WANGARI MAATHAI INSTITUTE FOR PEACE AND ENVIRONMENTAL STUDIES

Journal of Sustainability, Environment and Peace

Homepage: http://www.jsep.uonbi.ac.ke

ISSN: 2663-4627


# Woody Species Composition in Upper Tana River Floodplain of Kenya: Potential Effects of Change in Flood Regimes

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*Article history:*
Received: 10 May 2019
Received in revised form: 17 June 2019
Accepted: 19 June 2019
Available Online: 25 June 2019

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Key words:
floodplain
invasion
Tana River
woody species composition

## ABSTRACT

Floodplains of rivers in semi-arid areas of Africa are important refuge grazing areas and biodiversity spots. However, they are sensitive to changes in flood regimes. Vegetation data were collected in transects to capture inside and outside of the upper Tana River floodplain. The mean densities of the woody species and the basal areas of the tree species were determined and compared using a t-test for the vegetation inside and outside the floodplain. The importance value (IV 200) of the tree species was determined by summing up percentage relative density and relative basal area. Three groups of species were separated; those that occur in the floodplain only, those outside the floodplain only and those both inside and outside, with Rinorea elleptica, Commiphora riparia, and Prosopis juliflora having the highest density respectively. The invader Prosopis juliflora had a significantly higher mean density ($t = 5.44$, $P = 0.00$) and lower mean basal area ($t = -2.24$, $P = 0.03$) inside the floodplain. Prosopis juliflora contributed 33.2 to IV 200 and Vachellia tortilis 19.6, the highest inside and outside the floodplain respectively. The results show that changes in flood regime as a result of mega dam projects upstream and climate change can potentially modify species dynamics and invasion.

## 1. Introduction

Rainfall, fire, herbivory and resource-competition interact and operate at various spatial and temporal scales to structure savanna ecosystems (e.g. Scholes & Archer 1997; Ehrenfeld 2003). Other modifiers of plant community composition include climate and invasive species (Lovejoy & Hannah, 2006; Levine et al. 2003; Brooks et al. 2004; Getachew et al. 2012), grass competition (Riginos, 2009), flood disturbances (Amoros & Bornette, 2002; Child et al. 2010) and land use type (Van den Berg & Kellner, 2005; Kalema & Witkowski, 2012). Land use changes, competitive ecological advantages and climate change are key factors that influence the probability of biological invasion (Pasiecznic et al. 2001). All these factors can alter the structure of savanna ecosystems which are crucial for survival of humanity, livestock and wildlife.

In Tana River County, a number of factors could be responsible for influencing plant community composition. These factors include climate variability which influences flooding regimes and droughts, soil nutrient levels, degree of invasion principally by Prosopis juliflora and land use practices. Prosopis species are invasive and more resistant to drought than indigenous species (Olukoye et al. 2003) and thus have an advantage compared to the latter species. The floodplain is an asset to both crop farmers and livestock keepers because it contains more moisture and nutrients to support growth of food crops and pasture. Land clearance in the floodplain is done to ensure there is adequate light penetration to support crop farming, which can reduce the diversity and abundance of woody plant species. Changes in flooding regime and increased drought frequencies resulting from climate variability have added pressure on the ecosystem. Although floods provide water that is critical in arid and semi-arid regions, flood water can also disperse propagules of invasive plant species and provide nutrient rich conditions that enhance their growth (Howell & Benson, 2000). There are five dams along Tana River which serve to collect water for electricity generation, irrigation-based crop farming, fisheries, livestock as well as for domestic use. Of these dams, Masinga and Kiambere are large enough to alter the river's hydrological regime, sediment transport and the incidence of floods (Maingi & Marsh, 2002). The government of Kenya has planned to build a mega dam along the river to boost irrigation-based farming and address the flooding menace in the coast region in the light of climate change and food shortage.

Please cite this article as: Omari J. K., J. K. Mworia, N. Gichuki and C. Mligo (2019). Woody Species Composition in Upper Tana River Floodplain of Kenya: Potential Effects of Change in Flood Regimes. *J. sustain. environ. peace 1(3) 91–97*

This is important since predictions on the impact of climate change in the Tana River Basin by Muthuwatta et al. (2018) indicate long-term rainfall will increase and so will extreme weather events. However, while the dam project will control floods, it will reduce the peak flows, which will alter the dynamics of vegetation in the floodplain.

