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Seasonal Distribution of Physical Parameters of Soil in Catchment Area of Pandoga Sub Watershed in Shivalik Foothills of Una, India

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Abstract

Watershed projects in India are implemented with the twin objectives of soil and water conservation. Present study area falls in fragile and degraded foothills of Shivalik ranges. Aim of this study was to determine the physical parameters of soil in pandoga sub watershed catchment area for two seasons. Three–stage systematic sampling design was followed for soil sampling. Total twenty seven soil samples were collected from a depth of 0-20 cm. The collected soil sample was air dried, ground, sieved with 2 mm sieve, tagged, and stored for laboratory analysis. Physical parameters were analyzed using standard methodology. Soilcolour, soil texture changed within the sites but remain almost static with the season. Sand particles show dominance of over silt and clay in each site of study area. Bulk density, moisture content was higher in site 3 and show high mean value in post monsoon season against the pre monsoon season.

Key Words

Physical parameters, sub watershed, water availability

I. INTRODUCTION

Soil is a natural body of mineral and organic material, which differs among themselves as well as from underlying materials in their morphology, physical make up, chemical composition and biological characteristics (Solanki and Chavda, 2012). Large proportion of earth terrestrial surface has converted from natural ecosystems to human dominated system. These land uses changes affect the ecosystem soil properties (Paz-Kagan, *et al.*, 2014).

Soil fertility varies spatially from field to larger region scale, and is influenced by both land use and soil management practices (Sun *et al.*, 2003). Revealing spatial variability of soil fertility and its influencing factors are important to improve sustainable land use strategies (Qi *et al.*, 2009).

A watershed is a catchment area from which all water drains into a common point, for technical efforts to conserve soil and maximize the utilization of surface water and subsurface water for crop production (Kerr *et al.*, 2000). The government of India adopted watershed management on a large scale as a strategy to conserve rainwater and soil for increasing production of rain fed systems (Wani and Ramakrishna, 2005; Wani*et al.*, 2008) and to enhance the livelihoods of the rural poor (Sharma and Scott, 2005).

The present study was conducted (July 2013 - June 2014) in pandoga sub watershed catchment area which is located in rainfed agricultural area of Shivalik foot hills which is fragile and young. Therefore study is important to assess the physical parameters of soil in changed scenario after the sub watershed implementation in area.

II. MATERIALS AND METHODS

Pandoga sub watershed is one of the 22 sub watersheds implemented in SRIWMP (SWAN RIVER INTEGRATED WATERSHED MANAGEMENT PROJECT). SRIWMP was launched to convert flood and hazards region of rainfed agricultural area into natural gift. The Pandoga sub watershed was located at 31° 30'25.30"N Latitude and 76° 82' 02.24" E longitudes.Elevation of area is 350 to 600 m above mean sea level. Topography of the area is gentle to moderately sloping. Mean annual rainfall is approximately 1155mm with extreme variation in rainy and post rainy season. Temperatures also vary from high in summer season (May to June) to low in winter season. Agro climatic zone is Shivalik foot hills of Western Himalayan zoneThree–stage systematic sampling design was followed where watershed's catchment area was divided into three sites; second one was division of each site into three wards; third is triplicate soil sampling was done from each ward for two seasons (post monsoon and pre monsoon season) from a depth of 0-20 cm and then data was analyzed by following standard methodology; colour(Rice et al., 1941);texture(International pipette method (Piper, 1966));moisture content(Dry oven method),bulk density (core method

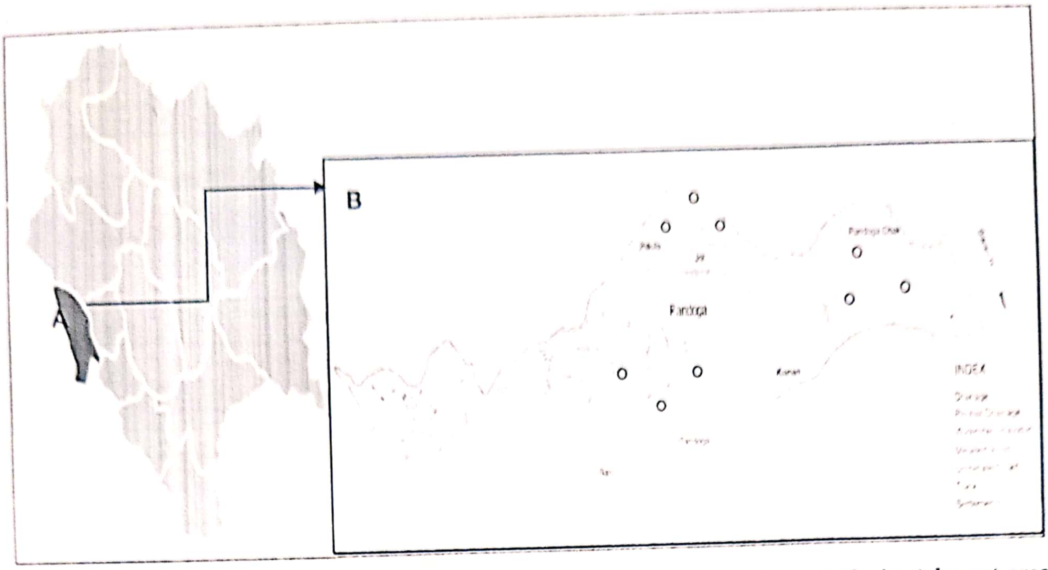

Figure 1: Location map A. Distt. Una in Himachal Pradesh; B. Pandoga sub-watershed catchment area

III. RESULT AND DISCUSSION

A) Physical Analysis

[SOIL COLOUR, SOIL TEXTURE, SOIL BULK DENSITY,SOIL MOISTURE CONTENT]

Results of present study revealed that soil colour varied from site to sites as: pale yellow to brownish gray or yellow in site 1, light gray to brownish gray in site 2, while pale yellow or dull yellow to brownish gray in site 3(Table1) . Woldeamlak and Stroosnijder, (2003) found the grayish soil colour in flood plain area where alluvial deposited during flooding. Soil texture controls the infiltration, water holding capacity, soil porosity, adsorption of nutrients, microbial activities, tillage and irrigation practices (Gupta, 2004). Results revealed that maximum mean sand percentage (75%) was found in ward 10 of site 2 and minimum mean sand percentage (64.33%) in ward 9 of site 1. Maximum mean silt was (23.33%) in wards of 4 of site 3 and minimum mean (17.33%) in ward 7 of site 3. Maximum mean clay was observed (15.66%) in ward 9 of site 1 and minimum mean in ward 10 of site 2 (Fig.2A). Sand particles dominate over silt and clay in all sites of study area. According to (Mortimore, 1989) sand particle dominate in arid and semi-arid climate. (Adamu, 1997) indicated that sandy textured soil are prone to erosion due to poor binding between the soils particles and create unstable structures. Differential particle size distribution in sites might be the result of differential soil conservation measures adopted. The soil at Pandoga sub watershed catchment area was sandy loam type of soil, same type of soil texture was observed from various altitudes of some western Himalayan regions (Jina*et al.*, 2011; Gupta and Sharma, 2016). During post monsoon season, maximum mean bulk density 1.54 gm/cm^3 was in ward 7 of site 3 and minimum mean bulk density1.37 gm/cm^{3}in ward 8 of site 1. However, during pre monsoon season maximum bulk density 1.50 gm/cm^3 was in ward 7 of site 3 and minimum 1.27 gm/cm^3 in ward 8 of site 1(Fig.2B). Results revealed that bulk density of post monsoon was higher than the pre monsoon seasons. Same trend was observed in the study of (Patel *et al.*, 2015) Higher bulk density in site 3 may be due higher percentage of sand, trampling effect of live-stock population. Sandy soils had relatively high bulk density since total pore space in sand was less than the silt and clay soil. Maximum mean moisture content was recorded by 17.58% and 17.14% was in ward 7 of site 3 in post and pre monsoon season respectively whereas minimum mean moisture content was recorded by 12.73% in ward 2 of site 2 during post monsoon season. Minimum mean moisture was 11.15% in ward 1 of site 2 during pre monsoon season. Soil moisture was increased by rainfall during rainy season (Fig.2C). The amount of water in the soil was mostly influenced by the quantity of precipitation occurred in that particular area (Fauzi*et al.*, 2015) while (Jina*et al.*, 2011) indicated that soil moisture shows a fixed seasonal trend i.e., it was higher during rainy season and decrease gradually in winters and summers. Higher moisture content in site 3 may be due to meeting point of Pandoga River with the Swan river and ground water recharging in site 3 through gravity gradient flow of water to underground region of pandoga.

