



## Diversity and Structure of Woody Species in Urban Forests of Sahel Cities, Niger

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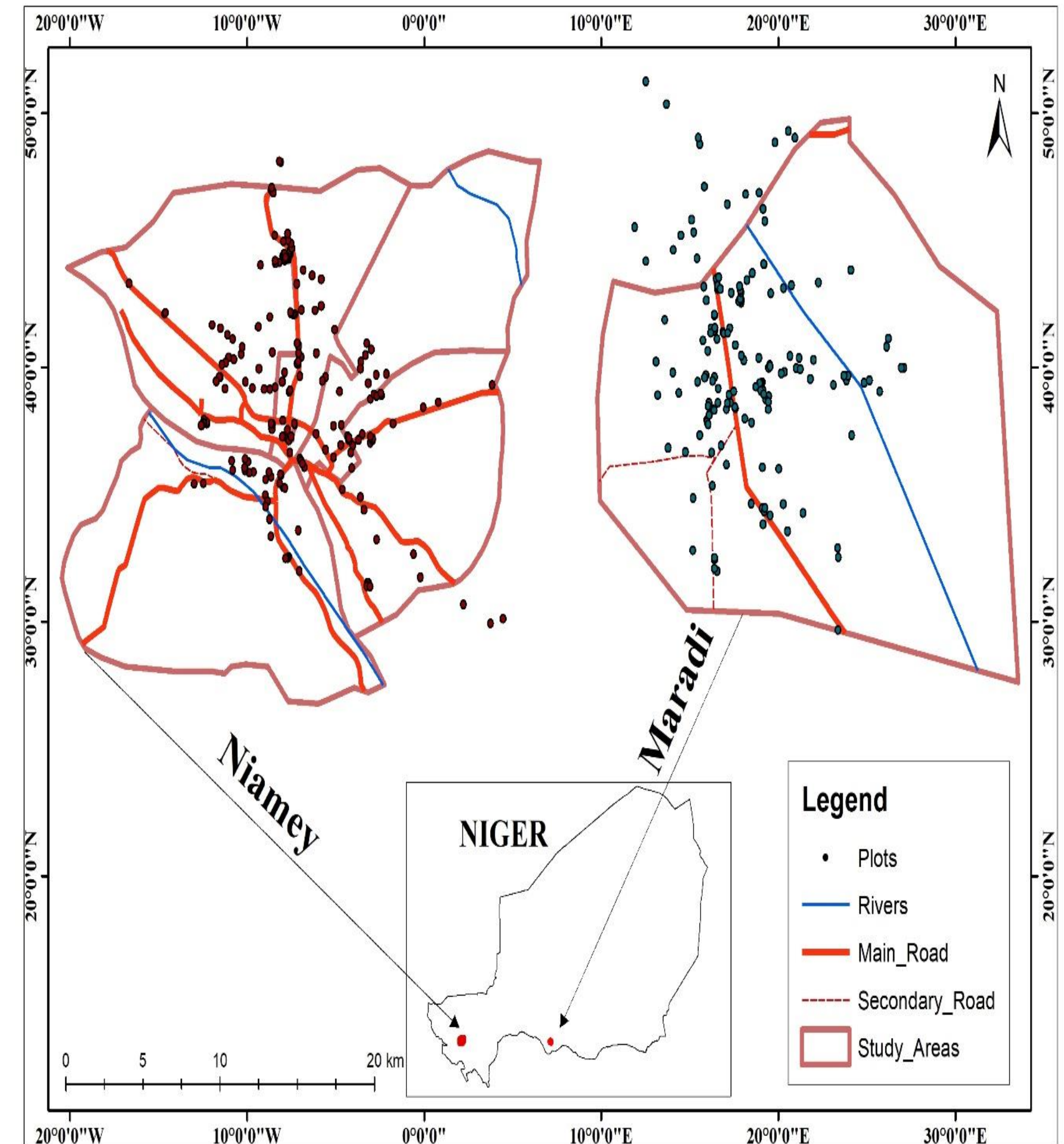


# *Overview of the project*

- Aim: To determine how urban forests shape species diversity and community structure of woody species in human settlements in the Sahel.
- Hypothesis: Built areas have higher Woody species diversity and structural values in Sahel urban areas than peri-urban areas. Does basal area correlated with specie richness?
- Sponsor: German Federal Ministry of Education and Research (BMBF) via West African Science Centre on Climate Change and Adapted Land Use (WASCAL, [www.wascal.org](http://www.wascal.org) ).
- PhD Work at Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

## Study areas

- Study area: Niamey and Maradi in Niger, West Africa.
- Population : (1,026,848 people in Niamey and 326,804 in Maradi)
- Climatic conditions: Rainfall : 150 mm to 350 mm; and annual mean temperature (29.2°C in Niamey, 27.3 °C in Maradi).
- Annual population growth (3.9%).
- Firewood constitutes 90% of the domestic energy.



