ASSESSMENT OF RIPARIAN VEGETATION IN DHRABI WATERSHED AND CHAKWAL REGION IN PAKISTAN

Dilawar Khan*, Abid Saeed*, Junaid Ahmad*, Imtiaz Qamar**, Fazal Yazdan**, Saleem ud Din** and Muhammad Tariq**

ABSTRACT:- Most of Pakistan lies in arid and semi-arid environment where forage for rearing of livestock and food for human being is the better option for that land use systems. Dhrabi watershed is one of the areas where, there is a high potential for forage and livestock production. The analysis includes assessment and role of this riparian vegetation which is very helpful for integrated watershed management in different watershed areas. Dhrabi watershed is a catchments area of Dhrabi reservoir and lies in district Chakwal. There were 88 species reported in the study area. The five plant communities recognized in the Dhrabi watershed on the basis of importance value (IV) by using line transect sampling method, these are; *Chrysopogon-Cynodon-Gymnosporea*, *Cynodon-Crysopogon-Acacia*, *Cynodon-Chrysopogon-Acacia*, *Chrysopogon-Cynodon-Conyza* and *Chrysopogon-Cynodon-Acacia*. On the basis of top three highest IV *Schoenoplectus-Phragmites-Cynodon* plant community were identified at western side of the Kallar Kahar Lake while *Cynodon-Phragmites-Typha* plant community was observed in eastern side by using 1x1 m quadrat method.

Key Words: Riparian Vegetation; Watershed; Forage; Livestock; Importance Value; Pakistan.

INTRODUCTION

Watershed is defined as geo-hydrological unit draining to a common point. Soil, water and vegetation are the most vital natural resources and watershed affects all of them. Judicious and effective management of these resources can ensure the sustained productivity of food, fodder, fiber, fuel, fruit and timber. The watershed approach provides a unique and effective way to assess the environment, identify problems, establish priorities for preservation or restoration and implement solutions (Bendix and Hupp, 2000).

The word "riparian" is derived from Latin ripa, meaning river bank. The term “riparian land” refers to any land which adjoins or directly influences a body of water. This includes the land immediately alongside small creeks and rivers including the river bank itself, gullies and dips which sometimes run with surface water, areas around lakes, and wetlands on river flood plains all of these land are called riparian land (Nair, 1994).

Riparian zones occur in many forms including grassland, woodland, wetland or even non-vegetative areas. In some regions the terms

* *PMAS-Arid Agriculture University Rawalpindi, Pakistan.*
** *National Agricultural Research Centre, Islamabad, Pakistan.*
Corresponding author: dilawar_afridi123@yahoo.com

riparian vegetation, riparian woodland, riparian forest, riparian buffer zone or riparian strip are used to characterize a riparian zone while any land which adjoins or directly influences a body of water is called as riparian land. Riparian land is important because of their role in soil conservation, their biodiversity, and the influence they have on aquatic ecosystems. In addition to being productive, riparian land is often a vulnerable part of the landscape susceptible to damage from agricultural and urban development, weed invasion and natural events such as floods so careful management of riparian lands is vital to the conservation of both biodiversity and economic productivity (Benhou et al., 2003).

The plant communities along the river margins are called riparian vegetation, characterized by hydrophilic plants. Riparian zones occur as long strips of vegetation adjacent to streams, rivers, lakes, reservoirs and other inland aquatic systems that affect or are affected by the presence of water. This vegetation contributes to unique ecosystems that perform a large variety of ecological functions. When riparian zones are damaged by construction, agriculture or silviculture, biological restoration can take place, usually by human intervention in erosion control and revegetation (Bull and Kirkby, 2002). The riparian vegetation, directly adjacent to watercourses plays an important role in strengthening stream bank, capturing fine sediment, filtering out pollutants, increasing infiltration, utilizing excess nutrients, providing shade for the stream, food and shelter for fish and wildlife, slowing runoff and reducing flood damage and controlling temperature and light (Holechek et al., 1995).

The district Chakwal is located in the South East of the Rawalpindi district and having two sub administrative units (Tehsil) Chakwal and Talagang. Dhrabi water reserve, Khai Dam and Kallar Kahar Lake are most common and well known water bodies of the area. The major land used is for the agriculture and livestock. The riparian vegetation consists of *Typha elephantina*, *Phragmites kiraka*, *Saccharum-spontaneum*. Present study comprised the riparian vegetation assessment and its role in water cleaning processes of Dhrabi watershed and Kallar Kahar Lake.

