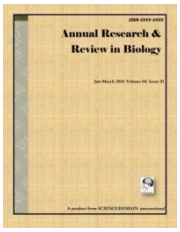

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Seasonal and Altitudinal Variation of Herbaceous Biomass of Nikyal Range Land, District Kotli Azad Jammu and Kashmir

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Authors' contributions

This work was carried out in collaboration between all authors. Author MSA designed the study, performed the field work, wrote the protocol, and wrote the first draft of the manuscript. Author NZM managed the analyses of the study and revised manuscript. Authors FA and NM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The aim of this study was to report the seasonal and altitudinal variation in herbaceous biomass along with the productivity of area.
Place and Duration of Study: This study was conducted in Nikyal valley located at altitudinal range of 1500-1900 m within the longitude 74o 04′ to 10′ east and latitude 33o 26′ to 29′ north during July 2012 to June 2013.
Methodology: The forage biomass was calculated by Harvest method using $1m^2$ quadrat. Five quadrats were selected from each community permanently. Above ground grasses and forbs were clipped up to 2cm and were placed in separate polythene bags. Both grasses and forbs were separately weighed and average was taken. The results were expressed in Kilo grams per hectares. Monthly sampling over one year was carried to

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determine its productivity.
Results: The average dry biomass production was 854 Kg/ha. The July and August were the most productive months (1387 Kg/ha and 1335 Kg/ha, respectively). The total dry biomass, biomass contributed by grasses and herbs generally increased from July to October and thereafter it progressively decreased till February and then again started increasing from March.
Conclusion: The variation in Biomass controlled by the amount and timing of precipitation and temperature inputs during the growing season.

Keywords: Biomass; altitudinal gradient; climate change; community dynamics.

1. INTRODUCTION

Biomass is a measure of resources of community which is tied up in different species. Vegetation composition based on dry weight is one of the best indicator of species importance within plant community [1]. This is a key property of ecosystems [2,3] that results from the mass balance between rates of gain due to productivity and losses due respiration and mortality [4]. The spatial variation of forest biomass is important because the emissions of carbon from deforestation are determined by the biomass of the forest actually deforested, not necessarily by the average biomass for a region [5]. Therefore, it is essential to describe the variation of biomass at multiple scales. The productivity and sustainability of the range land depends upon a number of factors such as rainfall, edaphic features, grazing system and seasonal availability of forage [6,7,8,9]. The protection and proper management of range land increased the total palatable vegetation cover [10,11].

Some work has been done on the forage biomass and productivity in different areas i.e [6,7,8,12,13,14,15,16,17,18]. However there is dearth of information on the Biomass and forage productivity of Azad Jammu and Kashmir. The only available references are [19,20] The aim of this study was to determine the seasonal and altitudinal variation in biomass and forage productivity of Nikyal range land which will be helpful for the range manager and ecologist in their future studies for assessment and management of this and similar other rangeland,

2. MATERIALS AND METHODS

2.1 Location and Climate

Nikyal Hills are situated in District Kotli, Azad Jammu and Kashmir at an altitude of 1500-1900m. They are located 30 km away from Kotli towards North. The investigated area lies within longitude 74o 04′ to 10′ east and latitude 33o 26′ to 29′ north. It is surrounded by Kotli on south, on western side by Tatapani, on Northern side by Mender and on east by Pir-Panjal.

The climate of Nikyal valley is of sub-tropical humid type with average annual rainfall of 95.60 mm. The maximum rainfall occurs during July amounting to 251.52 mm, while least rainfall occurs during November amounting to 14.44 mm (Fig 1). The hottest months of the year are June and July, with mean daily maximum temperature of 37.69°C and 34.82°C respectively and minimum temperature of 23.61°C and 23.62°C respectively, while the coldest months of year were December and January mean maximum temperature of

19.99°C and18.09°C respectively and minimum temperature of 5.49°C and 4.41°C respectively (Fig. 2). The average maximum and minimum relative humidity received by the area is 79.64 and 30.82% respectively (Fig. 3). (Source: Pakistan Metrological Department Lahore).

