UMYU Scientifica, Vol. 2 NO. 3, September 2023, Pp 142 – 152
https://doi.org/10.56919/usci.2323.020
ISSN: 2955 – 1145 (print); 2955 – 1153 (online)
A periodical of the Faculty of Natural and Applied Sciences, UMYU, Katsina

ORIGINAL RESEARCH ARTICLE

The Effects of Neem Tree (*Azadirachta indica* A. Juss) Invasion on the Growth of Indigenous Flora in Katsina State, Northwest Nigeria.

Bello Bello Musawa[1]*, Khalid Tukur[2], Isyaku Abubakar[3], Mustapha Sani Muhammad[4] and Mukhtar Lawal Abubakar[5].

[1, 2, 4, 5]Department of Science Laboratory Technology, Federal Polytechnic Kaura-Namoda, P.M.B 1012 Zamfara State, Nigeria.
[3]Biotechnology Advanced Research Centre, Sheda Science and technology Complex, P.M.B 186, Garki, Abuja, Nigeria.

ABSTRACT

Invasive or alien species are increasing in number, extent, and influence worldwide. They are both passengers and drivers of change, and they interact synergistically with many other facets of global change. The Neem trees have been grown successfully in all parts of Nigeria. Neem has become an invasive and naturalized species in various parts of Nigeria in quite diverse ecological and climatic conditions. The tree is adaptable to a wide range of climatic and topographic conditions. The objective of the study is to determine the effect of neem invasion on the growth of indigenous flora in Katsina state. The information on farmers' perception about Neem tree was obtained using semi semi-structured questionnaire. About 200 informants were interviewed. Direct counting of trees was conducted to determine the effect of Neem invasion on the indigenous flora. A total of 58 species of trees belonging to 47 genera within 15 families, of which family Fabaceae has the highest number of tree species, 44 affected by neem invasion in the study area. The result showed the effects of having neem in the farms. Some of the respondents believed that Neem spread easily, and nothing grew near it. Others believed that it's difficult to kill and grow back easily. The result indicated a number of tree species found in farms compared to the number of farmers needed for that tree. A lot of farmers preferred indigenous trees then Neem in their farms. In conclusion, in Katsina and from casual observations in the study areas, we have found that Neem is spreading in a way characteristic of an invasive species. They are spread by birds and other animals, becoming numerous under native trees. The trees themselves may become 'weeds. Since farmers in Katsina do not like Neem in their fields, it can be considered a weed, and because it can reproduce in large quantities at a considerable distance from the parent plant, it is, by definition, an invasive plant.

ARTICLE HISTORY

Received August 15, 2023.
Accepted September 26, 2023.
Published September 30, 2023.

KEYWORDS

Effects, Neem, invasion and indigenous flora.

INTRODUCTION

Globally, biological invasion by adventive (exotic) species is one of the major elements for the loss of biodiversity, ecosystem degradation and destruction. The invasion rate has increased greatly over decades (McNeely *et al.*, 2001; Millenn 2005, Richardson 2006). Biological invasions contribute to the decline of plant biodiversity worldwide, ecosystem degradation such as habitat change and exploitation, climate change, and associated effects, including the loss of keystone native species and altered ecosystem functioning (Grish and Batt, 2008; Mack *et al.*, 2000; Meiners *et al.*, 2001; McGeoch *et al.*, 2010; Millenn, 2005). However, invasion can reduce species richness and abundance through intra and interspecific competition (D'Antonio *et al.*, 1998; Christian and Wilson, 1999; Parker *et al.*, 1999; Meiners *et al.*, 2001). Invasive species usually compete with native plant species for available nutrients in the soil, which eventually affects species evenness in communities (Sharma *et al.*, 2009). Some of the exotic species can reproduce in the new regions after being introduced and may turn into a problem by competing with the native species and changing the structure and composition of the local ecosystem (Bello *et al.*, 2019; Abaje *et al.*, 2012; Borokini, 2011).