It is within this background that the study was conceptualized to determine the vegetation dynamics in Tana River County. The objective of the study was to compare woody plant composition inside and outside the floodplain in the light of climate variability and invasion.

## 2. Materials and Methods

### 2.1 Study area

The study was conducted in upper Tana River area of Tana River County, located in south-eastern Kenya. The main source of water in the region is the Tana River which floods twice annually as a result of the long and short rainy seasons that occur in March–May and October–November respectively. The floods are caused by rains that occur in the river catchment area located in Mount Kenya and the Aberdare Range (Maingi, 2006). Climate variability has caused changes in the Tana River flooding regime, and increased drought frequencies. Livestock grazing occurs mainly outside the floodplain and crop farming mainly in the floodplain. The intensity of these land-use activities has increased in recent times to support the increased human population. The area is semi-arid with rainfall being lowest at Garissa and highest in Garsen. The mean annual temperature is 28.0ºC, with February and July being the hottest and coldest months respectively. The key vegetation types include gallery forests, Acacia woodlands, and Acacia-Commiphora scrub forests interspersed with seasonal grasslands (Hughes, 1990). The trees found along the seasonal streams include; Vachellia tortilis, Senegalia senegal, Berchemia discolor, Hyphaene compressa, Salvadora persica and Dobera glabra (Gachathi et al. 1987). Prosopis juliflora, an invasive plant species has colonized the area forming dense bush patches both inside the floodplain and in adjacent irrigated areas (Hola and Bura Irrigation Schemes). This species and other Prosopis species were introduced in Tana River County in the 1980s and have resulted to large-scale colonization in this semi-arid region (Choge et al. 2002).

### 2.2 Data collection and analysis

Vegetation data collection was done before the start of the rainy season within the floodplain and outside the floodplain in Tana River Primate Reserve, Arawale National Reserve, Bura Irrigation Scheme, Hola Irrigation Scheme, Bura, Hola, Bura East, Makere, Chanani and Wenje (figure 1). Plots that were organized along 100m transects were adapted to collect data. A total of 62 transects which ran perpendicular to the river were used, 31 inside and 31 outside the floodplain. The transects inside and outside the floodplain were not spatially paired. Each transect was divided into 10m segments and sampling was done in the first and the last segments where each segment constituted one of the four sides of a 10m x 10m plot. Sampling of vegetation was done in the first and last segments of the transect. The tree species and large shrubs were sampled within the 10m x 10m plots. Small shrubs and woody species saplings were sampled in 5m x 5m subplots nested in the 10m x 10m plots. The seedlings were sampled using 0.5m x 0.5m quadrants which were placed randomly within the 5m x 5m subplots. Three replicate samples were collected per subplot, a total of six replicates per transect. Identification was done to species level with the assistance of a taxonomist. The basal area of trees was determined in m2 using the formula; A = 0.0796 c2/ 10,000 where c is circumference in cm. The relative densities and relative basal areas of tree species were determined as indicated in the formulae below:

$$\text{Relative density} = \frac{\text{Number of trees by species in plot x 100}}{\text{Total number of trees of all species}}$$

$$\text{Relative basal area} = \frac{\text{Total basal area of all plants of a species x 100}}{\text{Total basal area of all plants}}$$

Importance value (IV 200) = Relative density + Relative basal area (dominance)

The density and basal area means were compared using a t-test for data inside and outside the floodplain at 0.05 significant level (Zar, 1999).