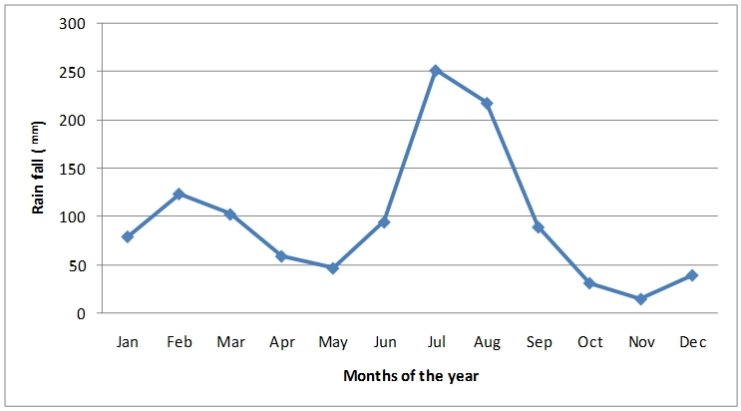

Fig. 1. Graphical representation of monthly variation in rain fall

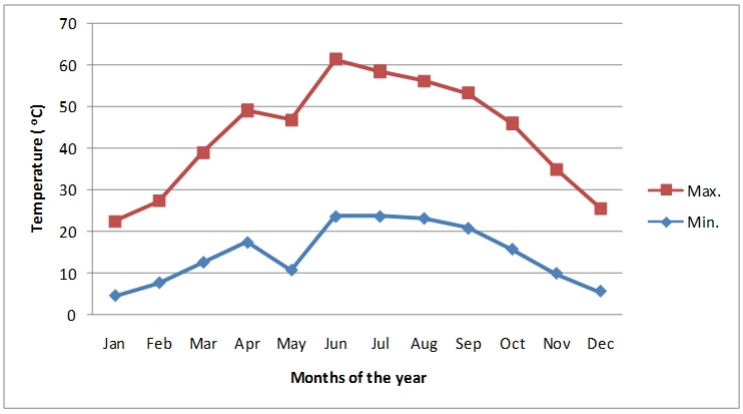

Fig. 2. Graphical representation of monthly variation in temperature

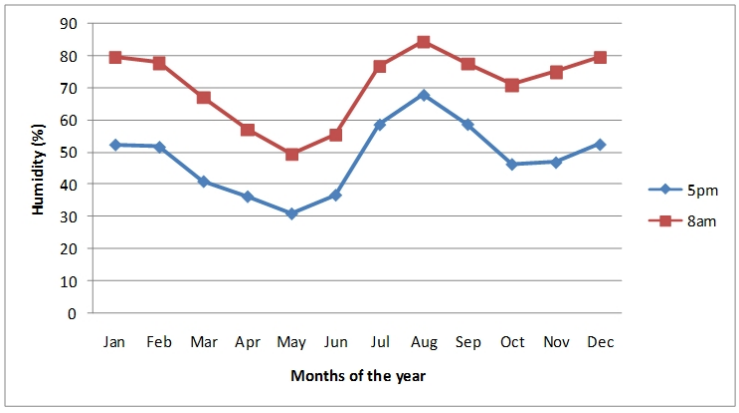

Fig. 3. Graphical representation of monthly variation in humidity

2.2 Methodology

The forage biomass was calculated by Harvest method using 1m2quadrat. Five quadrats were selected from each community permanently. Above ground grasses and forbs were clipped up to 2cm and were placed in separate polythene bags. Both grasses and forbs were separately weighed and average was taken. The results were expressed in Kilo grams per hectares. The above process was done for each month from July 2012 to June 2013 [1,21]. Regression analysis is used for data analysis. Biomass is used as dependent variable while rainfall and temperature are used as predictor. Analysis is performed in SPSS software.

3. RESULTS

The average biomass of the investigated area was 854 Kg/ha. The mean maximum herbaceous biomass was reported in July (1387 Kg /ha). There after it decreased from August to December ranging from 1335-771 Kg/ha. Biomass was low during January and February (169 to 111 Kg /ha). It again increased from March to June i.e 568-1016 Kg/ha (Table 1, Fig. 4). Biomass constantly increases with altitude (Alt. 1535-1870m). It was higher at the base and low at the higher altitude (Table 1, Fig. 5).

The P value for regression analysis between rainfall and biomass is 0.48 (Table 3). As p value is less than 0.05 so the results are non significant which mean that biomass is dependent upon rainfall. The R value is 0.56 (Table 2) which shows that there is positive relationship between biomass and rainfall.

The P value for regression analysis between temperature and rainfall is 0.38 (Table 5). As p value is less than 0.05 so the results are non significant which mean that biomass is dependent upon temperature. The R value is 0.68 (Table 4) which shows that there is positive relationship between biomass and temperature.

