Bangladesh J. Bot. **53**(4): 913-922, 2024 (December) DOI: https://doi.org/10.3329/bjb.v53i4.78637

# EFFECTS OF ROADSIDE CULTIVATION OF NAPIER GRASS (*PENNISETUM PURPUREUM* SCHUM) ON WILD NATURAL VEGETATION OF KALIGANJ, GAZIPUR, BANGLADESH

**MD ASHRAFUL ISLAM*** **AND M MAHFUZUR RAHMAN**

*Plant Ecology and Environment Laboratory, Department of Botany, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh*

*Keywords:* Roadside cultivation, *Pennisetum purpureum*, Kaliganj upazila

**Abstract**

Effects of roadside cultivation of exotic *Pennisetum purpureum* on floristic composition and phytodiversity of wild vegetation in natural roadsides of Kaliganj upazila, Gazipur were studied during 2023 to 2024. A total of 117 vascular plant species comprising of 108 genera under 47 families have been recorded in natural roadside area and a total of 38 vascular plant species comprising of 36 genera under 18 families have been recorded in *Pennisetum* cultivated roadside area. In natural roadsides, maximum 97 species belonged to dicotyledons followed by 18 monocotyledons and 2 pteridophytic species. In *Pennisetum* cultivated roadsides, maximum 30 species belonged to dicotyledons followed by 6 monocotyledons and 2 pteridophytic species. In *Pennisetum* cultivated roadsides, maximum Shannon-Weiner diversity index was 2.02±0.05 and minimum index was 1.99±0.05. In natural roadsides, maximum Shannon-Weiner diversity index was 2.70±0.07 and minimum index was 2.43±0.04. Average Jackknife species richness 31.98 was found in *Pennisetum* cultivated roadsides, and 107.62 was found in natural roadsides. The collected data on the selected roadsides of Kaliganj upazila showed the trends of gradual decrease in floristic composition and phytodiversity status of *Pennisetum* cultivated roadsides in comparison to natural roadsides, which indicated that *Pennisetum* cultivation might have negative impacts on floristic composition and phytodiversity status of natural roadsides.

## Introduction

It is expected that any country should require at least 25% vegetation coverage to fulfil the ecological balance of that country. The total forest area of Bangladesh is approximately 2.6 million hectares, which is almost 14.1% of the total land area of the country (FAO 2020). As a forest scarce country, Bangladesh must need to protect all sorts of wild vegetation for maintaining the ecological balance. Social forestry is trying to increase the vegetation by roadside plantation of plant species **(**Zakharenka 2021). But biological invasions depict one of the major threats to biodiversity which lead to alter the structure and function of natural ecosystems. Over the past two decades, invasive exotic plant species have come to be recognized as one of the most dreadful causes of species declines, and natural habitat destruction (Vitousek *et al*. 1997). A primary goal of restoration practitioners is to reverse a natural habitat to a more desirable condition which involves a particular species composition, community structure, and a set of ecosystem functions (Noss 1990). Infiltration of invasive species into a natural habitat may disrupt ecosystem processes, energy cycle, and functions by displacing wild native species (Collier *et al*. 2002). It seems reasonable that invasive species have capacity to become community dominants which may contribute to the alterations of existing ecosystem functions. Therefore, several definite policies, risk assessments, and legislations are now in place to regulate the spread of invasive species in natural ecosystems (Heywood and Brunel 2009).

*Author for correspondence: <rasel.ashraf.31@gmail.com>.

Napier grass (*Pennisetum purpureum* Schumach.) is native to eastern Africa and has been introduced to the tropics and subtropics of both hemispheres. It is a $C_4$ grass plant adapted to environments with high temperatures, high solar radiation, drought, and $N_2$ or $CO_2$ limitations (SiB Colombia 2020). It is the forage of choice not only in the tropics but also worldwide (Hanna *et al*. 2004) due to its desirable traits such as tolerance to drought and a wide range of soil conditions, and high photosynthetic and water-use efficiency (Anderson *et al*. 2008). Main components of biological invasions are anthropogenic activities that modulate the introduction and dissemination of invasive species and a large number of human activities supporting the spread of invasive plant species have been identified (Richardson *et al*. 2000). Roadside is a natural habitat which harbors a lot of wild vegetation with natural regeneration potentiality. Cultivation of exotic species in roadside may lead to the destruction of wild vegetation and may extinct some wild species. This species mainly cultivates in agricultural land where it has no effects on wild vegetation. But, cultivation of such agri-based crop species in roadside may have effects on wild natural plant species destruction. The spread of this species driven by disturbances is frequently linked to poor individual performance and reduced species diversity, which may lead to irreversible changes in the species composition of roadside vegetation. Therefore, the present investigation was conducted to know the impacts of cultivation of Napier grass on the floristic composition and phytodiversity status of roadside vegetation, and to provide data that might be helpful for proper management plans and sustainable restoration of wild natural vegetation.