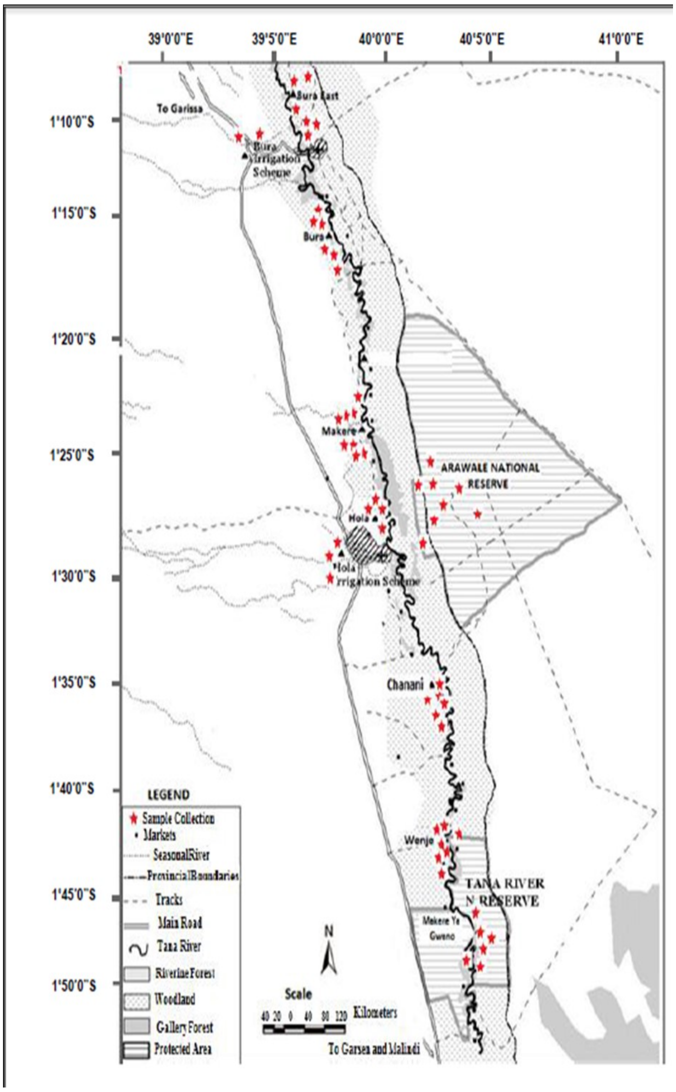


**Figure 1**: Map showing the location of sampling sites in Tana River (Source: Omari *et al.* 2018)

## 3. Results

Overall, a total of 100 woody plant species were identified; 48 tree species and 52 shrub species, whereas the woody species saplings and seedlings were 53 and 17 respectively. The overall mean densities inside the floodplain for trees and shrubs were 350±63 and 1540±257 plants/ha respectively, whereas outside the floodplain the densities were 285±37 and 1160±104 plants/ha for trees and shrubs respectively. The differences in density inside and outside the floodplain were not significant for both the trees ($t_{(108)} = 0.87$, $P = 0.39$) and the shrubs ($t_{(118)} = 1.63$, $P = 0.11$). However, the overall mean basal area of trees was significantly higher outside the floodplain ($t_{(349)} = -4.54$, $P = 0.00$), with 6.6±0.5 and 13.2±1.6 $m^2$ per hectare inside and outside the floodplain respectively. The overall density means of woody species saplings inside and outside the floodplain were 2550±410 and 1742±377 saplings/ha respectively, with no difference in the density ($t_{(108)} = 1.44$, $P = 0.15$).

**Table 1:** The mean densities, basal areas and IV 200 values of the trees inside the floodplain

| Tree species | Density (plants/ha) | Basal area ($m^2$/ha) | IV 200 |
|---|---|---|---|
| *Rinorea elleptica* | 850±650 | 4.0±1 | 6.9 |
| *Mangifera indica* | 600±100 | 9.3±2.6 | 6.8 |
| *Musa paradisiaca* | 600±0 | 4.6±0.1 | 3.0 |
| *Phoenix reclinata* | 600±0 | 7.3±2.8 | 3.0 |
| *Hunteria zeylanica* | 450±250 | 5.8±2.1 | 4.2 |
| *Sorindeia madagascari-ensis* | 450±150 | 5.5±1.8 | 4.1 |
| *Alangium salviifolium* | 300±0 | 5.7±3.2 | 1.4 |
| *Drypetes natalensis* | 300±0 | 6.5±2.3 | 1.5 |
| *Azadirachta indica* | 200±0 | 2.1±0.9 | 0.5 |
| *Ficus sycomorus* | 200±0 | 15.5±10.4 | 1.5 |
| *Hyphaene compressa* | 200±0 | 14.0±2.9 | 2.8 |
| *Polysphaera multiflora* | 200±100 | 10.7±6.1 | 2.4 |
| *Ziziphus pubescence* | 200±0 | 10.7±9.7 | 1.2 |
| *Excoecaria madagascari-ensis* | 150±50 | 12.8±6.8 | 2.0 |
| *Pavetta sphaerobotris* | 150±50 | 1.0±0.2 | 0.9 |
| *Vachellia elatior* | 133±33 | 4.2±0.7 | 1.6 |
| *Blighia unijugata* | 100±0 | 0.3±0 | 0.3 |
| *Celtis philipensis* | 100±0 | 6.3±0 | 0.5 |
| *Cordia gotzei* | 100±0 | 5.1±0 | 0.4 |
| *Diospyros abyssinica* | 100±0 | 0.5±0 | 0.3 |
| *Eucalyptus saligna* | 100±0 | 3.7±0 | 0.4 |
| *Kigelia africana* | 100±0 | 1.0±0 | 0.3 |
| *Tamarindus indica* | 100±0 | 17.9±0 | 0.8 |
| *Tapura fischeri* | 100±0 | 9.6±0 | 0.6 |

