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Investigation on the Mechanism of Erosion Control of *Ipomoea carneaJacq.* (Kafi Kancila / Kashe-Kwari) in Gombe State, Nigeria

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Abstract: ***Studies were conducted to investigate the mechanism of erosion control of Ipomoea carnea within Gombe State; Nigeria with the aim of investigating what features enabled the plant to successfully control erosion. Six sites were randomly selected within the metropolis taking consideration of presence of gullies and presence of the plant. Macro-morphological parameters of growth were then taken for each site. The morphology of the roots and stems of the plant were also observed and studied. Data on macro-morphological measurements obtained were subjected to Analysis of variance. The result showed that Site 6 (GRA) had the highest growth parameters while Site 1(GSU) recorded the lowest. The result of the root and stem morphology revealed that the plant produces horizontal branches which rapidly root along the downward side in contact with the ground, and give rise to many erect side branches. At the tip of the horizontal branch a secondary shrub (ramet) develops. The laid-down branch becomes a functional stolon, which persists and keeps mother and daughter plant connected. Individual plants thus easily expand in each direction with in-line offspring, covering several square meters. Decumbent branches also root in the soil before growing upwards establishing new plants separately from the main plant. It was therefore concluded that this mechanism of extension which contributes mostly to vegetative regeneration of the plant can be used for rapid propagation of the plant in the gullies hence it is a recommended plant for erosion control in Gombe State, Nigeria.***

1. Introduction

Ipomoea carnea Jacq. is a plant belonging to the family Convolvulaceae. The family has a great morphology, ecology, and world-wide distribution due to its occurrence. It is the largest genus in the flowering plant with over 500 species. It is a large, diverse group with common names including; morning glory, water convolvulus or kangkung, sweet potato, bind weed, moon flower etc. It comprises annual and perennial herbaceous plants, shrubs and small trees; most of the species are twining climbing plants (Shaltout *et al.*, 2006).

The genus occurs throughout the tropical and sub-tropical regions of the world. It is a native of South America, grows in dense populations along river beds, river banks, canals and other waterlogged (wetland) areas. It has become naturalized along canals, drains, road sides, and field edges in the Nile Delta, Egypt, and Gombe, Nigeria. The rapid growth rate, spread adaptability from xeric to aquatic habitats indicates that this plant may potentially become a disastrous invasive species in Egyptian water bodies, but it is commonly used to control erosion in Gombe State.

Ipomoea carnea, the pink morning glory, is a species of morning glory. It is a small tree or large shrub (Plate 1) growing to a height of 3meters or more, leaves are simple with alternate leaves, wide with pointed tips, rounded bases, leaves yield alkaloid with narcotic properties (poisonous). Clustered flowers with five fused sepals and petals and five stamens. The flowers are purple in color and are usually conspicuous and are visited by insects. It possesses a superior ovary composed of two fused carpel and obliquely placed in the flowers upon a basal disc of tissues. The fruit is usually a berry or a capsule. It can be easily grown from seeds.

The stem of *Ipomoea carnea* can be used for making paper. The plant is also of medicinal value. It contains a component identical to marsilin, a sedative and anticonvulsant. A glycosidic saponin has also been purified from *Ipomoea carnea* with anti-carcinogenic and oxy-toxic properties. Medically, its roots are boiled and used as laxative and to provoke menstruation, and the milky sap is used by traditional healers for skin diseases. However, it is very harmful when used wrongly, as it is a depressant on the central nervous system, and a relaxant for muscles meaning important stuff like breathing and staying alive. In view of the importance of this plant, information obtained in this research will help in shading more light on how the plant is able to control erosion in Gombe State, Nigeria.

Plate 1: *Ipomoea carnea*

It is in view of this that this study aims to determine the mechanism of erosion control of *Ipomoea carnea* (Kashekwari) and to assess the significance of variation in the leaf, stem, and roots in relation to different sites within Gombe metropolis.

