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CONSUMPTION OF BIOMASS WHILE GRAZING IN WESTERN HIMALAYAS : A CASE STUDY OF VILLAGE KIRMOO AND BALOTA

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Abstract

Himalayas are rightly considered as a fragile mountain ecosystem. As a result of economic development this eco-system has further been pressurized. This pressure has been particularly on the forest resources. In the present attempt two villages located at entirely different altitudinal climatic zones have been selected to study the consumption of biomass being grazed by livestock population and influence on the ecosystem of the region. Heiden formula with minor modifications to suit the local conditions has been used for assessing the biomass being consumed while grazing. The data obtained from the primary sources have been processed, tabulated and analysed.

Introduction

Himalayas are considered, and rightly so, as a delicate mountain eco-system. It is ecologically fragile system in its geological and morphological settings too. The plight of Himalayas is still more serious in respect of diminishing forest cover. Many species have already been eliminated, replaced or are in the process to reach this stage soon. As a result of it the Himalayas are experiencing serious ecological disorder viz. erratic river courses, rapid siltation of river beds, soil erosion and hydrological disorders etc. however, all these environmental problems emerged from so called economic development and anthropogenic transformation of the space. And in the process of economic development in the Himalayan region, forests resources would be the most obvious and easy victims because forests products are exploited for diverse purposes of economic transformation more particularly in the plain areas. Unfortunately, all this is done without any consideration of the overall natural productivity and stability of the natural process. The contribution of developing countries to the global environmental problem is a result of unsustainable land use practices (Singhal and Kumar: 1997).

The entire state of Jammu and Kashmir being situated in the Himalayas faces all these problems with added severity. The impact of large-scale exploitation of forests in the state as a whole has resulted in degradation of forests. Resultantly poverty and associated ills have gradually crept in the lives of the people. Mountain eco-system once densely forested has been drastically altered. In the process the inhabitants are facing a major ecological crises and economic hardships.

Forest grazing is perhaps the most important economic activity sustaining the human life in the Himalayan ecosystem and also influencing the ecology of forests to a larger extent. It is in this context that the present attempt is being made to understand consumptional behaviour of forest biomass while grazing in the forests in the selected two villages. Most of the slopes, the hill tops and even the valleys are subjected to intense grazing, not only by the livestock of the villagers but also by nomadic people who practice sheep and goat grazing in the hills between October and May. Grazing is recognized as the worst offender of greenery. It is generally believed that many of the Mediterranean regions have attained a near desertic condition because of excessive traditional grazing. The villagers in the villages in the hilly areas invariably practice cattle grazing and depend for the fodder on the forests. This aspect is important not only because the overgrowing livestock population is exerting tremendous pressures on the

slope of the Himalayas but also because the grasslands/pastures are not properly identified. Further it has been observed that far more animals than they could support continuously graze on them. There are no restrictions on grazing except in areas, which are closed for the purpose by notification. The *Rakhs* of the Forest Division are annually leased out for grazing to *Gujjars* and *Bakerwals* who maintain large flocks of cattle for their sustenance. This resorts to uncontrolled and disproportionate type of grazing which are mostly beyond the carrying capacity of the site. During summer the sheep, goat and cattle belonging to these nomads as well as locals migrate to the *Behaks* (*Behaks* or *Dhoks* – local term used for alpine pastures or grazing ground at higher altitude) or Alpine pastures, which with the onset of winter, come down to plains and *Rakhs* of Ramnagar, Billawar and even Udhampur. The incidence of grazing in these forests is high and beyond the carrying capacity of these forests. The uncontrolled grazing and browsing adversely affect the young regeneration of both conifers as well as broad-leaved species. Marked deficiency of regeneration particularly in the Fir forests is mainly due to the adverse effects of unrestricted grazing. Heavy grazing leads to an increase in non – palatable weeds and decrease in palatable plants species and grasses in the forest areas including pasturelands. Light grazing is often beneficial to the forest as it keeps down the unwanted under growth, thus reducing the chances of fire. Young regeneration of Oak (*Q. leucotrichophora*) is also damaged by the cattle both belonging to local population as well as those belonging to the nomadic *Gujjars* and *Bakerwals* who visit Ramnagar Forests, particularly the *Rakhs*, while enroute to and from their summer *Behaks* (pastures). They did not have any kind of input to maintain their productivity. There is no agency even today to analyze the so-called pastures in the country. The situation has led to the total degradation of 12.15 million hectares of land, which are supposed to serve as grazing ground for the domestic animals and as a result, forests have had to meet most of the grazing needs of the cattle and other domestic animals in the country (Lal : 1988). It becomes all the more significant to undertake the interaction of animals while grazing in the forestlands of the study area. It is important to mention here that the climate in the Himalayas restricts the movement of both men and animals outside their homes for certain months of the year necessitating thereby the stall feeding to the livestock during inclement weather conditions. As a result man has to store the grass withdrawn again from the forests for the purpose. The biomass so withdrawn has been assessed, based on primary data generated.