The overall density means of woody species seedlings were 31±10 and 14±3 inside and outside the floodplain respectively, and the density mean was marginally significant ($t_{(50)} = 1.860$, $P = 0.069$) inside the floodplain.
Some of the species were found only in the floodplain, others only outside the floodplain and the rest both inside and outside the floodplain.

### 3.1 Woody species found only inside the floodplain

The mean densities, basal areas and IV 200 values of the trees found only inside the floodplain are shown in table 1, and the mean densities of the shrubs and saplings in figures 2 and 3 respectively. *Rinorea elleptica* had the highest mean density and contributed the highest to IV 200, followed closely by *Mangifera indica*. The densities of *Thespesia danis* shrub and *Ricinus communis* saplings were the highest.

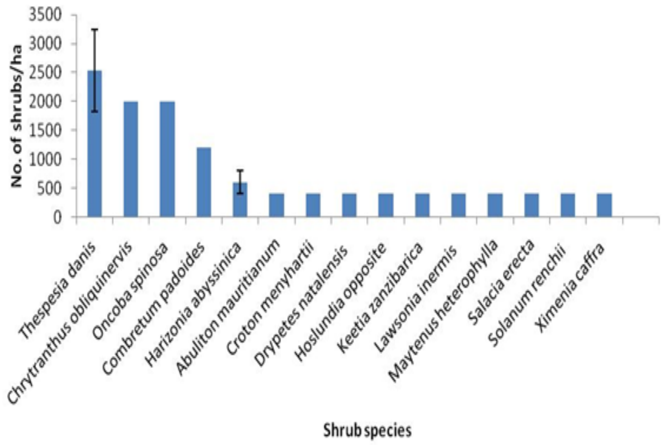


**Figure 2**: Mean density and standard errors of shrub species found only inside the floodplain. Error bars are missing where the standard error mean of the species was zero.

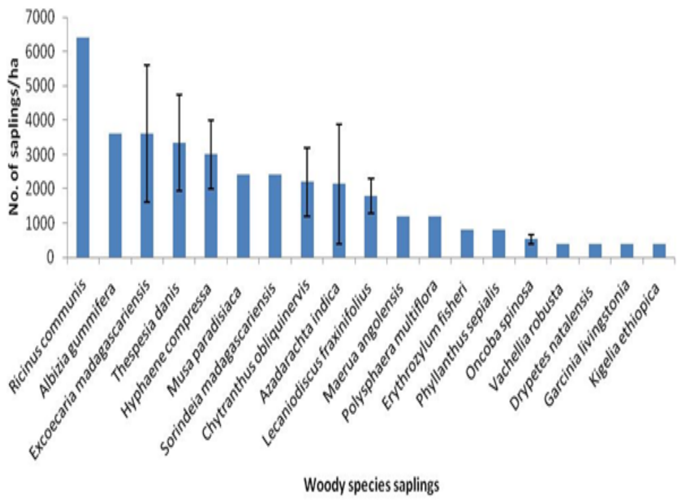


**Figure 3**: Mean densities and standard errors of woody species saplings found only inside the floodplain. Error bars are missing in cases where the standard error mean of the species was zero.

### 3.2 Woody species found only outside the floodplain

The mean densities, basal areas and IV 200 values of the tree species found only outside the floodplain are shown in table 2, and the mean densities of the shrubs and saplings in figures 4 and 5 respectively. Commiphora riparia contributed the highest to IV 200, attributed more to the high mean basal area. Salsola dendroides shrub had the highest density, whereas Boscia coriacea had the highest density of saplings.