Plants that play a vital role (serves as sources of food, medicine, timber, forage, pulp production, etc.) or ornamental purposes can spread as invasive plants beyond their cultivation area and become environmental pests (Ogbuewu *et al.*, 2011; Maydall 1990). There is considerable debate among international foresters concerning the use of indigenous flora versus adventive

Correspondence: Bello Bello Musawa. Department of Science Laboratory Technology, Federal Polytechnic Kaura-Namoda, P.M.B 1012 Zamfara State, Nigeria. ✉ bbmusawa004@gmail.com. Phone Number: +234 803 656 9616.
How to cite: Bello, B. M., Tukur, K., Sani, M. M., Abubakar, I., & Lawal, M. A. (2023). The Effects of Neem Tree (*Azadirachta indica* A. Juss) Invasion on the Growth of Indigenous Flora in Katsina State, Northwest Nigeria. *UMYU Scientifica*, 2(3), 142 – 152. https://doi.org/10.56919/usci.2323.020

species (Judd, 2004). Some foresters support introducing adventive species not indigenous flora to a given area, while others argue using local tree varieties (native species) (Musawa *et al.*, 2021; Judd, 2004). Non-indigenous trees are sometimes well suited to the ecological conditions in a given area (Bergner, 1998). Non-indigenous trees may increase site productivity where climatic and human pressures have degraded the soils. They may be easy to generate or provide locally unavailable products (Bergner, 1998). Several international foresters have debated against the careless introduction of species (Musawa *et al.*, 2021; Abaje *et al.*, 2012; Judd, 2004).

Neem (*Azadirachta indica* A. Juss) is a member of the Meliaceae (Mahogany) family belonging to the Indian subcontinent. It was later introduced into many tropical countries of America and Africa with a population of 18 to 30 million trees (Mathieu *et al.*, 2007). Neem is a rapid-growing, small to medium-sized, evergreen tree (7 to 25 m high) that sheds most of its leaves in the dry season and then blooms in full foliage (Ogbuewu *et al.*, 2011). The tree is adaptable to a wide range of climatic and topographic conditions. It thrives well in dry, stony, shallow soils and even hard calcareous or claypan soils. Neem tree requires little water and plenty of sunlight (Kithure *et al.*, 2015; Ogbuewu *et al.*, 2011). In recent years, attention has been to breeding and improving agroforestry and multipurpose species, especially tree species within the arid zone. Among those species, there has been a special interest in Neem.

The tree was introduced (adventive or exotic species) into Nigeria from Ghana, and it was first grown from the seed in Maiduguri, the then Bornu Province (now Borno State), Nigeria, in 1928 (National Research Council, NRC, 1992; Nwoekeabia, 1994). In Nigeria, Neem trees occupied more than 3,500 ha of land in Katsina, Kebbi, Sokoto, Borno and Zamfara in Northern Nigeria, with a density of about 1,400 trees per ha. It is now grown nationwide as a shade, shelter belt and avenue tree in villages, towns, hospitals, schools, government houses, offices, and railway stations (Elteraifi *et al.*, 2001).

The Neem trees have been grown successfully in all parts of Nigeria. Neem has become a naturalized species in various parts of Nigeria in diverse ecological and climatic conditions. Although the tree has been introduced to Nigeria for several decades from its natural habitat in the Indian subcontinent, its use was mainly as a shade, ornamental avenue tree. Neem has been utilized for over a thousand years in agriculture, food storage, industries, and for its medicinal properties. It has been used in commercial products such as shampoo, soaps and toothpaste. Neem is an immensely useful tree, widely known for its medicinal properties and use as an organic insecticide. Over the past century, tropical forests have been suffering from excessive rates of change as they are degraded or destroyed by human activities. Approximately one-fifth of the world's population lives specifically within tropical regions consisting of savanna-type vegetation (Bello *et al.*, 2010, 2019)

Nigeria is endowed with a unique vegetation cover with about 780 tree species, which may grow up to about 12.5m at maturity level (F.A.O. 2006). However, Nigeria, on the other hand, is one of the highest countries with deforestation rate and the highest in Africa; about 55.8% of its natural forest was destroyed between 2000 and 2005 (Onyekwelu *et al.*, 2005). Katsina state is very diverse regarding its vegetation cover, with the Neem tree being the dominant species; it is also blessed with many species of plants for various uses ranging from the shade, fuel wood, ethno medicine, food and many more. This richness of natural resources has led to many interruptions of the natural ecosystem by humans, leading to high deforestation rates (Abaje *et al.*, 2014).

