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DISTRIBUTION OF WEED SPECIES IN CASSAVA (*MANIHOTS* SPP) FIELDS USING GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN DERIVED SAVANNA AGRO-ECOLOGY OF NIGERIA

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ABSTRACT: *The investigation of weed spectrum in cassava fields was carried out in Derived savanna agro-ecology (Ido local government area) of southern Nigeria in August during the rainy season of 2017. Thirteen (13) cassava farms were surveyed. Coordinate points, elevation of the investigation sites and mapping were conducted with Geographic information system (GIS). Weed flora composition of each location was studied by sampling randomly using 'M' pattern of quadrat placement and average from the samples was recorded. Results showed that thirty six (36) weed species cutting across twenty one (21) families were identified. This showed the rich flora composition of the agro-ecology and the dominance of the identified weed flora. Tridax procumbens, Talinum fruticosum, Euphorbia heterophylla, Chromolaena odorata and Ageratum conyzoides were the most frequent weed species and evidently showed their broader environmental tolerance. Weediness in cassava fields ranged from $^{4.67}/_{10}$ to $^{8.33}/_{10}$ across locations. Cultural practices, cassava canopy coverage and location might have influenced the weediness and weed flora composition in cassava plots.*

KEYWORDS: Weed Flora Composition, Weediness, Geographic Information System (GIS), Derived Savanna

INTRODUCTION

Cassava (*Manihot esculenta Crantz*) is a major crop grown in Derived savanna agro-ecology of Nigeria. Cassava is one of the major staple foods in Nigeria and it provides major source of calories to many people in African countries (IITA, 2002). The production is heightened as a result of its foreign exchange earning potential and its ability to give substantial yield where other crops may fail.

Weeds, which could be annual, biennial, perennial, broad leaved, grasses, sedges, irrespective of their habitat are a major constraint in crop production. Weeds commonly occur in cassava crops, their infestation and poor management is a major yield-reducing factor (Melifonwu, 1994). The magnitude of yield loss in relation to weed infestation in cassava plot depends on crop cultivar, weed species, weed density, duration of interference, and environmental conditions (Maataoui *et al*. 2003, 2005; Harker *et al*. 2013; Das, 2011; Akobundu, 1987). Weed infestation in cassava causes root yield loss of about 46-95% (Olorunmaiye *et al*. 2009; Agahiu *et al*. 2011). Aside low soil fertility that is a common problem in continuous cropping in most tropical agro-ecologies, weed infestation significantly reduce crop yield and must be identified for appropriate management (Davis *et al*. 2005). The knowledge of weed diversity, biology and competition with crops is of importance in weed management.

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Surveying weed flora composition and distributions within a given agro-ecology can be useful for identifying potential weed problem and formulating weed management strategies to combat menace (Thomas, 1985; Lemerle *et al*. 2001; Fried and Reboud, 2007). This will also inform future weed science research efforts and prevent weeds from reaching endemic status. Significant changes in control strategies and cropping pattern will inevitably affect weed species composition in agricultural fields (Aluko *et al*. 2015), and weed surveys can help to monitor these effects.

According to Miller and Stafford (1991), map-based approach in which weed populations located on a map can be converted to a treatment or application map and used to control the sprayer of herbicides is essential for effective and precision weed control. Computer technology has been broadly utilized to design application systems for precision weed management in recent times. Investigation involving the use of Geographic Information Systems (GIS) to fully collect data and develop spatially accurate graphical data displays to enhanced weed management and minimize wastage (Main *et al.* 2004; Ahmad *et al.* 2010). The objective of this study was to identify weeds, quantify infestation status and map weeds in cassava fields in Ido LGA (Derived Savanna agro-ecology) of Nigeria.

MATERIALS AND METHODS

The investigation was carried out in Ido local government area (LGA) of Oyo state. Ido LGA is located in Derived savanna agro-ecology of southern Nigeria. The weed flora composition of thirteen (13) cassava fields in LGA was surveyed in August during the rainy season of 2017. The coordinate points and elevation of the investigation sites were determined with Global Positioning System (GPS). Weed flora composition of each location was studied with the use of 1 sq.m quadrat sampled randomly using 'M' pattern of sampling and average from the samples was recorded. Weed species observed were identified with the Handbook of West African weeds (2016). Weediness of cassava fields were visually rated using a scale of 1 to 10, where 1 is the lowest and 10 is the highest rate. Data collected were subjected to Descriptive Analysis. Mapping of frequent weeds and weed morphology were carried out with GIS to determine the geographical coverage of weeds.

RESULTS AND DISCUSSION

Table 1 shows the coordinates of the sampled locations in the study. The latitude ranged from 7.3915˚N (Apatagangan) to 7.5519˚N (Batake), while the longitude is from 3.6034˚E (Onikankan) to 3.8398˚E (Apatagangan). The altitude ranged from 140 – 263 m above sea level. This may play significant role in the types of weeds identified in the sampled locations within the agro-ecology.