**Table 2:** The mean densities, basal areas and IV 200 values of trees outside the floodplain

| Tree species | Density (plants/ha) | Basal area ($m^2$/ha) | IV 200 |
|---|---|---|---|
| Commiphora riparia | 300±100 | 14.3±5.4 | 6.4 |
| Albizia antihelmintica | 200±0 | 7.2±6.2 | 1.0 |
| Balanites pedicellaris | 200±0 | 16.8±9.1 | 1.6 |
| Commiphora africana | 200±0 | 13.0±1.5 | 1.4 |
| Commiphora baluensis | 200±0 | 16.3±6.7 | 1.6 |
| Lanea stuhlmannii | 200±0 | 9.3±8.6 | 1.1 |
| Sterculia africana | 200±0 | 4.9±4.7 | 0.9 |
| Grewia bicolor | 150±29 | 16.8±6.5 | 4.8 |
| Boscia coriacea | 100±0 | 8.5±3.0 | 1.1 |
| Commiphora campestris | 100±0 | 53.9±0 | 1.9 |
| Commiphora schimperi | 100±0 | 1.0±0 | 0.3 |
| Terminalia brownii | 100±0 | 13.5±0 | 0.7 |
| Terminalia spinosa | 100±0 | 2.7±0 | 0.4 |

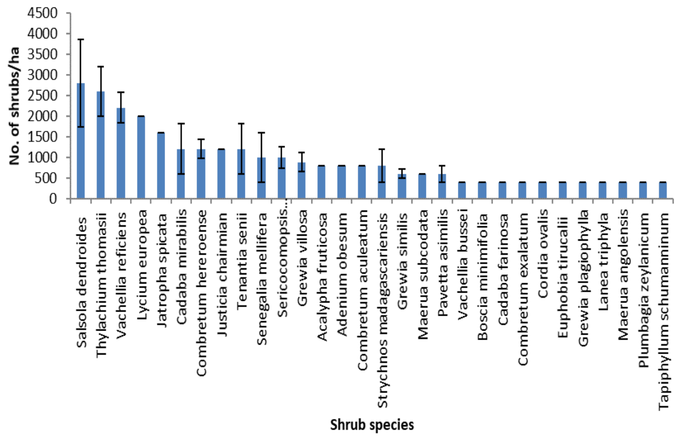


**Figure 4:** Mean density and standard errors of shrub species found only outside the floodplain Error bars are missing where the standard error mean of the species was zero.

### 3.3 Woody species inside and outside the floodplain

The number of tree and shrub species found both inside and outside the floodplain were eleven and seven respectively. Of the tree species (Table 3), the density of *Prosopis juliflora,* an invasive plant, was significantly higher inside the floodplain ($t = 5.44$, $P = 0.00$). The basal area of this plant was significantly lower inside the floodplain ($t = -2.24$, $P = 0.03$), while that of *Vachellia zanzibarica* was marginally significant ($t = -1.95$, $P = 0.08$). *Prosopis juliflora* contributed the highest to IV 200 inside the floodplain, while *Vachellia tortilis* contributed the highest to IV 200 outside the floodplain (Table 1). *Barleria taitensis* and *Grewia tembensis* shrubs had the highest density inside and outside the floodplain respectively. However, there was no difference in the densities of any of the shrubs (Table 4), woody species saplings (Table 5) and seedlings (Table 6) between inside and outside the floodplain.

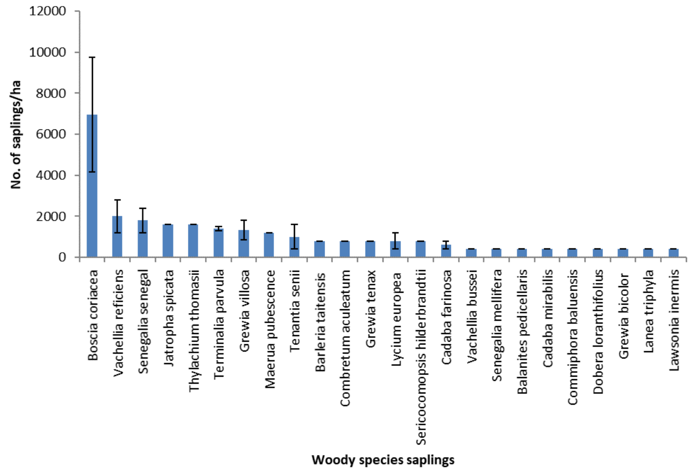


**Figure 5**: Mean densities and standard errors of woody species saplings found only outside the floodplain. Error bars are missing in cases where the standard error mean of the species was zero.

