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Assessment of Riparian Vegetation Alongside of Huluka River: West Shawa Zone, Central Ethiopia

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Abstract: Riparian vegetation which is an essential part of riverine ecosystems are highly disturbed and degraded over the world including in Ethiopia. The present study aims to examine the status woody species vegetation alongside of Huluka River. Total of 25 quadrant transects with 100 X 50m were laid out at every 1km distance perpendicular to the flow of the river. At the corners of all transects 10 × 10 m plots was used for the sampling of trees and plot size of 5 × 2 m that nested in the 10 × 10 m plot were used for sampling of shrubs and saplings. In each sample plot all tree species with height (≥2.5 m) and DBH (≥2.5 cm) were measured by using Suunto clinometers and calliper respectively, and all individual shrubs and sapling species were counted. Diversity indices such as Shannon diversity index (H'), evenness index (E), species richness (R), and Simpson diversity index (D) were calculated. A total of 25 trees species belonging to 21 families and 22 shrub species belonging to 19 families were recorded. 99% were indigenous, while the remaining was exotic species. *Acacia abyssinica, Juniperus procera* and *Olea africana* from tree species, and *Carissa edulis* and *Maytenus arbutifolia* from shrub were the most dominant species. Species diversity ranged between 0.43 and 2.47, whereas evenness ranged between 0.46 and 1.06. Species diversity and richness show increasing pattern from upstream of the river system (Dendi district) to the downstream of the river system (Ambo district), but it depends on the contiguous land uses i.e. riparian vegetation bordered with natural forests higher species richness and diversity, whereas those bordered with grazing land has lower species richness and diversity. The riparian vegetation along the river is highly converting to agricultural and grazing lands, and this results degradation of the vegetation.

Keywords: Hulluka, Riperian, Vegetation, Riverside Vegetation

1. Introduction

Riparian vegetation is plant communities that grown around streams, river banks and in marsh lands and it is an essential part of riverine ecosystems. Species diversity, structure and regeneration process of riparian vegetation along streams and rivers is varies from region to region and also along single river line with altitudinal gradients depend on the level of disturbance and activities of human interferences [4, 8]. Riparian vegetation provides innumerable essential ecological functions by providing shade to stream banks, minimizing floods, storing nutrients, retaining riparian soil moisture and improving quality of water [5], serve as a corridor between adjacent terrestrial and aquatic bodies [6, 9]. Riparian vegetation also provides diverse economical values; as a source forage for animals, source of fuel wood and other timber products, [1, 16].

Irrespective of its diverse function, riparian vegetation is highly degraded and disturbed due to different activities of human interferences. Extreme usage of riparian zones for farming [4], over grazing and selective cutting tree for charcoal, fuel wood and construction material from riparian vegetation [7] due to population pressure are the proximal cause of the decline of vegetation cover and impoverishment of the species diversity. Disturbances caused by these unlimited activities of human interference results reduction of native species richness, composition and productivity and production gained from vegetation [14], and loss of biodiversity contained in the riparian zone [15].

Globally, the disturbance and degradation in riparian vegetation is a multifaceted interaction of both natural and anthropogenic effects [12, 13]. In Ethiopia, the riparian vegetation is highly declining due to over utilization of vegetation alongside of streams, use of riverside land for

farm, free grazing and rapid expansion of invasive and exotic plant species [10, 12]. However, full scientific information on the status of species composition, diversity, density and structure of riparian vegetation in Ethiopia and particularly of Huluka River is limited. So the present study aims to examine the status woody species vegetation alongside of Huluka River.

2. Materials and Methods

2.1. Study Area

The study area was totally found in west showa zone of Oromia regional state, central Ethiopia along Huluka River. The Agro-ecology of the specific study area is categorized into two agro-climatic zones, highland (87%) and mid-highland (13%). Topographically the area is characterized as plateaus and plains. Specifically the study area covers two districts of west showa zone namely Dandi district (8°49'39.59"N, 38° 0'58.66"E) – (8°50'23.13"N, 37°57'25.13"E) which is initial and upstream region of Huluka river and Ambo district ((8°50'52.83"N, 37°57'13.93"E) – (8°57'31.17"N, 37°53'0.89"E) which is downstream region of the River. Huluka River is initially started from Dandi Highland Lake and crossing Ambo town of West showa zone. In many parts of west shawa zone, especially in Dandi and Ambo districts the river is used for irrigation, household consumption and industries.

