INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 14, No. 2, p. 360-372, 2019

RESEARCH PAPER OPEN ACCESS

Influence of riparian vegetation on living organisms: a case study of Dharabi watershed and Kallar Kahar Regions in Pakistan

Dilawar Khan[1], Gao Lushuang[1*], Huaguo Huang[1], Sher Shah[1], Sajjad Saeed[1], Saleem Uddin[2], Muhammad Nabi[3], Abubakar Sadiq Ibrahim[4], Emad Ud Din[3], Muhammad Amir[1]

[1] *College of Forestry, Beijing Forestry University, Beijing, China*

[2] *School of Biological Sciences and Technology, Beijing Forestry University, Beijing, China*

[3] *College of Environmental Science and Engineering, Beijing Forestry University, Beijing, China*

[4] *School of Economics and management, Beijing Forestry University, Beijing, China*

Key words: Kallar Kahar, Dharabi, Riparian vegetation, Diversity, ICARDA.

http://dx.doi.org/10.12692/ijb/14.2.360-372 Article published on February 27, 2019

Abstract

This study examined the influence of riparian vegetation on living organisms in Dharabi watershed and Kallar Kahar Lake. Riparian vegetation playing a key role in the maintains of biodiversity, such as providing: strengthens stream bank, captures fine sediment, filters out pollutants, increases infiltration, utilizes excess nutrients, provides food and shelter for fish and wildlife and reduces flood damage. The results show that Riparian vegetation in the area consists of typha *elephantine, Phragmites kiraka, Saccharum spontaneum*. The objective of the study was to find out the influence of riparian vegetation and the role of Riparian vegetation in the water cleaning process of Dharabi watershed and Kallar Kahar Lake. 84 species reported in the study area and five plant communities recognized in the Dharabi watershed on the basis of IVI by using line transect sampling methods which are Crysopogon, Cynodon, Gymnosporea, Acacia, and Conyza. However, the top three highest IVl value plant community Schoenoplectus, Phragmites and Cynodon was identified in western of the Kallar Kahar Lake. The studies also revealed that in the recreational area there was a major contribution of garbage disposable material such as Paraffin, Plastics of soft drinks and disposable meals packages. However, in the domestic area, the waste of material and garbage were daily home used material like shopping bags, newspaper or other household things. The overall effect of the garbage on the vegetation is very significant. The study also points out that bird diversity is less in that place where the relative garbage ratio is greater.

* **Corresponding Author:** Gao Lushuang ✉ gaolushuang@bjfu.edu.cn

Introduction

Riparian zones represent areas of strong biological, physical and chemical interaction between terrestrial and aquatic ecosystems (Gregory, Swanson, *et al.*, 1991). These areas are usually typed by high diversity of fauna, flora and environmental processes (Pusey and Arthington, 2003). The importance of the riparian zones to the aquatic environment is well recognized, as the terrestrial primary productivity derived from riparian zone is known as an important source of energy to riverine food webs (Junk, Bayley, *et al.*, 1989, Vannote, Minshall, *et al.*, 1980). The influence of the riparian zone on aquatic systems also includes thermal buffering, provision of shade, nutrient interception, storage and release and enhancement of bank stability (Arthington and Pusey, 2003, Beltrão, Medeiros, *et al.*, 2009, Junk, Bayley, *et al.*, 1989).

One of the most important roles of the riparian zone is the provision of coarse woody material as habitat and substrate for the aquatic fauna, such as invertebrates (Richards, Haro, *et al.*, 1997) and ash (Jungwirth, Muhar, *et al.*, 1995).The aquatic habitat has been found to be associated with the riparian vegetation or other correlated variables, such as turbidity and shading of the margins (Beltrão, Medeiros, *et al.*, 2009). Therefore, the state of this living space will influence the biotic structure and organization within aquatic systems (Allan and Flecker, 1993, Khan, Saeed, *et al.*, 2016, Mugodo, Kennard, *et al.*, 2006, Tait, Li, *et al.*, 1994).

The physical habitat of many aquatic environments worldwide has been degraded by human activities (Khan, Saeed, *et al.*, 2016, Mugodo, Kennard, *et al.*, 2006). Given the great number of links between riparian vegetation and the aquatic ecosystems, it is not surprising that fish assemblage's diversity and the composition and structure of their habitat have been linked to variations in the riparian cover (Vono and Barbosa, 2001). Riparian land is important because of their role in soil conservation, biodiversity, and the influence they have on aquatic ecosystems (Dudgeon, Arthington, *et al.*, 2006). In addition to being productive, riparian land is often a vulnerable part of the landscape susceptible to damage the agricultural and urban development, weed invasion and natural events such as floods so there will be need careful management of riparian lands is vital to the conservation of both biodiversity and economic productivity (Tockner, Bunn, *et al.*, 2008).

However, 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 vegetation (Christensen, Bartuska, *et al.*, 1996, Council, 1992). Riparian vegetation directly adjacent to watercourses plays an important role in providing strengthens stream bank, captures fine sediment, filters out pollutants, increases infiltration, utilizes excess nutrients, provides shade for the stream, provides food and shelter for fish and wildlife, slows runoff and reduces flood damage and control temperature and light (Khan, Saeed, *et al.*, 2016, Palone and Todd, 1998).

Riparian vegetation and watershed land use are important factors determining the health and integrity of stream ecosystems (Hrodey, Sutton, *et al.*, 2009). 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 (Naiman and Decamps, 1997). However, little is known about the role of these variables in determining the integrity of urban streams and even less about tropical urban streams (Naiman and Decamps, 1997).

Natural riparian ecosystems are important components of the landscape and serve as a vital link between aquatic and upland ecosystems (Lake, Bond, *et al.*, 2007). Riparian ecosystems are also major transition zones of matter, energy, and information transfer between aquatic and terrestrial ecosystems. Riparian ecosystems have important functions in water purification and non-point pollution control (Khan, Saeed, *et al.*, 2016, Lowrance, 1998, Zhao, Xu, *et al.*, 2009). Many studies have suggested that riparian vegetation may decrease N and P concentrations in both overland flow and in groundwater. However, changing the land use of riparian areas, such as converting forests into row crops, pastures, or lawns, can induce deterioration in river water quality. Thus, the establishment and management of riparian buffer zones are considered a viable option for controlling agricultural non-point source pollution in stream water (Wenger, 1999). Other studies have shown that the effects of land-use change on the environment are complex and difficult to predict and so, evaluating the effects of changes in riparian vegetation patterns on soil nutrient distribution and environmental pollution is imperative.