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2. Materials and Methods

2.1 Brief Description of Study Area.

Gombe State, Nigeria is located in the North-Eastern part of Nigeria, with coordinates 10˚15'N 11˚10'E/10.250˚N 11.167˚E. It shares borders with the States of Borno, Yobe, Taraba, Adamawa and Bauchi. Gombe State has many gully erosions within the metropolis and in almost all of its Local Government Areas.. The State has so many high lands and low lands, mountains, valleys. The study area includes; G.S.U, B.C.G.A, Barunde, Bagadaza, G.R.A and Mallam Inna all located in Gombe State, Nigeria.

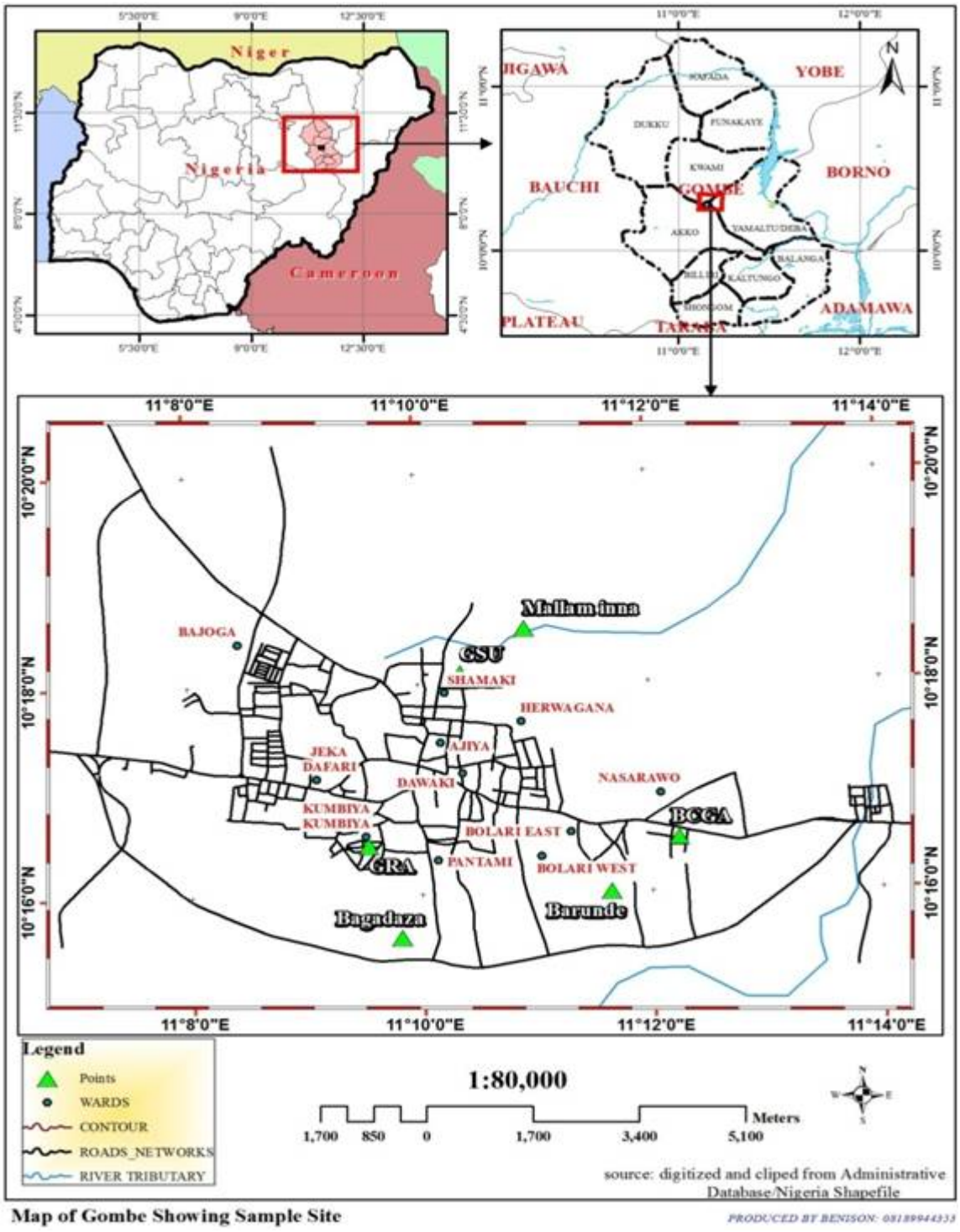

Figure 1: Map of Gombe showing study sites

Gombe State University (GSU)
This is situated in Tudun Wada adjacent Mallam Inna. It has a clay type of soil which is light brown in color. It has many *Khaya senegalensis* (mahogany), satellite trees, palm trees and many flowers. It has an elevation of 447m and lies between latitude: 10˚18`17.8' and longitude: 11˚12.133'. There are many deep gullies within the campus (Plate 2)

