Ballavpurdanga	181	1527	4690	6217	34.3	5060	11277	62.3
Sarkardanga	93	739	5568	6307	67.8	2965	9272	99.7
Kheledanga	114	924	2321	3245	28.5	3058	6303	55.3
Khejurdanga	62	529	2224	2753	44.4	2151	4904	79.1
Total	450	3719	14803	18522	41.2	13234	31756	70.6
Heterotrophs								
Ballavpurpara	245	1386	19558	20944	85.5	6572	27516	112.3

Table 5. Pattern of consumption of fuel energy (MJ/day).

Trophic levels autotrophs	Total popu- lation	Dry leaves & twigs	Persons using			Leaves, twigs	
			Wood	Cow dung cake	Coal briq- uate	Total	Per capita
Ballavpurdanga	181	181	181	6	—	2356	13.01
Sarkardanga	93	93	93	93	—	1320	14.19
Kheledanga	114	114	114	8	—	1386	12.16
Khejurdanga	62	62	62	62	—	587	9.47
Total	450	450	450	169	—	5649	12.55
Heterotrophs					—		
Ballavpurpara	245	5	5	235	182	132	0.54

Table 5. Continued.

Trophic levels autotrophs	Total popu- lation	Fuel energy consumption (MJ/day)						Total fuel energy	
		Wood		Cowdung cake		Coal briquette		(MJ/day)	
		Total	Per capita	Total	Per capita	Total	Per capita	Total	Per capita
Ballavpurdanga	181	2686	14.84	18	0.09	—	—	5060	27.95
Sarkardanga	93	1261	13.55	384	4.13	—	—	2965	31.88
Kheledanga	114	1624	14.24	48	0.42	—	—	3058	26.75
Khejurdanga	62	1234	19.91	330	5.32	—	—	2151	34.69
Total	450	6805	15.12	780	4.61	—	—	13234	29.41
Heterotrophs									
Ballavpurpara	245	1914	7.81	2052	8.37	2474	10.1	6572	26.82

consuming egg was lower among autotrophs (52%) than among the heterotrophs (84%). Conspicuous differences in the per capita energy consumption through egg were also seen among the trophic levels. The per capita energy intake was lower among the autotrophs (0.14 MJ/day) than that among the heterotrophs (0.48 MJ/day). Wide variation in egg energy consumption (0.08 MJ/day to 0.26 MJ/day) was noticed among the autotrophs indicating a marked difference in egg intake between them.

The distribution of fish energy among the trophic levels showed that fish was consumed in all the villages among the autotrophs and the heterotrophs. However, persons consuming fish was higher among the autotrophs (46.7%) than that among the heterotrophs (32%). But, per capita fish energy consumption was much lower (32.59 MJ/day) among the autotrophs as compared to that of the heterotrophs (78.06 MJ/day). The per capita fish energy consumption varied from 20.16 MJ/day to 59.32 MJ/day among the autotrophs. This indicated a skewed pattern of consumption of fish energy among the

trophic levels resulting in inequality in the quantity and frequency of intake and vice-versa.

The distribution of meat energy among the trophic levels revealed that only 7.8% of the families in the autotrophic layer consumed meat while among the heterotrophs 48% of the families consumed meat. The per capita consumption of meat energy was 0.15 MJ/day among the autotrophs; whereas, it was 1.13 MJ/day among the heterotrophs. The per capita meat energy consumption ranged from 0.02 MJ/day to 0.47 MJ/day among the autotrophs. It would be pertinent to mention here that the frequency of intake of meat energy varied greatly among the trophic levels. The total energy consumption through animal products also varied markedly at the trophic levels in which the autotrophs consumed much less energy as compared to that of the heterotrophs. This is in conformity with the findings of Tewari (5). The per capita animal energy consumption also followed a similar trend and wide variation (20.36 MJ/day to 59.87 MJ/day) was noticed in per capita animal energy consumption among the autotrophic villages.

The total intake of food energy by the two trophic levels in the study area is given in Table 4. It was evident that the level of total food energy consumption was less among the autotrophs than that of the heterotrophs ; the corresponding per capita food energy intake being 41.2 MJ/day and 85.5 MJ/day respectively. Even at the autotrophic level, the per capita food energy intake differed markedly (28.5 MJ/day to 67.8 MJ/day) among the villages.

Fuel Energy

The consumption of different types of fuel among the two trophic levels was recorded from a detailed survey in the study area. The data thus recorded were then converted into energy equivalents and the fuel energy inputs from different sources are presented in Table 5. Both the autotrophs and the heterotrophs used dry leaves and twigs, wood and cow dung cake in cooking their food. In addition to this, the heterotrophs also used coal briquette for cooking purpose.

The distribution of fuel energy as wood, dry leaves and twigs among the trophic levels showed that both these sources of fuel were used in all the villages among the autotrophs ; but only a few heterotrophs (2.0%) used these materials for cooking their food. Accordingly, per capita fuel energy consumption through these sources was much lower (7.8 MJ/day and 0.54 MJ/day respectively) among the heterotrophs as compared to those of the autotrophs (15.12 MJ/day and 12.55 MJ/day respectively). The variation in per capita fuel energy consumption through these sources was also not much wide among the autotrophs. This indicated that the autotrophs were mainly dependent on these natural sources of fuel energy for preparation of their food. In contrast to this, the heterotrophs were dependent mainly on cow dung cake and coal briquette as source of fuel energy for cooking their food. About 96 and 74% of the heterotrophs used cow dung cake and coal briquette respectively as fuel energy for preparation of their food ; whereas only 37% of the autotrophs used cow dung cake, no one used coal briquette for cooking their food. The per capita fuel energy consumption through these sources was much higher (8.4 MJ/day and 10.1 MJ/day respectively) among the heterotrophs as compared to those of the autotro-

phs (4.61 MJ/day respectively). Remarkable variation in per capita fuel energy consumption through cow dung cake was also noticed among the autotrophs ; only two out of four villages at this autotrophic level used even less than 1.0 MJ/day/person for cooking purpose.

The pattern of total energy consumption from various sources is presented in Table 5. The per capita total energy intake from different sources varied widely at the trophic levels. The autotrophic villages consumed much less energy than that of the heterotrophic village. Total energy consumption from various sources differed markedly within the autotrophic villages. The per capita total energy consumption through different sources was much higher (112.3 MJ/day) among the heterotrophs as compared to those of the autotrophs (70.6 MJ/day). The autotrophic villages also differed markedly in per capita total energy consumption through different sources (55.3 MJ/day to 99.7 MJ/day). The per capita total energy consumption may be taken as the assessment of the economic status of the users at different trophic levels. This is because different sources of energy should be judged not only by their energy content but also in terms of the costs involved in the form of commodities. They are also the indicators of standard of living. It was noticed that the level of energy consumption was less among the social autotrophs as compared to that of the heterotrophs. Even at the autotrophic level, the per capita energy intake differed markedly among the villages. The study of energy consumption indicates better living standard of the heterotrophs than that of the autotrophs.

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