Table 2 shows the weed flora composition in cassava fields in Derived savanna agro-ecology (Ido LGA) of Oyo state. Thirty-six (36) weed species, across twenty-one (21) families were identified in thirteen cassava fields surveyed. This showed the rich biodiversity of the agro-ecology and the dominance of the identified weed flora. The variation in weed spectrum might have been influenced by both location and cultural practices over time. This is in line with the findings of Aluko *et al*., (2015), that weed flora composition in a cropping system are influenced by the cultural practices. In a recent study comparing the invasiveness of speargrass

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(*Imperata cylindrica*) in different agro-ecologies, it was also detected that location, weed control method and weather elements (amount and distribution) influenced the density and geographical range (Aluko *et al*. 2018). Invariably, the weed control methods might have influenced the weed flora composition in the study location as better fraction (3/5 or 60%) of the identified weed species are annual weeds. According to Das, (2011), frequently disturbed agroecology are dominated by annual weeds due to their short growth cycle. Although, 40 % perennial weeds recorded might have adapted to the frequent manual weeding through their propagules. The longer duration of cassava (9 months – 2 years) might also influence the incidence of perennial weeds recorded in the locations.

In table 2, weed morphology recorded showed that 70% were broadleaf. Derived savanna agro-ecology shows wide biodiversity and richness in flora composition. In a disturb agro-ecology, where cropping activities are continuous, weed flora dynamics it's a continuum (Das, 2011). Changes do occur as a result of the various cropping activity. A shift in weed flora composition occur from grass weed to broadleaf weeds depending on the crop under cultivation and weed control option(s) adopted. Where dicot crop plants are cultivated, selective herbicides are normally applied to control grass weeds and viz. This invariably causes a weed flora shift from grass weeds to broad-leaf weed in dicot crop plants over time. This might account for the frequency of broad- leaf weeds and lower fraction of other weed types recorded in the study.

Table 3 shows the distribution of weeds composition at different locations in Ido LGA during rainy season of 2017.

Weediness of cassava fields in Ido LGA

Figure 1 shows the weediness in cassava fields in Derived savanna (Ido LGA) agro-ecology. Weediness ranged from $^{4.67}/_{10}$ to $^{8.33}/_{10}$ across locations. Weeds commonly occur in cassava crops and their infestation is a major yield-reducing factor (Melifonwu, 1994). Variations in weediness across location sampled might have resulted from differing cultural practices, timing of weed management intervention, location of the cassava plots, weed growth pattern and cassava canopy coverage. This might determine the magnitude of yield loss, depending on crop cultivar and duration of competition (Maataoui *et al*. 2003, 2004, 2005; Harker *et al*. 2013; Das, 2011). Weed infestation was reported to reduce cassava yield by about 46-95% as reported by Olorunmaiye *et al*., (2009) and Agahiu *et al*., (2011).

Figures 2 to 6 show the spread of predominant weed species in the study. The relative abundance of *Tridax procumbens, Talinum fruticosum, Euphorbia heterophylla, Chromolaena odorata, Synedrella nodiflora, and Ageratum conyzoides w*ere frequent weed species across the cassava fields studied. This might be due to high fecundity and dispersal mechanism of the aforementioned weed species. Evidently, these weed species had broader environmental dominance. Weed dominance is a function of weed type, host specificity, weed control option(s), crop cultivar and competitiveness, weeds fecundity and dispersal mechanism. High prolificacy and airborne seeds produced in *Tridax procumbens*, *Ageratum conyzoides, Synedrella nodiflora, Chromolaena odorata, and Aspillia Africana;* coupled with the drought tolerance of *Talinum fruticosum* and *Tridax procumbens* allow multiplication and over-seasoning in crop fields. The propagation and niche formation of *Euphorbia heterophylla* and *Talinum fruticosum* through explosive mechanism enhance multiplicity and geographical range and better adaption to adverse environments (Das, 2011; Akobundu, 1987). According to Bell, (2005), the weedy nature of these species often gives them advantage over desirable crop species because they often grow and reproduce quickly, have seeds that persist in the soil seed

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bank for many years, or have short life span with multiple life-cycle in the same growing season. This might have accounted for their dominance in the agro-ecology.

Summary

A survey of the weed richness was conducted in Ido LGA in Derived savanna agro-ecology of Nigeria, where crop production is the main occupation in the communities and cassava production formed staple and cash crop production activity. Thirty six (36) weed species cutting across twenty one (21) families were identified in thirteen cassava fields charted. This showed the rich biodiversity of the study area and the dominance of the identified weed flora. *Tridax procumbens*, *Talinum fruticosum*, *Euphorbia heterophylla*, *Chromoleana odorata*, *Synedrella nodiflora and Ageratum conyzoides were* the most frequent weed species across the cassava fields studied. Cultural practices and weed species adaptive traits might have influenced dominance of weeds identified. Weediness ranged from $^{4.67}/_{10}$ to $^{8.33}/_{10}$ across locations. This is a function of cultural practices.