The grazing of livestock is influenced to a larger extent by the climate of the area under discussion as it is the climate, which regulates the release of animals to the forests. The study area enjoys two dry and two wet spells in a year. March to June is the first dry spell, which is followed by a wet season from July to September in which rainfall is caused by the southwest monsoon. October to December is another period of dry season while from January to early March another wet season prevails in the region caused by the western disturbances. This single factor of climate is responsible for providing sufficient moisture for the growth of bio-mass necessary for activating the grazing by the animals on the one hand and restricting the grazing during both the wet seasons particularly during the winters, when it becomes difficult to reach the forest for grazing on the other. The community biomass increased from June and attained maximum biomass in August/September, it declined during winter season with further rise during summer season. The majority of grasses remained in the field throughout the year whereas most of the sedges, legumes and non-legumes completed their life cycle upto early winter. Exponential growth of plants in rainy season can be attributed to favourable conditions (temperature and moisture). In winter season, low community biomass resulted from maturity of many plants, low moisture and low temperature. In summer, slight increase in community biomass was due to resprouting of few perennials caused by retention of moisture of soil from precipitation received during winter season. Similar seasonal variations in above ground (live) biomass have been reported in other parts of India by Singh (1968), Kumar and Joshi (1972), Singh and Yadav (1974), Ambasht et al. (1972), Gupta et al. (1972), Gill (1975), Singh and Joshi (1985), Bawa (1986) and Kapoor (1987). As a result, it has been estimated on the basis of intensive and extensive field surveys that the

grazing in this area can be divided into two groups viz. the period of intense regular grazing and a period of intermittent and subdued grazing. In the first category we include the months from mid March to mid July, when animals can readily be released into forest for grazing followed by a period of intermittent grazing from July to August when due to rains animals are not allowed into the forest by the villagers. This again is followed by a period of intense grazing from mid September to mid November after which weather conditions restricts the animal movement outside the house particularly in higher reaches. Thus, we see that on an average, animals are allowed to graze for about eight months in a year. Weighing all the pros and cons and after consulting the local residents it was considered to take 182 days of grazing in different zones of the region to arrive at meaningful conclusions. One zone of the region lies in the sub-tropical environmental conditions which differ from other zones and as such it has been empirically observed that the grazing period in this zone gets extended up to 300 days except of course the monsoon season for which 65 days have been taken out in a year. The other factor that influences the grazing is availability of grasses in the forest, which again is directly related to the moisture and temperature conditions. Moisture for the growth of the grasses is almost available throughout the year and yet the low temperature conditions from November to March adversely influence the growth of grasses. It is due to this reason that we find that there are variations in the availability of grasses and resultantly withdrawal of biomass from forests due to grazing. It can thus be concluded for the sake of brevity that animals find almost enough grasses to graze to satisfy their need from mid May to mid September. While in the rest of the grazing period just identified, it becomes difficult for them to meet their food requirements and are compelled to remain under fed.