## Materials and Methods

Kaliganj is an upazila (sub-district) of Gazipur district in central Bangladesh, which is a part of the Dhaka division. Geographically, the study area is situated between 23°55'30" N latitude and 90°34'0.1" E longitude. The total land area is about 214.63 $km^2$ and the total forest area of the upazila is 35 hectors. This area is under the bio-ecological zone-3 'Madhupur Sal Tract' (Nishat *et. al*. 2002). Annual rainfall ranges from (2030-2290) mm, and temperature fluctuates from 11°c to 34°c. Soils are prominently deep red-brown terrace soils, and land mainly dominated by deciduous forest (Nishat *et. al*. 2002). The present study area has been divided into five different representative sites. The selected representative sites were recognized as- Site-A: Kaliganj pouroshova (23°55′26.39″N, 90°34′4.79″E); Site-B: Jamalpur union (23°58′1.19″N, 90°36′53.99″E); Site-C: Baktarpur union (23°57′39.5″N, 90°32′52.8″E); Site-D: Tumulia union (23°55′37.19″N, 90°32′59.9″E); and Site-E: Nagari union (23°54′50.4″N, 90°30′28.79″E). These sites were further divided into three sub-sites on the basis of roadside natural vegetation and *Pennisetum purpureum* cultivated roadside vegetation.

To complete the study, altogether eight field trips were conducted for collecting of field data and plant species in the tenure of 2023 to 2024. Plant samples were collected from different sub-sites followed by standard quadrat method (Braun-Blanquet 1932; Raunkiaer 1934) and the size of quadrat was determined as 2m×2m following species-area curve (SAC) method (Braun-Blanquet 1932). Collected plant specimens were properly processed by standard herbarium techniques (Hyland 1972; Jain and Rao 1977 and Alexiades 1996). The specimens were identified through consulting with expert taxonomists, cross-checking with herbarium specimens preserved at JUH and Bangladesh National Herbarium (DACB), and matching with different relevant taxonomic literatures, viz., Hooker (1872-1897), Prain (1903), Uddin and Hassan (2004), Siddiqui *et al.* (2007) and Ahmed *et al.* (2008-2009). From TROPICOS and IPNI database, different information of plants including scientific name(s) with original citation, family name, local name(s), habit, distribution and origin was recorded.

The values of Shannon-Wiener diversity indices were calculated by using the standard formula described by Kent and Coker (1992)-

Shannon-Weiner Diversity Index (H′) = $-\sum pi \ln pi$

Where, Pi = Proportion of individuals or the abundance species which expressed as a proportion of total cover;

Ln = Log base n.

Jackknife species richness values were calculated by using standard formula described by Kent and Coker (1992)-

Jackknife Species Richness (S) = $\mathbf{s + \left(\frac{n-1}{n}\right)^{k}}$

Where, s = Total no. of species in all quadrat;

n = No. of quadrat studied; k = No. of unique species.

**Results and Discussion**

Present study represents the floristic composition and phytodiversity index of the plant species of the selected *Pennisetum purpureum* cultivated roadsides and natural roadsides of Kaliganj upazila, Gazipur. From the recorded data, it was evident that a total of 117 vascular plant species comprising of 108 genera under 47 plant families have been recorded in natural roadside area. On the other hand, a total of 38 vascular plant species comprising of 36 genera under 18 plant families have been recorded in *Pennisetum purpureum* cultivated roadside area (Fig.1). From the recorded common roadside plant species, maximum 97 (82.9%) species belonged to dicotyledons followed by 18 (15.4%) monocotyledons and 2 (1.7%) pteridophytic species. From the recorded *Pennisetum* cultivated roadside species, maximum 30 (78.9%) species belonged to dicotyledons followed by 6 (15.8%) monocotyledons species and 2 (5.3%) pteridophytic species (Fig.2).

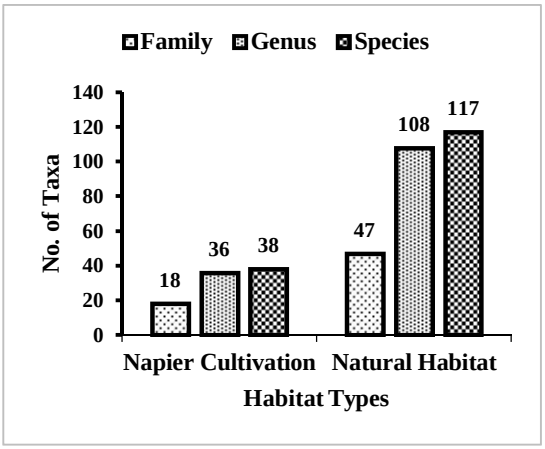


Fig. 1. Floristic composition of plants recorded from both habitats.

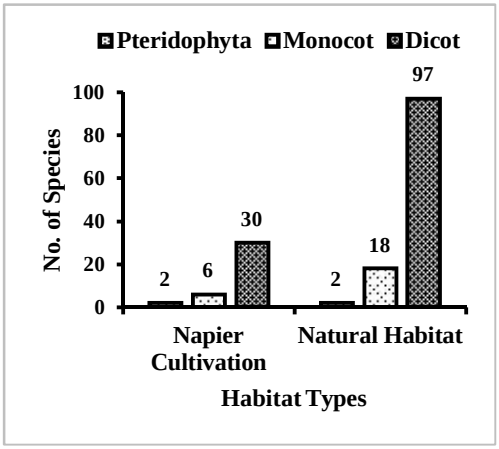


Fig. 2. Major groups of plant species recorded from both habitats.