In Katsina State, it has been observed that the Neem tree grows attached to the roots of native plants, competing for available nutrients and water (Bello *et al.*, 2010, 2019; Musawa *et al.*, 2019), thereby stressing the native trees, leading to an earlier death. Elsewhere, Neem has been reported to be allelopathic (Bello *et al.*, 2010; Judd, 2004), has a detrimental effect on many plants, and is known to be a strong competitor. Therefore, This study is thought to investigate the Neem tree's effect on the native species in the savanna region of Katsina State. Therefore, this study's objectives are to determine the effects of a Neem tree on indigenous flora in Katsina State.

MATERIAL AND METHOD

Study area

The study was conducted in Katsina state (figure 1), northern Nigeria. Katsina state is located between latitudes 11° 08' N and 13°22' N and longitudes 6°52' E and 9°20' E. The state covers an area of 23,938 sq km and lies in the northern Nigerian Sudan Savanna. The state is bordered by Niger Republic to the North, Jigawa and Kano States to the East, Kaduna State to the South and Zamfara State to the West. The state has 30°C and 21°C as the highest and lowest temperature of the year. The climate of Katsina State is the tropical wet and dry type (Tropical Continental Climate), classified by Koppen as Aw climate. Rainfall is between May and September, with very high intensity between July and August (Abaje *et al.*, 2014). The average annual rainfall varies from 550 mm in the northern part to about 1000 mm in the southern part of the State. The pattern of rainfall in the State is highly variable. As a result, the State is subject to frequent floods that can impose serious socio-economic constraints (Abaje *et al.*, 2012a). Nine local governments were selected for this research based on scanty vegetation in the areas, leading to several afforestation programs through E.E.C. (Economic European Commission) and KTARDA (Katsina State Agricultural and Rural Development Agency). There is much effect or high density of Neem in the study areas. The local governments were Batagarawa, Dutsinma, Funtua Jibiya, Maiadua, Ingawa, Mashi, Batsari and Mani local government.

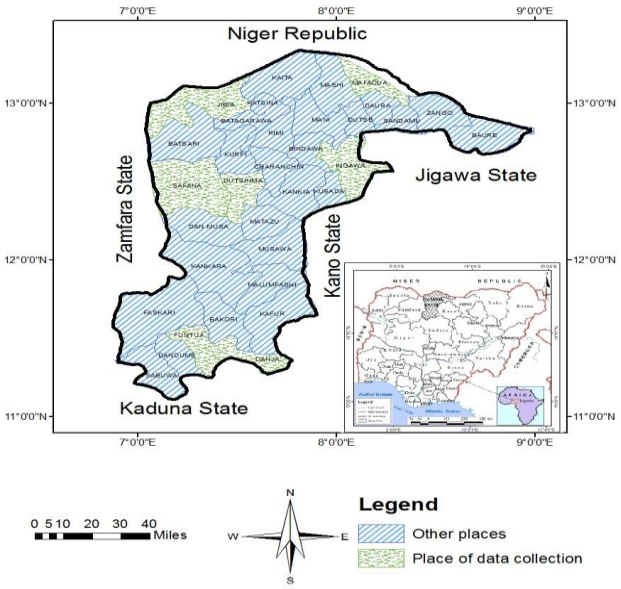

Figure 1: Map of Katsina state showing the study area

Table 1: Sampling location

Locality	Longitude	Latitude
Batagarawa	12°65'649" N	7°33'217 "E
Dutsinma	12°24'506"N	7°27'201"E
Funtuwa	13°31"246"N	7°18'422"E
Jibiya	13°06'109"N	7°17'134"E
Maiadua	13°11'250"N,	8°12'410"E
Ingawa	12°38'599"N	8°03'404"E
Mashi	12°48'858"N	7°65'504"E
Batsari	12°43'693"N	7°32'672"E
Mani	12°46'616" N	7°43'219 "E