Table 1: Coordinates of the sampled points in Ido LGA in 2017

Location	Name of Location	Latitude (˚N)	Longitude (˚E)	Altitude (m)
L1	Tade	7.412280	3.753407	179
L2	Oloke	7.439293	3.751627	189
L3	Apatagangan	7.391527	3.839766	168
L4	Inalende	7.482572	3.812663	263
L5	Olude	7.489612	3.824006	253
L6	Olorunda	7.506989	3.802049	236
L7	Ido	7.487569	3.738248	187
L8	Alaka 1	7.541916	3.684862	199
L9	Alaka 2	7.543938	3.681367	197
L10	Batake	7.551942	3.665564	183
L11	Onikanga	7.527077	3.670694	208
L12	Osho	7.512372	3.671093	166
L13	Onikankan	7.538715	3.603464	140

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Table 2: Summary of weed flora composition in cassava fields Derived savanna

Weed species	Family	Morphology	Life cycle	Weed frequency
Ageratum conyzoides L	*Asteraceae*	B	A	VF
Solanium torrum	*Solanaceae*	B	A/P	LF
Euphorbia heterophylla L.	*Euphorbiaceae*	B	A	F
Synedrella nordiflora	*Asteraceae*	B	A	LF
Commelina benghalensis L	*Commelinaceae*	Sp	P	LF
Panicum maximum Jacq	*Poaceae*	G	A/P	LF
Desmodium scorpiurus (sw) Desy	*Fabaceae*	B	A	LF
Mimosa pudica	*Mimosoideae*	B	A/P	F
Mimosa invisa (mart)	*Mimosoideae*	B	A/P	F
Acalypha fimbriata	*Euphorbiaceae*	B	A	LF
Axonopus compressus (sw.) P. Beauv	*Poaceae*	G	A/P	VF
Tridax procumbens L	*Asteraceae*	B	A/P	VF
Talinum fruticosum (Jacq.) Wild	*Portulacaceae*	B	A	LF
Calopogonium mucunoides	*Leguminoseae*	B	A/P	LF
Sclerocarpus africanus Jacq. Ex Murr	*Poaceae*	G	A/P	F
Ipomoae triloba	*Convolvulaceae*	B	A/P	F
Alchornea cordifolia	*Euphorbiaceae*	B	A	LF
Spigelia anthelmia (Linn)	*Loganiaceae*	B	A	LF

Legends: LF- Less frequent, F- Frequent, F- Frequent, VF- Very frequent, B- Broad leaf, P- Perennial, G- Grass, A- Annual, S- Sedge

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Table 2: Summary of weed flora composition in cassava fields Derived savanna cont'd

Weed species	Family	Morphology	Life cycle	Weed frequency
Euphorbia hirta (Linn.)	*Euphorbiaceae*	B	A	LF
Boerhavia diffusa	*Nyctaginaceae*	B	A/P	LF
Azadirachta indica	*Maliaceae*		P	LF
Aspillia africana	*Asteraceae*	B	A/P	LF
Chromolaena odorata	*Asteraceae*	B	A	VF
Ipomomea involvucrata	*Convolvulaceae*	B	A	LF
Ficus exasperata	*Moraceae*	B	P	LF
Senna occidentalis	*Caesaepinoideae*	B		LF
Mitracarpus villosus	*Rubiaceae*	B	A	LF
Newbouldia laevis	*Bignoniaceae*	B		LF
Cyperus rotundus	*Cyperaceae*	S	A	LF
Cochlorspermum planchoni	*Cochlospermaceae*	B		LF
Sida garckeana	*Malvaceae*	B	A/P	LF
Combretum hispidium (Lawson)	*Combretaceae*	B		LF
Brachiaria deflexa (schumah.) Robyns	*Poaceae*	G	A	LF
Imperata cylindrical	''	G	P	LF
Sporobulus pyramidalis	''	G	A	LF
Chestis femiginea	*Connaraceae*	B		LF

Legends: LF- Less frequent, F- Frequent, F- Frequent, VF- Very frequent, B- Broad leaf, P- Perennial, G- Grass, A- Annual, S- Sedge

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Table 3: Weed flora composition in cassava fields in Derived savanna in 2017

