

Regeneration Potential of Woody Species in Watershed Areas of Mezam Division, North West Region of Cameroon

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Received: 09 June 2025

Accepted: 23 June 2025

Published: 25 June 2025

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Abstract

This study assessed the regeneration potential of woody species around watersheds in Mezam Division whose floristic diversity is threatened by anthropogenic activities. Four transects were established with quadrats of sizes 10 m × 10 m on watersheds located in three municipalities in Mezam from which woody species were identified and diameter at breast height (DBH) of all individuals per species was measured. Regeneration status of each species was determined from the number of mature trees (DBH > 10 cm), saplings (10 cm > DBH > 2.5 cm) and seedlings (DBH < 2.5 cm). 52 woody species were identified along these watersheds. The uses most common across the species were timber, medicine, and firewood. There was New regeneration for 11 species (*Cornus sericea*, *Phytolacca americana*, *Paullinia pinnata*, *Rhamnus prinoides*, *Allophylus africanus*, *Palisota ambigua*, *Microlepidia speluncae*, *Siphonochilus aethiopicus*, *Coptosperma graveolens*, *Abrus precatorius*, *Alpinia purpurata*) and No regeneration for 41 species (*Pinus wallichiana*, *Terrminalia catappa*, *Aralia spinosa*, *Quercus suber*, *Prunus serotina*, *Albizia julibrissin*, *Mangifera indica*, *Eriobotrya japonica*, *Rhus typhina*, *Moringa oleifera*, *Spathodea campanulata*, *Persea americana*, *Quercus robur*, *Prunus persica*, *Citrus limon*, *Pyrus communis*, *Hura crepitans*, *Prunus domestica*, *Coffee arabica*, *Kiggelaria africana*, *Coccoloba pubescens*, *Roystonea regia*, *Eucalyptus camaldulensis*, *Pseudospondias microcarpa*, *Boehmeria japonica*, *Ficus exasperata*, *Trilepisium madagascariense*, *Inga laurina*, *Alchornea cordifolia*, *Ficus hispida*, *Persicaria virginiana*, *Terurichidium didymostemon*, *Trema orientale*, *Bridelia micrantha*, *Psidium guajava*, *Vachellia farnesiana*, *Juglans nigra*, *Maesopsis eminii*, *Canarium schweinfurthii*, *Ficus sur*). This study's findings highlight a need for assisted regeneration and protection of the woody flora of watershed ecosystems in Mezam Division.

Keywords: Biodiversity Loss, Degradation, Human Encroachment, Mezam Division, Watershed.

1. INTRODUCTION

Watersheds are instrumental in the effective functioning of hydrological systems, as they ensure ground water recharge and a steady supply of water for multiple uses (Fulai *et al.*, 2018). They are generally considered as points of development especially in countries which rely on water dependent activities. A major problem confronting watersheds remains the increase in human population and land use mutations, which set in to degrade the ecosystems. The implications on communities concerned are usually grave, including a decline in water quality and quantity which translates into the upsurge of water borne diseases and a drop in agricultural production. The increasing human population, coupled with the scarcity of favorable land for farming, grazing and construction of settlements appear to be the main drivers of watershed degradation. Watersheds are zones of conflicts because land users have different goals for the available natural resources. In this area, there is the encroachment of farmers into traditional grazing lands and straying of animals onto farmlands. These have resulted in social and economic conflicts which undermine efforts to improve the lives of large numbers of the No regeneration who depend on the resources for their survival and economic well-being (Kometa and Ashu, 2012). Cameroon, a country in Central Africa with an outlet to the Atlantic Ocean in the Gulf of Guinea, has enormous potentialities of water resources. It thus counts approximately 39,600 km² of inland water bodies internal and distributed in watersheds exploited for agriculture, construction, drinking, and several other uses. These basins are degraded by anthropogenic movements, reflected in strong urbanization, industrialization, agriculture, livestock, fisheries, deforestation, transport and

tourism. This problem of strong anthropogenic interference varies from one watershed to the other and is mainly related to pollution in all its forms (Santsa et al., 2018). The Bamenda Highlands, situated in the North West Region of Cameroon, are renowned for their rich biodiversity and unique ecological significance. This mountainous area is characterized by diverse forest ecosystems that not only support a wide range of plant and animal species but also play a critical role in regulating the hydrology of the region. The highlands serve as vital watersheds, providing essential water resources for local communities, agriculture, and ecosystems. However, these forests are increasingly threatened by human activities such as deforestation, agricultural expansion, and urban development, leading to a decline in tree species that are crucial for maintaining ecological integrity. Forests represent both public and private assets and as such are subject to a complex system of national and international laws and regulations. Wanton exploitation of forests around watersheds is at par with the sustainable forest management concept of a “dynamic and evolving concept, which aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations” (FAO 2020).