Site 1			
Ward	8	9	11
Colour	Pale Yellow to Yellow	Brownish Gray to Dull Yellow	Pale Yellow
Site 2			
Ward	1	2	10
Colour	Light Gray	Light Gray to Brownish Gray	Light Gray
Site 3			
Ward	3	4	7
Colour	Pale Yellow to Grayish Yellow	Dull Yellow to Brownish Gray	Brownish Gray

Table 1: Variation in soil colour at Pandoga sub watershed catchment area at different sites (nine wards)for post monsoon season.

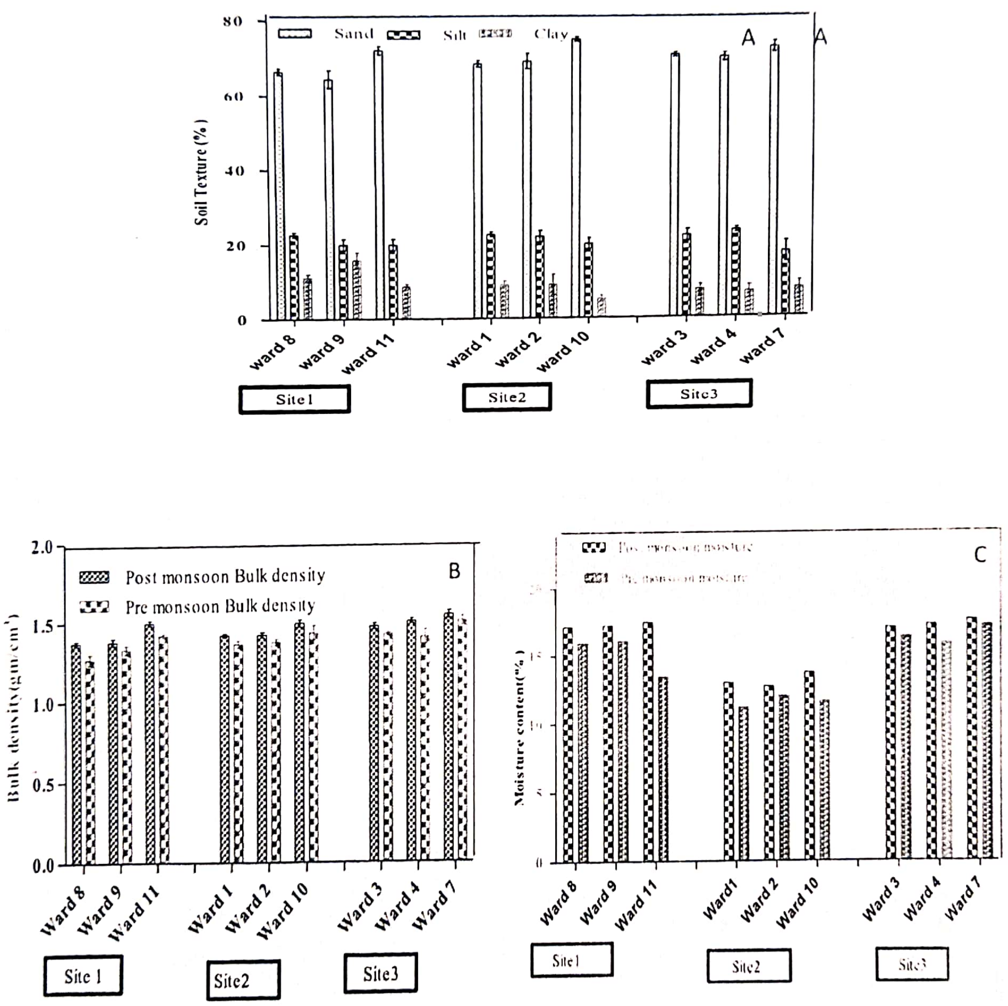

Fig.2: Variation in physical parameters of soil at Pandoga sub watershed catchment area at different sites (nine wards) during two different seasons. Values are ± S. E. n=3. [A: Textural distribution; B: Bulk Density; C: Moisture content]

IV. CONCLUSION

Pandoga sub watershed catchment area had influence on the soil physical parameter as study area experienced changed ecology (rainfed agro ecological region) by recharging ground water. Soil conservation measures (wire check dams, crate wire check dams, vegetation) affect the rate of erosion which ultimately affects the texture, bulk density and moisture holding of soil in different sites of study area. Fluctuations of Physical parameter results season wise as well as site wise indicated changing characters with the changed conservation measures.

REFERENCES

[1] NationalBank for Agriculture and Rural Development (NABARD) (2006) Watershed Development Fund Guidelines.

[2] Adamu GK. 1997. An assessment of erodobility of selected soils under different land management systems at Bayero University, Kano New campus: unpublished PGD Project Soil evaluation: BUK.

[3] Fauzie AK. Khudsar F A. Sreenivasa. 2015. Analysis of Soil Physico-Chemical Properties in Various Sites at Yamuna Biodiversity Park, Delhi (India). International Journal of Innovative Research in Science, Engineering and Technology. 4(8).

[4] Gupta PK. 2004. Soil, plant, water and fertilizer analysis. Shyam Printing Press. Agrobios, India.438.

[5] Gupta D, Sharma DP. 2016. Site and stand characteristics of hazelnut bearing forests in temperate region of Himachal Pradesh. International Journal of Farm Sciences. 6(1): 292-300.

[6] Jina BS. Bohara CS, Lodhiyal LS and Sah P, 2011. Soil characteristics in oak and pine forests of Indian Central Himalaya. E- International Scientific Journal, 3(1): 19-22.

[7] Kerr J. Pangare G. Pangare VL, George PJ, 2000. An Evaluation of dryland watershed development in India. EPTD Discussion paper 68. International food policy research institute. Washington. DC. USA, 137.

[8] Mortimore M. 1989. Adapting to drought: farmers, famine and desertification in West Africa: Cambridge: University Press.

[9] Paz-Kagan T. Shachak M. Zaadi E and Karniely A, 2014 A spectral soil quality index for characterizing soil function in areas of changed land use Geoderma 230-238.

[10] Patel MP. Gami B and Patel B, 2015. Seasonal Impact on Physical-Chemical Properties of Soil in North and South Gujarat IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS). 8 (6): 26-36

[11] Piper CS, 1966. Soil and Plant Analysis. Hans Publishers Bombay.

[12] Rice TD, D Nickerson, AMO, 1941. Neal and J. Tharp Soil Colour Charts. United State Department of Agriculture. Miscellaneous Publication No.425.

[13] Sharma BR and Scott CA, 2005. Watershed Management Challenges: Introduction and overview, In: Watershed Management Challenges: Improving Productivity, Resources and Livelihoods.eds: Sharma B.R. Samra J.S. Scott C A and Wani S P. International Water Management Institute (IWMI) and International Crop Research Institute for Semi arid Tropics (ICRISAT) publication. Malhotra Publishing House, New Delhi

[14] Solanki HA and Chavda NH. 2012. Physico chemical analysis with reference seasonal to changes in soils of Victoria park reserve forest. Bhavnagar (Gujrat) Life sciences leaflets.8.:62-68.