**Table 3:** The density (black), basal area (red) (Mean±SE), and IV 200 values (blue) of tree species found both inside and outside the floodplain. ±0 means there was no variation

| Species | In flood-plain | Outside floodplain | t- value | P - value |
|---|---|---|---|---|
| *Vachellia nilotica* | 100±0<br>6.0±0.0<br>0.5 | 400±0<br>2.1±1.1<br>1.4 | -<br>1.64 | -<br>0.20 |
| *Vachellia robusta* | 150±50<br>13.9±12.3<br>2.1 | 100±0<br>5.4±1.0<br>0.9 | 1.00<br>0.53 | 0.42<br>0.63 |
| *Vachellia tortilis* | 200±100<br>4.1±3.1<br>1.6 | 500±253<br>16.5±6.0<br>19.6 | -0.70<br>-0.81 | 0.51<br>0.43 |
| *Vachellia zanzibarica* | 267±33<br>2.1±0.4<br>2.8 | 300±0<br>8.2±3.7<br>3.2 | -0.78<br>-1.95 | 0.50<br>0.08<br>0.34 |
| *Dobera gla-bra* | 150±50<br>8.4±2.6<br>1.6 | 275±75<br>23.1±9.4<br>10.9 | -1.08<br>-0.79 | 0.44 |
| *Dobera loranthifoli-us* | 100±0<br>9.6±0.0<br>0.6 | 200±0<br>24.4±21.5<br>2.1 | -<br>-0.40 | -<br>-0.76 |
| *Lecaniodis-cus fraxini-folius* | 200±100<br>13.5±6.1<br>5.6 | 100±0<br>4.2±0.0<br>0.4 | 0.45<br>0.51 | 0.69<br>0.63 |
| *Maerua pubescence* | 100±0<br>2.0±0.0<br>0.3 | 240±117<br>11.5±3.5<br>7.6 | -0.49<br>-0.76 | 0.65<br>0.46 |
| *Prosopis juliflora* | 1825±259<br>5.6±0.7<br>33.2 | 460±93<br>10.0±2.6<br>13.5 | 5.44<br>-2.24 | 0.00<br>0.03 |
| *Salvadora persica* | 100±0<br>8.6±3.6<br>1.1 | 520±174<br>10.7±2.3<br>15.9 | -1.44<br>-0.25 | 0.21<br>0.80 |
| *Terminalia parvula* | 200±0<br>9.3±4.2<br>1.1 | 150±50<br>23.5±19.5<br>3.1 | 0.58<br>-0.56 | 0.67<br>0.62 |

**Table 4:** Comparison of density means of shrub species found both inside and outside the floodplain (Mean±SE), ±0 means there was no variation in density.

| Species | In floodplain | Outside floodplain | t- value | P - value |
|---|---|---|---|---|
| Barleria taitensis | 4000±1600 | 400±0 | 1.13 | 0.38 |
| Cordia sinensis | 533±133 | 1100±473 | -0.99 | 0.37 |
| Grewia tembensis | 400±0 | 2100±681 | -1.12 | 0.35 |
| Grewia tenax | 1200±0 | 1120±388 | 0.08 | 0.94 |
| Indigofera lupatana | 2400±2000 | 400±0 | 0.58 | 0.67 |
| Phyllanthus ovalifolius | 3440±627 | 1733±353 | 1.95 | 0.10 |
| Phyllanthus sepialis | 1600±693 | 400±0 | 0.87 | 0.48 |

**Table 5:** Comparison of mean density of woody species saplings found both inside and outside the floodplain (Mean±SE), ±0 means there was no variation in density.