Distribution of Questionnaire

To understand farmers' beliefs on the effect of neem on their farms, a structured questionnaire was designed to obtain information from the farmers, in which a total of two hundred (200) questionnaires were distributed across the nine (9) local governments under study (Bernard, 1994). The interviewers include farmers and village heads. The interview was conducted severally in order to get much information from the respondents using the formal interview method (Bernard, 1994).

Implication of neem on the growth and survival of indigenous flora

A field survey was conducted to check how many tree species were affected by Neem invasion. This was done by directly counting the tree species with Neem understory (Bello *et al.*, 2011).

RESULT AND DISCUSSIONS

Demographic information of the respondents

Figure 2 shows the gender of the respondents in which male (157) has a higher percentage (78%) compared to the female (43) having (22%).

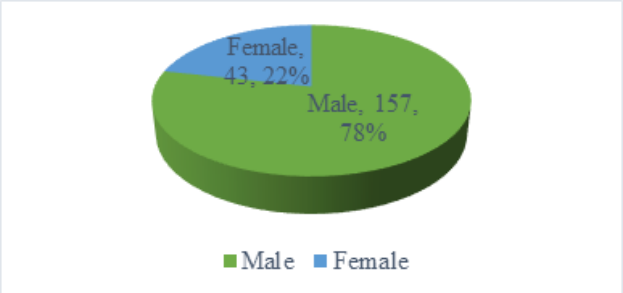

Figure 2: Gender of the respondents

The data obtained from the socio-demographic information showed that most respondents (67%) were males, while women constituted 33%. This is consistent with Togola *et al.*, (2005), who reported that men dominated the farming practice in Mali. This is probably due to the fact that women normally stayed at home taking care of their children and all home activities.

Farmers believed in the effect of having neem in their farms.

Figure 3, shown below, describes farmers who believed in the effect of having Neem on their farms, in which 30% stated that It's a pest, spreads easily, and nothing grows near it. 26% of the respondents stated that it is difficult to kill, and it will grow back. Other respondents, 24%, highlighted that it spread too many shades. Of the remaining respondents, 20% revealed that it disturbed other plants and killed other trees. There was no doubt that farmers were aware of how Neem was invading their fields. All farmers stated that Neem gets into their fields by humans and birds consuming the seeds and later eliminating them while perched in the tree, confirming the field observations. This is similar to a study in Burkina Faso, where 33% of the farmers stated that the presence of Neem is unfavourable to the development of associated cultures, notably millet and sorghum (Bationo *et al.*, 2004). None of the farmers made any positive Statements about Neem in farm fields.

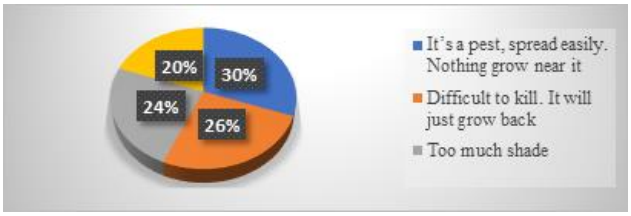

Figure 3: Farmers' beliefs on what is bad about having Neem on their farms. Farmers revealed that they do not like Neem in their farm fields. They believed it was detrimental to crop production, reducing the yields of crops surrounding the trees.