Therefore, improving water quality by reducing non-point source pollution is a big challenge in a developing country like Pakistan. One of the major reasons for soil surface runoff and loss in the associated nutrient is inappropriate land use and high-density fertilizer use (Khan, Shahnaz, *et al.*, 2013). The eco-service value of riparian vegetation buffers along the rivers has been underestimated and as such, a large amount of natural riparian vegetation was reclaimed which meet the increasing demand for food in the past 5 decades (Wang, 2012).

However, the main purpose of this research is to examine the influence of riparian vegetation on the living organisms. The specific objectives of the study are as follows; a) to assess the solid contaminant retained by the riparian vegetation; b) to examine the role of riparian vegetation on pollution, and c) to assess the role of riparian vegetation in water.

Materials and methods

Description of the study area

This study was conducted on riparian vegetation in Dharabi watershed and Kallar Kahar in 2017, which is located in district Chakwal at latitude of 32° 42' to 32° 55' N and longitude 72° 35' to 72° 48' E.

Dharabi reservoir was constructed in 2007 by Small Dams Organization of Irrigation department, Government of Punjab, fore irrigation purposes. It is located at the downstream boundary of the study area (watershed). Its gross and live water storage capacities are 45.6 and 15.6 million cubic-meters. The annual withdrawals for irrigation and evaporation losses were estimated are 7.2 MCM and 8.4MCM respectively. The reservoir will supply irrigation water to about 2600 ha, of arable land.

Riparian vegetation in Dharabi watershed covers 200 km^2 drainage areas at the outlet of Dharabi dam. Elevation varies between 466 and 800 meters. 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 temperature varies from -0.5°C in January to 16°C in July/August and the maximum temperature range from 24°C in January to 48°C in June. The average annual rainfall varies from 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 *Elusine flagelifera* (Chimber). The main land uses included the grazing land, rain fed agriculture on terrace fields, irrigated lands (by wells and dams), unused lands and wet lands (Khan, Saeed, *et al.*, 2016).

The Kallar Kahar is located between left and right limbs in the upper catchments of the watershed. The lake surface area varies between 1 and 1.5 km sq. and its depth varies between 3 and 6 meters. 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 agricultural processes. Nevertheless, this water spills into freshwater perennial stream. This lake is a tourist attraction and eco-system development is planned in the region. 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. Recently, the Government has planned to restore the lake integrity and diverted the town disposal from the lake to other place. It is a part of efforts to develop the lake as attractive tourists (Khan, Saeed, *et al.*, 2016, Sheikh, Month, *et al.*).

Sampling Site

The whole riparian vegetation in watershed area will to be divided into different zones, and sampling sites was being selected on the basis of this division. The representative sampling sites from each zone would to be selected randomly after visiting the target area for collection of data. Riparian area of the lake about 200 m away from the water boundary of Kallar Kahar.

Phytosociological attributes analysis

Line transect method were to be used for the assessment of plant communities, vegetation cover and carrying capacity (Kent and Coker, 1992). Under this technique, 100m long transect line were to be laid down on ground using the measurement tape quadrate of $1m^2$ will be laid at an interval of 25m on alternate side of the line.

(a) Measurement of Vegetation Cover

Vegetation cover percentage of riparian vegetation will be determined by using following equation:

$$Percent\ Cover = \frac{(Sum\ of\ int\ ercepts\ by\ a\ species\ on\ all\ the\ tran\ sec\ ts)}{(Total\ length\ of\ all\ the\ tran\ sec\ ts)} \ x\ 100$$

(b) Measurement of Vegetation composition

Riparian vegetation composition percentage will be assessed by following formula:

$$Percent\ Compositoin = \frac{(Sum\ of\ int\ ercepts\ by\ a\ species\ on\ all\ the\ tran\ sec\ ts)}{(Sum\ of\ int\ ercepts\ by\ different\ species\ on\ all\ the\ tran\ sec\ ts)} \ x\ 100$$

(c) Measurement of Density and Frequency

Following formulae will be used to calculate density and frequency percentage:

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

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

(d) Measurement of Relative Density, Relative Frequency and Relative Cover

With the help of following formulae we can calculate Relative Density, Relative Frequency and Relative Cover.

$$Re\ lative\ Density = \frac{Total\ individuals\ of\ a\ species}{Total\ individual\ of\ all\ species} \ x\ 100$$

$$Re\ lative\ Frequency = \frac{Frequency\ of\ a\ species}{Total\ frequency\ value\ of\ all\ species} \ x\ 100$$

$$Re\ lative\ Cover = \frac{Total\ int\ ercepts\ length\ of\ a\ species}{Total\ int\ ercept\ length\ of\ all\ species} \ x\ 100$$

$$Re\ lative\ Cover = \frac{Total\ int\ ercepts\ length\ of\ a\ species}{Total\ int\ ercept\ length\ of\ all\ species} \times 100$$

Importance value

Importance value was the sum of relative density, relative frequency, and relative cover. It will be determined by the following formula.

I .V = Relative Cover + Relative Frequency + Relative Density

I.V.I= I.V/ 3 or (Relative Cover + Relative Frequency + Relative Density) / 3.

On the basis of importance value, sampled of riparian vegetation were to be divided into different plant communities. The community within each stand was to be named as the 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

Phytosociological attributes analysis results (Dharabi water shed)

Transect area-1

This transect area is located in the riparian zone of Dharabi dam about 100 m from the water level.

Table 1 Floristic inventory data of study area.