From the recorded natural roadside species, the highest 71 (60.7%) species were recorded as herb followed by 12 (10.2%) tree (seedling), 21 (17.9%) shrub and 13 (11.2%) climbers. From the recorded *Pennisetum* cultivated roadside species, the highest 23 (60.5%) species were recorded as

herb followed by 3 (7.9%) tree (seedling), 5 (13.1%) shrub and 7 (18.5%) climbers (Fig. 3). Among the plant families of natural roadsides, maximum 10 species were found to exist under Asteraceae family followed by Euphorbiaceae (7 species), Poaceae (7 species), Fabaceae (7 species) and Araceae (6 species). Among the plant families of *Pennisetum* cultivated roadsides, maximum 7 species were found under Asteraceae family followed by Amaranthaceae (5 species), Fabaceae (4 species), Poaceae (4 species) and Pteridaceae (2 species) (Fig. 4).

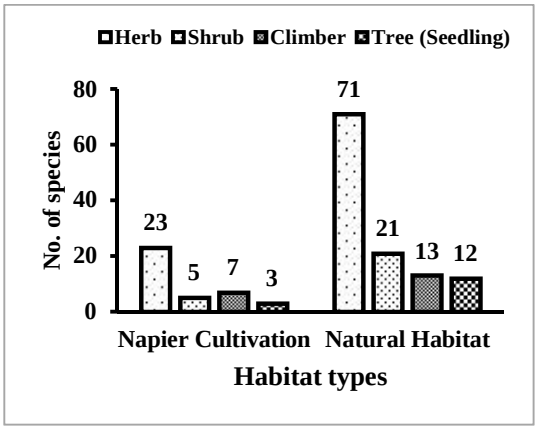


Fig. 3. Habit categories of plant species recorded from both habitats.

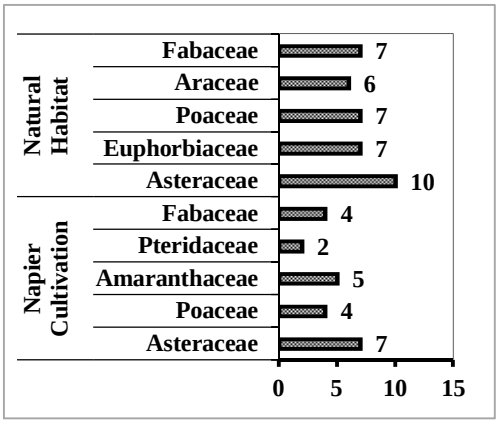


Fig. 4. Top five plant families recorded from both habitats.

**Table 1. A comprehensive checklist of common vascular plant species recorded from natural roadside habitats during 2023-2024.**

| Sl. No. | Scientific name | Family name | Bengali name | Cotyledon | Habit |
|---|---|---|---|---|---|
| 1 | *Ecbolium ligustrinum* (Vahl) Vollesen | Acanthaceae | Shial leza | Dicot | Herb |
| 2 | *Justicia adhatoda* L. | Acanthaceae | Basak | Dicot | Shrub |
| 3 | *Nelsonia canescens* (Lam.) Spreng. | Acanthaceae | Paramul | Dicot | Herb |
| 4 | *Ruellia tuberosa* L. | Acanthaceae | Chotpotey | Dicot | Herb |
| 5 | *Rungia pectinata* (L.) Nees | Acanthaceae | Pindi | Dicot | Herb |
| 6 | *Achyranthes aspera* L. | Amaranthaceae | Apang | Dicot | Herb |
| 7 | *Alternanthera paronychioides* A. St.-Hil. | Amaranthaceae | Jhuli khata | Dicot | Herb |
| 8 | *A. sessilis* (L.) (L.) R. Br. ex DC. | Amaranthaceae | Malancha | Dicot | Herb |
| 9 | *Celosia argentea* L. | Amaranthaceae | Morog Phul | Dicot | Herb |
| 10 | *Crinum asiaticum* L. | Amaryllidaceae | Shukdarshan | Dicot | Herb |
| 11 | *Centella asiatica* (L.) Urb. | Apiaceae | Thankuni | Dicot | Herb |
| 12 | *Calotropis gigantea* (L.) W.T. Aiton | Apocynaceae | Akondo | Dicot | Shrub |
| 13 | *Cryptostegia grandiflora* Roxb. ex R. Br. | Apocynaceae | Kriptoran | Dicot | Herb |
| 14 | *Ichnocarpus frutescens* (L.) W. T. Aiton | Apocynaceae | Parallia lata | Dicot | Climber |
| 15 | *Rauvolfia serpentina* (L.) Benth. Ex Kurz. | Apocynaceae | Sarpogondha | Dicot | Shrub |
| 16 | *Tabernaemontana divaricata* (L.) R. Br. ex Roem. & Schult. | Apocynaceae | Tagar | Dicot | Shrub |
| 17 | *Alocasia fornicata* (Roxb.) Schott | Araceae | Bish kachu | Monocot | Herb |
| 18 | *A. macrorhizos* (L.) G. Don | Araceae | Man kachu | Monocot | Herb |