Khalid *et al.*, (2021) stated that in forest management operations, inventories are used to determine the nature and distribution of biodiversity in a region. The quantification of tree species diversity is an essential aspect as it provides resources for many species. Being a dominant life form, trees are easy to locate precisely and to count and are also relatively better known taxonomically. In a recent study, it was found that the biodiversity status of an overwhelming majority of woody species around watersheds in Mezam Division of the Bamenda Highlands is either rare or endangered (Shibi and Ambebe, unpubl.), warranting ecological restoration reinforcement of conservation efforts. This study was aimed at assessing the natural regeneration potential of woody species around watersheds in Mezam Division as a primary step towards elevating the overall floristic diversity status of the ecosystem.

2. MATERIALS AND METHODS

2.1. Study Area

The study was carried out in Mezam Division. It is one of the seven divisions of the North West Region of Cameroon. It lies between latitudes 5°20” and 6°15”N and longitudes 9°7”and 10°21”E and covers a surface area of 1,841km² (Figure 1). It is made up of 27 autonomous villages. It has a population of about 700,000 inhabitants. Administratively, it is divided into seven sub-divisions, namely, Bamenda I, Bamenda II, Bamenda III, Bafut, Bali, Santa and Tubah which make up the seven local government areas or councils. It has a diversified relief with escarpments, plains, deep valleys and plateaus. The relief varies from 1000 m to 2500 m. It has a wet season that runs from mid-March to mid-November recording an annual average rainfall of 2288 mm and an annual average temperature of 19.7°. Mezam Division is the most important administrative division in the region as it host to the regional headquarter and the largest town in the region (Bamenda). Most of the villages are rural and the settlement is sparsely populated with extensive agricultural activities.

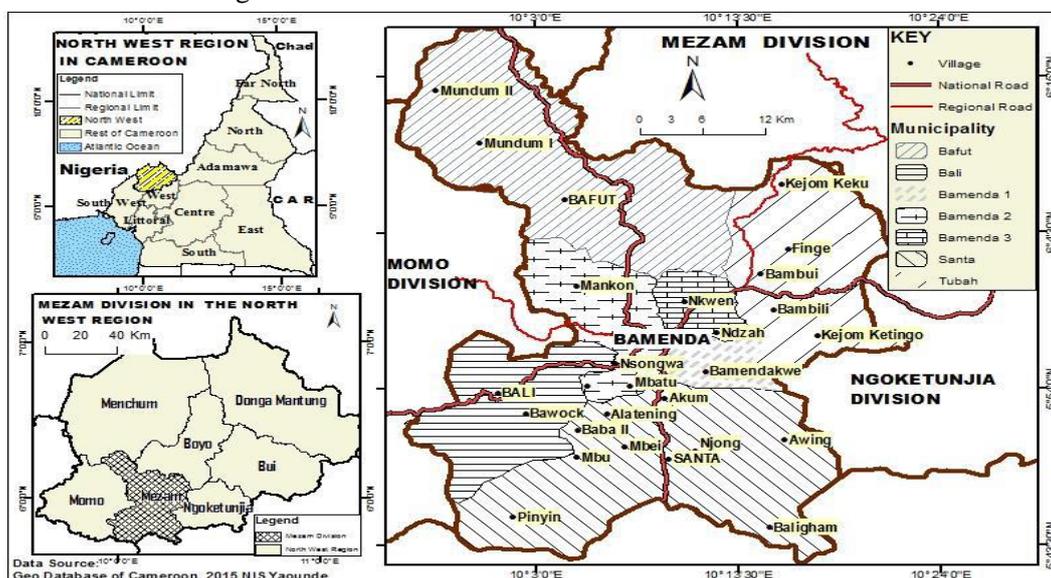


Figure 1. Location of Mezam Division in the North West Region of Cameroon

2.2. Experimental Design

The study was conducted in three subdivisions of Mezam Division each of which has a major watershed. The study sites were the Ntahmekeh watershed in Bamenda III Subdivision, Tubah Uphill watershed in Tubah Subdivision, Bamendankwe Highland watershed in Bamenda I Subdivision. For tree species diversity and abundance, a 10 sub plots (quadrat) of 10m by 10m each was mapped out at regular intervals of 50m along a line transect in an undisturbed and a disturbed site. Within each plot, all individual trees will be identified and counted. The tree numbers will then be grouped by species.