MATERIALS AND METHOD

Study Area

This study was conducted in 2009 on riparian vegetation in Dhrabi watershed and in Kallar Kahar located in district Chakwal at latitude of 32° 42' to 32° 55' N and longitude 72° 35' to 72° 48' E.

Small Dams Organization of Irrigation Department, Government of Punjab constructed Dharabi reservoir in 2007 for irrigation purposes. Its gross and live water storage capacities are 45.6 and 15.6 million m^3, respectively. The annual withdrawals for irrigation and evaporation losses were estimated 7.2 and 8.4 million m^3, respectively. The reservoir will supply irrigation water to about 2600 ha of arable land (Crumpacker, 1984).

The riparian vegetation in Dhrabi watershed covers 200 km^2 drainage areas at the outlet of Dhrabi dam. Elevation was 466 - 800 m. Slope varies from 2% in plain areas to more than 30% along hill sides. Land degradation in the watershed area dominantly exists in the form of water erosion, soil fertility depletion and soil structure deterioration. Minimum and maximum temperature vary from -0.5°C (January) to 16°C (July-August) and from 24°C (January) to 48°C (June), respectively. Average annual rainfall was 600 – 700 mm. The main vegetation type was scrub forest dominated by *Acacia modesta* (Phulai) and *Olea ferruginea* (Kaho). Most palatable grasses were *Cenchrus ciliaris* (Dhaman), *Cynodon dactylon* (Khabbal) and *Eleusine flagelifera* (Chimber). The main land uses included the grazing land, rainfed agriculture on terrace fields, irrigated lands (by wells and dams), unused lands and wet lands (ICARDA, 2008).

Kallar Kahar is located between left and right limbs in the upper catchments of the watershed area of 1-1.5 km^2 with depth of 3-6 m (Jeremy and Cooper, 2007). Two natural springs in the nearby hills feed the lake. The lake water is brackish, because of sulfur salts, and is not used for drinking or agricul=tural purposes. Nevertheless, this water spills into freshwater perennial stream. The lake was used as effluent disposal pond for the nearby Kallar Kahar town that has caused wild vegetative growth and reduced the effective lake area.

Sampling Site

The whole riparian vegetation in watershed area was divided into different zones, and sampling sites was being selected on the basis of this division. The representative sampling sites from each zone was selected randomly after visiting the target area for collection of data and the riparian area of the lake is about 200 m away from the water boundary of Kallar Kahar Lake (Jeremy and Cooper, 2007).

Phyto-sociological Attributes Analysis

Line transect method was used for the assessment of plant communities, vegetation cover and carrying capacity (Jeremy and Cooper, 2007). Under this technique 100 m long transect line was laid down on ground using 1 m^2 ADC quadrat (Vacca et al., 2005) at an interval of 25 m on alternate side of the line. The vegetation cover, vegetation composition, density and frequency, relative density, relative frequency and relative cover were measured by following formulas.

$$\text{Percent cover} = \frac{\text{Sum of intercepts by a species on all the transects}}{\text{Total length of all transects}} \times 100$$

$$\text{Percent composition} = \frac{\text{Sum of intercepts by species on all the transects}}{\text{Sum of intercepts by different species on all transects}} \times 100$$

$$\text{Density} = \frac{\text{Number of individuals of species in all quadrates}}{\text{Total area sampled}}$$

$$\text{Frequency (\%)} = \frac{\text{Number of quadrates in which a specie occurred}}{\text{Total number of quadrates sampled}} \times 100$$

$$\text{Relative density} = \frac{\text{Total individuals of a species}}{\text{Total individuals of all species}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Total frequency value of all species}} \times 100$$

$$\text{Relative cover} = \frac{\text{Total intercepts length of a specie}}{\text{Total intercept length of all species}} \times 100$$

Importance Value

Importance value (IV) is the sum of relative density, relative frequency and relative cover. It will be determined by the following formula.

IV = Relative Cover + Relative Frequency + Relative Density

IVI = IV/ 3 or (Relative Cover + Relative Frequency + Relative Density) / 3

On the basis of IV, sampled riparian vegetation was divided into different plant communities. The community within each stand was named for species having highest importance value irrespective of its habit. When two or more species closely approach each other in order of importance value then the communities share the names of these dominant species.