| Sl. No. | Scientific name | Family name | Bengali name | Cotyledon | Habit |
|---|---|---|---|---|---|
| 19 | *Amorphophallus paeoniifolius* (Dennst.) Nicolson | Araceae | Ol kachu | Monocot | Herb |
| 20 | *Colocasia esculenta* (L.) Schott | Araceae | Jangli kachu | Monocot | Herb |
| 21 | *Typhonium trilobatum* (L.) Schott | Araceae | Get kachu | Monocot | Herb |
| 22 | *Xanthosoma sagittifolium* (L.) Schott | Araceae | Dudh kachu | Monocot | Herb |
| 23 | *Blumea densiflora* DC. | Asteraceae | Nagorfuli | Dicot | Herb |
| 24 | *B. membranacea* Wall. Ex DC. | Asteraceae | Kukurshinga | Dicot | Herb |
| 25 | *Cyanthillium cinereum* (L.) H. Rob. | Asteraceae | Shialmutra | Dicot | Herb |
| 26 | *Eclipta prostrata* (L.) L. | Asteraceae | Kalokeshi | Dicot | Herb |
| 27 | *Mikania cordata* (Burm.f.) B.L. Rob. | Asteraceae | Assam lata | Dicot | Climber |
| 28 | *Parthenium hysterophorus* L. | Asteraceae | Parthenum | Dicot | Herb |
| 29 | *Sonchus arvensis* L. | Asteraceae | Chashar | Dicot | Herb |
| 30 | *Sphagneticola trilobata* (L.) Pruski | Asteraceae | Mahabhringaraj | Dicot | Herb |
| 31 | *Synedrella nodiflora* (L.) Gaertn. | Asteraceae | Nak phul | Dicot | Herb |
| 32 | *Tagetes erecta* L. | Asteraceae | Gada | Dicot | Herb |
| 33 | *Impatiens balsamina* L. | Balsaminaceae | Dopati | Dicot | Herb |
| 34 | *Trema orientalis* (L.) Blume | Cannabaceae | Banjiga | Dicot | Tree |
| 35 | *Canna indica* L. | Cannaceae | Kolabati | Dicot | Herb |
| 36 | *Crateva nurvala* Buch.-Ham.. | Capparaceae | Borun | Dicot | Tree |
| 37 | *Carica papaya* L. | Caricaceae | Pepe | Dicot | Tree |
| 38 | *Cleome rutidosperma* DC. | Cleomaceae | Nil hurhurey | Dicot | Herb |
| 39 | *C. viscosa* L. | Cleomaceae | Holud hurhurey | Dicot | Herb |
| 40 | *Combretum indicum* (L.) DeFilipps | Combretaceae | Madobi lata | Dicot | Climber |
| 41 | *Commelina diffusa* Burm. f. | Commelinaceae | Kanshira | Monocot | Herb |
| 42 | *C. longifolia* Lam. | Commelinaceae | Pani kanshira | Monocot | Herb |
| 43 | *Cordia dichotoma* G. Forst. | Cordiaceae | Bohola | Dicot | Tree |
| 44 | *Cheilocostus speciosus* (J. Koenig) C.D. Specht | Costaceae | Keomul | Dicot | Herb |
| 45 | *Luffa acutangula* (L.) Roxb. | Cucurbitaceae | Jhinga | Dicot | Climber |
| 46 | *Kyllinga brevifolia* Rottb. | Cyperaceae | Shabujnirbisa | Monocot | Herb |
| 47 | *Dioscorea alata* L. | Dioscoreaceae | Chupri alu | Monocot | Climber |
| 48 | *D. pentaphylla* L. | Dioscoreaceae | Jhum alu | Monocot | Climber |
| 49 | *Acalypha ciliata* Forssk. | Euphorbiaceae | Unknown | Dicot | Herb |
| 50 | *A. indica* L. | Euphorbiaceae | Muktajhuri | Dicot | Herb |
| 51 | *Croton bonplandianus* Baill. | Euphorbiaceae | Bandhone | Dicot | Herb |
| 52 | *Euphorbia milii* Des Moul. | Euphorbiaceae | Kata mukut | Dicot | Shrub |
| 53 | *Jatropha gossypiifolia* L. | Euphorbiaceae | Lalbherenda | Dicot | Shrub |
| 54 | *Ricinus communis* L. | Euphorbiaceae | Bherenda | Dicot | Shrub |
| 55 | *Trewia nodiflora* L. | Euphorbiaceae | Latim | Dicot | Tree |
| 56 | *Alysicarpus vaginalis* (L.) DC. | Fabaceae | Pinnata | Dicot | Herb |
| 57 | *Crotalaria pallida* Aiton | Fabaceae | Jhunjhuni | Dicot | Herb |
| 58 | *Derris scandens* (Roxb.) Benth. | Fabaceae | Kalai lata | Dicot | Climber |
| 59 | *Leucaena leucocephala* (Lam.) de Wit | Fabaceae | Ipil-Ipil | Dicot | Tree |
| 60 | *Pleurolobus gangeticus* (L.) J.St.-Hil. ex H.Ohashi & K.Ohashi (L.) DC. | Fabaceae | Salpan | Dicot | Shrub |