Weed species	Family	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**	**L11**	**L12**	**L13**
Ageratum conyzoides	*Asteraceae*	p	p	p	p	-	-	p	-	p	p	-	p	p
Solanum torrum	*Solanaceae*	-	-	P	-	-	-	-	-	-	-	-	-	-
Euphorbia heterophylla	*Euphorbiaceae*	p	p	-	p	p	-	p	p	p	p	-	p	-
Synedrella nodiflora	*Asteraceae*	p	-	p	-	p	-	p	-	-	-	-	-	-
Commelina benghalensis	*Commelinaceae*	P	-	p	-	-	-	-	p	-	-	-	-	p
Panicum maximum Jacq.	*Poaceae*	p	-	-	-	p	-	-	-	p	-	-	-	p
Desmodium scorpiurus (sw) Desy	*Fabaceae*		-	p	p	-	-	-	-	-	-	-	-	-
Mimosa pudica	*Mimosoideae*	-	-	p	-	-	-	-	-	-	-	-	-	p
Mimosa invisa (Mart.)	*Mimosoideae*	-	-	-	-	p	-	-	-	-	-	-	-	
Acalypha fimbriata	*Euphorbiaceae*	p	-	-	-	-	-	-	-	-	-	-	-	-
Axonopus compressus (sw) P.Beauv.	*Poaceae*	p	-	-	-	-	-	-	-	-	-	-	-	-
Tridax procumbens	*Asteraceae*	p	p	p	-	p	-	p	p	-	p	p	p	p
Talinum fruticosum Jacq.Wild	*Portulacaceae*	P	p	-	-	p	p	p	p	-	-	-	-	p
Calopogonium mucunoides	*Leguminoseae*	-	p	-	p	-	-	-	-	p	-	p	-	-
Sclerocarpus africanus Jacq.	*Poaceae*	-	p	-	-	-	-	-	-	-	-	-	-	-
Ipomea triloba	*Convolvulaceae*	p	p	-	-	-	-	-	-	-	-		-	-
Alchornea cordifolia	*Euphorbiaceae*	-	-	-	-	p	-	-	-	-	-	-	-	-
Spigelia anthelmia (Linn.)	*Loganiaceae*	p	p	p	-	-	-	-	-	-	-	-	-	p

Legends: LF - Less frequent, F – Frequent, VF - Very frequent

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Table 3: Weed flora composition in cassava fields in Derived savanna in 2017 cont'd

Weed species		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13
Euphorbia hirta	*Euphorbiaceae*	-	p	p	-	-	-	-	p	-	-	-	-	p
Boerhavia diffusa	*Nyctaginaceae*	p	-	-	-	p	-	-	p	-	p	-	-	p
Azadirachta indica	*Maliaceae*	-	-	p	-	-	-	-	-	-	-	-	-	-
Aspillia africana	*Asteraceae*	-	p	-	p	-	-	p	-	-	-	-	-	p
Chromolaena odorata	*Asteraceae*	-	p	p	p	-	p	-	-	p	-	p	-	p
Ipomea involucrata	*Convolvulaceae*	-	-	-	p	-	-	-	-	-	-	-	-	-
Ficus exasperata	*Moraceae*	-	-	-	p	-	-	-	-	-	-	-	-	p
Senna occidentalis	*Caesaepinoideae*	-	-	-	p	-	-	-	p	-	-	-	-	p
Mitracarpus villosus	*Rubiaceae*	-	-	-	-	p	-	p	-	-	p	-	-	-
Newbouldia laevis	*Bignoniaceae*	-	-	-	-	p	-	-	-	-	-	-	-	-
Cyperus rotundus	*Cyperaceae*	P	-	-	-	p	-	-	p	-	-	p	-	p
Cochlospermum planchoni	*Cochlospermaceae*	-	-	-	-	p	-	-	-	-	-	-	-	-
Sida garckeana	*Malvaceae*	-	-	p	-	-	-	p	-	-	-	-	-	-
Combretum hispidium (Lawson)	*Combretaceae*	-	-	-	-	-	-	p	-	p	-	-	-	-
Brachiara deflexa (Schumach) Rob	*Poaceae*	-	-	-	-	-	-	-	-	p	-	-	-	-
Imperata cylindrica	''	-	-	-	-	-	-	-	p	-	-	p	-	p
Sporobolus pyramidalis	''	-	-	-	-	p	-	-	-	-	-	-	p	p
Chestis femiginea	*Connaraceae*	-	-	p	-	-	-	p	-	-	-	p	-	

P – presence of weed

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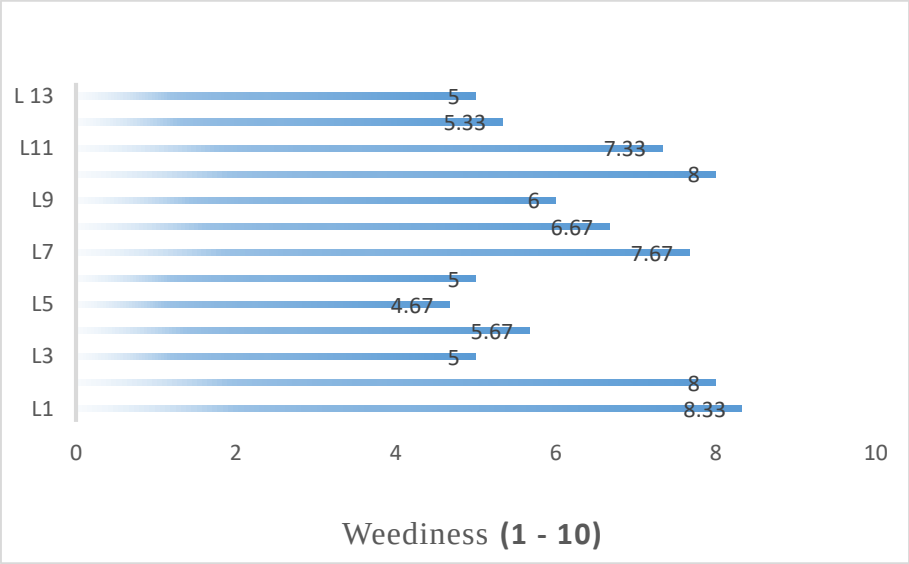