S. No	Botanical Name	Habit	S. No	Botanical Name	Habit	S. No	Botanical Name	Habit	S. No	Botanical Name	Habit
1.	*Acacia modesta*	Tree	22	*Conyza canadensis*	Herb	43	*Imperata cylinderica*	Grass	64	*Prosopus cineraria*	Tree
2.	*Acacia nilotica*	Tree	23	*Crysopogon spp.*	Herb	44	*Imperata cylindrica*	Grass	65	*Rananculus*	Herb
3.	*Achyranthus aspera*	Shrub	24	*Cuscuta reflexa*	herb	45	*Lantana camara*	Shrub	66	*Ricinus communis*	Shrub
4.	*Adhatoda zeylinica*	Shrub	25	*Cynodon dactlyon*	Grass	46	*Lythrus aphyca*	matri	67	*Rumex dentatus*	Herb
5.	*Aeriva jawanica*	Shrub	26	*Cynodon dactylon*	Grass	47	*Malvestrum coromendelinum*	Herb	68	*Saccharum bengalensis*	Grass
6.	*Albizzia lebbeck*	Tree	27	*Dalbergia sisso*	Tree	48	*Medicago polymorpha*	Herb	69	*Saccharum spontaneum*	Grass
7.	*Alternanthera purguns*	Spiny prostate herb	28	*Desmostachya bipinnata*	Grass	49	*Melilotus indica*	Herb	70	*Schoenoplect us sp.*	Grass
8.	*Amaranthus virdis*	Herb	29	*Desmostachya bipinnata*	Grass	50	*Morus alba*	Tree	71	*Setaria media*	Herb
9.	*Anagalus arvensis*	Herb	30	*Dicanthium annulatum*	Grass	51	*Morus nigra*	Tree	72	*Sissoria hitromala*	Herb
10.	*Artemisia*	Herb	31	*Dichanthium annulatum*	Grass	52	*Nerium olenander*	Shrub	73	*Solanum incanum*	Herb
11.	*Bacopa monnieri*	Hydrophyte herb	32	*Dodonae viscosa*	Shrub	53	*Octhochloa compressa*	Grass	74	*Solanum nigrum*	Herb
12.	*Bracheria reptans*	Shurb	33	*Eleusine compressa*	Grass	54	*Opuntia delnii*	Shrub	75	*Solanum surratense*	Prostrate herb
13.	*Calotropis procera*	Herb	34	*Eucalyptus globules*	Tree	55	*Oxalis corniculata*	Herb	76	*Tamarix aphylla*	Tree
14.	*Cannabis sativa*	Herb	35	*Euphorbia helioscopia*	Herb	56	*Panicum*	Grass	77	*Taraxicum officinalae*	Herb
15.	*Capparis decidua*	Shrub	36	*Euphorbia hirta*	Herb	57	*Parthenium hysterophoris*	Herb	78	*Themeda cyliata*	Grass
16.	*Capparis decidua*	Shurb/ Tree	37	*Euphorbia prostata*	Herb	58	*Phragmites karka*	Grass	79	*Typha*	Hydroph ytes
17.	*Carthamus oxycantha*	Herb	38	*Euphorbia thymifolia*	Herb	59	*Poa annua*	Grass	80	*Withania somnifera*	Shrubby herb
18.	*Cencherus ciliarus*	Grass	39	*Fagonia indica*	Herb	60	*Polygonum pleygium*	Herb	81	*Xanthium indicum*	Shrub
19.	*Cenchrus segitarus*	Grass	40	*Ficus bengalensis*	Tree	61	*Polypogon fugax*	Grass	82	*Xanthium indicum*	Shrub
20.	*Chenopodium album*	Herb	41	*Ficus carica*	Tree	62	*Populus deltodies*	Tree	83	*Ziziphus mauritiana*	Tree
21.	*Circium arvensis*	Herb	42	*Fumaria indica*	Herb	63	*Prosopis glandulosa*	Shrub	84	*Ziziphus numularia*	Shrub

The area have physiognomic dominance of *grass (sirala)* and the results of transect showed that *the Crysopogon* posse's highest ground cover (65 %), follow by *Cynodon dactylon (26 %)*. The *Crysopogon* had highest IVI value (56.6), while *Cynodon dactylon* and *Gymnosporea* roylenae had 34.5 and 2.47 respectively.Therefore, *Crysopogon, Cynodon, and Gymnosporea* in this transect are the top three plant community with highest importance value (Fig.1a).

Transect area- 2: This transect area is located in the riparian zone of Dharabi dam and the results of this transect shows that *the Crysopogon* posse's highest ground cover (32.36 %), while Acacia modesta have highest canopy cover (34.94 %). The *Cynodon dactylon* had highest IVI value (46.7), while *Crysopogon* and *modesta* with 27.1 and 14.9 IVI values respectively. Therefore, *Cynodon, Crysopogon and Acacia* in this transect are the top three plant community with maximum standing value (Fig.1b).

Transect area- 3: This transect area is located in the riparian zone of Dharabi dam and the results shows that *the Acacia modesta* posse's highest ground cover (34.48 %), while *Cynodon dactylon* have cover (30.9%) and *Crysopogon spp have* 24.67 % cover. It showed that *Cynodon dactylon* had highest IVI value (41.17), while *Crysopogon* and *Acacia modesta* with 27.8 and 15.03 respectively. Therefore, *Cynodon, Crysopogon and Acacia* in this transect are the top three plant community with premier status value (Fig.1c).