Implication of Neem on The Growth of Indigenous Flora

Comparisons of the effect of neem on different families

A total of 58 species of trees belonging to 47 genera within 15 families, of which family Fabaceae has the highest number of tree species, 44 affected by neem invasion in the study area, the family Apocynaceae, Balanitaceae, Combretaceae, Ebenaceae, Euphorbiaceae, Lamiaceae, Moraceae, Myrtaceae, Rhamanaceae, Sapotaceae (Table 2). The Fabaceae family is one of the most widely distributed and abundant groups and an important family of the earth's flora. Their success resulted from their tolerance of grazing herbivores and drought, their varied means of reproduction, and their versatility in photosynthesis. Iheyen *et al.*, (2009) also reported the Fabaceae family as the most abundant family in Ehor Forest Reserve, Edo State. This family's predominance may be due to their efficient seed dispersal mechanism. Most Fabaceae family members are wind-dispersed, which may account for their widespread occurrence. A similar study was carried out by Atiku and Bello (2011) at Wassaniya Forest Reserve of Sokoto State Abbat *et al.,* (2015) at Kanawa Forest Reserve in Gombe State (Nigeria), using the point-centered quarter method. Another study was carried out in the Yankari Game Reserve (Y.G.R.) in the Savanna-Woodlands of Northern Nigeria by Abdullahi (2010). The number obtained (Families and the number of species) in the present study was higher than that of Wassaniya Forest Reserve, probably because of the size, location, soil composition, soil types and climatic factors, which gave rise to a higher number of species. It was, however, higher than that of Yankari Game Reserve, because of the statute of Yankari as a game reserve and the area's moist–warm climate, geological and topographic nature. The species has high economic value, including medicinal and auxiliary purposes, foods, vegetables and animal fodder. John *et al.*, (2013) in Northern Botswana and Elizabeth (2011) studied in Kumasi, Ghana, also reported Fabaceae as the most represented family. This is due to the similarity in species recorded and close geographical characteristics with similar ecological distribution. However, this does not agree with Ikyaagba (2015) in Nigeria, whose studies postulated that Mimosoideae, Combretaceae, and Euphorbiaceae are the most represented families. .

Table 2. Tree families that are affected by neem tree invasion in Katsina State, Nigeria

Family	Botanical name	Local name	Common name
Anacardiaceae	*Lannea acida* A. Rich	Faru	African grape
Anacardiaceae	*Sclerocarya birrea* (A. Rich.) Hochst	Danya	
Anacardiaceae	*Anacardium occidentale* L.	Yazawa	
Anacardiaceae	*Mangifera indica* L.	Mangwaro	Mango
Apocynaceae	*Landolphia owariensis* P.Beauv.	Ciwo	
Arecaceae	*Borassus aethiopum* Mart.	Giginya	
Arecaceae	*Hyphaene thebaica* (L.) Mart.	Goriba	
Arecaceae	*Phoenix dactylifera* L.	Dabino	Dates
Balanitaceae	*Balanites aegyptiaca* (L) Dilile	Aduwa	Desert date
Burseraceae	*Commiphorahil debrandtii* (Engl.) Engli	Dashi	Corkwoods
Combretaceae	*Anogeissus leiocarpus* (DC) (Guill. And Perr.)	Marke	African birch
Combretaceae	*Combretum micranthum* G. Don	Geza	Kinkeliba
Ebenaceae	*Diospyros mespiliformis* Hochst. ex A. DC	Kanya	African ebony
Euphorbiaceae	*Hura crepitans* L.		Sandbox
Fabaceae	*Daniella oliveri* (Benn)	Tsatsagi	West African copal
Fabaceae	*Faidheribia albida* (Delile) A. Chev	Gawo	Winter thorn
Fabaceae	*Parkia biglobosa* (Jacq.) G. Don	Dorowa	African Locust Bean Tree
Fabaceae	*Prosopis Africana* (Guill. And Perr.) Taub	Kirya	African mesquite
Fabaceae	*Detarium senegalensis* (J.F) Gmel	Runhu	Ditax
Fabaceae	*Tamarindus indica* (L)	Tsamiya	Tamarind
Fabaceae	*Vachellia nilotica* (L)	Bagaruwa	Gum Arabic
Fabaceae	*Vachellia seyal*		
Fabaceae	*Cassia arereh* Delile	Malga	
Fabaceae	*Senegalia Senegal*		
Fabaceae	*Dichrostachys cinerea* (L.) Wight & Arn,	Dundu	
Fabaceae	*Senegalia polyacantha*		
Fabaceae	*Vachellia hebeclada* Dc.	Bakar kaya	
Fabaceae	*Albizia chevalieri* Harms	Katsari	
Fabaceae	*Burkea africana* Hook.	Bakin makarho	
Fabaceae	*Entada africana* Guill. & Perr.	Tawatsa	
Fabaceae	*Albizia coriaria*		
Fabaceae	*Senegalia ataxacantha* (D.C) Kyal	Sarkakiya	Flame thorn
Fabaceae	*Vachellia sieberiana* (D.C) Kyal	Farakaya	Paperbark thorn