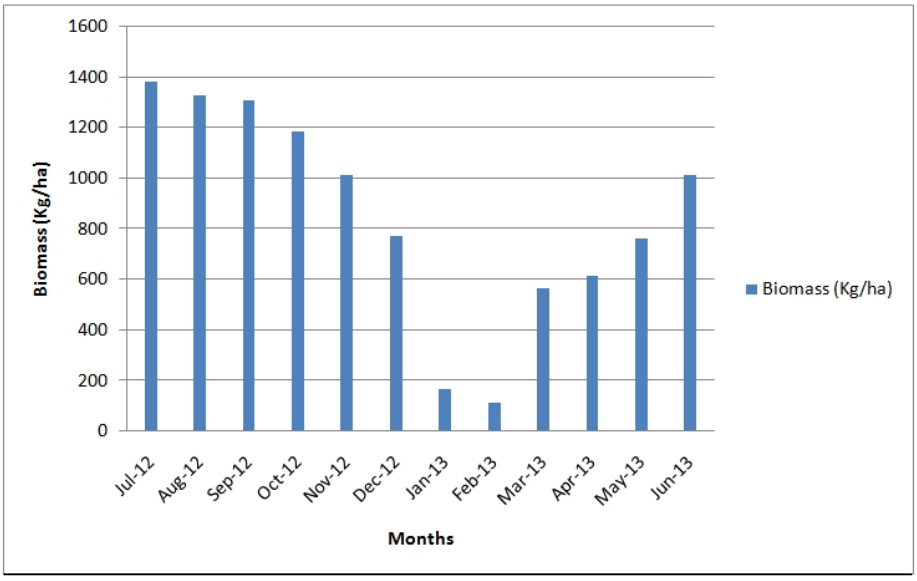

Fig. 4. Graphical representation of monthly variation in biomass at Nikyal hills

Table 1. Altitudinal variation in biomass DM (Kg/ha) of herbaceous species recorded from Nikyal valley during 2012-2013

	Alt. (m)	1535	1540	1595	1610	1620	1650	1655	1670	1700	1710	1760	1820	1870	Average
	Comm.	MPR	OPB	OTP	MRP	Q	RQO	OTP	M	QOJ	QMP	QRT	PQI	PQO	
Months	July 2012	1590	1565	1510	1485	1466	1425	1415	1395	1355	1330	1240	1170	1090	1387
	Aug 2012	1530	1510	1455	1440	1420	1385	1375	1330	1290	1274	1205	1115	1030	1335
	Sep 2012	1510	1497	1460	1423	1405	1365	1360	1330	1270	1255	1170	1060	975	1314
	Oct 2012	1390	1375	1315	1295	1280	1230	1223	1195	1140	1120	1030	940	855	1184
	Nov 2012	1260	1250	1192	1170	1160	1115	1000	970	925	905	825	745	640	1012
	Dec 2012	960	945	885	860	840	805	795	770	740	716	645	570	495	771
	Jan 2013	255	245	230	210	202	180	177	160	140	128	105	90	72	169
	Feb 2013	180	162	155	140	135	120	117	110	90	87	65	48	30	111
	Mar 2013	725	710	660	610	598	565	557	540	525	515	470	430	485	568
	Apr 2013	780	766	715	670	655	625	615	595	570	560	520	485	440	615
	May 2013	945	933	890	820	800	775	770	740	725	715	665	605	535	763
	June 2013	1210	1195	1140	1085	1065	1030	1015	990	970	960	900	855	790	1016
	Average	1028	1013	967	934	919	885	868	844	812	797	737	676	620	854

Key: Alt. = Altitude Comm = Communities name
MPR = Myrsine -Pinus- Rhus community, M = Myrsine, 0PB = Olea-Punica- Berberis, QOJ = Qurecus-Oxalis- Justica
OTP = Olea - Themeda –Pinus; QMB = Quercus- Myrsine- Berberis; MRP = Myrsine - Rhus-Pinus
QRT = Quercus- Rabdopsia- Themeda; Q = Quercus PQI = Pinus- Quercus – Indigofera
RQO = Rubus- Quercus-Oxalis community; PQO= Pinus- Quercus -Oxalis community