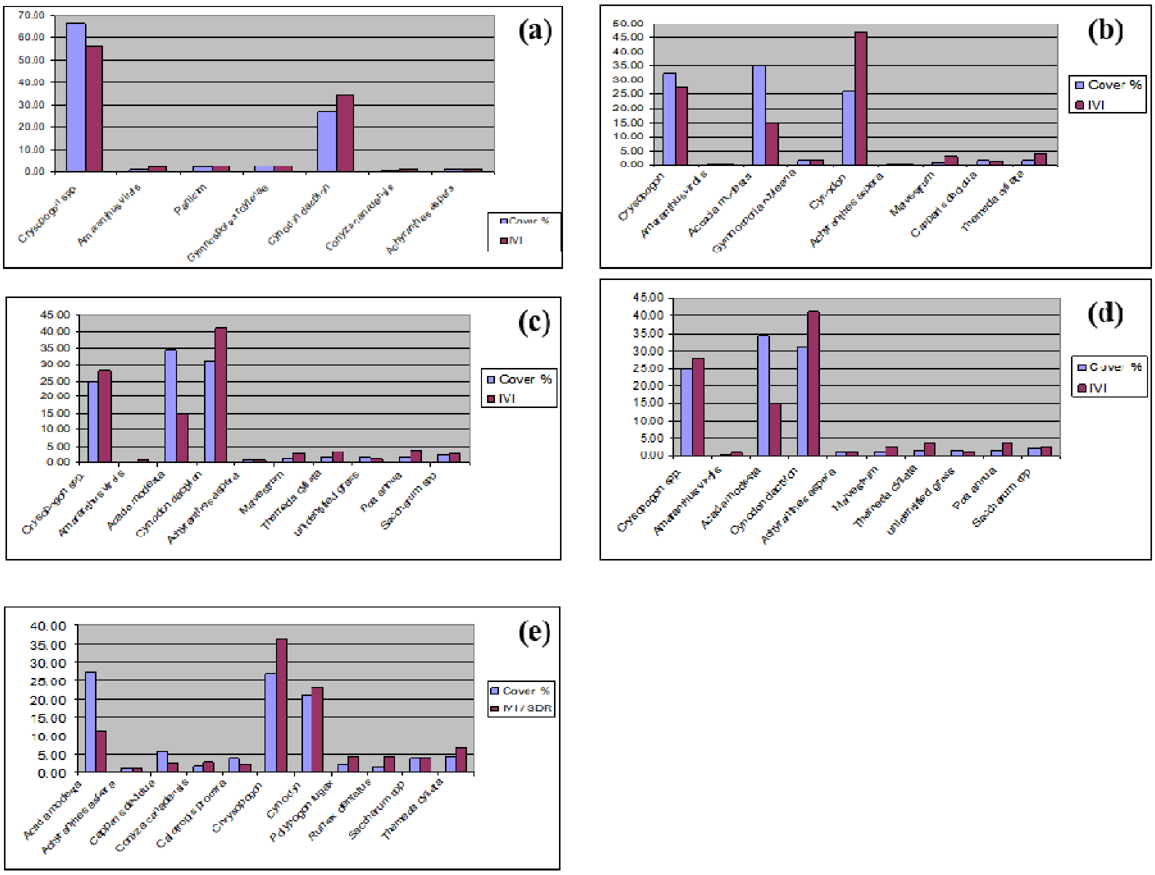

Fig. 1. Phytosociological parameters of Dharabi Watershed in different transects.

Transect area- 4: This transect area is located in the riparian zone of Dharabi dam and the results of transect 4 as shown in shows that *the Chrysopogon* posse's highest ground cover (30.42 %), while *Cynodon dactylon* have cover (19.17%) and *Conyza spp* have 17.67 % cover. *Chrysopogon* had highest IVI value (30.42) while *Cynodon* then *Conyza* with 19.17 and 17.67 respectively based on the presented results (Fig.1d).

Transect area- 5: The result from transect 5 findings shows that the percentage cover of *Acacia modesta* is 27.51%, *Chrysopogon spp* 27.04% and *Cynodon dactylon* 20.93 % cover. It showed that Chrysopogon had highest IVI value (36.61), *Cynodon had* IVI value (22.90) *and* Acacia had 11.59 IVI value.

Therefore, *Chrysopogon, Cynodon and Conyza* in this transect are the top three plant community with highest importance value (Fig.1e).

Phytosociological attributes analysis of Kallar Kahar Lake

In this area, two Zone of Kallar Kahar Lake was studied using quadrate method.

The zones (western and eastern side) were chosen because of clear physiognomic dominance of the different species and the result from this side is explained as follows;

Western side of Kallar Kahar Lake

The findings from Western side of Kallar Kahar lake shows that most of the area under study were covered by *Schoenoplectus* sp. with about 25.0%, *Phragmites karka* with about 23.1 % and *Cynodon dactylon* with 10.2 %. The results as presented in (Fig.2a).

Further shows that *Phragmites karka* was most frequent with R.F (15.6), *Schoenoplectus sp.* (12.5), *Amaranthus virdis* (9.4*),* *Cynodon dactylon* (9.4) and *Typha* spp with 9.4 relative frequency. It showed that the top three highest IV value are *Schoenoplectus, Phragmites and Cynodon* plant communities with IVI value of 20.9, 20.6 and 12.7 each respectively.

Eastern Side of Kallar Kahar Lake

The findings from this side shows that most of the area under consideration were covered by *Cynodon dactlyon* (22.82%), Phragmites *charka* (20.2%) and *Typha* spp with 11.9 % relative cover. The results shows that *Cynodon dactlyon* was most frequent with R.F (15.6) while *Typha Phragmitis carica*, Cynodon dactylon and *Xanthium indicum* with 9.4 relative frequency each. It showed that *Cynodon*, *Phragmites, and Typha* plant community were with the highest IVI value with 24.3, 14.5 and 10.0 each in eastern side of the Kallar Kahar Lake respectively (**Fig.2b**).