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(Plate 2).Gully erosion within GSU

2.1.1 B.C.G.A

Situated along road to Kwadon. It has a clay type of soil which is light brown in some places and dark brown in other places with *Azadirachta indica* as the predominantly abundant tree found there. It has an elevation: 390m and lies between latitude: 10˚16.306' and longitude: 11˚12.133'. There are many deep Gullies in BCGA. (Plate 3)

(Plate 3).Gully erosion in B.C.G.A

2.1.2 Barunde

Situated along By-pass. It has a sandy-clay type of soil with a high proportion of clay soil and few small stones, *Azadirachta indica* are the tree species predominantly found in the area with few *Cassia* spp. It has an elevation: 414m and lies between latitude: 10˚16.023' and longitude: 11˚11.377'.

(Plate 4). Gully erosion in Barunde

2.1.3 Bagadaza

This is situated along By-pass, adjacent to Barunde and opposite to Pantami. It has a light brown colored soil which contains clay and in some places loamy with few scattered *Azadirachta indica* trees. It has an elevation: 445m and lies between latitude: 10˚15.924'and longitude: 11˚09.902'. There are many deep Gullies in Bagadaza (Plate 5).

(Plate 5). Gully erosion in Bagadaza

2.1.4 G.R.A

This is situated adjacent new G.R.A and opposite Federal Low cost, with a clay soil which is light brown in color and has *Azadirachta indica* as the predominant plant species found in G.R.A. It has an elevation: 475m and lies between latitude: 10˚16.732' and longitude: 11˚09.384'. There are many Gullies in GRA(Plate 6).

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(Plate 6). Gully erosion in GRA

2.1.5 Mallam Inna

This is situated after G.S.U before reaching Arawa with few scattered trees and has a clay type of soil in some areas while in some areas it is loamy soil. It has an elevation: 441m and lies between latitude: 10˚18.627' and longitude: 11˚10.567'. There are many Gullies in Arawa.(Plate 7).

(Plate 7). Gully erosion in M/INNA.

3. Methodology For Plant Collection

Macro-morphological study

Ipomoea carnea was selected for this study, taxonomically identified and authenticated by comparing the collection with the available specimens and deposited in the herbarium of the Biological Sciences Department, Gombe State University. Six sites were randomly selected within the metropolis taking consideration of presence of gullies and presence of the plant. Macro-morphological parameters of growth were then taken such as leave number, leaf area, stem height, stem diameter, root length, diameter of root using measuring tape and rope. For each study site five points were selected at random of the plant under study,

(I) Ipomoea carnea, was uprooted (i.e., a single stem with its roots) and the roots were detached from the stem and a measuring tape was placed at the end of the stem thus taking the length of the root. The diameter of the root was also measured by tying a rope round the selected root and untied, then the rope was placed on a ruler and thus the diameter recorded. This was done for all the six study sites.

(II) The stem of *Ipomoea carnea* was measured from the ground to the tip of the stem using a measuring tape and the diameter was also measured by tying a rope round the selected stem and untied, then the rope was placed on a ruler and thus the diameter of the stem measured. The stems are intertwined at the base forming a network and the stems develop rhizoids at points that had contact with the soil.

(IV) *Ipomoea carnea* has a varying height based on the habitat found. It reached a height of about 6m on waste land but its height is below that in aquatic habitat (gullies).