Figure 1: Weediness of cassava fields at sampled locations in Ido LGA (Derived savanna) in 2017

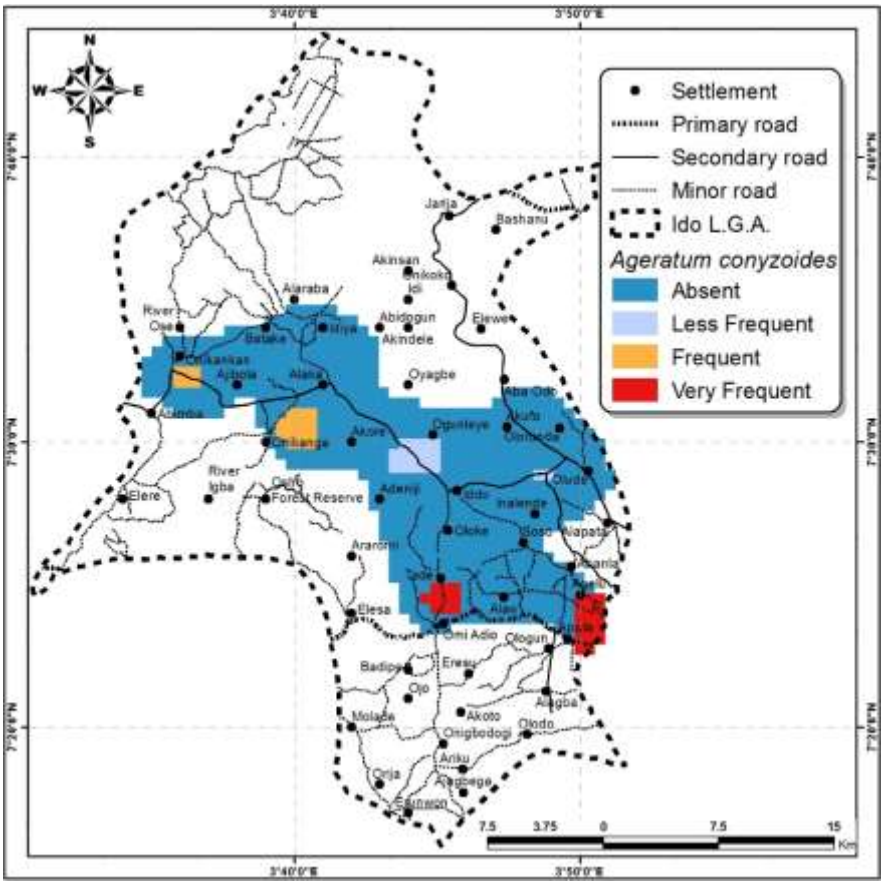

Figure 2: Distribution of *Ageratum conyzoides* in Ido LGA (Derived savanna)