| Species | In flood-plain | Outside floodplain | t- value | P - value |
|---|---|---|---|---|
| Vachellia zanzibarica | 533±133 | 400±0 | 0.78 | 0.5 |
| Cordia sinensis | 2200±200 | 400±0 | 5.20 | 0.12 |
| Dobera glabra | 1200±0 | 1760±601 | -0.38 | 0.72 |
| Phyllanthus ovalifolius | 3400±200 | 4800±0 | -4.04 | 0.15 |
| Prosopis juliflora | 8160±2084 | 5500±3008 | 0.75 | 0.48 |

**Table 6:** Comparison of mean density of woody species seedlings found both inside and outside the floodplain (Mean±SE), ±0 means there was no variation in density.

| Species | In floodplain | Outside floodplain | t-value | P-value |
|---|---|---|---|---|
| Cordia sinen-sis | 4±0 | 6±2 | -0.58 | 0.67 |
| Phyllanthus ovalifolius | 4±0 | 4±0 | - | - |
| Prosopis juliflora | 27±8 | 11±5 | 1.27 | 0.23 |

## Discussion

The floodplain was richer in tree species but poorer in shrub, saplings and seedlings. This was probably due to the fact that the taller trees inside the floodplain had large crowns that reduced the amount of light penetrating onto the shorter vegetation. Generally, the effect of shading reduced seedling recruitment and growth rates of shorter trees, some shrubs and non-woody species. This finding concurs with that of Kohyama (1993) who found that crowns of taller trees reduced the amount of light penetrating onto crowns of shorter trees, reducing their growth and seedling recruitment rates. Weeding is non-selective and uproots indigenous tree seedlings, some of which are slow growing. The density of saplings and seedlings indicates the potential of woody plant species to regenerate naturally (Mligo, 2009). Thus, the potential for regeneration as indicated by the seedling density, was higher in the floodplain. However, most of the seedlings thrived best between gaps of taller vegetation where there was sufficient light penetration.

In arid and semi- arid areas where there is minimal precipitation and frequent droughts, water availability strongly influences the composition and abundance of plant species. Flood water provides water and nutrients that enhance the growth of invasive plant species (Howell & Benson, 2000) and consequently the growth of other plant species. Seasonal river flooding, according to Amoros & Bornette (2002), can act as a natural disturbance, causing an abrupt change in natural plant communities (Resh et al. 1988). The similarity in the overall density of woody species inside and outside the floodplain, and the low overall basal area of tree species in the floodplain, suggests that other factors besides the floodplain influenced woody plant abundance. Anthropogenic disturbances such as clearing of vegetation to pave way for crop farming and weeding reduced the overall woody plant density and basal area of trees. The County government has also officially allowed charcoal production using Prosopis juliflora as a measure to reduce its density. However, this has only lowered the basal area of this invasive plant, but not its density since it sprouts right back after cutting. Moreover, the conditions in the floodplain favor its regeneration.

### Dynamics of vegetation inside the floodplain only

Among the 24 tree species found only inside the floodplain, Rinorea elleptica and the fruit trees Mangifera indica and Musa paradisiaca, mainly planted for commercial purposes, had the highest density. Of the shrub species that were found only inside the floodplain, Thespesia danis, an indicator of disturbance, had the highest density. This shrub was found mainly in Arawale National Reserve and also in areas frequented by cattle in Hola during the dry season and thus disturbed by livestock grazing. The plant species found only inside the floodplain are adapted to conditions of more moisture and nutrients. However, they are more susceptible to factors that influence flooding regimes, such as climate variability and flood control through construction of dams for generation of hydroelectric power. Construction of dams can reduce the quantity of floods and alter the peak flows, thereby affecting the density and diversity of plants due to reduced water and nutrients. A study by Maingi and Marsh (2002) demonstrated that the construction of Masinga and Kiambere Dams in 1981 and 1988 respectively had significantly augmented minimum river flows and reduced peak flows. Climate variability on the other hand can lead to either droughts or floods, reducing or increasing river flows and peak flows and hence the density and richness of woody plant species. The woody plant species that occur only inside the floodplain at low densities are likely to be most at risk because they are specific to this particular habitat.

### Dynamics of vegetation outside the floodplain only

The tree species found only outside the floodplain were fewer than those found only inside the floodplain. In the case of shrub species, the number of species found only outside the floodplain was double the number found only inside the floodplain. However, except for Salsola dendroides whose density was high, the other shrub species occurred at relatively low densities.