[15] Sun B, Zhou SL and Zhao QG. 2003. Evaluation of spatial and temporal changes of soil quality based on geostatistical analysis in the hill region of subtropical China. Geoderma. 115.85-99.

[16] Qi YB. Darilek JL and GU ZQ. 2009 Evaluating soil quality indices in an agricultural region of Jiangsu Province, China. Geodema. 149(3-4): 325-334.

[17] Wani SP, Ramkrishna YS, 2005. Sustainable management of rainwater through integrated watershed approach for improved for livelihoods. In; "Watershed Management Challenges; Improved Productivity, Resources Livelihoods", (eds.Bharat R Sharma, J S Samra. CA Scot and Suhas P Wani), IMMI Sri lanka. 39-60.

[18] Wani SP, Sreedevi TK, Reddy TSV, Venkateshvaralu B and Prasad CS, 2008. Community watersheds for improved livelihoods through consortium approach in drought prone rain fed areas. Journal of hydrological Research and Development. 23: 55-77.

[19] WoldeamlakBewket, Stroosnijder L, 2003. Effects of agro ecological land use succession on Soil properties in Chemoga Watershed, Blue Nile basin, Ethiopia Geoderma 111: 85-9

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Research Paper

Chemical Analysis of Soil of Pandoga Sub Watershed with the Seasons in Una (H.P), India

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ABSTRACT

Watershed is hydrological unit to manage diverse natural resources (soil, water, biodiversity) that are unevenly distributed within a given geographical area. It is implemented in India to enhance the livelihood security of the rural poor people by soil and water conservation. Present study area too falls in sub watershed catchment area. Present study was conducted to determine the soil status by chemical parameters of soil in Pandoga sub watershed catchment area for two seasons. Three-stage systematic soil sampling design was followed. Soil samples were analyzed using standard methodology for chemical parameters. pH value of all samples show alkaline nature for both seasons except for ward 4 of site 7 that had slightly acidic nature in pre monsoon season while electrical conductivity (EC) results shows that all soil samples are not saline in nature. Organic carbon, organic carbon matter, available nitrogen, available phosphorus and available potassium had high mean value in post monsoon season as compared to pre monsoon season.

Key words: Biological oxygen demand, chemical oxygen demand, electrical conductivity

I. INTRODUCTION

Watershed development was nothing but a risk management strategy to combat environmental degradation and deplorable ecosystems of rural India from acute distress caused by recurring droughts and intensity of floods or a course of action in a right perspective to exploit full potential of natural resources. Watershed projects play important role in managing soil and water resources throughout the world (Kerr and Chung, 2001). In 1990s the government of India too adopted watershed management to conserve rainwater and soil of rain fed ecosystem (Wani and Ramakrishna, 2005; Wani *et al.*, 2008).

Soil is a vital natural and non-renewable resource which performs environmental, economic and social functions. Soil quality is related to the soil capability which is old human civilization itself (Carter *et al.*, 2004). Soil quality has-been defined as the capacity of the soil to sustain biological productivity, environmental quality and enhance plant, animal and human health (Doran and Parkin, 1994). High quality soils not only produce better food and fiber but also help to maintain natural ecosystems (Griffiths *et al.*, 2010).

According to the IPCC, 2007 (Inter governmental Panel on Climate Change), global temperatures are expected to increase between 1.1 to 6.4°C during the 21st century and precipitation patterns will be altered. This altered climate will had a potential to threaten food security through its effects on soil properties and processes Brevik (2013). In order to mitigate losses in agricultural productivity due to seasonal climatic changes (heavy rainfall, drought etc.,) there is a need to monitor physical-chemical

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Principal, Govt. Shivalik College Naya Nangal-140126 properties of soil as it has a direct impact on soil health and subsequent crop yields.

Research on soil quality was initiated to address the issues of environment protection, agriculture productivity to tackle food security problem and to reduce land degradation in Pandoga sub watershed catchment area which is located in rainfed agricultural area of Shivalik foot hills. Soil erosion or degradation was the main challenge in this rainfed agriculture area.

II. MATERIALS AND METHODS

Study area

Pandoga sub watershed was implemented by SRIWMP (Swan River Integrated Watershed Management Project) to convert flood hazards region of rainfed agricultural area into natural gift. The Pandoga sub watershed was located at 31^0 30'25.30"N Latitude and 76^0 82' 02.24" E longitudes. Elevation of area is 350 to 600 m above mean sea level. Topography of the area is gentle to moderately sloping. Mean annual rainfall is approximately 1155 mm with extreme variation in rainy and post rainy season. Temperatures also vary from high in summer season to low in winter season. Agro climatic zone is Shivalik foot hills of Western Himalayan zone.

Methods

Three–stage systematic sampling design was followed as first one was division watershed's catchment area into three sites; second one was division of each site into three wards; third is triplicate soil sampling from each ward for two seasons (post monsoon and pre monsoon season) from a depth of 0-20 cm. Soil sample samples was analyzed by following standard methodology; pH and EC (pH and Electrical conductivity meter); organic carbon (Walkley and Black, 1934); soil organic carbon (OC value × 1.72) . NPK [(Micro - Kjeidhal procedure of Chapmann and Pratt, 1961; Olsen's et al., 1954; Flame photometerically (Piper, 1966)]. The data was statistically analyzed with the help of software Graph Pad Prism version 5.0 for standard error of mean values.

III. RESULT AND DISCUSSION

Chemical analysis

Soil pH of an area is controlled by the nature of the parent material, climate of the region, organic matter and topographic situation (Tamirat, 1992). Maximum mean pH was 7.60 in ward 9 of site 1 and minimum mean pH was 6.47 in ward 8 of site 1 during post monsoon season. Fluctuations in pH in same site may be due to differential application of fertilizers and manure in field by farmers. Soil pH raised by 2-3 units in the immediate vicinity of granule of urea (Tisdale *et al.*, 1985). However, during pre monsoon season maximum mean was 7.34 in ward 10 of site 2 and minimum mean 5.88 was in ward 4 of site 3. High pH in post monsoon may be due to addition of rain water in soil (Solanki, 2001). Soil pH was moderately alkaline in all sites in post monsoon season, while it was moderately alkaline to slightly acidic in nature in pre monsoon season. Soil alkalinity in arid soil was caused by naturally existing limestone in the soil (Solanki and Chavda, 2012). The decline in soil pH was due to the action of plants and soil microbes that help to degrade plant litter and convert it into humic acid (or later into humus) hence slowly decline the soil pH (Fauzie *et al.*, 2015).

Soil electrical conductivity was a measure of soluble salt ions and metals which allow the current to pass through them at any particular temperature. The results of electrical conductivity revealed that in post monsoon season maximum mean electrical conductivity was 0.38 milli mohs/cm in ward 7 of site 3 and the minimum mean electrical conductivity was 0.093 milli mohs/cm in ward 3 of site 3. However in pre monsoon season maximum mean electrical conductivity was 0.22 milli mohs/cm in ward 4 of site 3 and the minimum mean electrical conductivity recorded 0.08 milli mohs/cm in the ward 8 of site 1. Electrical conductivity results varied within the wards of sites as EC of soil varied with the moisture held in soil (Solanki and Chavda, 2012). Increase in electrical conductivity in post monsoon season attribute to high deposition of salt after monsoon season (Paine, 2005).

Soil organic carbon (SOC) was an important parameter affecting soil quality and agriculture sustainability (Guangyu *et al.*, 2010). It was evident that during post monsoon season maximum mean organic carbon was 0.830% in ward 8 of site 1 and minimum mean was 0.256% in ward 1 of site 2. However during pre monsoon season maximum mean organic carbon was 0.546% in ward 10 of site 2 and minimum was 0.190% in ward 1 of site 2. Organic carbon of study area varied with the wards and seasons. Low organic carbon was observed in pre monsoon but in ward 9 and ward 11 of site 1; ward 4 of site 2 had higher organic carbon in post monsoon season. High organic carbon in these wards might be high use of local fertilizers like animal manure and dung. Presence of soil microorganism in post monsoon season increased the decomposition of organic matter (Ingavale *et al.*, 2012). Decline of SOM generally resulted in the decline in soil fertility status and globally crop productivity (Bot and Benites, 2005). Hot humid and per humid climates are deficient in organic carbon due to intensive agricultural practices (Bhattacharya *et al.*, 2000).