Fabaceae	*Adansonia digitate* (L)	Kuka	Baobab
Fabaceae	*Daniella oliveri* Hutch. & Dalziel	Maje	
Fabaceae	*Ormocarpum pubescens* Hochst. Ex A. Rich)		
Fabaceae	*Pterocarpus erinaceus* Poir.	Madubiya	
Fabaceae	*Isoberlinia doka* Craib & Stapf	Doka	
Fabaceae	*Senna singueana* (Delile) Lock	Runhu	
Fabaceae	*Senegalia macrostachya* Rchb. Ex. D.C.	Gardaye	
Fabaceae	*Pericopsis laxiflora* (Benth.) Meeuwen		
Fabaceae	*Senna siamea* (Lam.) H.s Irwin & Barneby	Kesiya	
Fabaceae	*Albizia lebbeck* (L.) Benth,		
Fabaceae	*Ormocarpum sennoides* Willd.	Tsamiyar biri	
Fabaceae	*Pterocarpus santalinoides* Dc.	Gunduru	
Fabaceae	*Bauhinia reticulatum* (Schum.) Milne Redhead	Kalgo	
Fabaceae	*Bauhinia rufescense*(Lam)	Kawari	
Fabaceae	*Ficus platyphylla* Del.	Gamji	Guttapercha tree
Fabaceae	*Pericopsis lexiflora* (Benth.) Meeuwen	Farin makarho	
Fabaceae	*Dalbergia sissoo* Roxb.	Makari	
Lamiaceae	*Vitex doniana* Sweet.	Dinya	
Meliaceae	*Khaya grandifoliola*	Melina	
Meliaceae	*Khaya senegalensis*	Madaci	
Moraceae	*Ficus congenis* Engl.	Baure	Fig
Moraceae	*Ficus sthonningii* Bl.	Cediya	Strangler fig
Myrtaceae	*Eucalyptus camaldulensis* Dehnh	Turare	River red gum
Rhamanaceae	*Ziziphus spina-christi* (L.) Desf.	Kurna	Chist's thorn
Sapotaceae	*Vietllaria paradoza* C.F. Gartn	Kadanya	

During the survey, it has been observed that neem trees were growing under a canopy of old, shade-tolerant, late successional forest trees such as *Adansonia digitata, Ficus spp.*, and *Faidherbia albida, Parkia biglobosa, Daniella oliveri Combretum micranthum, Diospyros mespiliformis, Vietllaria paradoza, Ficus congenis, Tamarindus indica, Sclerocarya birrea, Balanites aegyptiaca, Senegalia senegal, Vachellia nilotica, Vachellia sieberiana, Albizia chevalieri, Cassia arereh, Anacardium occidentale, Mangefera indica Ficus platyphylla* (Table 3) and many other local trees. These relic trees have remained in the fields since the land was cleared from the bush two or more generations ago. Trees were left in the fields because they were either useful and did not affect crops, or they contained gins (sprits), which harm people who collect or kill the trees in which they reside. Neem has a rapid rate of germination; once established in an area, it will be difficult to eradicate. The research also explains that in each rainy season, many Neem seeds germinate and grow every year on the farms, taking the population of native species. The result corresponds to the work of Judd (2004), which stated that fifteen farms were surveyed around Njawara village for a total area of nineteen hectares. 87 mature trees were measured, and 21 species were found. Fewer than half the trees (45%) had Neem growing under them.