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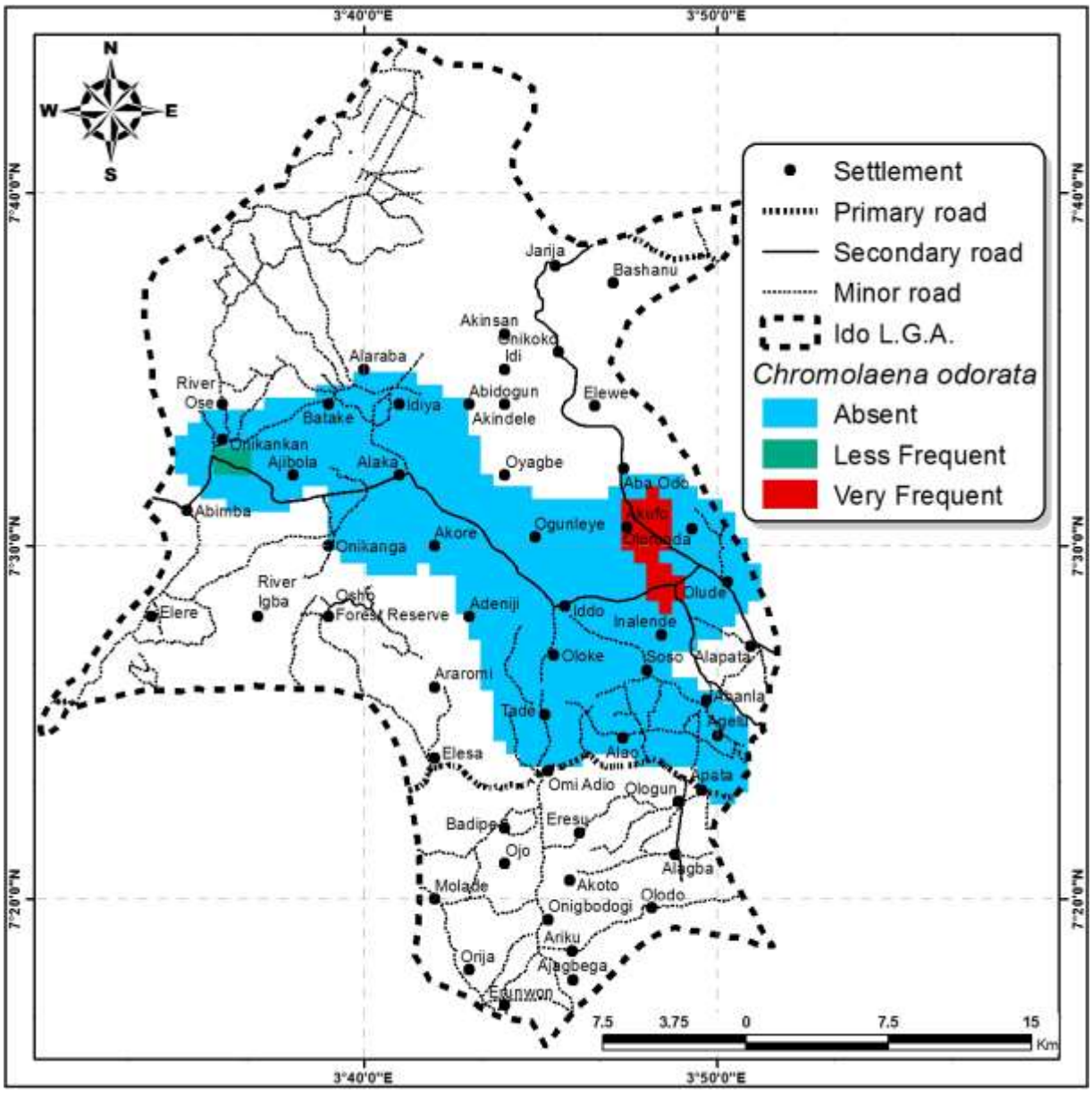

Figure 3: Distribution of *Chromolaena odorata* in Ido LGA (Derived savanna)

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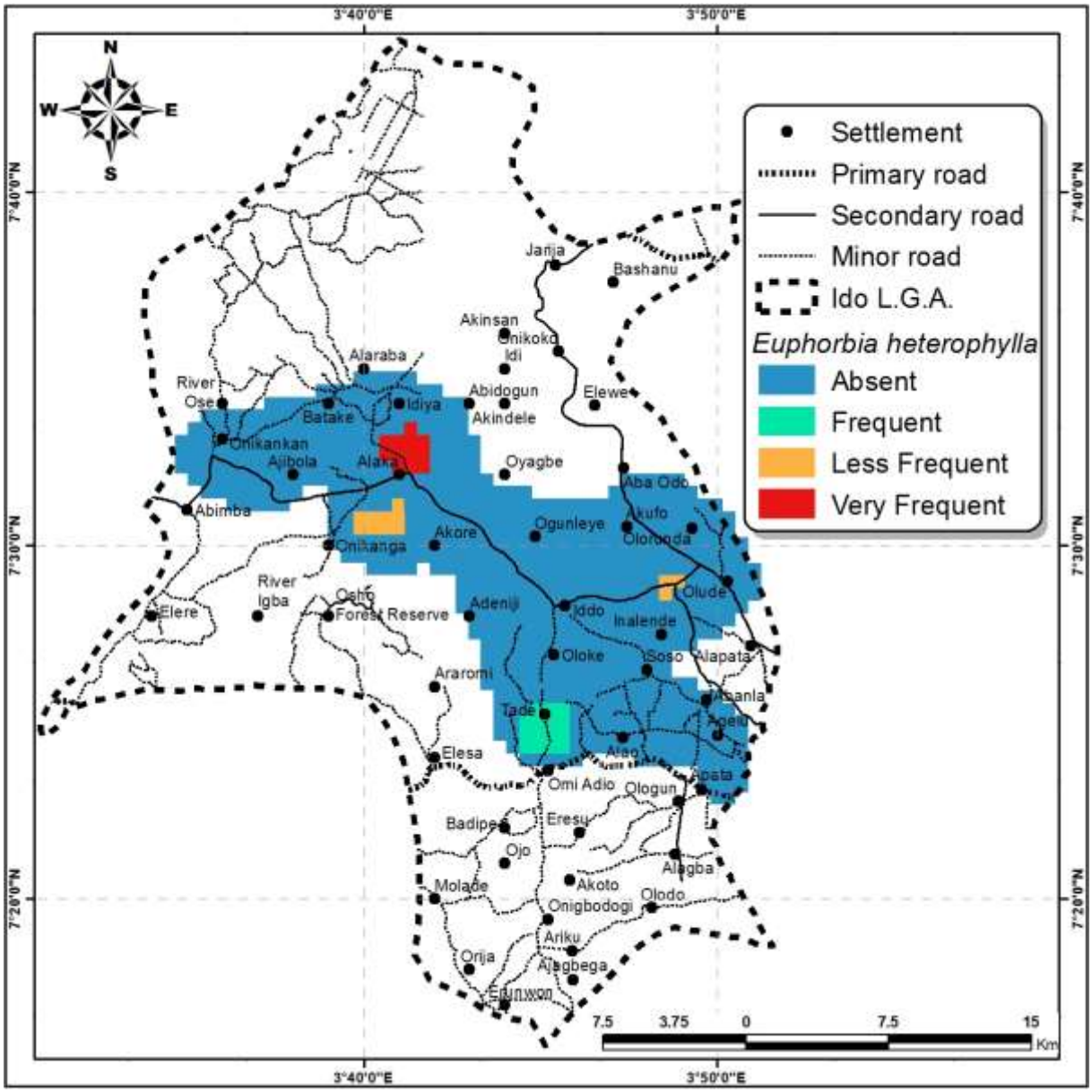