RESULTS AND DISCUSSION

Floristic Inventory of Study Areas

Study area with scars vegetation of different life form namely grasses, herbs, shrubs, and trees represents the typical arid zone vegetation. The common flora of this regions comprises *Eucalyptus globules*, *Prosopis glandulosa, Albizza lebbeck, Dodonea viscosa*, *Tamarix indica*, *Nerium oleander*, *Tephrosia purpuria, Opuntia dilnii, Fagonia indica, Solanum incanum, Saccharum bengalensis, Acacia nilotica, Ziziphus mauritiana, Acacia modesta, Dalbergia sisso, Calotropis procera, Dichanthium annulatum, Prosopis juliflora, Saccharum spontaneaum, Apparis decidua* and *Ziziphus nummularia.*

Mostly hilly arid area with sparse vegetation dominated by cacti plants and thorns plants which are well adapted to the environmental and climatic conditions. The north of the study area is very humus and soil is perfect for the agriculture. The vegetation comprised *Prosopis glandusa, Typha noducifolia, Opuntia delnii, Acacia modesta, Calotropis procera, Cannabis sativa* and *Prosopis cineraria* etc

Phyto-sociological Assessment of Study Areas

Some plants showing xerophytic characters like *Acacia modesta*, *Gymnosporea roylena* were very dominant shrubs because the area is hilly and the most of rainfall water move down as runoff and remaining moves down under the force of gravity so less water is available for plants.

Zone two of Kallar Kahar Lake was studied by quadrate method i.e., western and eastern side because of clear physiognomic dominance of the different species. On the basis of coverage percentage, the most of the study area is covered by *Schoenoplectu* sp. (25.0%) followed by *Phragmites karka* (23.1%) and

Cynodon dactylon (10.2%). The results showed that the *Phragmites karka* was most frequent with relative frequency of 15.6 followed by *Schoenoplectus* sp. (12.5), *Amaranthus virdis* (9.4), *Cynodon dactylon* (9.4) and *Typha* sp. (9.4). On the basis of top three highest IV *Schoenoplectus -Phragmites - Cynodon* plant community was observed having IVI value 20.9, 20.6 and 12.7, respectively in western of the Kallar Kahar lake (Table 1) and on the basis of coverage percentage the most of the study area is covered by *Cynodon dactlyon* (22.82%) followed by *Phragmites karka* (20.2%) and *Typha* sp. (11.9%). The results show that *Cynodon dactlyon* was most frequent with R.F (15.6) proceeds *Typha, Phragmites karka, Cynodon dactylon* and *Xanthium indicum* with 9.4 R.F each and *Cynodon-Phragmites–Typha* plant community was observed having IVI value 24.3, 14.5 and 10.0, respectively in eastern side of the Kallar Kahar lake (Table 2) on the basis of top three highest IV value.

Riparian vegetation and water-shed land use are important factors determining the health and integrity of stream ecosystems. Intact riparian vegetation has been related to healthy stream conditions as it traps and filters runoff that may contaminate streams and provides important resources (e.g., leaf litter) for aquatic organisms. However, little is known about the role of these variables in determining the integrity of urban streams and even less about tropical urban streams (Stromberg et al., 1997).

Watersheds are the areas of the world which by reason of physical limitations, low and erratic preci-pitation, rough topography, poor drainage, and/or cold temperatures are unsuited to cultivation. Inspite of

Table 1. Phytosociological attributes of Western side of Kallar Kahar Lake

Species	RC	RF	RD	IVI
Amaranthus virdis	9.4	9.4	7.2	8.6
Artemisia	1.6	3.1	0.7	1.8
Cenchrus ciliarus	0.8	3.1	3.6	2.5
Chenopodium album	4.0	6.3	3.6	4.6
Cynodon dactylon	10.2	9.4	18.7	12.7
Eleusine compressa	4.8	3.1	5.8	4.6
Malvestrum coromendelinum	0.5	3.1	0.7	1.4
Oxalis corniculata	0.2	3.1	0.7	1.3
Phragmites karka	23.1	15.6	23.0	20.6
Polygonum plebejum	4.8	6.3	2.9	4.7
Rumex dentatus	0.8	3.1	0.7	1.6
Saccharum spp.	4.0	3.1	0.7	2.6
Schoenoplectus sp.	25.0	12.5	25.2	20.9
Setaria media	0.8	3.1	2.2	2.0
Typha spp.	5.6	9.4	2.9	6.0
Xanthium indicum	4.4	6.3	1.4	4.0
	100	100	100	100