# Introduction

- Urban forests serve important socio-economic and ecological functions.
- They have many peculiar characteristics different from natural forests and plantation forests e.g. location, size, shape and ...
- They are influenced by the decisions of a wide range of stakeholders with different interests and capacities for managing forests.
- Through urban forests different species are assembled from far and near and made to interact in a manner which may not occur in natural ecosystems.
- There is therefore a need to explore these peculiarities for a better understanding of the socio-economic and ecological contexts under which urban forests exist and function.
- One of the important characteristics of a forest is its species diversity.
- In regions endowed with high biodiversity such as the humid tropics natural forests may be far superior to urban forests in species diversity.
- However in dry environments such as the Sahelian region that have low species diversity, it is uncertain how species diversity and other forest characteristics in urban forests compare with those in natural and semi-natural forests.

- Survey design: Stratified random sampling

Strata : commercial areas, administrative areas, forested areas, road, school, residential areas which form the built areas and peri-urban forest.

- Plot method and questionnaire about if the species are planted or are natural stand kept during construction
- Dendrometric variables : height, diameter at breast height using graduated poles and diameter tape
- Biodiversity indices (Shannon, evenness, richness), origin of the species (Native or exotic) and number of genera and families were used for floristic analysis.
- Structural parameters (Basal area and stem density) for analyzing the structure.
- ANOVA, and descriptive statistics to analyse the pattern of diversity and structure across land use and land cover gradient.

# Results

- A total of 115 woody species was documented belonging to 82 genera in 35 families in two cities.
- Exotic species accounted for 62 and 77% of all species in two cities.
- Residential areas had a higher species richness than other land uses.
- Built area forests had a higher species richness than peri-urban forest.
- Biodiversity indices and structural parameters varied significantly ( $p < 0.001$ ) among the LUC In both cities.
- About 58% of the native species were natural stands kept in Niamey
- While 62 % of native species were planted in Maradi .
- Richness had effect on basal area ( $p < 0.001$ ) among the LUC In both cities.

Cities	LULC	Stem density (ha)	Basal area (m <sup>2</sup> /ha)	Richness	Shannon	Evenness	Exotic	Native
Niamey	Administrative areas	82	8.49	38	2.79	0.77	22	16
Maradi		158	15.37	52	2.67	0.68	27	25
Niamey	Commercial areas	51	6.79	13	1.78	0.69	6	7
Maradi		184	14.54	30	2.4	0.71	17	13
Niamey	Forested areas	65	6.4	38	2.05	0.56	13	25
Maradi		90	4.98	41	2.6	0.7	13	28
Niamey	Residential areas	66	5.78	45	2.85	0.75	23	22
Maradi	Residential areas	216	11.62	56	2.67	0.66	35	21
Niamey	Road	108	16.3	28	2.33	0.7	16	12
Maradi		192	19.36	31	1.33	0.39	17	14
Niamey	School	74	10.35	35	1.84	0.52	16	19
Maradi		117	9.3	29	0.84	0.25	14	15
Niamey	Peri-urban forest	48	5.74	25	2.5	0.78	6	19
Maradi		43	3.65	22	2.62	0.85	2	20
Niamey	Overall	70	59.85	86	2.69	0.6	42	44
Maradi		126	78.82	91	2.45	0.54	44	47

## DISCUSSION

- The results show a high species diversity in both cities as the Shannon diversity index for the two cities was greater than 2.0, which indicates medium to high diversity (Magurran, 2004).
- Urban areas are biodiversity refugia (Alvey ,2006) which was also confirmed by our study that Sahel cities (Niamey and Maradi).
- A high diversity is also critical for the provision of multiple ecosystem services (Nowak and Dwyer, 2007) which implies the need for sustainable conservation of woody species in two cities.
- Urban areas are dominated across the world by exotic species which was confirmed by our study.
- But this should be a worry for native species conservation as this may lead to biotic homogenization (Mckinney, 2006).

### 3. Discussion

- Peri-urban forest had less specie diversity even the native flora which may indicate the depletion or loss of native species diversity as pointed out by (Larwanou and Saadou, 2005).
- The high stem density is an indication of urban afforestation programmes in two cities.
- Diversity increases productivity measured by basal areas in the two cities. This matches the finding of (Erskine et al., 2006)
- This may be due tree enthusiasts may be the ones likely to plant many species and in the same way plant many stems thus creating a relationship between diversity and basal area.
- Residential areas had higher diversity which may be due to the socio-economic background of urban dwellers in two cities. (private individual control as against institutional control in other LULC types).
- Native woody species are used in urban greening in Maradi which is important for urban youth urban forestry education. (Green belt of Niamey,1965; National Arbour Day (1974, each 3 August); Sékou Touré green space of Maradi (1982); Operation Green Sahel (1980) etc.)



## Conclusions

- Findings show that Niamey and Maradi have a high tree species richness and that the woody flora is dominated by individuals of exotic origin.
- Species diversity and structure decrease from peri-urban forests to the built areas.
- This information is essential for sustainable management of urban forests in Niger, including planning for conservation measures and enhancement planting.
- Details of composition and structure of urban flora provided in this study can be adapted into programs that evaluate ecosystem services of urban forests, allowing inclusion of urban vegetation in urban-planning decisions for sustainable cities in Niger.



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