A SURVEY OF WEEDS ALONG A TRIBUTARY OF THE CHICO RIVER SYSTEM IN SUYO, ILOCOS SUR, NORTHERN LUZON, PHILIPPINES

Karen A. Ballada and Inocencio E. Buot Jr.

Received: 23.06.2023 / Accepted: 14.11.2023

Abstract: Weed species composition and dominance along river systems are important pieces of information for monitoring river ecosystem health and the development of a sound ecosystem management plan. This study surveyed the species composition and dominance of weeds along a major tributary of the Chico River System in Suyo, Ilocos Sur. A total of 78 morphospecies belonging to about 65 genera in 26 families were documented. The dominant species recorded were *Calopogonium caeruleum* (Benth.) C. Wright (Fabaceae) and *Chromolaena odorata* (L.) R.M. King & H. Rob (Asteraceae) with 8.398 and 6.417 summed dominance ratios, respectively. This is followed to a lesser degree by *Homonoia riparia* Lour. (Euphorbiaceae), *Saccharum spontaneum* (Poaceae), *Commelina diffusa* Burm.f. (Commelinaceae), *Alternanthera sessilis* (L.) DC. (*Amaranthaceae*), *Kirganelia reticulata* (Poir.) Baill. (*Phyllanthaceae*), *Paspalum conjugatum* P.J.Bergius (Poaceae), and *Tithonia diversifolia* (Hemsl.) A.Gray (Asteraceae). These plants were mostly identified as common weeds in the Philippines. In Suyo, Ilocos Sur, the observed dominance of these weed species is largely due to their fast growth rate, high fecundity, and their seeds being easily dispersed by wind and water. Similarly, growth and proliferation of weeds are also controlled physically by the substrate type and the fluctuating level of the river water during rainy and dry seasons. It is suggested that the frequency and cover of these weeds be monitored regularly. Also, field monitoring will allow close surveillance of emergence of new weed species which may lead to possible outbreaks and infestations in the agricultural villages along the Chico River system.

Keywords: common weeds, cover, dominant species, frequency

Introduction:

Weeds are “out of place” plants. They are frequently the pioneering species well-adapted to dominate in open and disturbed areas. Most weed species are not usable by humans but their value to the environment is significant. They improve the soil quality by providing excellent initial cover that prevents soil erosion and by helping cycle soil

Karen A. Ballada:
Department of Biology
College of Arts and Science
Don Mariano Marcos Memorial State University
Bacnotan, La Union
and Institute of Biological Sciences
University of the Philippines
Los Baños, Laguna
Philippines

Inocencio E. Buot Jr.:
Institute of Biological Sciences
College of Arts and Sciences
University of the Philippines
Los Baños, Laguna
Philippines

Corresponding author email:
kaballada@up.edu.ph

nutrients (Araujo-Junior et al. 2015). Some weeds are even consumed as vegetables, while others have medicinal values. Unfortunately, uncontrolled weeds can reduce crop yield, by affecting the quantity and quality of harvests by way of competition for sunlight, space, nutrients, water that are needed for the growth and development of cultivated plants (Donayre et al. 2019). Moreover, some weeds have become invasive in certain regions and have caused severe negative impacts on agriculture and biodiversity, as well as human health (van Wilgen et al. 2022). To prevent or avoid such effects, understanding the current state, monitoring and proper management of weeds in a given area must be developed based on scientific data.

Studies have been undertaken to document the composition of riparian vegetation in several rivers in the Philippines. Such studies aimed to understand important ecological relationships such as floral diversity and soil quality (Almadin et al. 2020), assess the potentials of riparian plants as phytoremediators (Napaldet and Buot 2017, 2019), and assess biodiversity status (Malabrigo et al. 2014; Balangen et al. 2021). Unfortunately, relatively few studies have been done to document the weed composition of the littoral zones of the Chico River system in Northern Luzon. To date, no studies have been conducted on the littoral and riparian vegetation in Suyo, Ilocos Sur. This paper aimed to survey the composition and dominance of weeds along a tributary of the Chico River System meandering down the Municipality of Suyo, Province of Ilocos Sur. Specifically, it aimed to document and identify the weed species thriving in the area, determine which species are dominant, explain their distribution and prevalence in relation to the physical conditions of the area and weed management practices of the locals. Results of this study provide the base line data on the kinds of weeds existing and dominating the littoral zone of this portion of the river. Data on cover, frequency and dominance of the weed species will provide insights on the possible invasiveness of weeds. Knowledge on the species composition of weeds along the littoral and riparian zones are pivotal in understanding the dynamics of weed dispersal along rivers. Moreover, information from this study can be used as reference in developing weed management strategies or monitoring activities appropriate to the location or area.

Materials and methods:

The municipality of Suyo, Ilocos Sur is situated in the northwestern portion of the Luzon Island (16°59′36″N 120°33′44″E), about 336 km from Manila. The study site is along a tributary of the Chico River System that flows towards the northwestern coast of Luzon, passing through Suyo, Ilocos Sur. This tributary connects to the Amburayan River and drains into the South China Sea at the boundary of the nearby towns of Tagudin, Ilocos Sur and Sudipen, La Union. Its continuous flow irrigates the fertile flatlands of Suyo, Tagudin and Sta. Cruz in Ilocos Sur (Fig. 1).

The tributaries of the river system are very important to the locals. Barangays surrounding the river primarily depend on rice and crop production as their source of income and most of the lands are irrigated by the river. The river also provides fish, crayfish and edible mollusks as food, and the panoramic views and clear waters have been attracting visitors and local tourists.