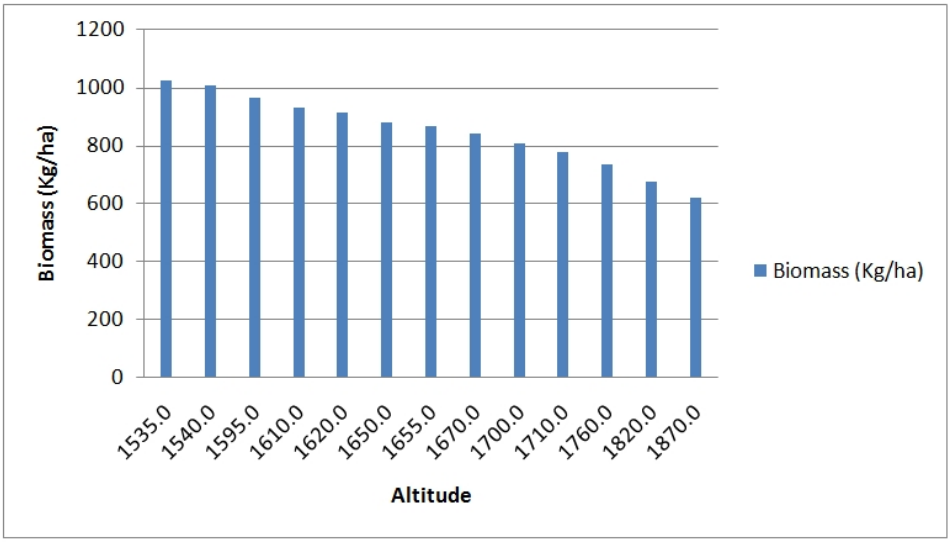

Fig. 5. Graphical representation of altitudinal variation in biomass at Nikyal hills

Table 2. Model Summary of Regression analysis between rainfall and biomass

Model	R	R Square	Adjusted R square	Std. Error of the estimate
1	.560[a]	.314	.245	376.13738

[a]*Predictors: (Constant), rainfall*
[b]*Dependent Variable: biomass*

Table 3. ANOVA (Rainfall and Biomass)

Model		Sum of squares	df	Mean Square	F	Sig.
1	Regression	647724.965	1	647724.965	4.578	.048[a]
	Residual	1414793.285	10	141479.329		
	Total	2062518.250	11			

[a]*Predictors: (Constant), rainfall*
[b]*Dependent Variable: biomass*

Table 3. Model Summary of regression analysis between temperature and biomass

Model	R	R Square	Adjusted R Square
1	.603[a]	.364	.301

[a]*Predictors: (Constant), Temperature*
[b]*Dependent Variable: biomass*

Table 4. ANOVA[b] (Temperature and biomass)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	751088.692	1	751088.692	5.727	.038[a]
	Residual	1311429.558	10	131142.956		
	Total	2062518.250	11			

[a]*Predictors: (Constant), Temperature*
[b]*Dependent Variable: biomass*

4. DISCUSSION

The dry weight of living matter, including stored food present in a species population and expressed in terms of a given area or volume of the habitat is called biomass. It is the mass of living biological organisms in a given area or ecosystem at a given time [19,20].

Biomass of any area is influenced by number of factor such as community structure, species composition, Slope, Soil type, precipitation, road construction, land use history and population density. Rain fall and temperature are the main factors which influence the biomass of any area [14,20].

Mean Maximum biomass in the study area was 1387 – 1314 Kg /ha during July to September which decreased up to 771 Kg/ha during December. January to February biomass was dropped down up to 169- 111 Kg/ha and then again started increasing in the month of March (568 Kg/h) which further increased from April to June from 763- 1016 Kg/ha.. The highest biomass in the investigated area was due to high rainfall in the months of July to September (251.52 – 89.01mm). Similar finding were reported by 20 in Ganga Chotti and Bedori Hills. In Ganga Chotti the climate varies from moist temperate to Sub-alpine While in Nikyal Hills the climate differs from dry to moist temperate.

Temperature is the factor which influences the biomass. In the investigated area biomass was high at the base and decreased with the increase in altitude. In our area temperature was high in the month of July (35°C) it decreased up to December (20°C). The highest biomass in the month of July might be due to the temperature 14 reported that in the Harboi area the climatic factors such as rainfall and temperature influence the biomass during the months of summer. Our findings are in accordance with 19, 20 who reported similar findings in their study areas.

Biomass varies with changes in climatic conditions such as rainfall and temperature. It increases in the months of summer due to high temperature and decreases in the months of winter due to low temperature [12]. Similarly in the investigated area highest amount of biomass was reported in the months of summer and lowest in the months of winter, so our findings in this regard agree with them. Similar findings were also reported by [21,22,23,24,25]

Biomass decreases with the increase in altitude in Nikyal valley. However, in the high altitude of Dharbi range land biomass was higher because of less grazing pressure while at the lower elevation grazing pressure was higher that is why biomass decreased [13]. In the investigated area biomass was higher at the lower elevation and lower at the high altitude due to low temperature at high altitude.

5. CONCLUSION

The variation in Biomass controlled by the amount and timing of precipitation and temperature inputs during the growing season. This study reflects that overgrazing, over exploitation and soil erosion were strongly suffering the range, which must be cared for. Blend of different traditional and modern methods of range management along with the participation of local communities were recommended for sustainable use of range.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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