Table 3: Number of tree species with and without a neem invasion.

Tree species	Has neem invasion	Has no neem invasion	Total
Lannea acida A. Rich	23	74	97
Sclerocarya birrea (A. Rich.) Hochst	3	15	18
Anacardium occidentale L.	13	204	227
Mangifera indica L.	52	424	476
Landolphia owariensis P.Beauv.	1	7	8
Borassus aethiopum Mart.	47	126	173
Hyphaene thebaica (L.) Mart.	286	465	751
Phoenix dactylifera L.	7	86	93
Balanites aegyptiaca (L) Dilile	86	251	337
Commiphorahil debrandtii (Engl.) Engli	35	126	162
Anogeissus leiocarpus (DC) (Guill. And Perr.)	19	91	110
Combretum micranthum G. Don	45	306	351
Diospyros mespiliformis Hochst. ex A. DC	16	87	103
Hura crepitans L.	1	18	19
Daniella oliveri Hutch. & Dalziel	17	82	99
Cassia arereh Delili	13	67	80
Faidheribia albida (Delile) A. Chev	216	396	612

Parkia biglobosa(Jacq.) G. Don	48	198	246
Prosopis Africana (Guill. And Perr.) Taub	0	15	15
Detarium senegalensis (J.F) Gmel	39	97	136
Tamarindus indica(L)	16	56	72
Vachellia nilotica (L.) Delile	98	318	416
Vachellia seyal	31	216	237
Senegalia Senegal	22	189	211
Dichrostachys cinerea (L.) Wight & Arn,	6	67	73
Senegalia polyacantha	9	116	125
Vachellia hebeclada Dc.	19	102	121
Albizia chevalieri Harms	7	78	85
Burkea africana Hook.	2	41	43
Entada africana Guill. & Perr.	2	33	35
Albizia coriaria	1	16	17
Senegalia ataxacantha (D.C) Kyal	78	208	386
Vachellia sieberiana (D.C) Kyal	81	201	282
Adansonia digitate (L)	165	398	563
Ormocarpum pubescens Hochst. Ex A. Rich)	3	18	21
Pterocarpus erinaceus Poir.	9	51	60
Isoberlinia doka Craib & Stapf	4	22	26
Senna singueana (Delile) Lock	13	57	70
Senegalia macrostachya Rchb. Ex. DC.	8	34	42
Pericopsis laxiflora (Benth.) Meeuwen	0	18	18
Senna siamea (Lam.) H.s Irwin & Barneby	0	31	31
Albizia lebbeck (L.) Benth,	18	86	94
Dichrostachys cinerea (L.) Wight & Arn,	2	31	33
Burkea africana Hook.	0	13	13
Ormocarpum sennoides Willd.	0	14	14
Pterocarpus santalinoides Dc.	6	28	34
Bauhinia reticulatum (Schum.) Milne Redhead	127	416	543
Bauhinia rufescense (Lam)	37	156	193
Ficus congenis Engl.	9	56	65
Ficus platyphylla Del.	4	37	41
Pericopsis lexiflora (Benth.) Meeuwen	3	35	38
Dalbergia sissoo Roxb.	2	17	19
Vitex doniana Sweet.	5	51	56
Khaya grandifoliola	3	29	32
Khaya senegalensis	8	61	69
Ficus thonningii Bl.	16	61	77
Eucalyptus camaldulensis Dehnh	125	341	466
Ziziphus spina-christi (L.) Desf.	108	345	458
Vietllaria paradoza C.F. Gartn	0	16	16