| Sl. No. | Scientific name | Family name | Bengali name | Cotyledon | Habit |
|---|---|---|---|---|---|
| 61 | *Sesbania cannabina* (Retz.) Poir. | Fabaceae | Dhonchi | Dicot | Shrub |
| 62 | *Spatholobus parviflorus* (Roxb.) Kuntze | Fabaceae | Palashi lata | Dicot | Climber |
| 63 | *Hypericum japonicum* Thunb. | Hypericaceae | Basanta | Dicot | Herb |
| 64 | *Anisomeles indica* (L.) Kuntze | Lamiaceae | Gobura | Dicot | Herb |
| 65 | *Clerodendrum infortunatum* L. | Lamiaceae | Bhat | Dicot | Herb |
| 66 | *Hyptis capitata* Jacq. | Lamiaceae | Tata tokma | Dicot | Herb |
| 67 | *Ocimum basilicum* L. | Lamiaceae | Bantulsi | Dicot | Herb |
| 68 | *Volkameria inermis* L. | Lamiaceae | Shita vat | Dicot | Shrub |
| 69 | *Barringtonia acutangula* (L.) Gaertn. | Lecythidaceae | Hejol | Dicot | Tree |
| 70 | *Lindernia crustacea* (L.) F. Muell. | Linderniaceae | Chapra ghas | Dicot | Herb |
| 71 | *Punica granatum* L. | Lythraceae | Dalim | Dicot | Shrub |
| 72 | *Abutilon indicum* (L.) Sweet | Malvaceae | Petari | Dicot | Shrub |
| 73 | *Hibiscus schizopetalus* (Dyer) Hook. f. | Malvaceae | Jhumko jaba | Dicot | Shrub |
| 74 | *H. vitifolius* L. | Malvaceae | Bankarpas | Dicot | Shrub |
| 75 | *Melochia corchorifolia* L. | Malvaceae | Tiki-okra | Dicot | Shrub |
| 76 | *Pentapetes phoenicea* L. | Malvaceae | Bandhuli phul | Dicot | Shrub |
| 77 | *Sida acuta* Burm. f. | Malvaceae | Kureta | Dicot | Herb |
| 78 | *S. cordata* (Burm. f.) Borss. Waalk. | Malvaceae | Pitberela | Dicot | Herb |
| 79 | *Melastoma malabathricum* L. | Melastomataceae | Ban tejpata | Dicot | Shrub |
| 80 | *Melia azedarach* L. | Meliaceae | Goranim | Dicot | Tree |
| 81 | *Stephania glabra* (Roxb.) Miers | Menispermaceae | Thandamanik | Dicot | Climber |
| 82 | *S. japonica* (Thunb.) Miers | Menispermaceae | Akandi manik | Dicot | Climber |
| 83 | *Tiliacora racemosa* Colebr. | Menispermaceae | Baghlata | Dicot | Climber |
| 84 | *Tinospora crispa* (L.) Hook. f. & Thomson | Menispermaceae | Gulancha | Dicot | Climber |
| 85 | *Ficus hispida* L. f. | Moraceae | Kakdumur | Dicot | Tree |
| 86 | *Streblus asper* Lour. | Moraceae | Sheora | Dicot | Tree |
| 87 | *Moringa oleifera* Lam. | Moringaceae | Sajna | Dicot | Tree |
| 88 | *Boerhavia diffusa* L. | Nyctaginaceae | Purnarnava | Dicot | Herb |
| 89 | *Phyllanthus reticulatus* Poir. | Phyllanthaceae | Chitki | Dicot | Shrub |
| 90 | *Scoparia dulcis* L. | Plantaginaceae | Bondhone | Dicot | Herb |
| 91 | *Axonopus compressus* (Sw.) P. Beauv. | Poaceae | Carpet ghas | Monocot | Herb |
| 92 | *Chrysopogon aciculatus* (Retz.) Trin. | Poaceae | Prem kanta | Monocot | Herb |
| 93 | *Cynodon dactylon* (L.) Pers. | Poaceae | Durba ghas | Monocot | Herb |
| 94 | *Digitaria sanguinalis* (L.) Scop. | Poaceae | Mukurjoli | Monocot | Herb |
| 95 | *Eragrostis unioloides* (Retz.) Nees | Poaceae | Koni ghas | Monocot | Herb |
| 96 | *Oplismenus burmanni* (Retz.) P. Beauv. | Poaceae | Jabri durba | Monocot | Herb |
| 97 | *Paspalum conjugatum* P.J. Bergius | Poaceae | Moisshya ghas | Monocot | Herb |
| 98 | *Persicaria barbata* (L.) H.Hara | Polygonaceae | Biskatali | Dicot | Herb |
| 99 | *Portulaca oleracea* L. | Portulacaceae | Boronunia | Dicot | Herb |
| 100 | *Ceratopteris thalictroides* (L.) Brongn. | Pteridaceae | Pani lettuce | Pteridophyta | Herb |
| 101 | *Pteris vittata* L. | Pteridaceae | Imodi pteris | Pteridophyta | Herb |
| 102 | *Zizyphus oenoplia* (L.) Mill. | Rhamnaceae | Bonboroi | Dicot | Shrub |
| 103 | *Gardenia coronaria* Buch.-Ham. | Rubiaceae | Koinur | Dicot | Tree |
| 104 | *Hedyotis scandens* Roxb. | Rubiaceae | Unknown | Dicot | Climber |