2.3. Data Collection

Woody species within each quadrat were identified based on expert knowledge and a plant identification app known as Plant Net. Prior to being used for the identification, the app was pre-tested for accuracy. The diameter at breast height (DBH) of each individual plant per species was measured with either a calibrated diameter tape or vernier caliper. Plants with DBH > 10 cm were classified as trees while those with 10 cm > DBH > 2.5 cm and DBH < 2.5 cm were placed under the category of saplings and seedlings, respectively, and then quantified per species (Dibaba et al. 2014; Gebrehiwot and Hundera, 2014; Bogale et al. 2017). The uses of the species were obtained from the internet.

2.4. Data Analysis

The regeneration status of each species was determined by comparing the population size of seedlings, saplings and mature trees (Dhaulkhandi et al. 2008; Tiwari et al. 2010; Gebrehiwot and Hundera, 2014; Deressa et al. 2023) and then screening on following scale:

- “Good” regeneration, if seedling > sapling > mature tree;
- “Fair” regeneration, if seedling < sapling > mature tree;
- “No regeneration” regeneration, if a species survives only in the sapling stage, but not as seedlings (even though saplings may be less than, more than, or equal to mature);
- “New”, if a species has no mature, but only sapling and/or seedling stages
- “No regeneration” if a species has mature trees but less sapling and seedlings.

3. RESULTS

3.1. Uses of Woody Species in Watershed Areas in Mezam Division

Fifty-two (52) woody species were encountered in the study area (Table 1). They were determined to provide a plethora of ecosystem services. For instance, *Psidium guajava*, *Canarium schweinfurthii*, *Pseudospondias microcarpa*, *Rhamnus prinoides*, *Allophylus africanus*, *Prunus domestica*, *Ficus exasperata*, *Microlepis speluncae*, *Ficus hispida*, *Eucalyptus camaldulensis*, *Moringa oleifera* offer provisioning services in the form of food, medicine firewood and/or construction material, *Siphonochilus aethiopicus*, *Terurichidium didymostemon*, *Allophylus africanus*, *Pinus wallichiana*, *Terrminalia catappa*, *Prunus serotina* are of cultural relevance as ornamentals, and *Trema orientale*, *Maesopsis eminii*, *Allophylus africanus*, *Paullinia pinnata* provide a regulatory function in the form of erosion control. There are several other uses associated with the plants which generally overlapped across species. Aside from the direct benefits to humans, the woody species maintain the ecological functioning and health of the watersheds. They belonged to 29 families.

Table 1. Woody species and uses in watershed areas in Mezam Division

Species	Family	Common name	Economical uses
<i>Trema orientale</i>	Ulmaceae	Indian hemp	Timber, fuel wood, medicine, soil erosion control, shade and ornamentals
<i>Abrus precatorius</i>	Fabaceae	Rosarypea	Timber, shade, soil improvement, fodder, medicinal, erosion control
<i>Siphonochilus aethiopicus</i>	Zingiberaceae	African ginger	Culinary, medicine, ornamental
<i>Albizia julibrissin</i>	Fabaceae	Mimosa or Silk tree	Medicinal use, ornamentals