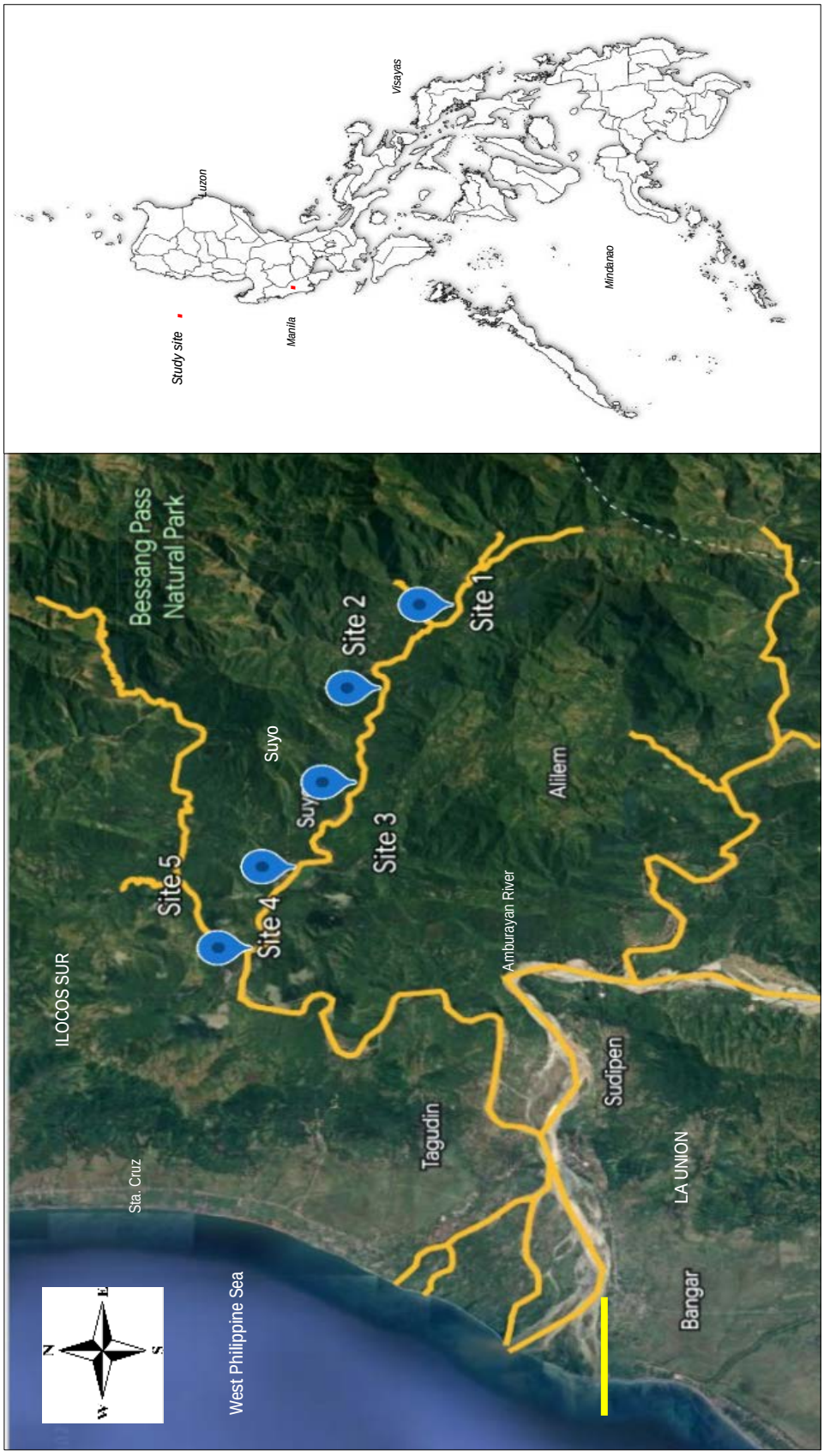

Figure no. 1 Location of the study site in Northern Luzon (right) and the location of the sampling stations along the tributary in Suyo, Ilocos Sur (left) as plotted in Google Earth™. Scale bar: 5 km

Survey Method

Five (5) sampling stations approximately 3.5 to 4.0 km apart were established along the tributary. The distances of the sampling stations and the river width were measured using the Google Earth Application and were recorded (Tab. 1 and Fig. 1). In each station, the littoral zone of the opposing river banks with diverse weeds were sampled using Line Intercept Method with slight modification. Line Intercept Method is useful in estimating the cover of plant species by adding the intercept distances of each species and expressing this total as a proportion of transect length. Transect lines of 30 m in length were laid on opposite river banks of each sampling station, perpendicular to the direction of waterflow. A total of 10 transect lines were laid in the data gathering of this study.

Table no. 1 Location, distances and river width measurements of the 5 sampling stations in the study site

Location (Sitio/Barangay)	River width	Terrain and kind of substrate
Station 1 (Dadtuco, Man-atong)	23 m	Very steep slopes, thin soil layer on rocks
Station 2 (Coscosnong, Man-atong)	30 m	Steep slopes, sandy soil
Station 3 (Kiblungan, Uso)	36 m	Steep slopes, sandy soil
Station 4 (Suyo Proper)	67 m	Flood plain, sandy soil
Station 5 (Urzadan)	124 m	Wider flood plain, sandy soil

Plants intercepted by the transect lines were documented, recorded, taxonomically identified and verified using published references (Caton et al. 2004; Donayre et al. 2018) and on-line databases (Pelser et al. 2011 onwards; POWO 2023). Frequency and cover were used as the main indicators determining the total dominance of each plant. The Dominance or Cover (C), Relative Cover (RC), Frequency (F), Relative Frequency (RF), and Summed Dominance Ratio (SDR) were computed using the following formula:

Dominance or Cover (C)

$$C = \frac{TCA}{TT} x\ 100$$

where:
TCA = total intercept length of species A
TT = total transect length

Relative Cover (RC)

$$RC = \frac{TCA}{TC} x\ 100$$

where:
TCA = total intercept length of species A
TC = total of intercept lengths for all species

Frequency (F)

$$F = \frac{J}{K} x\ 100$$

where:
J = number of intervals in which a species occurs
K = total number of transect intervals

Relative Frequency (RF)

$$RF = \frac{F}{TF} x\ 100$$

F = frequency value for a species
TF= total frequency values for all species

Summed Dominance Ratio (SDR)

$$SDR = \frac{RC + RF}{2}$$

where:
RC = relative coverage
RF = relative frequency

Results and discussion:

Species richness and dominance of weeds

A total of 78 morpho-species belonging to about 65 genera and 26 families was documented in the five (5) sampling stations along the river banks of the Chico River System tributary in Suyo, Ilocos Sur. These weeds grow on exposed sandy soils or thin layer of soils on top of boulders. The location, river width, terrain and substrate type, as well as photos of the sampling sites are shown in Table 1 and Figure 2 (Annexes). Sandy soil is the common substratum observed in the sampling stations, and the river width ranges from 23 to 124 m.

The seventy-eight (78) documented morpho-species of weeds consisted of one (1) fern, twenty-three (23) monocots (mostly grasses) and fifty-four (54 species) dicots. Most of the species are herbaceous (49), twenty (20) are shrubs, and eleven (11) are tree saplings. Much of the herbaceous and shrub species are considered weeds and some are listed as invasive species. The list of the documented weeds in the study area is conveyed in Table 2 (Annexes).

The composition of weeds is typical of lowland vegetation in the Philippines, with few species common in the cooler, mountainous regions of higher elevations in the head waters of the river. Most likely, *Tithonia diversifolia* was transported downstream by water flow or wind. Also, the species richness in this study is lower as compared to other published riparian vegetation studies (Malabrigo et al. 2014; Balangen et al. 2021; Napaldet and Buot 2017, 2019). In this study, only the littoral zones where weeds are abundant were sampled.

Many of the documented species were most likely transported and deposited by the flowing water from the upstream. This is indicated by the presence of saplings of tree species among the herbaceous and shrubby weeds even without a nearby mother plant. Also, similar species occur across the five sampling stations. Throughout the years, the river has been displaying fluctuating water levels. It can suddenly rise by as much as 3 m during the rainy seasons, flooding the littoral zones and low-lying farms. The water level quickly subsides and recedes during the summer months.

In addition, most of the recorded weeds are herbaceous and fast-growing shrubs. These plants generally reach their reproductive stage in relatively few months. It seems this is an effective adaptation to the seasonal fluctuations in the water level of the river, wherein plants alongside the riverbanks were uprooted and washed during the rainy season. Hence, these plants need to complete their vegetative and reproductive cycles before the rainy seasons.

The dominant species in the study area, in decreasing values, are *Calopogonium caeruleum* (Benth.) C. Wright (Fabaceae), *Chromolaena odorata* (L.) R.M. King & H. Rob (Asteraceae), *Homonoia riparia* Lour. (Euphorbiaceae), *Saccharum spontaneum* L. (Poaceae), *Commelina diffusa* Burm.f. (Commelinaceae), *Alternanthera sessilis* (L.) DC. (Amaranthaceae), *Kirganelia reticulata* (Poir.) Baill. (Phyllantaceae), *Paspalum conjugatum* P.J.Bergius (Poaceae), and *Tithonia diversifolia* (Hemsl.) A.Gray (Asteraceae). These species are widely distributed in the Philippines and in other tropical and subtropical countries (POWO 2023).

Calopogonium caeruleum is a tropical creeping climbing highly-branching perennial vine species (Fig. 3, Annexes). It is an introduced species that flower profusely. The slightly pubescent leaves of *C. caerulem* are alternate, trifoliate with the center leaflet rhomboid in shape and oblique lateral leaflets. The leaves are also dorsiventral and have entire to partly undulate margins. The inflorescence is an elongated terminal raceme, with campanulate and 5-lobed calyx and bluish violet (ca. 1 cm) corolla. The fruit pods are linear, flattened, straight, dehiscent, and contain up to 7 seeds. The seeds are flattened, greenish yellow to yellowish brown, shiny, ca. 5 mm long. Mature seeds of this plant can were observed to be released as

early as January and continues to flower up to the month of June.

The high SDR of *C. caeruleum* can be attributed to its sprawling nature, prolonged and prolific reproduction through seeds, and lesser susceptibility to insect attack (Tan et al. 1976). It is a good pioneer species that prevents soil erosion and improve soil fertility (Cook et al. 2005), hence used as crop cover in other countries. Its flattened seeds were observed to be easily carried by flowing water, which may explain its occurrence in most of the sampling sites.

The second dominant species is the *Chromolaena odorata*, locally called "bulasting" (Fig. 4, Annexes). Including *Tithonia diversifolia*, these Asteraceae are among the widely known invasive species and have been considered destructive in farm lands in Africa, India, and China by competing with crops and native species for space and nutrients (CABI 2016). *Chromolaena odorata* is shrub with long but not twining branches that grows up to 2 m tall in open and disturbed areas. Its leaves are opposite, membranous, triangular to cordate in shape, and have broadly toothed margins. The young leaves exhibit purple tints, while the flowers are arranged in heads or capitula (ca. 7 mm in length) arranged as sub-corymb in axillary and terminal clusters. The florets are all disc-florets of dull off-white color.