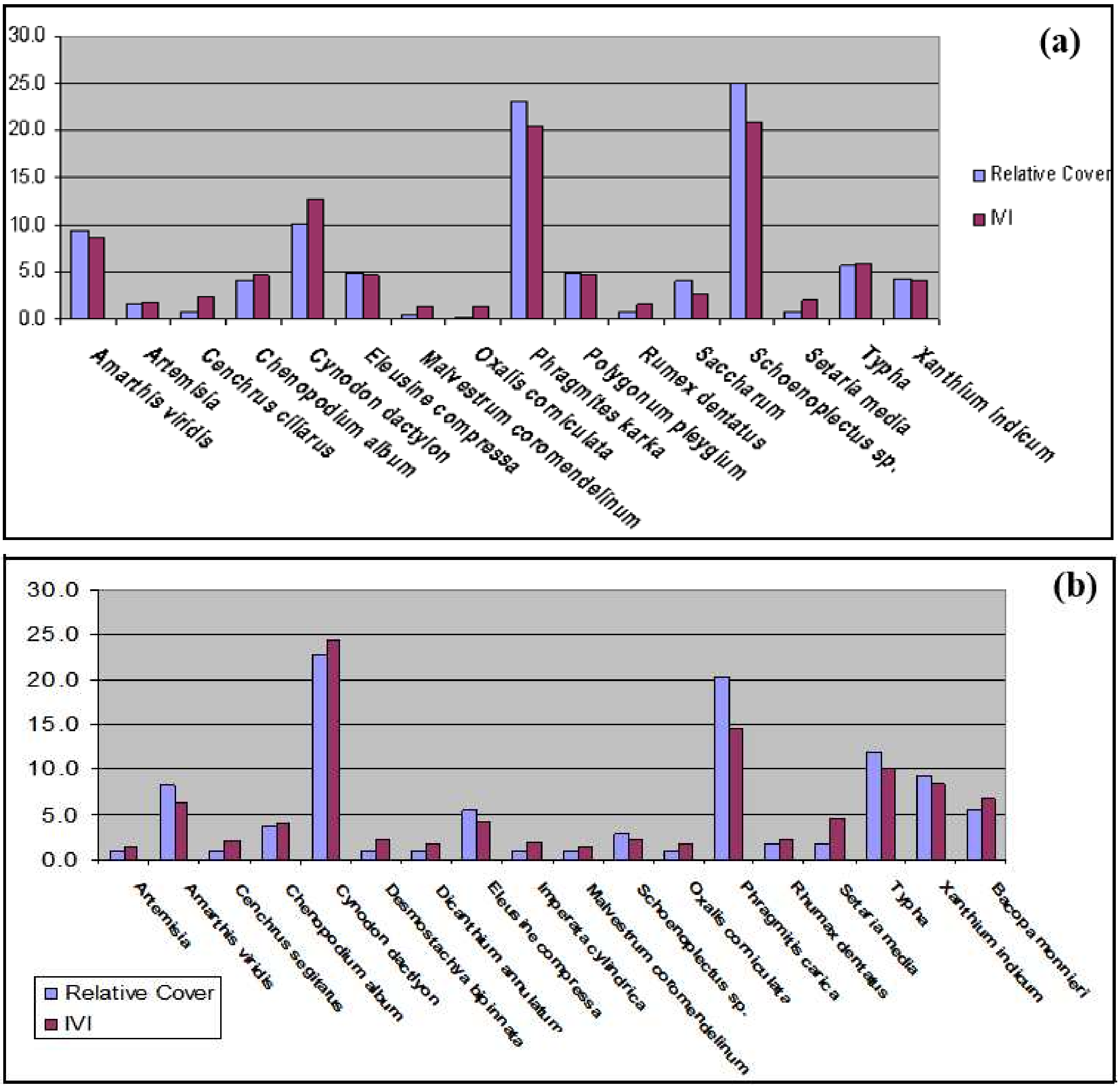

Fig. 2. Phytosociological parameters of Kallar Kahar Lake in different transects.

Effect of contamination on vegetation coverage and vegetation weight biomass in Dharabi watershed area

The current findings showed that the recreational site mostly contain disposed garbage of tourist, near community and hotel garbage, and the garbage much affected the area's beauty and pollute the water quality, and also affected the habitat and quantity of aquatic species. The findings from this study showed that recreational site (Fig.3a) had more garbage as compare to domestic site (**Fig.3b**). So, we can say that domestic site of this area contain low garbage as compare to recreational site because the people on this site are living permanently and dislike damaging the beauty of nearby areas of Lake. Here most of the garbage was due to wind or unconsciously disposed material and it was evidenced from the findings that the site has less garbage cover ratio. However, the comparison between recreational and domestic sites, in which we can easily differentiate between vegetation and garbage covers of both site of this area (Fig.3c).