The woody plant species that occurred only outside the floodplain were adapted to drier conditions compared to those found only inside the floodplain. These species depend on natural precipitation for regeneration and growth and thus would not be affected by changes in flooding regimes caused by construction of dams upstream. However, droughts linked to climate variability can affect their abundance since water is the main factor limiting germination, emergence and survival of seedlings in arid and semi-arid areas (Rohner & Ward 1999; Stave et al. 2006). The other threats to the existence of these species would be anthropogenic causes such as cutting down the woody species for charcoal production and for construction purposes.

**Dynamics of woody species found both inside and outside the floodplain**

The plant species that occurred both inside and outside the floodplain can thrive in varied moisture conditions. Moreover, the species outside the floodplain can help preserve the species in case those inside the floodplain are threatened by climate variability and other anthropogenic factors. Since flood water provides water and nutrients that enhance growth of plants, all the plant species are expected to thrive better inside the floodplain than outside the floodplain. However, this only applied to Prosopis juliflora whose density was high inside the floodplain. This finding concurs with that of Mworia et al. (2011) who found the regeneration of this invasive plant to be high inside the floodplain. The high IV 200 value of Prosopis juliflora inside the floodplain was therefore attributed mainly to its high density rather than its basal area which was significantly low. Prosopis juliflora and Lecaniodiscus fraxinifolius were the only species with IV 200 values that were higher in the floodplain than outside. Some indigenous trees like Vachellia tortilis, Salvadora persica, Dobera glabra and Maerua pubescence had IV 200 values that were higher outside the floodplain than inside. For these trees, the high IV 200 values were attributed to both their densities and basal areas. The anthropogenic disturbances in the floodplain such as weeding negatively affect the indigenous plants. Weeding is non-selective and uproots indigenous plant seedlings, many of which are slow growing, reducing their density and diversity.

The invasion of Prosopis juliflora was higher inside the floodplain since nutrient enrichment increases invasion (Davis et al. 2000; Kolb et al. 2002). This resulted to reduction in diversity of native species by competitively displacing them through direct competition for abiotic resources (Levine et al. 2003). A research in the Czech Republic by Hejda et al. (2009) found that species diversity, richness and evenness were reduced in invaded plots as well as at the landscape scale. Introduction of invasive species leads to change in the structure and composition of native communities (Rice & Emery, 2003) and can even lead to their extinction (Ortega & Pearson, 2005). A research by Gooden & French (2014) on non-interactive effects of plant invasion and landscape modification on native communities in south eastern Australia found that invasion resulted to altered community compositions and reduced rates of woody plant recruitment. It is possible that the increased invasion by Prosopis juliflora contributed to reduced rates of recruitment and hence resulted to a decline in the density of the indigenous species in close proximity.

## 4. Conclusion

The results have shown that the potential for regeneration of woody species was higher inside the floodplain. Prosopis juliflora had the highest IV 200 value which was attributed to its high density. Among the indigenous tree species, Vachellia tortilis contributed the highest to IV 200 outside the floodplain. The most important trees in the study area in order of importance were Prosopis juliflora, Vachellia tortilis, Salvadora persica, Dobera glabra, Maerua pubescence, Rinorea elleptica, Mangifera indica, Commiphora riparia, Vachellia zanzibarica and Lecaniodiscus fraxinifolius. Vegetation community composition and structure in Tana River County varied with the cross-sectional floodplain gradient. It was influenced by climate variability, invasion by Prosopis juliflora and land-use practices. The effect of dam construction and climate variability, coupled with the effects of land use changes and Prosopis invasion could have synergistic effects, seriously affecting the composition of indigenous plant species. The risk is more for the species found at low densities only inside the floodplain where the density of Prosopis juliflora is significantly high. The construction of the new dam will reduce water quantity and nutrients downstream and further limit the establishment and survival of these species. Plant species which had high densities outside the floodplain will likely be favored if they are not harvested for charcoal production or/and other uses.

**Acknowledgements**

The authors acknowledge the Organization for Women in Science for the Developing World (OWSD) for financing the study. Special gratitude goes to Kimeu Musembi and Kyalo Mutiso for assisting in data collection and identification of vegetation in the study area. Last but not least, we are grateful to Kenya Wildlife Service for facilitating access to Tana River and Arawale National Reserves in Tana River County.

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