Nitrogen was important nutrients required for plant growth because it was the major constituent of all proteins, chlorophyll and nucleic acids while deficiency of it might cause stunted growth and yellowish leaves. Maximum available nitrogen was 359.12Kg/ha and 321.96kg/ha in ward 7 of site 3 and minimum was112.85kg/ha and 108.48kg/ha in ward 2 of site 2 in post and pre monsoon season respectively. The major proportion of nitrogen in the soil was influenced by organic matter present in the soil (Borkar, 2015). Higher available nitrogen was observed in post monsoon season which might be due to luxuriant growth of nitrogen fixing bacteria (blue green soil algae) as soil had sufficient water, favourable temperature and humidity. In contrast nitrogen lost from soil by leaching as it moves with soil water below the root zone (Solanki and Chavda, 2012). Nitrogen mean value fluctuate within wards of selected sites. Reason behind these results might be mineralization of organic that released large amount of nitrogen in soil (Prasad *et al.*, 2008).

Phosphorus available in adequate amount stimulates and hastens plant growth (Solanki and Chavda, 2012). It was evident that maximum mean available phosphorus was 49.28kg/ha and 37.71kg/ha in ward 7 of site 3 during post and pre monsoon season respectively. Minimum mean was 26.88kg/ha in ward 9 of site 1 during post monsoon season and minimum mean phosphorus 4.67 kg/ha was in ward 1 of site 2 during pre monsoon season. High amount of mean available phosphorus in site 3 might be due to run-off of fertilizer from its neighboring high- land area or washed away during precipitations. Higher available phosphorus was observed in post monsoon season as it might be due to adsorption of phosphate ions on suspended particles and might be assimilation of phosphate ions by phytoplankton (Solanki and Chavda, 2012).It was evident that during post monsoon season was 537.33 kg/ha and 351.19 kg/ha during pre monsoon in ward 7 of site 3 whereas minimum mean was 100.80 kg/ha and 92.77 kg/ha in ward 2 of site 2 during post and pre monsoon season respectively. Higher available potassium was observed in post monsoon season. However, reverse results were observed by (Kumar and Srikantaswami, 2012) as potassium present in soil dissolved in water and eroded off.

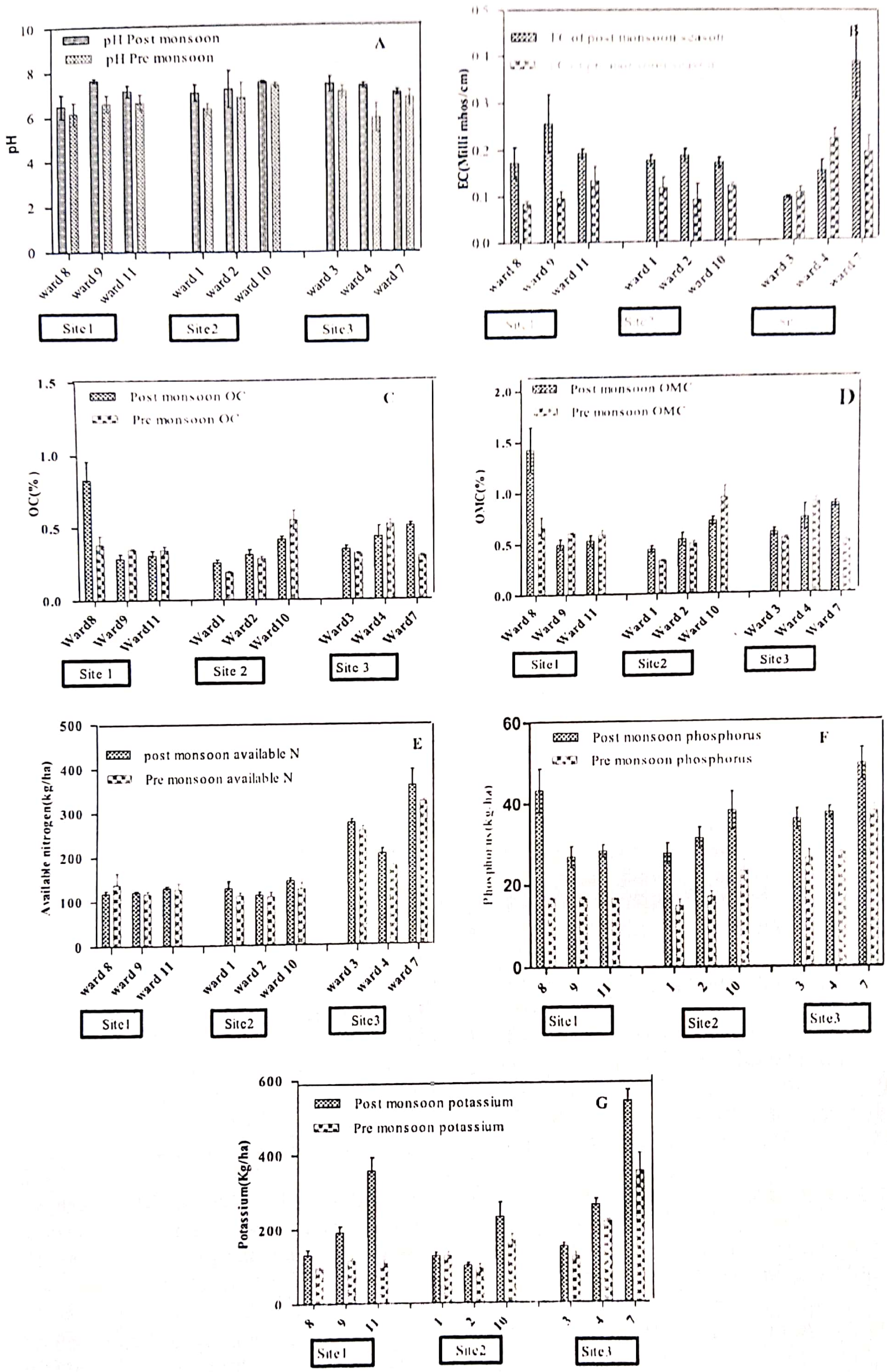

Fig.1: Variation in physical parameters of soil at Pandoga sub watershed catchment area at different sites (nine wards) during two different seasons. Values are mean ± S. E. n=3. [A: pH; B: EC; C: OC; D: OMC; E: Avail N; F: Avail. P; G: Avail. K]

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IV. CONCLUSION

Research study site had influence on the soil chemical parameter as it experienced changed ecology due to soil conservation measures (wire check dams, crate wire check dams, vegetation) adopted. These affect the rate of erosion and level of ground water in study sites. Availability of water in study sites had changed cropping pattern. Chemical analysis of soil indicated variation of parameters with the season as season wise as well as with the site as differential application of manure, fertilizers and pesticides.