Like *C. caeruleum*, *C. odorata* also enjoys high cover and frequency in this study. This plant is widely distributed in the Philippines probably because of its high reproductive capacity and adaptability to wide eurytopic and edaphic conditions (Codilla and Metillo 2011; personal communication, February 26, 2023). In the study area field observations revealed that *C. odorata* seems to benefit from both water and wind for its seed dispersal. The presence of pappus or hairs on its achene fruit aids to seed dispersal by wind. In addition, *C. odorata* has been used by locals as herbal plant to treat wounds, as reported in other parts of the country (Codilla and Metillo 2011).

Tithonia diversifolia is a less-dominant species with a SDR value of 2.44. It is common in cooler regions of the country. This shrub is an introduced species, usually 1-3 m tall, with alternate leaves that is lobed and pubescent underneath (Fig. 5, Annexes). Flower heads have bright yellow ray florets, one or several per branch, and born on swollen peduncle. Though this plant is reported as medicinal with bioactive compounds (Gutierrez et al. 2015; Ang et al. 2019; Ajao and Moteetee 2017), it is not commonly used by the locals in the study area.

In this study, *T. diversifolia* was only documented in 3 transect lines of stations 1 and 2. The temperatures in these stations are observed to be cooler due to partial shading in the terrain. Perhaps, the generally warmer microclimatic conditions in the other sites are not favorable for the species, limiting its distribution to only the cooler areas of the tributary.

Homonoia riparia, locally called "dumanay" (Fig. 6, Annexes), and *Saccharum spontaneum* (Fig. 7, Annexes) are other dominant species, which were observed to grow closest to the flowing water. *Homonoia riparia* is a highly-branching shrub, 1-2 m tall, that grows on wet soil of the riverbanks. Its stem is reddish-brownish with increasing pubescence towards apex. The leaves are narrow lanceolate in shape, have chartaceous texture, minutely and sparsely serrated leaf margins, the leaf base and apex are cuneate. The inflorescence is an axillary spike of up to 10 cm long. The male flowers are reddish, glabrous, with lanceolate sepals, while the female flowers are crowded and pubescent, and bear fruits of orbicular and pubescent capsules about 5 mm in diameter. Its deep root system provides superb anchorage which explains its occurrence in proximity to the flowing water. The seeds were also described to be highly resistant and can withstand transport in water. Broken stems of this plant are also capable of regrowing if established on a solid substrate.

According to the locals in the study area, the long and pliable stems of *H. riparia* were harvested before as raw material in basket making. Also, due its abundance in the river,

the highly branching stems are also being collected, bundled and strategically placed in the water to be used as cover or temporary home of wild fishes. In other countries, *H. riparia* is also reported to contain bioactive compounds and has medicinal properties (Yang et al. 2007; Patil et al. 2014; Kanniparambil et al. 2017) but the locals do not support such practice in the area.

Saccharum spontaneum is an erect perennial grass, locally called "talahib" or "ledda", that grows up to 3 m as observed in situ (Fig. 7, Annexes). It features thin, highly fibrous, tillering stems sometimes with creeping rhizomes, linear leaf blade up to 1 m long, and produces a single terminal panicle of fluffy white color per tiller. It was observed that the rhizomatous stem and extensive roots of this plant provide good anchorage against water current and prevents or reduces soil erosion (Mondal et al. 2021). Also, stems carried by flowing water when trapped in between stones can easily root and become established. Yet, clusters of this plant in the study area did not grow profusely due to seasonal rise of water level and increasing water current during rainy months. Mature stems of this weed are used as raw materials for mats (Balangcod and Balangcod 2018). It is also harvested by the locals in the study area as forage for their ruminants.

Commelina diffusa is an annual to perennial creeping herb (Fig. 8, Annexes). It occurs throughout the tropical and subtropics regions of the world (Holm et al. 1977). Its stems that can grow up to 1 m long, easily root at the nodes. The leaves are generally lanceolate in shape, acute to acuminate in apex, with few marginal hairs. The bracts that subtend the spathe (flower) are broad, rounded at the base and gradually tapers to the apex. The blue, small flowers are actinomorphic and the seeds are dark brown.

The observed dominance of *C. diffusa* in the study area could be attributed to its fast growth rate and the long and soft stems that can be fragmented and carried away by running river water during the rainy seasons. The stems were observed to root easily at the nodes. This plant has also been reported as being used to heal swelling, treat urinary tract infection and respiratory tract infections, diarrhea, enteritis, and hemorrhoids, as well as fever, malaria, insect, bug bites, rheumatoid arthritis, gonorrhea, influenza, and bladder infection, etc. (Prima et al. 2019). Again, this is not observed as a practice among the locals in the study area.

Alternanthera sessilis (Fig. 9, Annexes) is an annual or perennial herbaceous, fast-growing invasive weed in several countries (Gupta 2014). It is adapted to grow on a wide range of soil types in seasonally-waterlogged areas as well as dry areas (Holm et al. 1997). It exhibits strong tap roots and its stem is generally prostate, creeping, and often rooting at the nodes. Its leaves are simple, opposite, broadly lanceolate or spatulate with short petiole. The inflorescence are dense, sessile, silvery-white clusters of compressed spikes in the leaf axils. The fruits are small, flattened, and enclose dark-brown to black, disc-shaped glossy seeds.