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<i>Alchornea cordifolia</i>	euphorbiaceae	Bitter leaf or African tea	Medicine, food, dyes, timber, fodder, traditional crafts.
<i>Alchornea cordifolia</i>	Euphorbiaceae	Christmas bush	Timber, fuel wood, medicine
<i>Allophylus africanus</i>	Sapindaceae	African soapberry	Food production, medicinal, ornamental, wood, erosion control
<i>Alpinia purpurata</i>	Zingiberaceae	Red ginger	Culinary, medicine, ornamental
<i>Coffea arabica</i>	Arecaceae	coffee	Production of coffee
<i>Aralia spinosa</i>	Araliaceae	Prickly elder	Medicinal plant, food, furniture
<i>Boehmeria japonica</i>	Urticaceae	Large leaf or falsenettle	Fiber, medicine, soil erosion control
<i>Bridelia micrantha</i>	euphorbiaceae	Bridelia	Medicinal, timber, fuelwood, tannin, habitat for wildlife
<i>Canarium schweinfurthii</i>	Burseraceae	African elemi	Timber, resin, ornamentals, rubber, medicine, food, agroforestry
<i>Citrus limon</i>	Rutaceae	Lemon	Fuits, medicinal, ornamental
<i>Coccoloba pubescens</i>	Polygonaceae	Mountain grape	Timbers, ornamentals
<i>Coptosperma graveolens</i>	Rubiaceae	Bitter bark	Medicine, timber, crafts and furniture, habitat for wildlife
<i>Cornus sericea</i>	Cornaceae	Red Osier dogwood	Soil retention, dye production
<i>Eriobotrya japonica</i>	Rosaceae	Loquat	Medicinal plant, wood, fruit
<i>Eucalyptus camaldulensis</i>	Myrtaceae	Red-river gum	Biofuel extraction, ornamental, timber, bee production
<i>Ficus exasperata</i>	Fucaceae	Forest sandpaper	Timber, fuel wood, medicine,
<i>Ficus sur</i>	Moraceae	Bush Fig	Fruit production, medicinal, wood, ornamental, shade
<i>Ficus hispida</i>	Morsceae	Hairy fig	Timber, fuel wood, medicine
<i>Hura crepitans</i>	Euphorbiaceae	Sand-box tree	Ornamentals, timbers, medicinal plant
<i>Inga laurina</i>	Fabaceae	Guama	Timber, fuel wood, medicine
<i>Juglans nigra</i>	Juglandaceae	Black walnut	wood, carbon sequestration, medicine, landscaping
<i>Kiggelaria africana</i>	Achariaceae	Wild peach	Timbers, fibers, ornamentals
<i>Maesopsis eminii</i>	Rhamnaceae	African rubber tree	Timber, ornamentals, rubber, medicine, paper and pulp, agroforestry, erosion control
<i>Mangifera indica</i>	Anacardiaceae	Mango	Fruits, vegetables, timbers, medicinal plant, dyes
<i>Microlepia speluncae</i>	Dennstaedtiaceae	Limpleaf fern	Timber, fuel wood, medicine
<i>Moringa oleifera</i>	Moringaceae	Moringa or drum stick	Medicinal use, improves water quality, vegetables, wood, dye, oil production
<i>Palisota ambigua</i>	Commelinaceae	African lily	fuel wood, ornamental
<i>Paullinia pinnata</i>	Sapindaceae	Princess or empress tree	Reforestation and afforestation, erosion control, biomass production, medicinal
<i>Persea americana</i>	Lauaceae	Aligator pear	Medicinal, vegetable, oil production
<i>Persicaria virginiana</i>	Polygonaceae	Jumpseed	Timber, fuel wood, medicine
<i>Phytolacca Americana</i>	Phytolaccaceae	Pigeon berry	Dye production, timber, wood
<i>Pinus wallichiana</i>	Pinaceae	Bhutan pine	Timber, ornamentals,
<i>Prunus persica</i>	Rosaceae	Peach	Timbers, ornamentals
<i>Prunus domestica</i>	Rosaceae	Plum	Vegetables, oil production, medicinal

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<i>Prunus serotina</i>	Rosaceae	Mountain black cherry	Medicinal plants, dye production, wood, timber, ornamentals
<i>Pseudospondias microcarpa</i>	Anacardiaceae	African hog plum	fruit production, medicine, shade and ornamentals
<i>Psidium guajava</i>	Myrtaceae	Guava	Fruit production, nutritional value, medicinal, wood, essential oils
<i>Pyrus communis</i>	Rosaceae	Common pear	Vegetables, oil production, medicinal
<i>Quercus robur</i>	Fagaceae	Penduculate oak	Timber, wood. Production of wine cork, ornamentals
<i>Quercus suber</i>	Fagaceae	Cork Oak	Ornamentals, produce insulation panels, cloth manufacturing
<i>Rhamnus prinoides</i>	Rhamnaceae	African false currant	fruit production, medicine, shade and ornamentals
<i>Rhus typhina</i>	Anacardiaceae	Staghorn sumac	Production of dye, ornamental,
<i>Roystonea regia</i>	Arecaceae	Royal palm	Timbers, fibers, ornamentals
<i>Spathodea campanulata</i>	Bignoniaceae	African tulip tree	Ornamentals, fruits, medicinal, timber
<i>Terrminalia catappa</i>	Combretaceae	Indian almond	Timber, ornamentals, fruits, essential oils, medicinal plant
<i>Terurchidium didymostemon</i>	Euphorbiaceae	African rubber tree	Timber, ornamentals, rubber, medicine
<i>Trilepisium madagascariense</i>	Moraceae	False- fig	Fruit production, medicinal, wood, ornamental, shade
<i>Vachellia farnesiana</i>	Fabaceae	Sweet acacia	Timber, fuel wood, medicine, , shade, ornamentals, soil improvement, honey production