Table 2. Phytosociological attributes of Eastern side of Kallar Kahar Lake

Species	RD	RF	RC	IVI
Artemisia	0.5	3.1	0.9	1.5
Amarthis viridis	4.1	6.3	8.3	6.2
Cenchrus setagirus	2.3	3.1	0.9	2.1
Chenopodium album	1.8	6.3	3.7	3.9
Cynodon dactlyon	34.6	15.6	22.8	24.3
Desmostachya bipinnata	2.8	3.1	0.9	2.3
Dicanthium annulatum	1.4	3.1	0.9	1.8
Eleusine compressa	3.7	3.1	5.5	4.1
Imperata cylindrica	1.8	3.1	0.9	2.0
Malvestrum coromendelinum	0.5	3.1	0.9	1.5
Schoenoplectus sp.	0.9	3.1	2.8	2.3
Oxalis corniculata	1.4	3.1	0.9	1.8
Phragmites karka	13.8	9.4	20.2	14.5
Rhumax dentatus	1.8	3.1	1.8	2.3
Setaria media	5.1	6.3	1.8	4.4
Typha	8.8	9.4	11.9	10.0
Xanthium indicum	6.5	9.4	9.2	8.3
Bacopamon nieri	8.3	6.3	5.5	6.7

the growth limitations these areas are a source of forage for free-roaming domestic animals, source of wood products, water and habitat of wildlife. Rangelands are primary resource base available to rural people and are vital for local economics. All areas of the world that are not barren deserts, farmed, or covered by bare soil, rock, ice, or concrete can be classified as rangelands and constitute 70% of world land area (Holechek et al., 1995).

Riparian areas are the main source of moisture for plants and wildlife within watersheds, especially in arid regions or during the dry season in more temperate climates. Riparian areas with a high density and diversity of foliage, both vertically and horizontally, can provide habitat and food for a diversity of birds and other terrestrial wildlife, including many endangered and threatened species. Many animals also use these moist areas as travel corridors between feeding areas. Riparian vegetation growth, soil fertility and porosity, water quality, and stream flow conditions all affect the ability of fish and wildlife to thrive in streams and their associated riparian areas (Naiman and Decamps, 1997).

Riparian areas are important because most human settlements have historically developed along these rivers and there is, therefore, a need to treat their pollutant loading to protect the quality of river water. Moreover, in addition to improving water quality, restoring wetlands reclaims lost habitats and protects coastlines (Stromberg et al., 1997). Riparian areas include streams, stream banks, and wetlands adjacent to streams. These areas have a water table high enough to interact with plant roots and affect their growth throughout most of the year. Plant species that thrive in riparian areas are adapted to wet and flooded conditions. They are also adapted to re-grow root systems in sediments deposited through soil erosion (Mitsch, 2007).

Disturbance by floods can also affect biodiversity: species richness in some watersheds is greatest where steep valley floor gradients allow for high-energy floods. The recognition and analysis of hydro-geomorphologic influences on riparian vegetation are complicated by multiple scales of environmental interactions, by the covariance of some environmental variables and by feedbacks between vegetation and flood regimes.

However, when upland watershed conditions are degraded, heavy runoff can flow over or through riparian plants and move directly into river channels. Severe erosion in upland areas can degrade riparian areas by burying plants under sediments. Fine sediments brought in by erosion can degrade stream habitat by filling in stream pools, altering the shape of stream channels, and covering rocky stream bottoms thereby eliminating important food producing, shelter and spawning areas (Naiman and Decamps, 1997).

Runoff and erosion also bring in seeds of non-native or non-riparian plant species. Invasive and non-water-loving plant species can reduce habitat for native species and lower the water table by crowding out more functional and palatable riparian species. They can also create a fire risk by increasing fuel loads (Stromberg et al., 1997).

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Water flows from upland areas through riparian areas and eventually into streams. Healthy riparian areas are able to absorb, hold and use much of the water that flows off from healthy upland areas. Healthy riparian areas are also able to chemically and biologically bind or detoxify many contaminants contained in this water. However, if upland areas are degraded or covered with roads, parking lots, and rooftops that do not allow the water to seep into the soil, even the healthiest riparian area will be unable to absorb and filter large volumes of water, nutrients and contaminants flowing through it. Therefore, the first step in riparian protection is ensuring that land management practices across the watershed conserve soil and water resources (Auble, 1994).

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AUTHORSHIP AND CONTRIBUTION DECLARATION

S.No	Author Name	Contribution to the paper
1.	Mr. Dilawar Khan	Conceived the idea, Overall management of the article, Data collection, Data entry in SPSS and analysis
2.	Mr. Abid Saeed	Wrote abstract, Methodology, Introduction, References
3.	Mr. Junaid Ahmad	Results and Discussion
4.	Dr. Imtaiz Qamar	Technical input at every step
5.	Mr.Fazal Yazdan	Did SPSS analysis
6.	Mr.Saleemud Din	Conclusion

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