| Sl. No. | Scientific name | Family name | Bengali name | Cotyledon | Habit |
|---|---|---|---|---|---|
| 105 | *Flacourtia indica* (Burm. f.) Merr. | Salicaceae | Bauchi | Dicot | Shrub |
| 106 | *Nicotiana plumbaginifolia* Viv. | Solanaceae | Ban tamak | Dicot | Herb |
| 107 | *Physalis angulata* L. | Solanaceae | Futka | Dicot | Herb |
| 108 | *Solanum torvum* Sw. | Solanaceae | Gota begun | Dicot | Shrub |
| 109 | *Pouzolzia zeylanica* (L.) Benn. & R. Br. | Urticaceae | Kullaruki | Dicot | Herb |
| 110 | *Lantana camara* L. | Verbenaceae | Kutus kanta | Dicot | Shrub |
| 111 | *Phyla nodiflora* (L.) Greene | Verbenaceae | Vuiokra | Dicot | Herb |
| 112 | *Ampelocissus latifolia* (Roxb.) Planch. | Vitaceae | Angur lata | Dicot | Herb |
| 113 | *Cissus adnata* Roxb. | Vitaceae | Bhatia lata | Dicot | Herb |
| 114 | *Leea asiatica* (L.) Ridsdale | Vitaceae | Banchalita | Dicot | Shrub |
| 115 | *Tetrastigma angustifolium* Planch. | Vitaceae | Nekungriubi | Dicot | Herb |
| 116 | *Hedychium coronarium* J. Koenig | Zingiberaceae | Dolon chapa | Dicot | Herb |
| 117 | *Zingiber officinale* Roscoe | Zingiberaceae | Ada | Dicot | Herb |

**Table 2. A comprehensive checklist of vascular plant species recorded from *Pennisetum purpureum* cultivated roadside habitats during 2023-2024.**

| Sl. No. | Scientific name | Family name | Bengali name | Cotyledon | Habit |
|---|---|---|---|---|---|
| 1 | *Achyranthes aspera* L. | Amaranthaceae | Apang | Dicot | Herb |
| 2 | *Alternanthera paronychioides* A. St.-Hil. | Amaranthaceae | Jhuli kata | Dicot | Herb |
| 3 | *A. sessilis* (L.) R. Br. ex DC. | Amaranthaceae | Malancha | Dicot | Herb |
| 4 | *Amaranthus graecizans* L. | Amaranthaceae | Unknown | Dicot | Herb |
| 5 | *A. viridis* L. | Amaranthaceae | Notey Shak | Dicot | Herb |
| 6 | *Colocasia esculenta* (L.) Schott. | Araceae | Jangli Kachu | Monocot | Herb |
| 7 | *Ageratum conyzoides* (L.) L. | Asteraceae | Fulkuri | Dicot | Herb |
| 8 | *Chromolaena odorata* (L.) R.M. King & H. Rob. | Asteraceae | Bon motmotia | Dicot | Herb |
| 9 | *Cyanthillium cinereum* (L.) H. Rob. | Asteraceae | Shialmutra | Dicot | Herb |
| 10 | *Mikania cordata* (Burm.f.) B.L. Rob. | Asteraceae | Assam lata | Dicot | Climber |
| 11 | *Pseudelephantopus spicatus* (B. Juss. ex Aubl.) C.F. Baker | Asteraceae | Unknown | Dicot | Herb |
| 12 | *Synedrella nodiflora* (L.) Gaertn. | Asteraceae | Nak phul | Dicot | Herb |
| 13 | *Tridax procumbens* (L.) L. | Asteraceae | Tridhara | Dicot | Herb |
| 14 | *Cleome rutidosperma* DC. | Cleomaceae | Nil hurhurey | Dicot | Herb |
| 15 | *Merremia hirta* (L.) Merr. | Convolvulaceae | Holud ful | Dicot | Climber |
| 16 | *Coccinia grandis* (L.) Voigt | Cucurbitaceae | Telakucha | Dicot | Climber |
| 17 | *Dioscorea pentaphylla* L. | Dioscoreaceae | Jhum alu | Monocot | Climber |
| 18 | *Crotalaria pallida* Aiton | Fabaceae | Jhunjuni | Dicot | Herb |
| 19 | *Leucaena leucocephala* (Lam.) de Wit | Fabaceae | Ipil-Ipil | Dicot | Tree |
| 20 | *Pleurolobus gangeticus* (L.) J.St.-Hil. ex H.Ohashi & K.Ohashi (L.) DC. | Fabaceae | Salpan | Dicot | Shrub |
| 21 | *Senna alata* (L.) Roxb. | Fabaceae | Dadmardan | Dicot | Shrub |
| 22 | *Clerondendrum infortunatum* L. | Lamiaceae | Bhat | Dicot | Shrub |
| 23 | *Barringtonia acutangula* (L.) Gaertn. | Lecythidaceae | Hejal | Dicot | Tree |
| 24 | *Sida acuta* Burm. f. | Malvaceae | Kureta | Dicot | Herb |
| 25 | *Urena lobata* L. | Malvaceae | Atlera | Dicot | Shrub |
| 26 | *Stephania japonica* (Thunb.) Miers | Menispermaceae | Akandi manik | Dicot | Climber |
| 27 | *Tiliacora racemosa* Colebr. | Menispermaceae | Baghlata | Dicot | Climber |