Regeneration status was “new” for 21 % of the species which were comprised of *Cornus sericea.*, *Phytolacca americana.*, *Paullinia pinnata*, *Rhamnus prinoides*, *Allophylus africanus*, *Palisota ambigua*, *Microlepis speluncae*, *Siphonochilus aethiopicus*, *Coptosperma graveolens*, *Abrus precatorius*, *Alpinia purpurata*. The remaining 79 % of woody species (*Pinus wallichiana*, *Terrminalia catappa*, *Aralia spinosa*, *Quercus suber*, *Prunus serotina*, *Albizia julibrissin*, *Mangifera indica*, *Eriobotrya japonica*, *Rhus typhina*, *Moringa oleifera*, *Spathodea campanulata.*, *Persea americana*, *Quercus robur*, *Prunus persica*, *Citrus limon*, *Pyrus communis*, *Hura crepitans*, *Prunus domestica*, *Coffee arabica* , *Kiggelaria africana*, *Coccoloba pubescens.*, *Roystonea regia*, *Eucalyptus camaldulensis.*, *Pseudospondias microcarpa*, *Boehmeria japonica*, *Ficus exasperata*, *Trilepisium madagascariense*, *Inga laurina*, *Alchornea cordifolia*, *Ficus hispida*, *Persicaria virginiana*, *Terurchidium didymostemon*, *Trema orientale*, *Bridelia micrantha*, *Psidium guajava*, *Vachellia farnesiana*, *Juglans nigra*, *Alchornea cordifolia*, *Maesopsis eminii*, *Canarium schweinfurthii*, *Ficus sur*) were of the “no regeneration” category.

Table 2. Regeneration capacity of woody species in watershed areas in Mezam Division

Species	Family	Seedlings	saplings	Trees	Status
<i>Abrus precatorius</i>	Fabaceae	6	-	-	New
<i>Siphonochilus aethiopicus</i>	Zingiberaceae	3	-	-	New
<i>Albizia julibrissin</i>	Fabaceae	-	-	5	No regeneration
<i>Alchornea cordifolia</i>	Euphorbiaceae	-	-	2	No regeneration
<i>Alchornea cordifolia</i>	Euphorbiaceae	-	-	6	No regeneration
<i>Allophylus africanus</i>	Sapindaceae	-	1	-	New
<i>Alpinia purpurata</i>	Zingiberaceae	2	-	-	New
<i>Aralia spinosa</i>	Araliaceae	-	-	4	No regeneration
<i>Boehmeria japonica</i>	Urticaceae	-	-	4	No regeneration
<i>Bridelia micrantha</i>	Euphorbiaceae	-	-	2	No regeneration
<i>Canarium schweinfurthii</i>	Burseraceae	-	-	2	No regeneration
<i>Citrus limon</i>	Rutaceae	-	1	1	No regeneration
<i>Coccoloba pubescens</i>	Polygonaceae	-	-	1	No regeneration
<i>Coffee arabica</i>	Arecaceae	-	-	3	No regeneration
<i>Coptosperma graveolens</i>	Rubiaceae	-	1	-	New