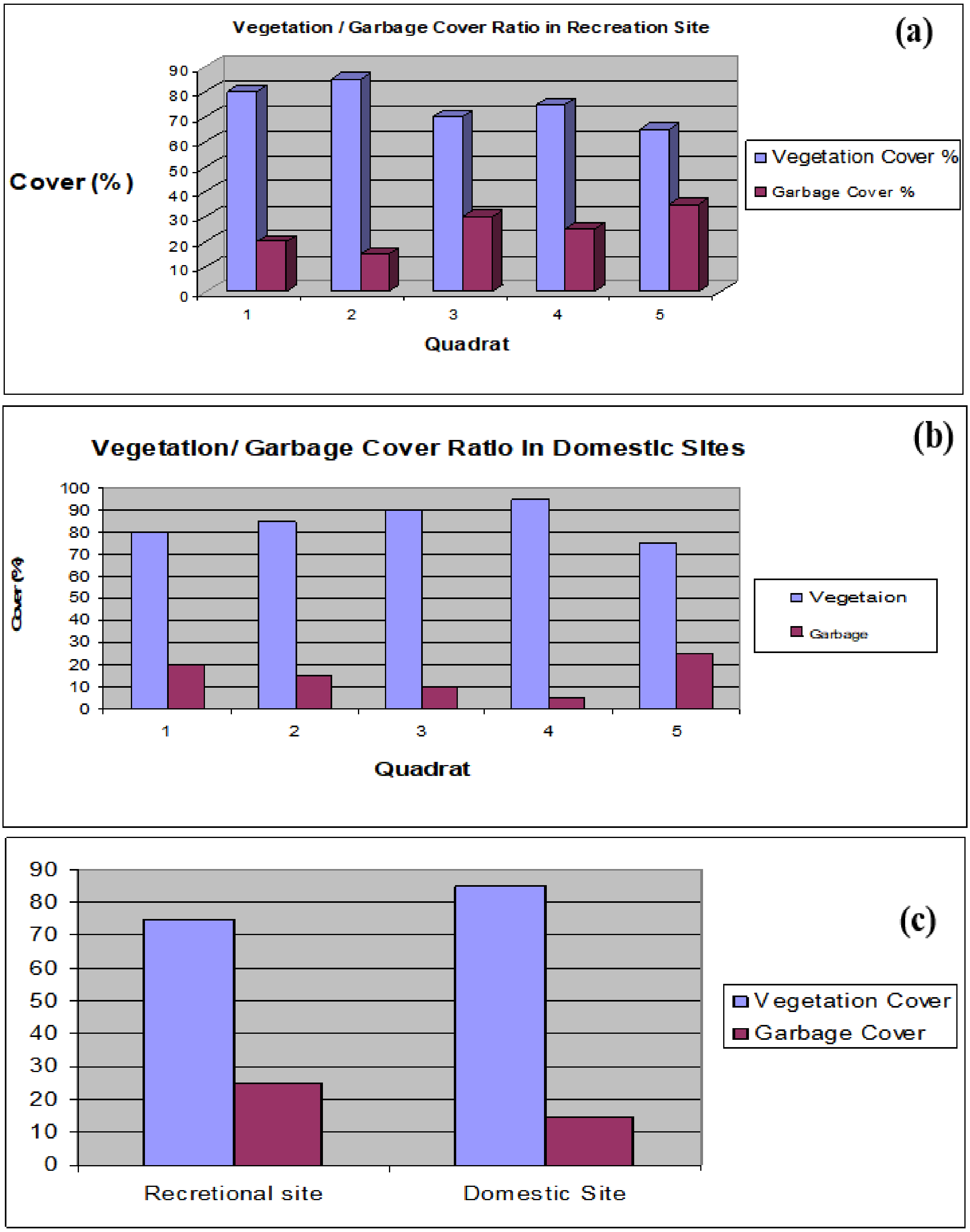

Fig. 3. Effect of contamination on vegetation coverage and vegetation biomass in Dharabi watershed.

Effect of Contamination on Vegetation Biomass Weight in Kallar Kahar

From the findings as presented showed that recreational site contain mostly disposed garbage of tourist, near community and of hotel garbage, this garbage much affected the area's beauty and pollutant the water quality. The recreational site garbage were mostly in solid form and also heavy in weight which affected the habitat and quantity of aquatic species much **(Fig.4a).**

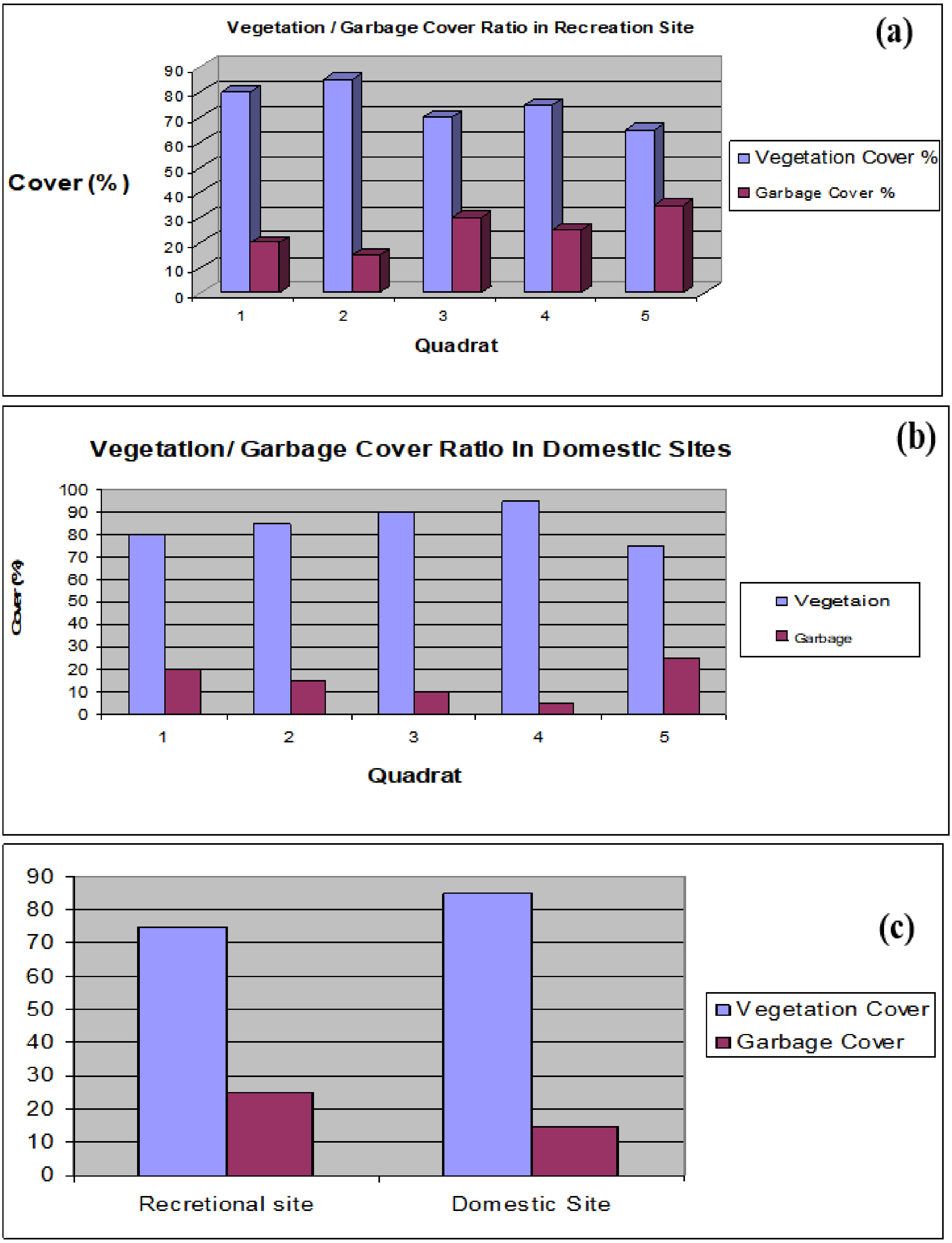

Fig. 4. Effect of Contamination on Vegetation Biomass Weight in Kallar Kahar.

In the domestic site of this area contains low garbage as compare to recreational site because the people living here permanently and dislike damaging the beauty of nearby areas of Lake. In this site, the garbage is in light weight which can fly with wind, this type of garbage also affected the beauty of the area and also most of garbage was due to wind or unconsciously disposed material. However, the figure shows less garbage weight ratio as compare to recreational site (Fig.4b) The comparison between recreational and domestic sites, in which it clearly differentiate between the vegetation and garbage weight of both site of this area (Fig.4c).