The dominance of *A. sessilis* in the study area can be attributed to its fast growth, its ability to propagate vegetatively and by seeds. Recorded to be flowering all year, its numerous fruits are dispersed by both wind and water (Pancho 1986). Moreover, this weed is not usable by the locals in the study area.

Paspalum conjugatum, considered an invasive species, is a vigorous perennial grass that creeps and serves as an excellent cover, dominating open rocky substrate with thin soils (Fig. 10, Annexes). It tolerates high disturbance levels, can grow under partial shade, easily spread by stolons and seeds, and tolerant to wide edaphic conditions (CABI 2018). The leaf blades are lanceolate to linear, thin, not hairy, with acute apex. The slender inflorescence is terminal, digitate racemes, spikelets arranged in 2 rows (Rojas-Sandoval 2022).

In this study, this grass was documented only in 4/10 transect lines and its cover is lower compared to the other dominant species. Perhaps the sandy substratum common along the littoral zone and the seasonal rise in water level of the river during

rainy season limits the invasion of this grass. Rise in water level submerges most of the grass species and even easily washed them out as sand and soil are easily carried by the flowing water.

Kirganelia reticulata (Fig. 11, Annexes) is a widely distributed shrub in the Philippines, common in lowland and medium elevation thickets. It is highly-branching but rarely climbing or becoming tree-like. The stem is brown to gray with slender branches. The leaves are elliptic to ovate in shape of no more than 3 cm long, entire leaf margin, cuneate to rounded leaf base, obtuse apex, glabrous and shortly petiolate. Fruits are usually solitary in leaf axils, bluish black when ripe, and contain around 6 seeds. Its cover and frequency can be considered moderate to low. It is known for its medicinal potentials in various countries (Soni et al. 2013), but not in the study area.

Results of this study revealed 78 morpho-species of weeds documented in the area. This indicates that weeds are the dominant vegetation thriving on the littoral zones of the selected tributary of the Chico River System in Suyo, Ilocos Sur. The observed dominance of some weed species is largely due to the characteristic high fecundity of these weeds, and their seeds can easily be dispersed by wind and water. However, growth and proliferation of the weeds seem to be controlled physically by the substrate type and the fluctuating level of the river water during rainy and dry seasons. Thus, among the weeds, we suggest that the frequency and cover of these weeds be monitored regularly and possible management plan be prepared. This is to avoid possible losses when these eventually become invasive. Also, field monitoring will allow close scrutiny of emergence of new weed species. The flowing river water can pick and carry with it seeds or plant parts of other invasive species on its way down.

Weed management by the locals in the study area

The impact of weeds in the life of local farmers is less compared to the devastating effects of the golden apple snail invasion. It is observed that the locals in the study area manage weeds in their farms and rice fields mechanically by manual weeding. Prior to the planting season, weeds along the sides of the rice paddies are removed using shovels and bolos. Use of herbicides is rarely practised. However, weeding is not regularly observed in areas outside the homesteads, farms, and pathways of the locals. Seemingly, the locals in the study area are not affected by the existence of weeds, and quite have attuned their life harmoniously with the presence of weeds in their surroundings.

Conclusions:

There are 78 morpho-species of weeds documented in the littoral zones of the selected tributary of the Chico River in Suyo, Ilocos Sur. These species are commonly found in the lowland areas of the Philippines. The dominant species are *Calopogonium caeruleum*, *Chromolaena odorata*, *Homonoia riparia*, *Saccharum spontaneum*, *Commelina diffusa*, *Alternanthera sessilis*, *Kirganelia reticulata* and *Tithonia diversifolia*. Their dominance can be attributed to their highly adapted nature to disturbance, broad range of tolerance to environmental factors, fast-growth rate, high fecundity, and their seeds are easily dispersed by wind and water. Due to this, some of them are listed as invasive species. Moreover, the locals in the study are quite attuned to the existence of weeds in their farms and homesteads, and even use some of them to treat wounds, as raw materials, and fodder.

Rezumat:

UN STUDIU AL BURUIENILOR DE-A LUNGUL UNUI AFLUENT AL SISTEMULUI HIDROGRAFIC CHICO DIN SUYO, ILOCOS SUR, NORDUL LUZONULUI, FILIPINE

Compoziția și dominanța speciilor de buruieni de-a lungul sistemelor fluviale sunt informații importante pentru monitorizarea sănătății ecosistemelor fluviale și pentru dezvoltarea unui plan de gestionare a ecosistemului. Acest studiu a analizat compoziția și dominanța speciilor de buruieni de-a lungul unui afluent major al sistemului fluvial Chico din Suyo, Ilocos Sur. În total, au fost documentate 78 de morfospecii aparținând la aproximativ 65 de genuri din 26 de familii. Speciile dominante înregistrate au fost *Calopogonium caeruleum* (Benth.) C. Wright (Fabaceae) și *Chromolaena odorata* (L.) R.M. King & H. Rob (Asteraceae) cu 8,398 și, respectiv, 6,417 rapoarte de dominanță însumate. Acestea sunt urmate, într-o mai mică măsură, de *Homonoia riparia* Lour. (Euphorbiaceae), *Saccharum spontaneum* (Poaceae), *Commelina diffusa* Burm.f. (Commelinaceae), *Alternanthera sessilis* (L.) DC. (Amaranthaceae), *Kirganelia reticulata* (Poir.) Baill. (Phyllanthaceae), *Paspalum conjugatum* P.J.Bergius (Poaceae) și *Tithonia diversifolia* (Hemsl.) A.Gray (Asteraceae). Aceste plante au fost identificate în principal ca buruieni comune în Filipine. În Suyo, Ilocos Sur, dominanța observată a acestor specii de buruieni se datorează în mare parte ratei lor de creștere rapidă, fecundității ridicate și faptului că semințele lor sunt ușor de dispersat prin vânt și apă. În mod similar, creșterea și proliferarea buruienilor sunt, de asemenea, controlate fizic de tipul de substrat și de nivelul fluctuant al apei râului în timpul anotimpurilor ploioase și uscate. Se sugerează ca frecvența și acoperirea acestor buruieni să fie monitorizate în mod regulat. De asemenea, monitorizarea pe teren va permite o supraveghere atentă a apariției unor noi specii de buruieni care pot duce la posibile focare și infestări în satele agricole de-a lungul sistemului râului Chico.