2.2. Sampling Design

Total of 25 quadrant transects which is 100 X 50m were laid out at every 1km distance perpendicular to the flow of the river. Fewer transects were set in cases where sections of transects were bare land of cultivated for crops or grazing land without any tree or shrubs species. In all transects a 10 × 10 m plots (at each corner of transect) was used for the sampling of trees and plot size of 5 × 2 m (which is nested in the 10 × 10 m plot) were used for sampling of shrubs and saplings. In each sample plot all tree species with height (≥2.5 m) and DBH (≥2.5 cm) were measured by using Suunto clinometers and calliper respectively, and all individual shrubs and sapling species were counted.

2.3. Data Analysis

Diversity indices such as Shannon diversity index (H'), Shannon equitability/evenness index (E), species richness (R), and Simpson diversity index (D) were calculated. These indices provided information about the rarity and commonness of species in a community. High value of H' shows that the relative abundance of the different species in the sample is even, low value indicates few species are more abundant. Shannon-Wiener Diversity Index (H') $= -\sum_{i=1}^{\infty} pi \ln(pi)$, Where, pi = si /N (si = number of individuals of a species, N = total number of individuals of all the species). Evenness index (E) $= \frac{H'}{\ln S}$, Where H′ is Shannon–Weaver diversity index and S = total number of species in a sample. Species richness of the riparian vegetation (R) $= \frac{S-1}{\log N}$, Where, R=species richness, S=total number of species in a sample, and N=total number of individuals of all the species. Simpson diversity index (D) =1-$\sum pi^2$, Where D is Simpson's diversity index and pi is the proportion of individuals found in the i^{th} species. The value of Simpson's diversity index for rare species is little weight while more weight to the most abundant species. The value of D ranges from 0 (low diversity) to a maximum of (1−1/S), where S is the number of species.

3. Results and Discussion

3.1. Adjacent Land Use Alongside of Hulluka Riparian Vegetation

In the study area hulluka River is contiguous with three types of land uses i.e. Grazing land, crop land and natural forest (Figure 1). From these land uses grazing land covers larger areas while natural forest is the least.

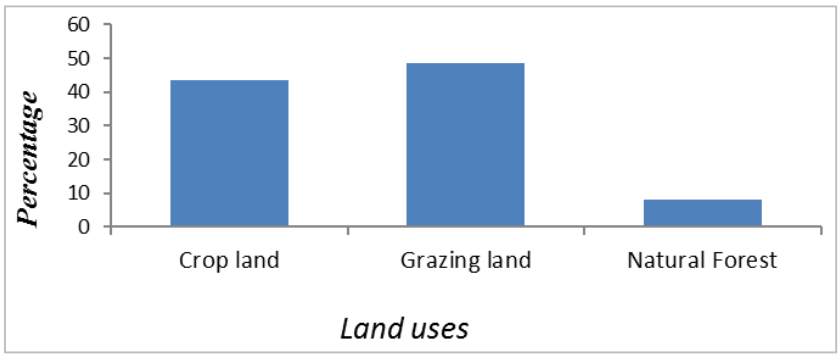

Figure 1. *Adjacent land use alongside of Hulluka riparian vegetation.*

3.2. Floristic Composition of Riparian Vegetation Along Hulluka River

In the study area a total of 47 woody species (25 trees species belonging to 21 families and 22 shrub species belonging to 19 families) were recorded. From observed species in the study area 99% were indigenous, while the remaining 1% is exotic species. Among tree species *Acacia*

abyssinica, *Juniperus procera* and *Olea africana* were most frequently observed tree species along Hulluka River, while *Acokanthera schimperi* and *Acacia seyal* were rarely observed species (Table 1). At the family level, *Fabaceae* and *Myrtaceae* respectively were the most diverse families in the area (Figure 2). For shrub species *Carissa edulis* and *Maytenus arbutifolia* were most frequently recorded species, at the family level *Capparidaceae*, *Rosaceae* and *Verbenaceae* (Figure 3) were the most dominant shrubs families. Present study indicated that Hulluka riparian vegetation forest is floristically rich in comparison to other studies conducted in other riparian vegetation of west showa [2], however, it is poor comparable with Walga River, South western showa [11].