| Sl. No. | Scientific name | Family name | Bengali name | Cotyledon | Habit |
|---|---|---|---|---|---|
| 28 | *Ficus hispida* L. f. | Moraceae | Kakdumur | Dicot | Tree |
| 29 | *Phyllanthus reticulatus* Poir. | Phyllanthaceae | Chitki | Dicot | Shrub |
| 30 | *Cynodon dactylon* (L.) Pers. | Poaceae | Durba ghas | Monocot | Herb |
| 31 | *Dactyloctenium aegyptium* (L.) Willd. | Poaceae | Kakpaya | Monocot | Herb |
| 32 | *Eleusine indica* (L.) Gaertn. | Poaceae | Malankuri | Monocot | Herb |
| 33 | *Sporobolus diandrus* (Retz.) P. Beauv. | Poaceae | Benajoni | Monocot | Herb |
| 34 | *Ceratopteris thalictroides* (L.) Brongn. | Pteridaceae | Pani lettuce | Pteridophyta | Herb |
| 35 | *Pteris vittata* L. | Pteridaceae | Imodi pteris | Pteridophyta | Herb |
| 36 | *Hedyotis scandens* Roxb. | Rubiaceae | Unknown | Dicot | Climber |
| 37 | *Spermacoce articularis* L. f. | Rubiaceae | Bahos | Dicot | Herb |
| 38 | *Ampelocissus latifolia* (Roxb.) Planch. | Vitaceae | Angur lata | Dicot | Herb |

The present study also revealed that, the Shanno-Weiner diversity indices and the Jackknife species richness values were varied in both the selected habitats. In *Pennisetum* cultivated roadsides, maximum Shannon-Weiner diversity index 2.02 was found in site B and site D and minimum 1.99 was found in site E. In natural roadsides, maximum Shannon-Weiner diversity index 2.70 was found in site D and minimum 2.43 was found in site C, (Table 3). Remarkably, this study indicated that the values of Shannon-Weiner diversity indices of *Pennisetum* cultivated roadsides were distinctly smaller than indices values recorded from natural roadsides.

**Table 3. Shannon-Weiner diversity index and Jackknife species richness of selected sites and sub-sites of the *Pennisetum purpureum* cultivated roadsides and natural roadsides.**

| Site | Sub-site | *Pennisetum* cultivation | | Natural habitat | |
|---|---|---|---|---|---|
| | | Shannon-Weiner Diversity Index | Jackknife Species Richness | Shannon-Weiner Diversity Index | Jackknife Species Richness |
| **A** | SS-1 | 1.97 | 29.65 | 2.61 | 107.43 |
| | SS-2 | 2.04 | 34.53 | 2.54 | 98.38 |
| | SS-3 | 1.99 | 30.72 | 2.44 | 112.31 |
| | Mean | 2.0±0.03 | 31.64±2.56 | 2.53±0.08 | 106.04±7.06 |
| **B** | SS-1 | 2.08 | 32.59 | 2.59 | 111.47 |
| | SS-2 | 2.01 | 34.53 | 2.71 | 114.34 |
| | SS-3 | 1.97 | 34.47 | 2.27 | 108.43 |
| | Mean | 2.02±0.05 | 33.86±1.10 | 2.52±0.22 | 111.43±2.95 |
| **C** | SS-1 | 1.96 | 31.53 | 2.47 | 106.53 |
| | SS-2 | 2.07 | 28.65 | 2.44 | 109.47 |
| | SS-3 | 2.01 | 34.47 | 2.39 | 102.43 |
| | Mean | 2.01±0.05 | 31.55±2.91 | 2.43±0.04 | 106.14±3.53 |
| **D** | SS-1 | 2.06 | 31.59 | 2.77 | 109.34 |
| | SS-2 | 2.01 | 33.53 | 2.63 | 111.31 |
| | SS-3 | 1.99 | 34.53 | 2.71 | 107.34 |
| | Mean | 2.02±0.03 | 33.21±1.49 | 2.70±0.07 | 109.33±1.98 |
| **E** | SS-1 | 2.07 | 27.72 | 2.58 | 98.47 |
| | SS-2 | 1.97 | 29.65 | 2.43 | 107.53 |
| | SS-3 | 1.98 | 31.59 | 2.67 | 109.38 |
| | Mean | 1.99±0.05 | 29.65±1.93 | 2.56±0.12 | 105.12±5.83 |
| **Average of sites (A+B+C+D+E)** | | 2.01 | 31.98 | 2.54 | 107.62 |

On the other part, in *Pennisetum* cultivated roadsides, maximum Jackknife species richness 33.86 was found in site B and minimum 29.65 was found in site E. In natural roadsides, maximum Jackknife species richness 111.43 was found in site B and minimum 105.12 was found in site E, (Table 3). In *Pennisetum* cultivated roadsides, average Jackknife species richness was 31.98 and 107.62 was found in natural roadsides. Remarkably, this study indicated that the values of Jackknife species richness of *Pennisetum* cultivated roadsides were distinctly smaller than richness values recorded from natural roadsides.

The number of undergrowth plant taxa as well as the phytodiversity index was found to be the highest in natural roadsides which was followed by *Pennisetum* cultivated roadsides (Fig.1 and Table 3). The findings that natural roadsides harboring the maximum species diversity index are comparatively stable ecosystems compared to any other cultivated ecosystems are congruence with Narayan *et al*. (1994) because they stated that higher values of diversity index showed greater stability of any ecosystem. So, it is also evident through the present study that the ecosystem of natural roadsides is more sustainable than ecosystem of *Pennisetum* cultivated roadsides.