Study Area

The present study, which is based on the field work, concerns the two villages located in the Western Himalayas and forms the part of Udhampur district of Jammu and Kashmir state. One of the villages is Balota, which is situated in the middle Himalaya and is about 27 kilometres from the town of Ramnagar (tehsil of District Udhampur). It is situated at an altitude of 2450 metres. A fair weathered road connects Ramnagar with Basantgarh. The village is located towards north east of Basantgarh. A 7 km narrow hilly pathway connects the village Balota with Basantgarh. Thus the village is located in a remote area having difficult approach and remains cut off from the other parts of the country particularly during incriminating weather conditions.

The other village Kirmoo is situated at an altitude of 780 metres. The village is 28 kilometres from Udhampur and lies towards the south-west of Ramnagar. A *kacha* track of 6km joins the village with Ramnagar tehsil. The study area, which lies in two different altitudinal zones, experiences different climatic conditions. The village located at higher altitudes (Balota) experiences temperate type of climate. This, therefore, influences the variation in the consumption of biomass by the livestock while grazing. The low altitude region (Kirmoo) lies in the sub-tropical climate zone exhibits a different pattern both in grazing hours as well as in grazing period in a year.

Methodology

The assessment of biomass consumed during the grazing in the forests has been calculated on the basis of a selected methodology. In the initial stages it was considered to take into account the type of animal grazing and the average height and type of the grasses to assess the biomass consumed per animal during a day's (normally taken 8 hrs on an average) grazing. The experts in this field were consulted and opinion sought. But later it was considered most appropriate to use **Heiden's formula** for calculating the biomass consumed from the excreta released by the animals while grazing. Heiden devised a formula from the excrement released by an animal rather than assessing the same from the average weight of the animal. From the amount of absolute dry matter fed and excrement released, Heiden was able to determine certain definite relationship of the latter to the former. These, of course, varied from different animals, being 2.10 for the horse, 3.80 for the cow, and 1.80 for sheep. For example, says Heiden "if a horse receives 20 lbs of dry matter daily, the manure produced would be 42 lbs" i.e., to say 20 x 2.10 = 42 lbs (as quoted by

Chowhary : 1985). This 42 lbs of excrement is in the wet form so giving a due recognized consideration of wetness in the excrement. One can also calculate the dry absolute dry matter in the excrement release, as Heiden again state that "dung in fresh state contains 70 – 80 per cent water". In the present study for such calculations an average of 70 and 80 i.e., 75 per cent has been considered to be the water content in the fresh dung.

Heiden has not made any assessment about the goat, oxen and buffalo. However, in the present study after having a detail discussion with the veterinary scientists (Senior Officers of Jammu and Kashmir State Animal Husbandary Department) working in the field. Goat was equated with the available data for sheep. But in case of buffalo and oxen, after conducting experiment in the field, in collaboration with veterinary scientists, it was concluded that value for buffalo and oxen comes to 4.5 in the area for establishing relationship between dry matter fed and the excrement released in these cases. Now for example we find that a cow has released 7 Kg. of wet excrement during the grazing hour we will presume that it contains 75 per cent water and only 25 per cent dry dung and this 25 per cent dry dung is equal to 1.75 Kg. It would therefore mean that the cow has consumed 1.75 x 3.8 Kg of dry matter while grazing which comes to 6.65 Kg in a day this assessment would be for the dry biomass only (25 per cent of the wet biomass). It can therefore, very conveniently be said that the cow in question has consumed 6.65 Kg. x 4 = 26.60 Kg. of wet biomass from the forest while grazing if it has released 7 Kg. of wet excrement as 6.65 Kg is dry biomass grazed by the cow.

Thus, in order to asses the bio mass consumed while grazing, the excrement released by different categories on animals was actually collected in the field, weighed and recorded and it is from this excrement that the actual consumption of wet bio mass was estimated by using the methodology discussed above.

Processes and Problems

It has been maintained, while discussing the methodology to assess the biomass consumed while grazing, that the excrement released by different categories of animal would be taken into consideration for achieving the results, it, therefore, becomes necessary to measure the actual excrement released by different types of animals while grazing, if the actual biomass grazed is to be estimated. As such a detailed field work becomes necessary and the same was done. Five animals of the same category were selected over a period of a week. The excrement released was immediately weighed and data recorded. On the basis of this data actual average excrement per day was calculated so as to be able to estimate the biomass consumed while grazing. The process was repeated for every category of animals found in the villages concerned. The data so generated is tabulated and recorded for analysis. Although the process was cumbersome but six field workers worked honestly, tirelessly for seven days to generate the data from which calculations for actual biomass consumed were made.