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VI. REFERENCES

- Bhattacharyya T, Pal DK, Mandal C, Velayutham M.. Organic carbon stock in Indian soils and their geographical distribution, Current Science. 2000; 79(5). 655-660.
- Borkar AD. Studies on Some Physico chemical Parameters of Soil Samples in Katol Taluka District Nagpur (MS), India. Research Journal of Agriculture and Forestry Sciences. 2015; 3(1): 16-18.
- Bot A and Benites J.The importance of soil organic matter Key to drought-resistant soil and sustained food production. Food and Agriculture Organization of the United Nations, Rome. 2005
- Brevik EC. The potential impact of climate change on soil properties and processes and corresponding influence on food security. Departments of Natural Sciences and Agriculture and Technical Studies, Dickinson State University, Dickinson, ND. 2013
- Chapman HD and Pratt PF. Methods of analysis for soils, plants and waters. Division of Agricultural Sciences, University of California. 1961
- Carter M R, Andrews SS. Drinkwater L E. Systems approaches for improving soil quality. In 'Managing soil quality: challenges' (Eds. P Scjonning,S elmholt, BT Christensen. 2004;261-281.
- Doran JW, Parkin TB. Defining and Assessing Soil Quality. In JW Doran, DC. Coleman, Bezdicek DF and Stewart B A (Eds.). Defining Soil Quality for a Sustainable Environment. SSSA Special Publication. 1994; 3-23.
- Fauzie AK, Khudsar F A, Sreenivasa. Analysis of Soil Physico-Chemical Properties in Various Sites at Yamuna Biodiversity Park, Delhi (India). International Journal of Innovative Research in Science, Engineering and Technology. 2015; 4(8);7220-28.
- Griffiths BS, Ball BC, Bohanec M. Integrating soil quality changes to arable agricultural systems following organic matter addition, or adoption of a ley-arable rotation. Applied Soil Ecology. 2010; 46(1):43-5.
- Guangyu C, Xin C and Yi S. Profile distribution of soil organic carbon under different land use type in Sanjing Plain. World Congress of Soil Science, Soil Solutions for a Changing World. 2010; 183-185.
- Ingavale RR, Mohite SA, Shinde TV, Jadhav AS and Raut PD. Studies on physico-chemical characteristics of soil of Bhogawati River bank in Kolhapur District. Proceeding of International Conference, SWRDM. 2012
- IPCC (Intergovernmental Panel on Climate Change). Climate change 2007. Fourth Assessment Report. Cambridge University Press, Cambridge, U.K. 2007.
- Kerr J. Chung K. Evaluating Watershed Management Projects, CAPRI Working Paper NO.17, IFPRI, and Washington, DC. 2001.
- Kumar SD, Srikantaswamy S. Study of physico chemical characteristics of industrial zone soil of mysore city, Karnataka, India. International Journal of Environmental Science. 2012; 3(1): 224-232.
- Olsen SR, CV Cole, Watanbe FS, Dean LA. Estimation of available phosphorus in the soil by extraction with sodium bicarbonate. U.S. Department of Agriculture Circular. 1954; 939.
- Paine JG. Determining Salinization Extent, Identifying Salinity Sources, and Estimating chloride mass using surface, borehole, and airborne electromagnetic Induction

methods, Water Resource Research. 2015; 39 (3): 1059.

- Solanki HA. Study on pollution of soils and water reservoir near industrial areas of Baroda. PhD thesis submitted to Bhavnagar University, Bhavnagar. 2001.
- Solanki HA and Chavda NH. Physico – chemical analysis with reference seasonal to changes in soils of Victoria park reserve forest, Bhavnagar (Gujarat).Life sciences leaflets. 2012; 8, 62-68.
- Tamirat T. Vertisol of Central Highlands of Ethiopia: Characterization and Evaluation of Phosphorus Statues. Master's Thesis, Alemaya University, Dire Dawa. 1992
- Tisdale ST, Nelson WL and Beaton JD. Soil fertility and fertilizers. 4th ed. Macmillan publishing company, New York. 1985
- Walkley A and Black IA. An examination of the Degtjareff method for Determining soil organic matter, and proposed a modification of the chromic acid titration method. Soil Science. 1934; 37:29-38.
- Wani SP, Ramkrishna YS. Sustainable management of rainwater through integrated watershed approach for improved livelihoods. In; "Watershed Management Challenges; Improved Productivity, Resources Livelihoods", (eds.Bharat R Sharma, J S Samra, CA Scot and Suhas P Wani), IMMI Sri lanka. 2005; 39-60.
- Wani SP, Sreedevi TK, Reddy TSV, Venkateshvaralu B and Prasad CS. Community watersheds for improved livelihoods through consortium approach in drought prone rain fed areas. Journal of hydrological Research and Development. 2008; 23: 55-77.

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SPATIAL DISTRIBUTION OF VEGETATION ALONG SELECTED SUBWATERSHED CATCHMENT AREA OF UNA DISTRICT OF HIMACHAL PRADESH

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Abstract: watershed management entails the rational utilization of land and water resources for optimum production but minimum hazard to natural and human resources. The flora investigation revealed a total of 136 species, 112 genera and 49 families. The floristic composition enumerated Site 1 had 114 species comprising trees, shrubs, herbs grass and climbers, Site 2 and site 3 had 95 and 73 species respectively. Floristic composition of study area revealed 36 trees belongs to 27 genera, 17 shrubs belongs to 17 genera, 62 Herbs belongs to 55 genera, 9 grasses belongs to 9 genera and 9 climbers belongs to 9 genera while one parasite was also observed . Site wise distribution of life form results showed Phanerophytes: 31.62% (43 spp.) in site 1; 26.47% (36 spp.) in site 2: 18.38% (25 spp.) in site 3. Distribution of Therophytes in site1, site 2, site 3 was 30.14 % (41spp.), 31.62 % (43spp.), and 19.85% (27spp.), respectively. Cryptophytes showed 3.67 % (5spp), 1.47 % (2spp); 2.20 % (3spp) in site 1, site 2 and site3, respectively; Hemicryptophytes 5.15 % (7spp.) and Chamaephytes 5.15% (7spp) was same in site 1 while Hemicryptophytes 4.14% (6spp.), 2.20% (3spp.) was in site 2 and 3 respectively and Chamaephytes 5.88% (8spp) and 4.41 % (6 spp.) in site 2 and site 3. Geophytes present in all sites with the 0.73%. Results of present study revealed that both Phanerophytes and Therophytes acted as a depicting factor for deciding the phytoclimate i.e.. warm-moist and warm-dry climate.

Keywords: Biological spectrum, Floristic composition, Phytoclimate, life form

1. Introduction

Floristic composition specifies plant community of any particular area, which can be authenticated through plant citation of herbarium specimens and of that area where they exist. Plants and environment are closely related to each other. Plants compete with each other chiefly for nutrition and adjust themselves either through developing adaptation. Any change in environmental conditions leads to alter the structure and composition of vegetation cover there. According to Raunkiaer (1934) plants adjust themselves to the existing environmental conditions variously, tend to reduce their requirements by diminishing size, height, foliage and period of growth. He described plant communities in terms of life form composition and classified them into five major life forms: phanerophytes, chamaephytes, hemicryptophytes, cryptophytes and therophytes. The ratio of life forms of different species in term of number or percentage in any floristic community is called biological spectrum (Milne and Milne 1971) which can be used to indicate the stratification and layering pattern of the community (Rao, 1968: Krebs, 1994), and to determine the nature of bioclimate or phytoclimate (Malik *et al.*, 2006).

Biological spectra possess high proportion of at least one life form whose percentage value is much higher than that of the same life form in a normal spectrum; this indicates the predominance of particular type of climate that favours the development of that life form in a higher proportion. Moreover, as occurrence of similar biological spectrum ably reflects identical climatic conditions of different regions, the biological spectrum is also prepared in order to know the trends of vegetation development and phytoclimate.

Watershed management is the process of guiding and organizing land use and other resources in a watershed to provide desired goods and services to people while enhancing the resource base without adversely affecting

...ral resources and the environment (Wani *et* al., 2001). The present study was conducted in pandoga sub watershed catchment area which is located in rainfed agricultural area of Shivalik foot hills to access the floristic composition in changed scenario after the soil and water control measures adopted.