References:

AJAO A., MOTEETEE A. (2017), *Tithonia diversifolia* (Hemsl) A.Gray. (Asteraceae: Heliantheae), an invasive plant of significant ethnopharmacological importance: A review, *South African Journal of Botany* 113: 396-403.

ALMADIN F.J.F., ABING B.R.L., ARBAS B.J.R., CULOB E.G. (2020), Relationship of Floral Community and Soil Quality in Selected Riparian Banks of Lower Agusan River Basin, Philippines, *Journal of Ecosystem Science and Eco-Governance* 2(1): 32-41.

ANG A.M.G., ENOT M.M., BALTAZAR G.J.D., ALINAPON C.V., BUNCALES E.O., BARBOSA G.B. (2019), Antioxidant and cytotoxic activity of the leaf ethanolic extracts of *Tithonia diversifolia* and *Gliricidia sepium* from Bukidnon, Philippines, *Asian Journal of Biological and Life Sciences* 8(1): 8-15.

ARAUJO-JUNIOR C.F., MARTINS B.H., HIGASHI V.Y., HAMANAKA C.A. (on line) (2015), The Role of Weed and Cover Crops in Soil and Water Conservation in a Tropical Region. In: *Weed Biology and Control*, Pilipavicius V. ed. InTech. DOI: 10.5772/59952.

BALANGCOD T.D., BALANGCOD K.D. (2018), Plants and Culture: Plant utilization among the local communities in Kabayan, Benguet Province, Philippines, *Indian Journal of Traditional Knowledge* 17(4): 609-622.

BALANGEN D.A., CATONES M.S., BAYENG J.M., NAPALDET J.T. (2021), Floral diversity of Intek River in Tuba, Benguet, Northern Philippines, *Journal of Wetlands Biodiversity* 11: 63-79.

CABI INTERNATIONAL (on line) (2016), *Tithonia diversifolia*: *Factsheets for farmers. Plantwise Plus Knowledge Bank*, https://doi.org/10.1079/pwkb.20167800565. Accessed from https://plantwiseplusknowledgebank.org/doi/epdf/10.1079/pwkb.20167800565.

CABI INTERNATIONAL (on line) (2018), *Paspalum conjugatum (buffalo grass) data sheet*, https://www.cabidigitallibrary.org/doi/10.1079/cabi compendium.38951

CATON B.P., MORTIMER M., HILL J.E. (2004), *A practical guide to weeds of rice in Asia*, International Rice Research Institute, Los Baños, Philippines, 116 p.

CODILLA L.T., METILLO E.B. (2011), Distribution and abundance of the invasive plant species *Chromolaena odorata* L. in the Zamboanga Peninsula, Philippines, *International Journal of*

Environmental Science and Development 2(5): 406-410.

COOK B.G., PENGELLY B.C., BROWN S.D., DONNELLY J.L., EAGLES D.A., FRANCO M.A., HANSON J., MULLEN B.F., PARTRIDGE I.J., PETERS M., SCHULTZE-KRAFT R. (on line) (2005), *Tropical forages: an interactive selection tool*. https://cgspace.cgiar.org/handle/10568/49072

DONAYRE D.K.M., MARTIN E.C., SANTIAGO S.E., LEE J.T. (2018), *Weeds in Irrigated and Rainfed Lowland Ricefields in the Philippines*, 2nd edition, Philippine Rice research Institute (PhilRice), Maligaya, Science City of Munoz, Nueva Ecija, Philippines.

DONAYRE D.K.M., SANTIAGO S.E., MARTIN E.C., CORALES R.G., LEE J.T., KUMAR V., JANIYA J.D. (2019), *Weeds of Vegetables and other Cash Crops in the Philippines*, Philippine Rice research Institute (PhilRice), Maligaya, Science City of Munoz, Nueva Ecija, Philippines.

GUPTA A.K. (2014), *Alternanthera sessilis*. In: *The IUCN Red List of Threatened Species* Version 2014. http://www.iucnredlist.org

GUTIERREZ R.M., BALLADA K., PATACSIL M. (2015), The antibacterial property of *Tithonia diversifolia* (Wild Sunflower) extract from Baguio-Benguet areas in the Philippines, in response to exposure to vehicular traffic, *Asian Journal of Microbiology, Biotechnology, and Environmental Sciences* 17(1): 43-52.

HOLM L.G., PLUCKNETT D.L., PANCHO J.V., HERBERGER J.P. (1977), *The world's worst weeds. Distribution and biology*, University Press of Hawaii, Hawaii, USA, 609 p.

HOLM L., DOLL J., HOLM E., PANCHO J.V., HERBERGER J.P. (1997), *World weeds: natural histories and distribution*, John Wiley & Sons, Hoboken, 129 p. + xv.