Phytosociological assessment of riparian vegetation in study area

Floristic inventory of study Areas

Floristic composition is the variety of individual species that occur in a stand or region. Knowledge of the floristic composition and structure of communities is critical to understanding the greater dynamics of ecosystems. Floristic checklists are often the only source of botanical information for a particular area and may serve as a useful starting point for more detailed study (Keith, 1988). Because of their conciseness, the listing of species is easy to handle and less time consuming (Saima *et al.*, 2009) that aids in the identification and correct naming of species, essential resources for biodiversity estimates and biogeographic studies. Furthermore, this information provides important public outreach and fundamental information to use in addressing the biodiversity crisis (Funk *et al.*, 2007).

Study area scars vegetation of different life form grasses, herbs, shrubs, and trees represents the typical arid zone vegetation. The common flora of this regions compromise of, Eucalyptus globules, *Prosopis glandulosa, Albizza lebbeck, Dodonae viscosa, Tamarixindica, Nerium oleander, Tephrosia purpuria, Opuntiadilnii, Fagoniaindica, Solanumincanum, Saccharum bengalensis, Accacia nilotica, Ziziphus mauritiana, Acacia modesta, , Dalbergiasisso, Calotro pisprocera, Dichanthium annulatum. Prosopis juliflora, Saccharum spontaneaum, Capparis decidua, Ziziphus nummularia.*

Mostly hilly arid area with scars vegetation dominated by cacti plants and thorns plants which are well adapted to the environmental and climatic conditions. The north of the study points is very humus and soil is perfect for the agriculture point of view, that why going to destination we observed that there are several crops, vegetable and fruits are cultivated. The vegetation compromised of *Prosopis glandusa, Typha noducifolia, Opuntia delnii, Accacia modesta, Calotropis procera, Cannabis sativa and Prosopis cineraria* etc.

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 (Council, 2002, Fan, Chang, *et al.*, 2009, Khan, Saeed, *et al.*, 2016, Novotny, 2003). However, an inevitable feature of these systems in tropical and subtropical areas is natural disturbance brought about by the occurrence of hurricanes (or typhoons, as they known in the north-west Pacific area). Massive amounts of sediment can be accumulated as a result of flooding after a single tropical storm and an Australian study has shown that the function of wetlands in retaining phosphorus can be significantly compromised by such storms (Bonell, Hufschmidt, *et al.*, 2005, Fan, Chang, *et al.*, 2009). This is because of the prolonged forestry activity and the frequent, intensive fire regime. Frequent fire causes the soil to become water repellent which in turn accelerates erosion and could carry a serious environmental and economic cost. Hot fires also destroy most soil-stored seed and, return of seed is slow because seed dispersal distances for most Fynbos plant species are very short being moved either by ants or, following seed release after fire, tumbling across the soil surface in the wind (Currie, Milton, *et al.*, 2009). It is necessary to sow seed on sites where the natural seed bank has been lost and the transformed site exceeds

50 m in diameter because natural re-colonization will not occur beyond the dispersal ranges of seeds (Currie, Milton, *et al.*, 2009). The lack of natural vegetation leaves the soil surface exposed allowing erosion gullies to form after the pines were removed (Le Maitre, Gaertner, *et al.*, 2011, Richardson, Holmes, *et al.*, 2007, Zhang, Yang, *et al.*, 2004).

Our result show that riparian areas protect water quality by capturing, storing, and treating water that flows through their soils. A thick growth of diverse vegetation, plant residues covering the soil surface, and porous, non-compacted soil facilitate water capture. High stream banks with high water tables provide water storage capacity (Allan and Castillo, 2007). Vigorously growing plants take up nutrients transported into riparian areas while active populations of both aerobic and anaerobic soil organisms degrade many contaminants that flow into these areas. Chemicals in soil minerals and soil organic matter also capture or facilitate biological detoxification of contaminants (Bolan, Kunhikrishnan, *et al.*, 2014). Understanding these components of healthy riparian areas can help guide land management practices that protect riparian areas and water quality (Gilliam, 1994).

Our study also revealed that riparian vegetation 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, 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 (Gilliam, 1994, Khan, Saeed, *et al.*, 2016).

Conclusion

Chakwal District is located in the south east of the Rawalpindi district and having two sub administrative units (Tehsil) Chakwal and Talagang. Dharabi water reserve, Khai Dam and Kallar Kahar Lake are most common and well known water bodies of the Chakwal. The major land used is for the agriculture and livestock. The Riparian vegetation consists of Typha elephantine, Phragmites kiraka, Saccharum spontaneum. The study trip was comprised of two phases according to the objective of the study i.e. the influence of riparian vegetation and role of Riparian vegetation in cleaning process of Dharabi watershed and Kallar Kahar Lake.

There are 84 species reported in the study area and there are five plant communities recognized in the Dharabi water shed on the basis of IVI by using line transect sampling method which are Crysopogon, Cynodon, Gymnosporea, Acacia, and Conyza

However, the findings revealed that the top three highest IV value were Schoenoplectus, Phragmites and Cynodon plant community was identified in western of the Kallar. The studies also revealed that in the recreational area there was major contribution of the garbage disposable material such as Paraffin, Plastics of soft drinks and disposable meals packages. However in domestic area the waste material and garbage were daily home used material like shopping bags, newspaper or other house hold things. The overall effect of the garbage on the vegetation is very significant. The study also point out that the bird diversity is less in that place where the relative garbage ratio is greater.

References

Allan JD, Castillo MM. 2007. Stream ecology: structure and function of running watersSpringer Science & Business Media.

Allan JD, Flecker AS. 1993. Biodiversity conservation in running waters. BioScience **43,** 32-43.

Arthington AH, Pusey BJ. 2003. Flow restoration and protection in Australian rivers. River research and applications **19,** 377-395.

Beltrão GDBM, Medeiros ESF, Ramos RTdC. 2009. Effects of riparian vegetation on the structure of the marginal aquatic habitat and the associated fish assemblage in a tropical Brazilian reservoir. Biota Neotropica **9,** 37-43.

Bolan N, Kunhikrishnan A, Thangarajan R, Kumpiene J, Park J, Makino T. 2014. Remediation of heavy metal (loid) s contaminated soils–to mobilize or to immobilize? Journal of Hazardous Materials **266,** 141-166.