4. Results

Table 1

Site	Leaf number	Leaf area	Root length	Root diameter	Stem length	Stem diameter
1	8.07±63.2a	34.41±1.18a	6.53±48.8ab	0.51±1.71b	13.91±1.71abc	0.51±7.65b
2	15.71±39.2b	53.73±1.86a	12.70±29.2b	0.55±2.36b	35.41±58.8c	0.72±6.65b
3	14.13±47.2ab	40.46±1.37a	15.01±47.8ab	0.62±1.34b	27.57±1.04bc	0.72±7.03b
4	15.14±46.6ab	42.13±1.43a	20.21±60.0a	1.25±6.62a	41.69±1.52ab	0.65±6.12b
5	16.21±41.6ab	49.92±1.50a	9.45±57.4a	1.24±6.84a	38.32±1.67a	1.10±6.36b
6	20.35±56.0ab	66.58±1.44a	24.07±47.2ab	1.50±6.52a	73.62±1.28ab	2.48±10.3a
F	1.729	1.032	2.335	34.153	4.079	7.851
Significance	0.166	0.442	0.073	0.000	0.008	0.000

Means with different alphabets are significantly different at P<0.05.

Key; Site 1=GSU, Site 2= Mallam Inna, Site 3= Barunde, Site 4= Bagadaza, Site 5= BCGA, and Site 6= GRA.

The result in Table 1 shows that Site 6 had the highest value for leaf number (20.35±56.0ab) while Site 1 had the lowest value (8.07±63.2a). Site 6 had the highest value (66.58±1.44a) for leaf area while Site 1 had the lowest value (34.41±1.18a). Site 6 had the highest value (24.07±47.2ab) for root length while Site 1 had the lowest value (6.53±48.8ab). Site 6 had the highest value (1.50±6.52a) for root diameter while Site 1 had the lowest value (0.51±1.71b).Site 6 had the highest value (73.62±1.28ab) for stem length while Site 1 had the lowest value (13.91±1.71abc). Site 6 had the highest value (2.48±10.3a)

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for stem diameter while Site 1 had the lowest value (0.51±7.65b).

Results of the Morphological Study

Plate8. Showing rhizoids

Plate 9.Showing horizontal branches (stolon)

5. Discussion

Mechanism of Erosion Control using morphological features

The study revealed that *Ipomoea carnea* subsp. fistulosa was able to spread rapidly by vegetative means, whereas horizontal branches rapidly root along the downward side in contact with the ground, and give origin to many erect side branches. This is consistent with the works of (Lovett-Doust, 1981a). At the tip of the horizontal branch a secondary shrub (i.e. ramet) develops. The laid-down branch becomes a functional stolon, which persists and keeps mother and daughter plant connected. Individual plants thus can easily expand in each direction with in-line offspring, covering dozens of square meters (Lovett-Doust, 1981a). This mechanism of extension which contributes most to vegetative regeneration, and thus is a most potential process that may have intriguing consequences for the concepts of individuality and its evolutionary implementations. This is consistent with the works of (Lovett-Doust, 1981a). It was also observed that Decumbent branches root in the soil before growing upwards establishing new plants separately from the main plant (Plate 9). This is consistent with the works of (Lovett-Doust, 1981a). Reproduction by seed was also common as observed. Fruits dehisce during dry season (November/December) by the splitting of the dry fruit-wall and the hairy seeds are dispersed by wind as well as water. The seed do not germinate immediately because of a hard seed coat which is impervious to water .This is similar to the findings of Keeler (1975) who reported 8-9 hours for the anthesis, 1-2 days for the development or abortion of fruits and 4-5 weeks for the maturation of the seeds of *Ipomoea carnea.*

Macro-morphology

The results of this study shows that the populations along Site 6 had the highest leaf production and/or leaf area, while those in Site 1 had the lowest (Table 1). This may be attributed to sufficient moisture along the gully compared with the other sites. Leaf growth and production is dependent upon the rate of supply of the limiting resource (Shinozaki & Kira, 1956). Grier & Running (1977) stated that leaf area is a suitable parameter to interpret site water balance relationships of plant communities. Both leaf area and leaf consistency are related to the moisture conditions prevailing in the site occupied by the plant. The moisture conditions are reflected by climatic and soil factors and it may be difficult to distinguish between the effects of either (Werger & Ellenbroek, 1978).

Leaf size directly affects light interception, light penetration through the canopy and leaf energy balance. Leaves are often smaller in species occupying habitats with high light, low nutrients or low moisture availability (Hamann, 1979; Niinemets & Kalevi, 1994).

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