Table 1. *Frequency of tree species along Hulluka River.*

S/N	Tree Species	Family	Frequency	Percent
1	*maesa lanceolata*	*Primulaceae*	10.00	1.31
2	*Salix mucronata*	*Salicaceae*	37.00	4.86
3	*Buddleja polystachya*	*Scrophulariaceae*	20.00	2.63
4	*Eucalyptus globulus*	*Myrtaceae*	22.00	2.89
5	*Croton macrostachyus*	*Euphorbiaceae*	31.00	4.07
6	*Podocarpus falcatus*	*Podocarpaceae*	24.00	3.15
7	*Dombeya torrida*	*Sterculiaceae*	35.00	4.60
8	*Rhus vulgaris Meikle*	*Anacardiaceae*	33.00	4.34
9	*Vernonia amygdalina*	*Asteraceae*	7.00	0.92
10	*Olea africana*	*Oleaceae*	98.00	12.88
11	*Juniperus procera*	*Cupresaceae*	101.00	13.27
12	*Gardenia ternifolia*	*Rubiaceae*	10.00	1.31
13	*Syzygium guineense*	*Myrtaceae*	49.00	6.44
14	*Ficus sur*	*Moraceae*	5.00	0.66
15	*Hagenia abyssinica*	*Casuarinaceae*	3.00	0.39
16	*hypericum revolutum*	*Hypericaceae*	35.00	4.60
17	*prunus africana*	*Rosaceae*	9.00	1.18
18	*Acacia abyssinica*	*Mimosaceae*	157.00	20.63
19	*Albizia gummifera*	*Fabaceae*	7.00	0.92
20	*Acokanthera schimperi*	*Apocynaceae*	3.00	0.39
21	*Ekebergia capensis*	*Casuarinaceae*	7.00	0.92
22	*Pittosporum viridiflorum*	*Pittosporaceae*	39.00	5.12
23	*Acacia seyal*	*Fabaceae*	2.00	0.26
24	*Cordia africana*	*Boraginaceae*	15.00	1.97
25	*Erythrina brucei*	*Fabaceae*	2.00	0.26

Table 2. *Frequency of shrub species along Hulluka River.*

S/N	***Shrub species***	***Family***	Frequency	Percent
1	*Premna schimperi*	*Verbenaceae*	7.00	0.95
2	*Carissa edulis*	*Apocynaceae*	93.00	12.62
3	*Calpurnia aurea*	*Fabaceae*	9.00	1.22
4	*vernonia auriculifera*	*Asteraceae*	29.00	3.93
5	*Rubus steudneri*	*Rosaceae*	3.00	0.41
6	*Phytolacca dodecandra*	*Phytolaccaceae*	53.00	7.19
7	*Capparis tomentosa*	*Capparidaceae*	23.00	3.12
8	*Rosa abyssinica*	*Rosaceae*	49.00	6.65
9	*Dodonaea angustifolia*	*Sapindaceae*	41.00	5.56
10	*Maytenus arbutifolia*	*Celastraceae*	85.00	11.53
11	*Dovyalis abyssinica*	*Salicaceae*	62.00	8.41
12	*Lippia javanica*	*Verbenaceae*	21.00	2.85
13	*Arundinaria alpina*	*Poaceae*	2.00	0.27
14	*Bersama abyssinica*	*Melianthaceae*	17.00	2.31
15	*Phoenix reclinata*	*Arecaceae*	14.00	1.90
16	*Euclea racemosa*	*Ebenaceae*	42.00	5.70
17	*Myrsine africana*	*Primulaceae*	46.00	6.24
18	*Rhamnus staddo*	*Rhamnaceae*	51.00	6.92
19	*Erica arborea*	*Ericaceae*	13.00	1.76
20	*Capparis fascicularis*	*Capparidaceae*	32.00	4.34
21	*Myrica salicifolia*	*Myricaceae*	4.00	0.54
22	*Osyris compressa*	*Santalaceae*	40.00	5.43