Figure 4: Distribution of *Euphorbia heterophylla* in Ido LGA (Derived savanna)

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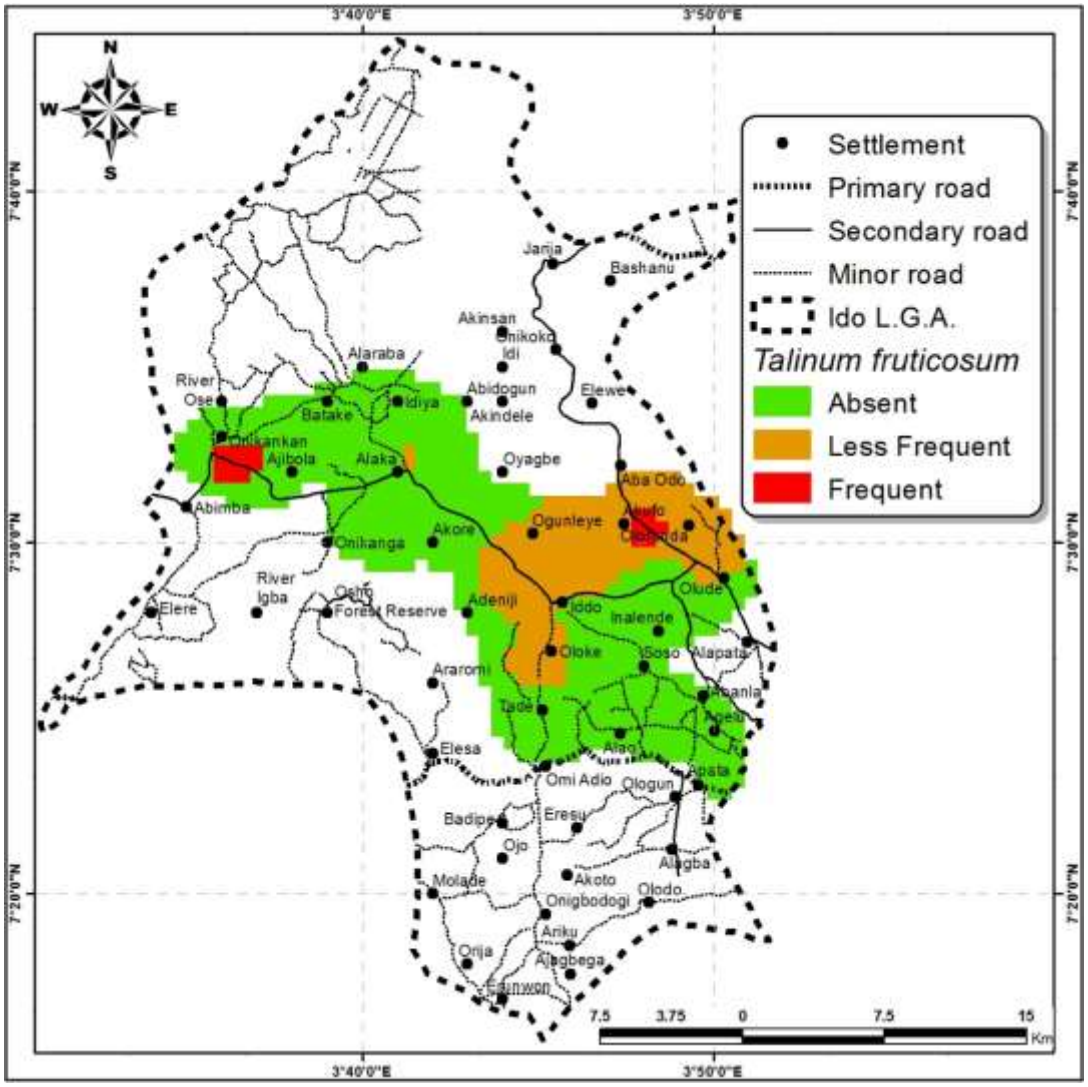