2. MATERIALS AND METHODS

2.1 Study area

The present study was randomly selected (Pandoga sub watershed) implemented to control the hazards of Swan river which lies in Shivalik foothills of Una district of Himachal Pradesh in India (Figure 1). Geographical area of Study area was 2300 ha. while physiographic condition varies from plain to undulating hills. The climate of the area is sub-tropical to tropical. Study area lies 31°17'52" to 31°52'0" N and Longitude 75°58'2" to 76°28'25" E. Mean annual rainfall is approximately 700 mm. Temperature too varied extremely with 45° C (maximum temperature) in summer season (May to June) and 3° C (minimum) in winter season

2.2 METHDOLOGY

Extensive field survey study was conducted to study floral distribution within selected three sites of pandoga sub watershed based upon distance and water availability contrasts. Field study area was divided into three sites Site 1, Site 2, Site 3. All species occurring in these sites were collected representative specimens of plant species were processed for herbarium preservation and consulted with the Botanical Survey of India, Northern Zone Dehradun (UttraKhand). Data on life forms (Raunkiaer's system of classification) were recorded too. Biological spectrum was prepared on the basis of percentage species composition in each life-form following (Raunkiaer, 1934). Phyto climate was of present study was assessed by comparing biological spectrum with normal Raunkiaer biological spectrum.

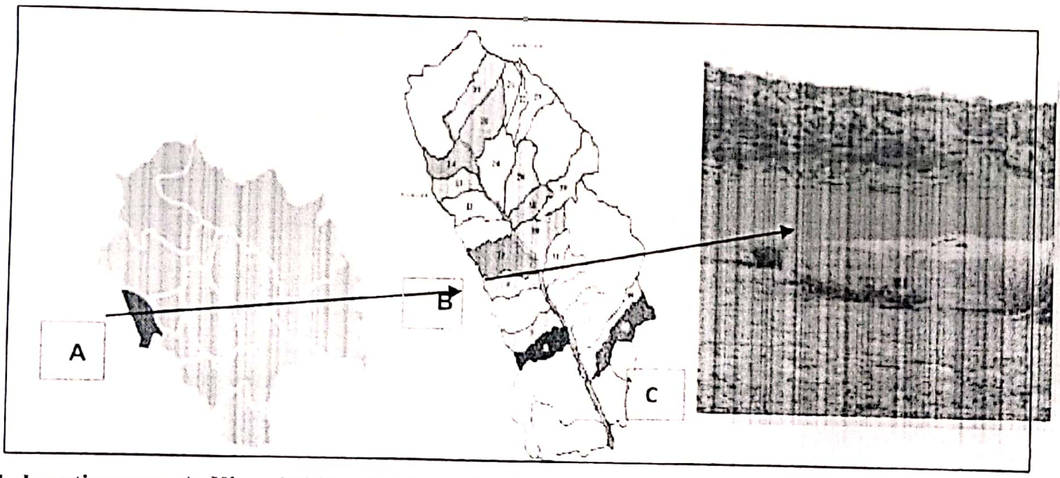


Figure 1: Location map- A. Himachal Pradesh in India; B. Pandoga sub-watershed in Swan river catchment area; C Site of pandoga sub watershed

3. Result and discussion

3.1Flora of region

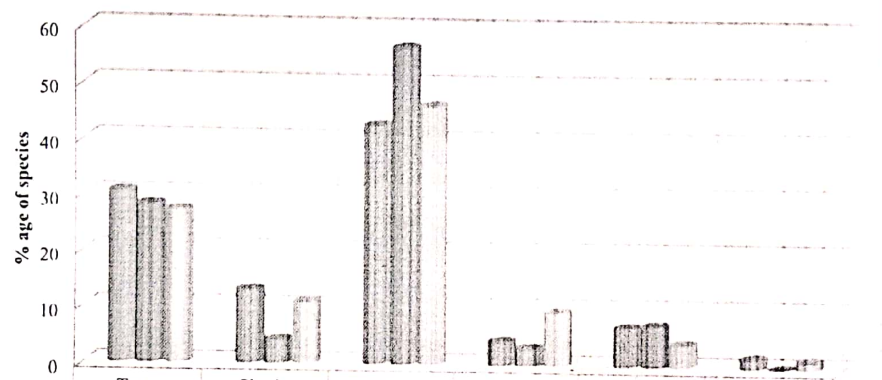
Shivalik belt Of Himachal Pradesh is bestowed with a rich flora. Out of the 47,000 plant species observed in the India 3245 species (7.32%) are available in the state of Himachal Pradesh (Verma, 2000). Plant samples collected during field survey of three different sites revealed total of 136 plant species belonging to 49 families while Site 1 had 114 species comprising trees, shrubs, herbs grass and climbers, Site 2 and site3 had 95 and 73 species respectively. Floristic composition of study area revealed 36 trees belongs to 27 genera, 17 shrubs belongs to 17 genera, 62 Herbs belongs to 55 genera, 9 grasses belongs to 9 genera and 9 climbers belongs to 9 genera while one site was also observed (Table 1). Maximum diversity of herbs was observed during rainy season while it gradually decreases with the arrival of winter and summer seasons. It might be due to unavailability of sufficient moisture and optimum temperature suit for their growth and development. Dominance of herbs was too observed by Reddy *et al.* (2011) in his study in Rajasthan, India.

Table 1: Habit wise distribution of flora

Habit	Species number	Genera number
Trees	36	27
Shrubs	17	17
Herbs	62	55
Grasses	9	9
Climbers	9	9
Sedges	2	1
Parasite	1	1

3.2 Site wise distribution of flora

Site wise distribution of flora showed that trees 30.71% (35 species with 13 families), shrubs 13.16% (15species with 12 families) and climbers (8 species with 6 families) showed dominance in site 1 over the site 2 and site 3; herbs dominated in site 2 (54 species with 24 families) over the site 1 (49 species with 24 families) and site 3 (34 species with 18 families) (Fig.2).



	Trees	Shrubs	Herbs	Grasses	Climbers	Sedges
Site 1	30.71	13.16	42.98	4.38	7.02	1.75
Site 2	28.42	4.21	56.84	3.16	7.37	0
Site 3	27.41	10.95	46.58	9.59	4.11	1.37

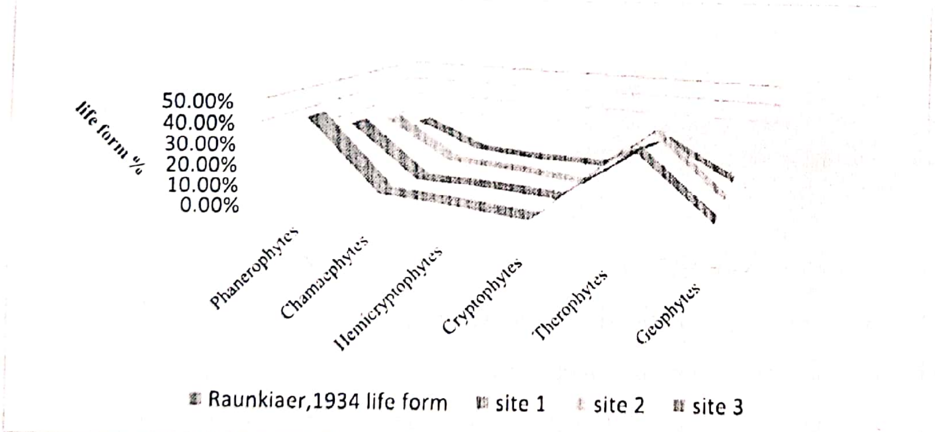
Fig. 2: Site wise distribution of plants in Pandoga sub watershed catchment area

3.3 Life form and biological spectrum

Plant life-form based on the position and degree of protection to the renewing buds, which are responsible for the renewal of the plant's aerial body when the favourable conditions arrive. It was taken as a good indicator of climate and was assumed to have evolved in response to the environmental conditions and presented a preliminary architect of that vegetation. In present study six different life forms (phanerophytes, chamaephytes, hemicryptophytes, cryptophytes, therophytes and geophytes) were recorded based on Raunkiaer's system of classification. Site wise distribution of life form results showed Phanerophytes: 31.62% (43 spp.) in site 1; 26.47% (36 spp.) in site 2: 18.38% (25 spp.) in site3. Distribution of Therophytes in site1, site 2, site 3 was 30.14 % (41spp.), 31.62 % (43spp.), and 19.85% (27spp.), respectively. Cryptophytes showed 3.67 % (5spp), 1.47 %

p); 2.20 % (3spp) in site 1, site2 and site3, respectively; Hemicryptophytes 5.15 % (7spp.) and Chamaephytes .15% (7spp) was same in site 1 while Hemicryptophytes 4.14% (6spp.), 2.20% (3spp.) was in site 2 and 3 respectively and Chamaephytes 5.88% (8spp) and 4.41 % (6 spp.) in site 2 and site 3. Geophytes present in all sites with the 0.73% (Fig.3).