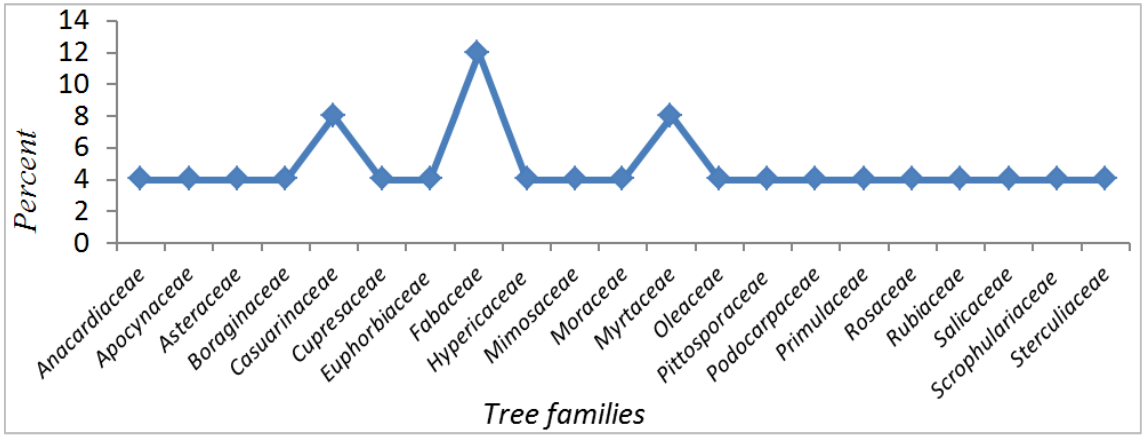

Figure 2. *Percentage tree alongside of Hulluka River in Family level.*

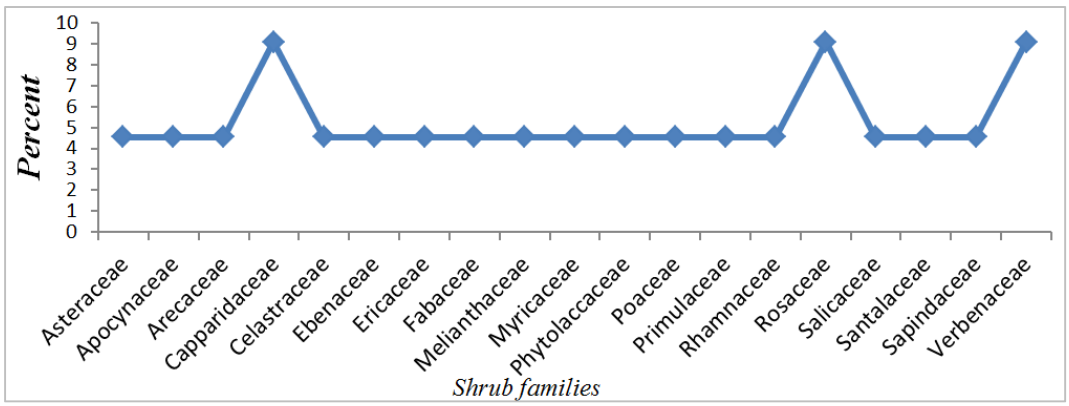

Figure 3. *Percentage shrubs alongside of Hulluka River in Family level.*

3.3. The Riparian Diversity, Richness and Evenness Among Sampling Transects

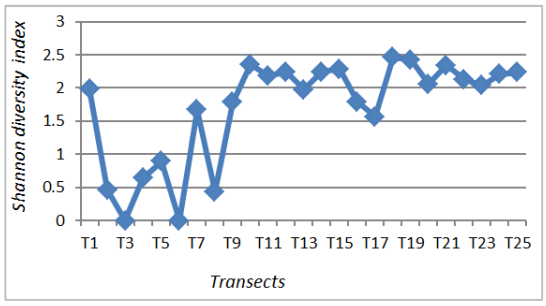

Figure 4. *Shannon diversity index along transects.*

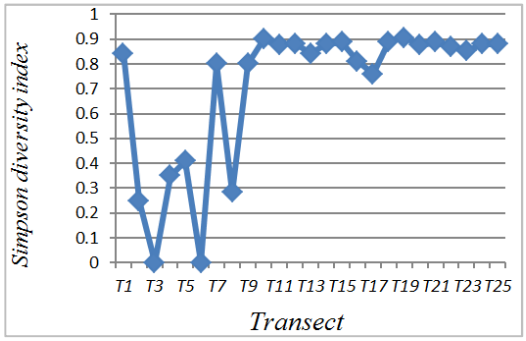

Figure 5. *Simpson diversity index along transects.*

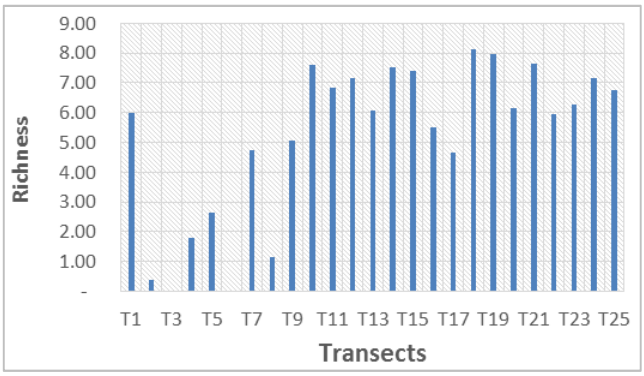

Figure 6. *Mean of species richness among transects.*

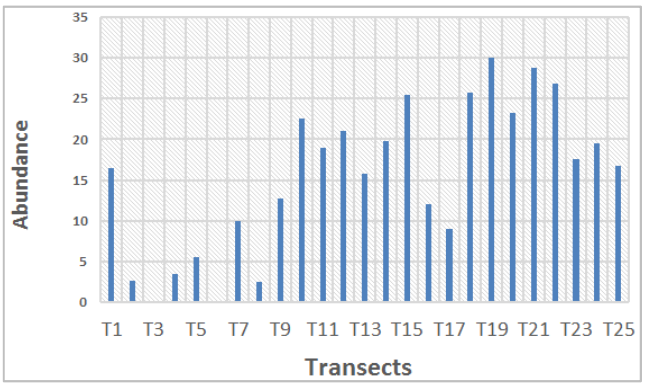

Figure 7. *Mean species abundance among transects.*

The species diversity ranged between 0.43 and 2.47 (Figure 4), whereas the species evenness ranged between 0.46 and 1.06 (Figure 5). Except for the first transect species diversity and species richness displayed that slightly increasing pattern from upstream of the river system (Dendi district) to the downstream of the river system (Ambo district). But at the first transect which is located at the starting of the river (Dandi lake) species diversity and richness were higher than some succeeding transects due to the existence of plantation and sparse natural forest around the lake. But the increasing trend of species diversity and richness did not continue at some transects where the riparian vegetation adjoins with grazing land. The differences in riparian plant species diversity and evenness among sampling sites were statistically significant ($P < 0.05$) based on the one-way analysis of variance.

4. Conclusion

The present study describes the riparian floristic composition riparian vegetation along altitudinal gradient on Hulluka River in the central Ethiopia. These floristic composition groups of riparian vegetation are characterized by species richness, diversity, and evenness and correlated with contiguous land use types such as grazing land, farm land and natural forests. In the study area 48%, 44% and 8% of the riparian vegetation were adjoining with grazing land, farm land and natural forests respectively. The area in which riverside riparian vegetation is bordered with natural forests higher species richness and diversity were observed, whereas low species richness and diversity was observed in grazing land sides. Except in some sampling plots where sections of transects were set bare land, the lower stream riparian vegetation of Hulluka River had higher number of species richness and diversity. In the area the riparian vegetation along the river is highly converting to agricultural and grazing lands, and this results degradation of the vegetation. Therefore, it needs special priority to conserve important native species which are ecologically and environmentally important.

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