Present findings conclude that *Pennisetum purpureum* cultivation in the natural roadsides affected the association of natural wild species and hampered local ecosystem composition. On the other hand, this fast-growing grass has the potentiality to reduce the growth of local wild species because, it can regenerate rapidly by suppressing the propagules of any wild species. As it is rhizomatous with vigorous root system, it can reach up to 4-7 m in height (Heuze *et al*. 2020) which can reduce the availability of water for local natural plant species. Therefore, it has been suggested that this fast-growing Napier grass should be avoided from cultivation in natural roadsides for future eco-friendly management and restoration of wild vegetation in roadside ecosystems.

## References

Ahmed ZU, Begum ZNT, Hassan MA, Khondker MM, Kabir SMH, Ahmad M, Ahmed ATA, Rahman AKA and Haque EU (eds.) 2008-2009. Encyclopedia of Flora and Fauna of Bangladesh. 6-10. Angiosperms. Dicotyledons. Asiatic Society of Bangladesh, Dhaka.

Alexiades MN 1996. Selected Guidelines for Ethno Botanical Research: A Field Manual. The New York Botanical Garden, New York. pp. 99-133.

Anderson WF, Dien BS, Brandon SK and Peterson JD 2008. Assessment of Bermuda grass and bunch grasses as feed stocks for conversion to ethanol. Appl. Biochem. Biotech.**145**: 13-21.

Braun-Blanquet J 1932. Plant Sociology: The Study of Plant Communities. McGreaw-Hill Book Co. Inc. New York.

Collier MH, Vankat JL and Hughes MR 2002. Diminished plant richness and abundance below *Lonicera maackii*, an invasive shrub. American Midland Naturalist. **147**: 60-71.

FAO (Food and Agricultural Organization) 2020. State of the World's Forest 2020. Food and Agriculture Organization (FAO). Rome, Italy. United Nations.

Hanna WW, Chaparro CJ, Mathews BW, Burns JC, Sollenberger LE and Carpenter JR 2004. Perennial pennisetums. In: Moser LE, Burson BL and Sollenberger LE, (eds.), Warm-season ($C_4$) Grasses. American Society of Agronomy: Monograph Series. **34**: 503-535.

Hyland BPM 1972. A technique for collecting botanical specimens in rain forest. Flora Malesiana Bulletin. **26**: 2038-2040.

Heuzé V, Tran G, Giger-Reverdin S and Lebas F 2020. Elephant grass (*Pennisetum purpureum*). Feedipedia, a programme by INRAE, CIRAD, AFZ and FAO.

Heywood VH and Brunel S 2009. Code of Conduct on Horticulture and Invasive Alien Plants. Netherlands: The Hauge.

Hooker JD 1872-1897. The Flora of British India. Vol. I-VII. Second edn. Periodical Expert Book Agency, Delhi, India. pp. 5568.

Jain SK and Raw RR 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrows Printers and Publishers. pp.157.

Kent M and Coker P 1992. Vegetation Description and Analysis: A practical approach. The CRC Press, Inc. Belhaven Press, London. 363 pp.

Narayan D, Agarwal M, Pandey J and Singh J 1994. Changes in vegetation characters downward of an aluminium factory in India. Ann. Bot. **73**: 557-565.

Nishat A, Huq SMI, Barua SP, Reza AHMA and Khan ASM 2002. Bio-ecological Zones of Bangladesh. World Conservation Union, Dhaka, Bangladesh. 141 pp.

Noss R 1990. Indicators for monitoring biodiversity: a hierarchical approach. Conservation Biol. **4**: 355-364.

Raunkiaer C 1934. The Life Form of Plant and Statistical Plant Geography. Claresdon Press, Oxford.

Richardson DM, Pyšek P, Rejmánek M, Barbour MG, Dane Panetta F and West CJ 2000. Naturalization and invasion of alien plants: Concepts and definitions. diversity distributions **6**(2): 93-107.

Prain D 1903. Bengal Plants. Vols. 1 and 2 (Ind. Repr. 1963). Botanical Survey of India, Calcutta. pp. 1-1319.

SiB Colombia 2020. Catalogo de la Biodiversidad de Colombia, Sistema de informacion sobre Biodidersidad de Colombia. Recuperado de: https://catalogo.biodiversidad.com/file.

Siddiqui KU, Islam MA, Ahmed ZU, Begum ZNT, Hassan MA, Khondker MAM, Rahman MM, Kabir SMH, Ahmad M, Ahmed ATA, Rahman AKA and Haque EU (eds.) 2007. Encyclopedia of Flora and Fauna of Bangladesh. 11. Angiosperms; Monocotyledons. Asiatic Society of Bangladesh, Dhaka.

Uddin MZ and Hassan MA 2004. Flora of Rema-Kalenga Wildlife Sanctuary. IUCN Bangladesh Country Office, Dhaka, Bangladesh. 122 pp.

Vitousek PM, Antonio CMD, Loope LL, Rejmanek M and Westbrooks R 1997. Introduced species: a significant component of human-caused global change. New Zealand Journal of Ecology. **21**: 1-16.

Zakharenka A 2021. Importance of Roadside Tree Planting in Bangladesh. Natural Resource Management Specialist, World Bank.

*(Manuscript received on 30 September, 2024; revised on 21 December, 2024)*