Result of all sites revealed that Therophytes and Phanerophytes percentage was higher than the other life form percentage. Site wise results of shows that life form almost in all sites decrease from site1 to site 3. High proportion of Therophytes in study area indicated its adaptability to arid condition of summer and cold condition of winter. This showed their effective strategy for survival. Same results were observed by (Memariani *et al.*, 2009) in Vezg region of Iran. According to Raunkiaer (1934) and Kovacs-Lang *et al.* (2000) Therophytes was abundant in arid and semi-arid region and in disturbed area. Cryptophytes were reported less than the normal spectrum which indicated that the area was not subjected to severe climatic conditions as reported for alpine regions by (Santvan and Agarwal, 1993: Rawat and Pangety, 1985) while lesser number of Chamaephytes indicated that area did not belong to colder and higher altitude conditions as reported (Braun- Blanquet, 1938). The plant communities of the study area also revealed the lesser representation of Hemicryptophytes. This suggested that disturbance may favour the occurrence of Therophytes but induces reduction of Hemicryptophytes. The Hemicryptophytic phytoclimate also corresponded to a cold humid climate, typical of high latitudes or high altitudes. These factors could somehow be analogous to the stress imposed by cold in high altitude regions and in this case, they would favour species with renewing buds protected at the level of the soil surface or under the ground, as the Hemicryptophytes. Results of present study revealed that both Phanerophytes and Therophytes acted as a depicting factor for deciding the phytoclimate i.e., warm-moist and warm-dry climate. The study area experiences alternation of long dry period with moderate rainfall, warm dry and warm



[Ph -Phanerophytes, Ch -Chamaephytes, Th-Therophytes, Hem-Hemicryptophyte, Cr-Cryptophytes, Geo- Geophytes]

Fig. 3.: Site wise distribution of Biological spectrum as per Raunkiaer normal life form classification

Spatial distribution of flora

Out of total 36 trees encountered in over all three sites. *Terminalia arjuna* were missings from site 1 and 3. This indicated that it was confined only to site 2. However *Terminalia chebula, Acacia pseudo-eburnea, Butea monosperma, Tamarindus indica, Acacia modesta, Broussontia papyrifera, Ficus auriculate, Ficus bengalensis, and Aelgle marmelos* trees were missing from the site 2 and site 3. It showed that these trees confined only to site 1. *Mallotus philipensis, Bauhinia variegata, Cassia fistula, Acacia catechu, Ficus racemosa, Ficus religiosa, Phoenix paludosa* were missing from site 3.

6, *Calotropis procera, Solanum xanthocarpum* was missing from site 1and site 2. *Adhatoda vesica., Carissa randas, Jatropha curcas, Aconogonum tortuosum, Murraya koenigi., Wathinia somnifera, Dodonae viscosa., Vitex negundo* was missing from site 2 and site 3. *Diospyros cordifolia* was missing only from site 3. *Ipomoea carnea, Ricinus communis, Urena labota* was missing from site 2 only.

Among the herbs *Alternanthera pungens, Cirsium arvensis, Gnaphalium pensylvanicum, Coronopus didymus, Evolvulus nummularis* was missing only from site1. *Alternanthera sessil* was missing in site1 and site 2. *Aerva sanguinolenta, Spilanthes acmella, Trichodesma, Plumbago zeylinca* was missing from site 1 and site 3. *Asparagus racemous, Sonchus oleraceus, Argemone maxicana, Zizyphus nummulari was* missing from site 2 only. *Artemisia scoparia, Abutilion bidentatum* was missing from site 2 and site 3. *Eclipta alba, Galinsgo parviflora., Euphorbia geniculata, Euphorbia granulata, Euphorbia helioscopia, Lathyrus aphaca, Melilotus indicus, Aloe vreatourn, Malvastrum coromandelianum , Malva rotundifolia, Sida ovate, Sida rhombifolia, Boerhaavia diffusa, Phyllanthus niruri, Anagallis arvensis, Ranunculus muricatus, Ranunculus sceleratus , Nicandra physalodes , Grewia hirsuta* was missing from site 3 only.

Cuscuta reflexa parasite was missing from site 2 and site 3 *Acacia modesta, Terminalia arjuna, Terminalia chebula. Acacia pseudo-eburnea., Aelgle marmelos* was confined to site 1 only as well as are in one or two number only. *Dalbergia sisoo* was observed in each site but they are in dry condition mostly *Broussontia papyrifera* confined only to site1 but in higher frequency than other tress in site. *Calotropis procera, Murraya koenigi, Wathinia somnifera, Dodonae viscosa.,* confined only to site 1 as well had only one or two in number but *Vitex negundo* observed along the bank of Pandoga river in site1. *Asparagus racemous , Eclipta alba, Spilanthes acmella, Abutilion bidentatum, Trichodesma indicum* observed in one or two number in Pandoga sub watershed catchment area while *Arstiolochia grandiflora* was the climber observed in one number in site 1 (appendix Table 1*)*.Besides to non-agriculture area and waste land, vegetation was also confined to small hill of the area. This area mostly characterized by moderate to large sized trees, shrubs and grasses. The trend of habitat destruction, cultivation, grazing and construction work, industrialization area would turn the vegetation area into commercialized area down the stream.

4. Conclusion

The study is unique because it is to examine the flora in sub watershed catchment area which lies in semi arid and fragile and young foothills of Shivalik region of north western Himalayas. Implementation of sub watershed in region influenced the anthropogenic activities like farming practices, cropping pattern. The dominance of Therophytes indicated that the investigated area was under heavy biotic pressure due to various anthropogenic activities.

5. *ACKNOWLEDGMENT:*

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REFERNCES

[1] Braun-Blanquent. 1938. *J. Plant Sociology* (Transl. by fuller, G. D. and H. S. Conard). McGraw Hill, New York.

[2] Kovacs-Lang E, Kroel-Dulay G, Kertesz M, Fekete G, Bartha S, Mika J, Dobi-Wantuch I, ReddiT, Rajkai K, Hahn I. 2000 .Changes in composition of sand grassland along a gradient in Hungary and implication for climate change. Phytocoenology. 30:385-407.

[3] Krebs CJ.1994 .*Ecology: The Experimental Analysis of Distribution and Abundance*. Harper Collins. California. 467 p.

[4] Malik S, Bhattacharya A and Mukherjee A. 2006. Biological spectrum of Chandur Forest in Hooghly District, West Bengal. Indian Journal of Forestry. 29(2): 145–148.

[5] Memariani F, Joharchi MR, Ejehadi H, Emaildzadeh K. 2009. A contribution to the flora and vegetation of Binalood mountain range, NE Iran: Florestic and chronological studies in Ferezi region. Ferdowsi, University. internat. J. Bio. Sci. 1:1-19.

[6] Milne L & Milne M.1971. The Arena of Life. The Dynamics of Ecology. Double day Natural History Press, Gardern City, New York, 240 p.

[7] Misra, M.K. and B.N. Misra .1981. Association and Correlation of plant species in a tropical grassland community. Tropical Ecology 22: 88-98.

[8] Rao CC.1968. Biological spectrum of Karamnasa watershed flora. In: Misra R & Gopal B (eds) Proceeding of Symposium on recent advances in Tropical Ecology, Banaras Hindu University, Varanasi, India, Part-II. Rawat, G. S. and Y. P. S. Pangety (1985). Addition to the flora of U. P. hills. *J. Econ. Tax. Bot.*, **6(3):** 693-695.