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<i>Cornus sericea</i>	Cornaceae	3	-	-	New
<i>Eriobotrya japonica</i>	Rosaceae	-	-	5	No regeneration
<i>Eucalyptus camaldulensis</i>	Myrtaceae	-	4	6	No regeneration
<i>Ficus exasperata</i>	Fucaceae	-	-	3	No regeneration
<i>Ficus sur</i>	Moraceae	-	-	3	No regeneration
<i>Ficus hispida</i>	Morsceae	-	-	1	No regeneration
<i>Hura crepitans</i>	Euphorbiaceae	-	-	2	No regeneration
<i>Inga laurina</i>	Fabaceae	-	-	3	No regeneration
<i>Juglans regia</i>	Juglandaceae	-	-	4	No regeneration
<i>Kiggelaria africana</i>	Achariaceae	-	-	2	No regeneration
<i>Maesopsis eminii</i>	Rhamnaceae	-	-	6	No regeneration
<i>Mangifera indica</i>	Anacardiaceae	-	-	8	No regeneration
<i>Microlepia speluncae</i>	Dennstaedtiaceae	12	-	-	New
<i>Moringa oleifera</i>	Moringaceae	-	2	3	No regeneration
<i>Palisota ambigua</i>	Commelinaceae	1	-	-	New
<i>Paullinia pinnata</i>	Sapindaceae	-	1	-	New
<i>Persea americana</i>	Lauaceae	-	3	3	No regeneration
<i>Persicaria virginiana</i>	Polygonaceae	1	-	-	No regeneration
<i>Phytolacca americana</i>	Phytolaccaceae	4	-	-	New
<i>Pinus wallichiana</i>	Pinaceae	-	-	8	No regeneration
<i>Prunus domestica</i>	Rosaceae	-	3	6	No regeneration
<i>Prunus persica</i>	Rosaceae	-	1	1	No regeneration
<i>Prunus serotina</i>	Rosaceae	-	-	1	No regeneration
<i>Pseudospondias microcarpa</i>	Anacardiaceae	-	-	2	No regeneration
<i>Psidium guajava</i>	Myrtaceae	-	3	3	No regeneration
<i>Pyrus communis</i>	Rosaceae	-	1	5	No regeneration
<i>Quercus robur</i>	Fagaceae	-	-	3	No regeneration
<i>Quercus suber</i>	Fagaceae	-	-	5	No regeneration
<i>Rhamnus prinoides</i>	Rhamnaceae	-	1	-	New
<i>Rhus typhina</i>	Anacardiaceae	-	-	3	No regeneration
<i>Roystonea regia</i>	Arecaceae	-	-	3	No regeneration
<i>Spathodea campanulata</i>	Bignoniaceae	-	-	3	No regeneration
<i>Terrminalia catappa</i>	Combretaceae	-	-	3	No regeneration
<i>Terurchidium didymostemon</i>	Euphorbiaceae	-	-	1	No regeneration
<i>Trema orientale</i>	Ulmaceae	-	-	4	No regeneration
<i>Trilepisium madagascariense</i>	Moraceae	-	-	3	No regeneration
<i>Vachellia farnesiana</i>	Fabaceae	-	-	3	No regeneration

4. DISCUSSION

Regeneration of plants depends on a combination of factors controlling seed availability, germination, seedling growth and establishment. Environmental conditions play a crucial role in establishment and distribution of seedlings (Bhat et al. 2020). The unfavorable nature of the growing medium for germination could therefore be brought forward as the main reason for the no regeneration potential of woody species witnessed on the watersheds. Seed dormancy is an evolutionary adaptation that retains seed viability during environmental conditions which do not favour germination or seedling survival. It plays a key role in maintaining soil seed banks. Some of such stressors include temperature, water, light, and salinity (Gul et al. 2013). A good example of a species which exhibits seed dormancy is *Canarium schweinfurthii* whose hard testa presents a physical barrier to the uptake of water and oxygen for germination (Garba et al. 2023). It was found in a recent study (Tanwie et al. 2023), that germination of *C. schweinfurthii* seeds can be induced by subjecting them to a warm water treatment which is a great contrast to the cold water conditions prevalent in the watersheds.

Similar to wetland ecosystems in Mezam Division (Tanwie et al. 2024), the watersheds are heavily exploited for food, construction material, firewood, and medicine. In addition, large areas of land are being converted from woody to farmland for crops and vegetables with short-term economic returns to sustain a rapidly growing human population. The wanton clearing of naturally regenerated seedlings and saplings to meet the socio-economic aspirations of the local peoples is also an important contributor

to the high frequency of the “no regeneration” status. Meanwhile the “new” regeneration status that was also noted in the watersheds was attributed to introduction of the species onto the area through reforestation, afforestation programs and seed dispersal by wind, insects and other animals as reported previously by Bogale et al. (2017) from a study in Ethiopia.

5. CONCLUSION

In general, the watersheds were good regeneration potential as the woody species were either of “new” or to a larger extent “no regeneration” status. To ensure sustainability of the ecosystems, it is necessary to explore physical, physiological, and quality attributes of the woody plant seeds so as to gain some insight into possible reasons for difficulties in germination. Such information will present directives for management practices to improve the regeneration potential of the watersheds.

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Citation: Juliette Muyuka Shibi, Titus Fondo Ambebe. *Regeneration Potential of Woody Species in Watershed Areas of Mezam Division, North West Region of Cameroon. International Journal of Forestry and Horticulture (IJFH)*. 2025; 11(1):22-29. DOI: <https://doi.org/10.20431/2454-9487.1101003>

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