KANNIPARAMBIL X.S., HANEEFA S.M., ANAND D.R., MAHESHWARI R., SHREEDHARA C.S., SETTY M.M. (2017), Antioxidant and nephroprotective activities of the extract and fractions of *Homonoia riparia* Lour., *Pharmacognosy Magazine* 13(49): 25-30.

MALABRIGO JR P.L., UMALI A.G.A., ELEC J.P. (2014), Riparian Flora of Kaliwa River Watershed in the Sierra Madre Mountain Range, Philippines, *Ecosystems and Development Journal* 5(1): 11-22.

MONDAL A.K., PARUI S.M., TRIPATHI S. (2021), Checking Riverside Erosion Naturally, *Science Reporter*: 38-41.

NAPALDET J.T., BUOT JR I.E. (2017), Floral diversity assessment of Balili River as potential phytoremediators, *Journal of Wetlands Biodiversity* 7: 17-28.

NAPALDET J.T., BUOT JR I.E. (2019), Diversity of aquatic macrophytes in Balili River, La Trinidad, Benguet, Philippines as potential phytoremediators, *Biodiversitas. Journal of Biological Diversity* 20(4): 1048-1054.

PANCHO J.V. (1986), Weeds of vegetable farms in La Trinidad, Benguet, Philippines, *Weed control in tropical crops* 2: 1-8.

PATIL R.S., GODGHATE A.G., SAWANT R.S. (2014), Phytochemicals & antimicrobial activity of leaves of *Homonoia riparia* L., *International Journal of Pharma and Bio Sciences* 5(2): 352-356.

PELSER P.B., BARCELONA J.F., NICKRENT D.L. eds. (on line) (2011 onwards), Co's Digital Flora of the Philippines. www.philippineplants.org.

PLANTS OF THE WORLD ONLINE (POWO) (on line) (2023). http://www.plantsoftheworldonline.org/.

PRIMA A.A., AHMED R., FARUK A., ZAFROON Z., DASH P.R. (2019), Pharmacological importance of *Commelina diffusa* (Commelinaceae): A Review, *International Journal of Life Sciences and Review* 5(1): 1-05.

ROJAS-SANDOVAL J. (online) (2022), *Paspalum conjugatum* (buffalo grass), CABI Compendium, CABI International. https://doi.org/10.1079/cabicompendium.38951

SONI R.K., DIXIT V., CHANDRA A., IRCHHAIYA R., SINGH N., SINGH H. (2013), *Kirganelia reticulata* (Poir) Baill. A review on its botany, ethnobotany, phytochemistry and pharmacology, *Journal of Drug Delivery and Therapeutics* 3(6): 168-184.

TAN K.H., PUSHPARAJAH E., SHEPHERD R., TEOH C.H. (1976), *Calopogonium caeruleum*, a shade-tolerant leguminous cover for rubber, *Proc. Rubber Research Institute of Malaysia Planters Conf.*, Kuala Lumpur, p. 45-62.

VAN WILGEN B.W., ZENGEYA T.A., RICHARDSON D.M. (2022), A review of the

impacts of biological invasions in South Africa, *Biological Invasions* 24(1): 27-50.
YANG S.M., LIU X.K., QING C., WU D.G., ZHU D.Y. (2007), Chemical constituents from the roots of *Homonoia riparia*, *Acta pharmaceutica Sinica* 42(3): 292-296.

Annexes:

Figure no. 2 Photos of the five (5) sampling stations along the tributary

Site 1

Site 2

Site 3

Site 4

Site 5

Figure no. 3 Habit and inflorescence (a), flower (b), and fruit (c) of *Calopogonium caeruleum*

a.

b.

c.

Istros – Museum of Braila "Carol I"

Figure no. 4 Habit (a) and reproductive structures (b, c) of *Chromolaena odorata*


a.

b.

c.

Figure no. 5 Habit (a) and leaves (b) of *Tithonia diversifolia*


a.


b.

Figure no. 6 Habit (a), leaf morphology (b), female flowers (c), and male flowers (d) of *Homonoia riparia*

a.

b.


c.


d.

Figure no. 7 Habit of *Saccharum spontaneum* (a, b)

a.


b.

Figure no. 8 Habit of *Commelina diffusa* (a, b)

a.


b.

Figure no. 9 Habit of *Alternanthera sessilis*

Figure no. 10 Habit (a) and inflorescence (b) of *Paspalum conjugatum*

a.

b.

Figure no. 11 Habit (a) and fruit (b) of *Kirganelia reticulata*

a.

b.

Table no. 2 List, cover (C), relative cover (RC), frequency (F), relative frequency (RF), and summed dominance ratio (SDR) of the weed species along the river bank of a tributary of the Chico River System in Suyo, Ilocos Sur.