Figure 5: Distribution of *Talinum fruticosum* in Ido LGA (Derived savanna)

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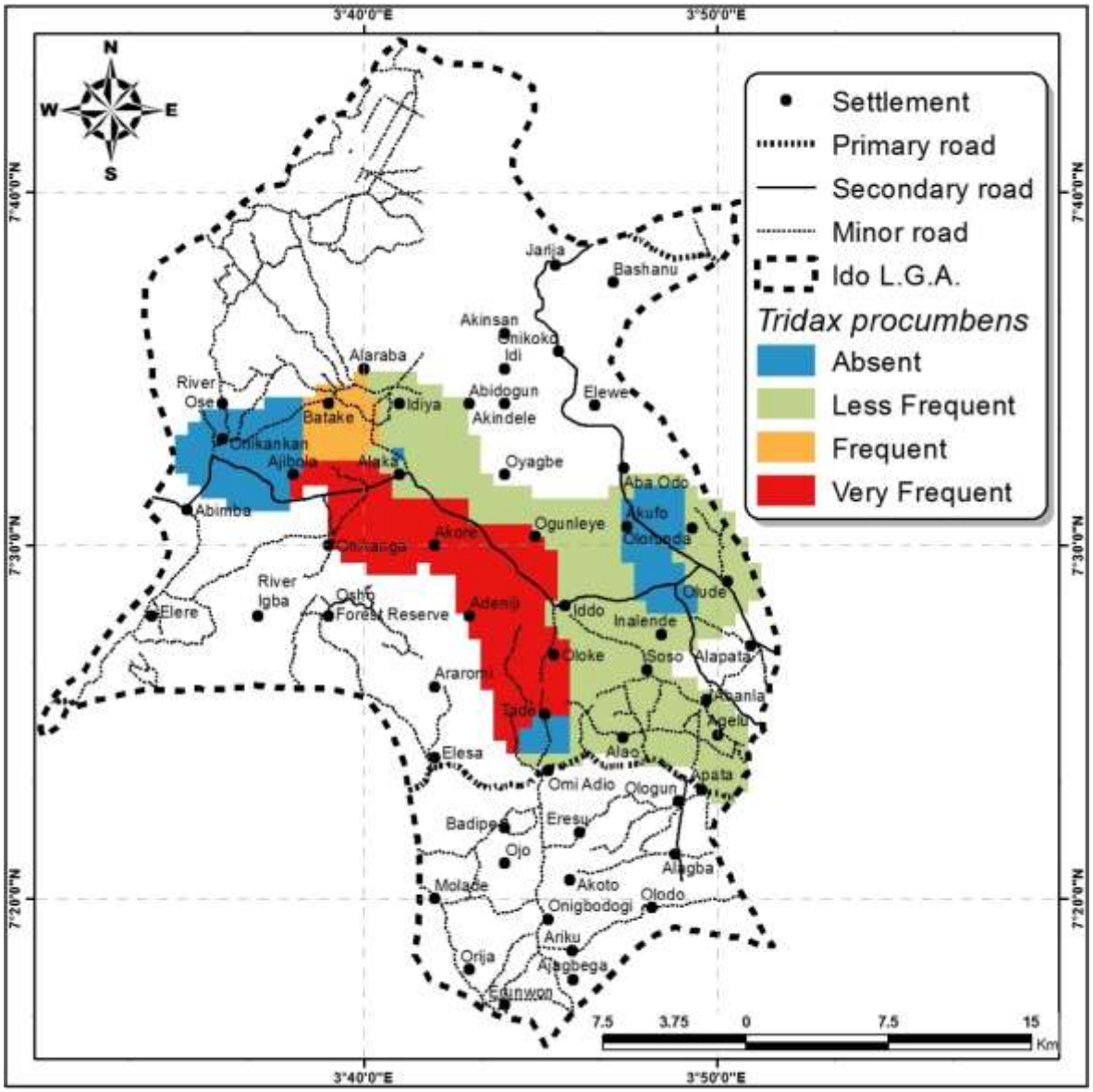

Figure 6: Distribution of *Tridax procumbens* in Ido LGA (Derived savanna)

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