[9] Reddy CS, Hari Krishna P, Meena SL, Bharadwaj R & Sharma KC .2011. Composition of Life Forms and Biological Spectrum along Climatic gradient in Rajsthan, India. International Journal of Environmental Sciences. 1(7): 1632–1639.

[10] Santvan, V. K. and H. O. Agrawal.1993. Floristic composition of grassland above treeline in Northwest Himalaya. In: Himalayan Biodiversity Conservation Strategies, U.Dhar (ed.), G. B. Pant Institute of Himalayan Environment and Development. 245-250.

[11] Verma. Economic valuation of forests of Himachal Pradesh, IFM Bhopal. 2000.

[12] Wani SP, Pathak P, Tan HM, Ramakrishna A, Singh P and Sreedevi TK. 2001.. Integrated watershed management for minimizing land degradation and sustaining productivity in Asia in Integrated Land Management Productivity in Asia, zafar addel (Ed.) proceedings of joint unucas International Workshop,Beijing ,China. 207-230.

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Appendix

Table 1: Habit classification, life forms of plants and site wise distribution at Pandoga sub watershed catchment area

S. No.	Family	Species Name	Life Form	Habit	Plant Distribution Site Wise		
					Site I	Site 2	Site III
1	Acanthaceae	*Adhatoda vesica*	Ph	Shrub	+	-	-
2	Amaranthaceae	*Achyranthes aspera*	Th	Herb	+	+	+
		Aerva sanguinolenta	Ph	Herb	-	+	-
		Alternanthera sessil	Ch	Herb	-	-	+
		Alternanthera pungens	Ch	Herb	-	+	+
		Amaranthus Caudatus	Th	Herb	+	+	-
		Amaranthus viridis	Th	Herb	+	+	-
		Chenopodium alba	Th	Herb	+	+	-
3	Anacardiaceae	*Lannea coromandelica*	Ph	Tree	+	+	
		Mangifera indica	Ph	Tree	+	+	-
4	Apocynaceae	*Carissa carandas*	Ph	Shrub	+	-	-
		Calotropis procera	Ch	Shrub	-	-	-
5	Asparagaceae	*Asparagus racemous*	Cr	Herb	+	-	-
6	Aristolochiaceae	*Arstiolochia grandiflora*	Ph	Climber	+	-	-
7	Asteraceae	*Ageratum conizoides*	Ch	Herb	+	+	-
		Artemisia scoparia	Hem	Herb	+	-	-
		Bidens biternata	Ch	Herb	+	+	-
		Eclipta alba	Th	Herb	+	+	-
		Cirsium arvensis	Th	Herb	-	+	-
		Gnaphalium pensylvanicum	Th	Herb	-	+	
		Parthenium hysterophous	Ch	Herb	+	+	-
		Sonchus oleraceus	Th	Herb	+	-	-
		Galinsgo parviflora	Th	Herb	+	+	-
		Spilanthes acmella	Th	Herb	-	+	-
		Xanthium strumarium	Th	Herb	+	+	-
8	Brassicaceae	*Coronopus didymus*	Th	Herb	-	+	-
9	Boraginaceae	*Cordia dichotoma*	Ph	Tree	+	+	-
		Trichodesma indicum	Th	Herb	-	+	-
10	Canabaceae	*Cannabis sativa*	Th	Herb	+	+	-
11	Caryophyllaceae	*Stellaria media*	Th	Herb	+	+	-
12	Combretaceae	*Terminalia arjuna*	Ph	Tree	-	+	-
		Terminalia chebula	Ph	Tree	+	-	-
13	Commelinaceae	*Commelina paludosa*	Th	Herb	+	+	-
14	Convolvulaceae	*Evolvulus nummularis*	Ch	Herb	-	+	-
		Ipomoea carnea	Ph	Shrub	+	-	-
		Ipomoea aquatic	Hem	Climber	+	+	-
15	Cucurbitaceae	*Coccinia indica*	Th	Climber	+	+	-
		Bryonopsis laciniosa	PH	Climber	+	+	-
16	Cuscutaceae	*Cuscuta reflexa*	Ph	Herb	+	-	-
17	Cyperaceae	*Cyprus paniceus*	Cr	Herb	+	-	-
		Cyprus rotundus	Cr	Sedge	+	-	-

	Ebenaceae	*Diospyros cordifolia*	Ph	Shrub	+	+	-
19	Euphorbiaceae	*Euphorbia geniculata*	TH	Herb	+	+	-
		Euphorbia granulate	Th	Herb	+	+	-
		Euphorbia helioscopia	Th	Herb	+	+	-
		Euphorbia hirta	Th	Herb	+	+	-
		Jatropha curcas.	Ph	Shrub	+	-	-
		Ricinus communis Linn	Ch	Shrub	+	-	-
		Mallotus philipensis	Ph	Tree	+	-	-
20	Fabaceae	*Acacia pseudo-eburnea*	Ph	Tree	+	-	-
		Butea monosperma	Ph	Tree	+	-	-
		Dalbergia sisoo	Ph	Tree	+	+	-
		Lathyrus aphaca	Th	Herb	+	+	-
		Medicago polymorpha	Th	Herb	+	+	-
		Melilotus indicus	Th	Herb	+	+	-
		Rhynchosiaminima	Ph	Climber	+	+	-
		Tripholium tomentosum	Th	Herb	+	+	-
		Vicia rigidula	Th	Climber	+	+	-
		Bauhinia variegata	Ph	Tree	+	+	-
		Cassia fistula	Ph	Tree	+	+	-
		Cassia laevigata	Th	Herb	-	+	-
		Tamarindus indica	Ph	Tree	+	-	-
		Acacia Arabica	Ph	Tree	+	+	-
		Acacia catechu	Ph	Tree	+	-	-
		Acacia nilotica	Ph	Tree	+	-	-
		Acacia modesta	Ph	Tree	+	-	-
		Albizzia lebbeck	Ph	Tree	+	-	-
21	Fumariaceae	*Fumaria parviflora*	Th	Herb	+	+	
22	Laminaceae	*Mentha longifolia*	Geo	Herb	+	+	-
		Ocimum sanctum	Th	Herb	+	+	-
		Pogostemonbenghalens	Ph	Large herb	+	+	-
23	Liliaceae	*Aloe vrea.*	CR	Herb	+	+	-
24	Malavaceae	*Abutilion bidentatum*	Th	Herb	+	-	-
		Bombax ceiba	Ph	Tree	+	+	+
		Malvastrum coromandelianum	Th	Herb	+	+	-
		Malva rotundifolia	Th	Herb	+	+	-
		Sida acuta	Th	Herb	+	+	-
		Sida ovate	Th	Herb	+	+	-
		Sida rhombifolia	Th	Herb	+	+	-
		Urena labota	Th	Shrub	+	-	-
25	Meliaceae	*Melia azedarach*	Ph	Tree	+	+	-
		Azadirachta indica	Ph	Tree	+	+	-
		Cedrella toona	Ph	Tree	+	+	-
26	Menispermaceae	*Cissampelos pareira*	Ph	Herb	+	+	-
		Tinospora cordifolia	Ph	Climber	+	+	-
27	Moraceae	*Broussontia papyrifera*	Ph	Tree	+	-	-
		Ficus auriculate	Ph	Tree	+	-	-
		Ficus bengalensis	Ph	Tree	+	-	-
		Ficus palmate	Ph	Tree	+	+	-
		Ficus racemosa	Ph	Tree	+	+	-
		Ficus religiosa	Ph	Tree	+	+	-
		Moras alba	Ph	Tree	+	+	-
28	Moringaceae	*Moringa oleifera*	Ph	Shrub	+	+	-
29	Myrtaceae	*Eucalyptus camaldulens*	Ph	Tree	+	+	-