Family	Scientific Name	C	RC	F	RF	SDR
Acanthaceae	*Justicia* sp.	2.607	3.340	10	0.704	2.022
	Unidentified sp. 1	0.185	0.237	10	0.704	0.471
Amaranthaceae	**Alternanthera sessilis*	2.966	3.800	40	2.817	3.308
	Amaranthus spinosus	0.182	0.233	30	2.113	1.173
Apocynaceae	*Tabernaemontana pandacaqui*	1.503	1.926	30	2.113	2.019
Asteraceae	*Ageratum conyzoides*	0.113	0.145	20	1.408	0.777
	Conyza canadensis	0.133	0.171	10	0.704	0.438
	Crassocephalum crepidioides	0.263	0.337	10	0.704	0.521
	**Chromolaena odorata*	5.621	7.201	80	5.634	6.417
	Mikania cordata	0.951	1.218	30	2.113	1.665
	Sphagneticola trilobata	1.940	2.485	10	0.704	1.595
	Synedrella nodiflora	0.532	0.682	10	0.704	0.693
	**Tithonia diversifolia*	2.167	2.776	30	2.113	2.444
	Tridax sp.	0.133	0.171	10	0.704	0.438
Commelinaceae	**Commelina diffusa*	3.306	4.236	40	2.817	3.526
Convolvulaceae	*Ipomea batatas*	0.533	0.683	10	0.704	0.694
Cucurbitaceae	*Melothria pendula*	0.580	0.743	20	1.408	1.076
Cyperaceae	*Cyperus rotundus*	0.208	0.266	40	2.817	1.542
	Cyperus kyllingia	0.061	0.078	10	0.704	0.391
	Cyperus sp. 1	0.077	0.098	10	0.704	0.401
	Cyperus sp. 2	0.103	0.132	10	0.704	0.418
Euphorbiaceae	*Acalypha* sp. 1	0.907	1.162	10	0.704	0.933
	Acalypha sp. 2	1.1812	2.321	40	2.817	2.569
	Acalypha sp. 3	0.160	0.205	10	0.704	0.455
	Euphorbia heterophylla	0.133	0.171	10	0.704	0.438
	Euphorbia hirta	0.618	0.792	20	1.408	1.100
	**Homonoia riparia*	4.474	5.733	50	3.521	4.627
	Macaranga tanarius	0.363	0.465	20	1.408	0.937
Fabaceae	**Calopogonium caeruleum*	8.712	11.162	80	5.634	8.398
	Calopogonium mucunoides	0.126	0.161	10	0.704	0.433
	Centrosema mucuroides	0.677	0.867	10	0.704	0.786
	Crotalaria pallida	0.577	0.739	10	0.704	0.722
	Desmodium sp.	0.404	0.518	10	0.704	0.611
	Gliricidia sepium	0.118	0.151	10	0.704	0.427
	Leucena leucocephala	0.444	0.569	30	2.113	1.341
	Mimosa pudica	1.038	1.329	10	0.704	1.017
	Unidentified sp. 1	0.347	0.444	10	0.704	0.574
Lamiaceae	*Anisomeles indica*	0.150	0.192	10	0.704	0.448
	Clerondrendum quadriloculare	0.347	0.444	10	0.704	0.574
	Gmelina sp.	0.793	1.016	20	1.408	1.212
Malvaceae	*Malvastrum coromandelianum*	0.272	0.348	20	1.408	0.878
Moraceae	*Ficus septica*	0.275	0.352	20	1.408	0.880
	Ficus ulmifolia	0.673	0.863	20	1.408	1.136
Myrtaceae	*Psidium guajava*	0.573	0.735	10	0.704	0.719
Orchidaceae	*Dendrochilum* sp.	0.167	0.214	10	0.704	0.459
Passifloraceae	*Passiflora foetida*	0.550	0.705	10	0.704	0.704
Phyllanthaceae	*Antidesma bunius*	0.490	0.628	10	0.704	0.666
	Glochidion luzoniense	0.130	0.167	10	0.704	0.435
	**Kirganelia reticulata*	2.201	2.820	50	3.521	3.171

Plantaginaceae	*Scoparia dulcis*	0.033	0.043	10	0.704	0.373
Poaceae	*Bambusa* sp.	0.567	0.726	10	0.704	0.715
	Bothriocloa sp. 1	1.067	1.367	10	0.704	1.035
	Bothriocloa sp. 2	2.486	3.185	10	0.704	1.945
	Cenchrus sp.	0.433	0.555	10	0.704	0.630
	Chloris sp.	1.233	1.580	20	1.408	1.494
	Digitaria sp. 1	0.370	0.474	10	0.704	0.589
	Digitaria sp. 2	0.274	0.350	10	0.704	0.527
	Eleosine indica	0.346	0.443	20	1.408	0.926
	Imperata cylindrica	1.299	1.664	20	1.408	1.536
	**Saccharum spontaneum*	4.756	6.093	30	2.113	4.103
	**Paspalum conjugatum*	2.498	3.200	40	2.817	3.008
	Paspalum sp. 1	1.102	1.412	20	1.408	1.410
	Paspalum sp. 2	0.514	0.658	20	1.408	1.033
	Rottboellia exaltata L. f.	0.367	0.470	20	1.408	0.939
	*Unidentified sp. 1	4.367	5.594	10	0.704	3.149
	Unidentified sp. 2	0.167	0.214	10	0.704	0.459
Rutaceae	*Capparis micracantha*	0.073	0.094	10	0.704	0.399
Sapindaceae	Unidentified sp.	1.033	1.324	10	0.704	1.014
Solanaceae	*Solanum diphyllum*	0.030	0.038	10	0.704	0.371
Urticaceae	Unidentified sp. 1	0.073	0.094	10	0.704	0.399
	Unidentified sp. 2	0.077	0.098	10	0.704	0.401
	Unidentified sp. 3	0.060	0.077	10	0.704	0.391
Verbenaceae	*Lantana camara*	1.000	1.281	10	0.704	0.993
	Stachytarpheta jamaicensis	1.761	2.256	20	1.408	1.832
Zingiberaceae	*Globba campsophylla*	0.043	0.056	10	0.704	0.380
Pteridophyta	*Pteridium* sp.	0.110	0.141	10	0.704	0.423
Unidentified	Sapling	0.033	0.043	10	0.704	0.373
Unidentified	Sapling	0.187	0.239	10	0.704	0.472

Note: * - species with high dominance ratio