Grasslands in village Kirmoo constitute a very important aspect of physical landscape. Significance of these grasslands lies in the fact these support an ever-growing population of livestock of the village to a larger extent. It is only during the winter months when the western disturbances cause wide spread rains in this area and heavy snowfall at higher reaches that it becomes difficult for the owner to allow the animals to graze freely in the forests otherwise grazing season in this village is extensive. The season, stretches from mid-February to mid-December extends for about 300 days in a year. Thus high temperature and availability of required amount of moisture enhance the biological activities and thus influences the productivity of grasslands.

Another important aspect of the natural environment in this village (Kirmoo) is that the grasslands, unlike in other case study i.e., village Balota, is not located on precipitous slopes thereby allowing the livestock to graze with ease and comfort. Further climatic conditions and comparative longer days due to the low latitudes allow the animals to graze for longer periods of time in a day. All these factors when put together would suggest a higher rate of biomass consumption in this village (Kirmoo) which has been reflected in the data generated and analyzed in the following discussion.

Table – 1
Estimated Consumption Of Biomass While Grazing In Village Kirmoo (per animal per day) (in Kgs.)

Type of animal	Actual average excrement (wet) recorded	Average consumption of biomass (wet)
Cow	7.5	28.50
Buffalo	8	36.00
Sheep	2.6	4.68
Goat	2.6	4.68
Pack animal	3	6.30

Table – 2
Total Biomass Consumed And Excrement Released In The Village Kirmoo (in Kgs.)

Type of animal	Total population	Excrement released	Percentage	Biomass consumed	Percentage
Cow	771	5782.5	68.72	21973.5	74.02
Buffalo	136	1088	12.82	4896	16.49
Sheep	358	930.8	11.06	1675.44	5.64
Goat	186	483.6	5.75	870.48	2.93
Pack animal	43	129	1.53	270.9	0.91
Total	1494	8413.9		29686.32	

Total excrement (wet) = 8.41 metric tonnes/day

Total biomass consumed (wet) = 29.68 metric tonnes/day

Total quantity of excreta released in 300 days = 2524.17 MT.

Total quantity of biomass consumed in 300 days = 8905.89 MT.

Discussion

Analysis of tables – 1 and 2 reveal that the average consumption of biomass while grazing per day in respect of cow is 28.5 Kg. in village Kirmoo. The data further show that buffalo on an average graze 36 kg of biomass per day. These differences may be attributed to micro-level variation in the availability of grasses both in time and space. Total consumption of biomass, however, is dependent and has a correlation with the total livestock population, which is ultimately related to the size of the village and number of houses it holds. This therefore, requires a further deliberation on individual village as under:

In village Kirmoo which has 331 households and a total livestock population of 1494 withdraw maximum amount of grass biomass while grazing. The analysis of table reveals that maximum average biomass while grazing in a day in Kirmoo is consumed by cows (74.02 per cent) followed by the buffaloes (16.49 per cent). The sheep and goats respectively consume 5.64 and 2.93 per cent leaving the rest 0.91 per cent to the pack animals (Table – 2). On the total the animals of different categories together consume 8905.89 metric tonnes of biomass in 300 days which comes to 29.68 metric tonnes per day. On the other hand total excrement released by the livestock population in the forests comes to 8413.9 Kg. per day. As such the total livestock population consumes as much as 8905.89 metric tonnes of grass biomass over a period of 300 days in a year with a return of 2524.17 metric tonnes of excrement to the forest areas which is 28.34 per cent of the biomass withdrawn.

Table – 3
Estimated Consumption Of Biomass While Grazing In Village Balota
(per animal per day) (in Kgs.)