Bonell M, Hufschmidt MM, Gladwell JS. 2005. Hydrology and water management in the humid tropics: hydrological research issues and strategies for water managementCambridge university press.

Christensen NL, Bartuska AM, Brown JH, Carpenter S, D'Antonio C, Francis R. 1996. The report of the Ecological Society of America committee on the scientific basis for ecosystem management. Ecological applications **6,** 665-691.

Council NR. 1992. Restoration of aquatic ecosystems: science, technology, and public policyNational Academies Press.

Council NR. 2002. Riparian areas: functions and strategies for managementNational Academies Press.

Currie B, Milton SJ, Steenkamp J. 2009. Cost–benefit analysis of alien vegetation clearing for water yield and tourism in a mountain catchment in the Western Cape of South Africa. Ecological Economics **68,** 2574-2579.

Dudgeon D, Arthington AH, Gessner MO, Kawabata ZI, Knowler DJ, Lévêque C. 2006. Freshwater biodiversity: importance, threats, status and conservation challenges. Biological reviews **81,** 163-182.

Fan C, Chang FC, Ko CH, Sheu YS, Teng CJ, Chang TC. 2009. Urban pollutant removal by a constructed riparian wetland before typhoon damage and after reconstruction. Ecological Engineering **35,** 424-435.

Gilliam J. 1994. Riparian wetlands and water quality. Journal of environmental quality **23,** 896-900.

Gregory SV, Swanson FJ, McKee WA, Cummins KW. 1991. An ecosystem perspective of riparian zones. BioScience **41,** 540-551.

Hrodey PJ, Sutton TM, Frimpong EA, Simon TP. 2009. Land-use impacts on watershed health and integrity in Indiana warmwater streams. The American Midland Naturalist **68,** 76-95.

Jungwirth M, Muhar S, Schmutz S. 1995. The effects of recreated instream and ecotone structures on the fish fauna of an epipotamal river. The Importance of Aquatic-Terrestrial Ecotones for Freshwater Fish. Springer **34,** 195-206.

Junk WJ, Bayley PB, Sparks RE. 1989. The flood pulse concept in river-floodplain systems. Canadian special publication of fisheries and aquatic sciences **106,** 110-127.

Kent M, Coker P. 1992. Vegetation description andanalysis. BocaRaton, CRC.

Khan D, Saeed A, Junaid A, Qamar I, Yazdan F, Ud Din S. 2016. Assessment of riparian vegetation in Dhrabi watershed and Chakwal region in Pakistan. Pakistan Journal of Agricultural Research 29.

Khan S, Shahnaz M, Jehan N, Rehman S, Shah MT, Din I. 2013. Drinking water quality and human health risk in Charsadda district, Pakistan. Journal of cleaner production **60,** 93-101.

Lake P, Bond N, Reich P. 2007. Linking ecological theory with stream restoration. Freshwater biology

52, 597-615.

Le Maitre DC, Gaertner M, Marchante E, Ens EJ, Holmes PM, Pauchard A. 2011. Impacts of invasive Australian acacias: implications for management and restoration. Diversity and Distributions **17,** 1015-1029.

Lowrance R. 1998. Riparian forest ecosystems as filters for nonpoint-source pollution. Successes, limitations, and frontiers in ecosystem science. Springer **45,** 113-141.

Mugodo J, Kennard M, Liston P, Nichols S, Linke S, Norris RH. 2006. Local stream habitat variables predicted from catchment scale characteristics are useful for predicting fish distribution. Hydrobiologia **572,** 59-70.

Naiman RJ, Decamps H. 1997. The ecology of interfaces: riparian zones. Annual review of Ecology and Systematics **28,** 621-658.

Novotny V. 2003. Water quality: diffuse pollution and watershed managementJohn Wiley & Sons.

Palone RS, Todd AH. 1998. Chesapeake Bay riparian handbook: a guide for establishing and maintaining riparian forest buffersUS Department of Agriculture, Forest Service, Northeastern Area State.

Pusey BJ, Arthington AH. 2003. Importance of the riparian zone to the conservation and management of freshwater fish: a review. Marine and Freshwater Research **54,** 1-16.

Richards C, Haro R, Johnson L, Host G. 1997. Catchment and reach-scale properties as indicators of macroinvertebrate species traits. Freshwater Biology **37,** 219-230.

Richardson DM, Holmes PM, Esler KJ, Galatowitsch SM, Stromberg JC, Kirkman SP, 2007. Riparian vegetation: degradation, alien plant invasions, and restoration prospects. Diversity and distributions **13,** 126-139.

Sheikh AT, Month AAU, Plan BBA, Zone EEE, Rights IIP, Feet MMA. 2013. List of Boxes. Population **58,** 29.

Tait CK, Li JL, Lamberti GA, Pearsons TN, Li HW. 1994. Relationships between riparian cover and the community structure of high desert streams. Journal of the North American Benthological Society **13,** 45-56.

Tockner K, Bunn SE, Gordon C, Naiman RJ, Quinn GP, Stanford JA. 2008. 4 Á Flood plains: critically threatened ecosystems **79,** 34-39.

Vannote RL, Minshall GW, Cummins KW, Sedell JR, Cushing CE. 1980. The river continuum concept. Canadian journal of fisheries and aquatic sciences **37,** 130-137.

Vono V, Barbosa FA. 2001. Habitats and littoral zone fish community structure of two natural lakes in southeast Brazil. Environmental Biology of Fishes **61,** 371-379.

Wang J. 2012. Eco-services for urban sustainability in the Yangtze River Delta of China: strategies for physical form and planning.

Wenger S. 1999. A review of the scientific literature on riparian buffer width, extent and vegetation.

Zhang B, Yang YS, Zepp H. 2004. Effect of vegetation restoration on soil and water erosion and nutrient losses of a severely eroded clayey Plinthudult in southeastern China. Catena **57,** 77-90.

Zhao T, Xu H, He Y, Tai C, Meng H, Zeng F. 2009. Agricultural non-point nitrogen pollution control function of different vegetation types in riparian wetlands: A case study in the Yellow River wetland in China. Journal of Environmental Sciences **21,** 933-939.