Type of animal	Actual average excrement (wet) recorded	Average consumption of biomass (wet)
Cow	6.5	24.7
Buffalo	8.4	37.8
Sheep	2.8	5.04
Goat	2.8	5.04
Pack animal	3.5	7.35

Table – 4
Total Biomass Consumed And Excrement Released In The Village Balota (in Kgs.)

Type of animal	Total population	Excrement released	Percentage	Biomass consumed	Percentage
Cow	504	3276	33.71	12448.8	44.36
Buffalo	163	1369.2	14.09	6161.4	21.31
Sheep	1131	3166.8	32.59	5700.24	20.31
Goat	209	585.2	6.02	1053.36	3.75
Pack animal	377	1319.5	12.96	2700.95	9.62
Total	1100	9716.7		28064.75	

Total excrement (wet) = 9.71 metric tonnes/day
Total biomass consumed (wet) = 28.06 metric tonnes/day
Total quantity of excreta released in 182 days = 1768.44 MT
Total quantity of biomass consumed in 182 days = 5107.78 MT

Working on the similar lines the data for other village viz. Balota were generated to work out the biomass consumed while grazing. The analysis of table – 3 reveals that cow in Balota consume 24.7 Kg of biomass in a day. Similar variations, although not significant, do exist in other types of animals as well. These differences not withstanding, the total biomass (wet) consumed by all the livestock (of all types) in the village Balota has been placed at 28.06 metric tonnes per day which gives a total consumption during the entire grazing season of 182 days as 5107.78 metric tonnes per day (table – 4).

But while grazing these animal returns some biomass to the forests in the shape of their excrement. The same, as said earlier, has also been estimated. And in the village under study the total excrement released by the livestock in a day comes to 9.71 metric tonnes per day and in 182 days of grazing it totals to 1768.44 metric tonnes. It is this biomass which helps these grass and pasturelands to maintain proper health. Further analysis of the table – 4 reveals that maximum biomass is consumed by cows followed by buffalo, sheep, pack animal and goats respectively.

Conclusion

The principal objective of the study was to understand the resource movement in the identified study area in fragile Himalayan environment differentiated by various physical characteristics. The study was undertaken to see the man-forest interactive scenario in the face of man's ever growing demands from nature. An attempt was, therefore, made to generate the actual data pertaining to the selected parameters, which were considered to be most significant in resource movement in the area under study. All this, not

withstanding, it must be clearly understood that withdrawal of the forest biomass as assessed and analyzed can not be a static phenomena as it is associated with the biologically active agents where dynamics is the law and always remains in the state of flux. It is pertinent to mention that the introduction of technology in the study area is slowly changing the lifestyle of the people and this style is likely to undergo a further change resulting in the changing pattern of the forest biomass utilization. In such a situation a study like the present one would surely provide directions for further investigations, leading to the assessment of the forest in terms of the biomass generation and ultimately its proper and optimum use. Keeping all these factors into account it is all the more important to make an overall assessment of the biotic interaction, as conceived for all the regions under study, to bring out a critical assessment of the variations found in the patterns of biotic interaction with forest at different altitudinal and more so in different (as influenced by altitude) environmental conditions.

Finally it can be said about the biotic – interaction with the forests in the region under study on the basis of the two case studies that the biomass transfers from one system to the other is not a closed system. The present study has taken only two aspect of biotic-interaction i.e., the forests and the man/animal. The inputs in the form of photosynthesis, is a complex process and is beyond the scope of our study, yet they make a primary energy flow system. A system in which the forests and grass lands makes their food directly by photosynthesis in the present of sunlight and this energy is then transferred to the live stock by grazing. Further, the energy is transferred to the soils in form of their animal excreta. It would be appropriate to state that the stability of biomass flow system in the form of energy and nutrients depends heavily on the ability of forests and grass lands to sustain themselves under heavy biotic pressures and stresses. Further the ability to regenerate in their natural environment to convert the external input of energy and nutrients into biomass at a rate, which will ultimately sustain the demand for fuel and fodder. This is most important for the sustainability of agricultural base, on which the whole economy of the region depends. Thus for sustaining the agriculture the demand and supply relationship between forests on the one hand and the requirement of the villagers on the other have to be balanced by the man himself prudently for the betterment and future utilization.

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