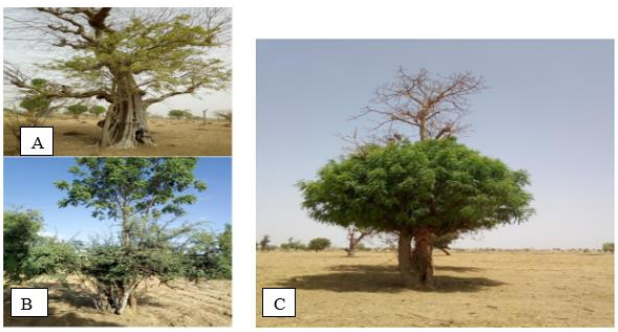

Figure 4: The Figure (A) above Shows that a more than 10m long giant *Anageissus leocapus* with Neem attached to it, (B) Neem tree about 3m tall with greenish leaves with several branches and twigs growing versus *Daniella oliveri* on bare soil. The great implication of Neem tree invasion on other trees causes the death of the tree (C).

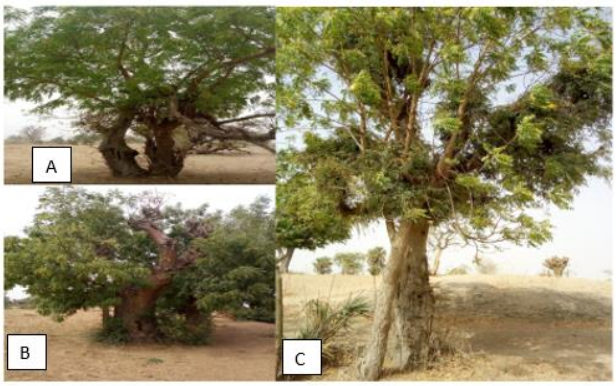

Figure 5: (A) showed that more than 10m long giant *Combretum micranthum* invaded with Neem tree. (B) Old grown *Adansonia digitata* (local name: kuka) with big growing Neem tree in Dutsin-ma local government. (C) Neem tree attached to *Tamarandus indica.* Picture: Kurfi local government

A strong relationship can be seen between the tree species farmers need and the trees found in their farms (Table 4). More importantly, *Parkia biglobosa, Piliostigma reticulatum, Prosopis africana, Ziziphus mauritiana, Terminalia spp.*, *Faidherbia albida*, *Prosopis africana*, *Adansonia digitata, Daniella oliveri, Vachellia ataxacantha* and *Bauhinia rufescense* etc were all trees that farmers need and were found in the field in large numbers. This finding agreed with the report of Judd (2004), which stated that *Terminalia spp.*, *Faidherbia albida*, *Prosopis africana*, and *Cordyla africana* were all trees that farmers needed. This shows that despite comments about the negative effects of trees in the farm shading other trees, farmers are protecting the trees that they like. This is also in line with the finding of Nadal and Bahadur (1997), which stated that Neem were the only species that were found on farms in a great number that farmers did not recommend.

Table 4: Number of tree species found in farms compared to the number of farmers needed for that tree

Species	Total number of trees	Number of trees needed by the farmers
Lannea acida A. Rich	87	14
Sclerocarya birrea (A. Rich.) Hochst	67	16
Anacardium occidentale L.	1412	71
Mangifera indica L.	2200	87
Landolphia owariensis P.Beauv.	56	5
Borassus aethiopum Mart.	312	9
Hyphaene thebaica (L.) Mart.	212	12
Phoenix dactylifera L.	31	0
Balanites aegyptiaca (L) Dilile	356	33
Commiphorahil debrandtii (Engl.) Engli	156	13
Anogeissus leiocarpus (DC) (Guill. And Perr.)	431	71
Combretum micranthum G. Don	1679	61
Diospyros mespiliformis Hochst. ex A. DC	167	27
Hura crepitans L.	27	0
Daniella oliveri Hutch. & Dalziel	231	9
Cassia arereh Delili	23	0
Faidheribia albida (Delile) A. Chev	886	43
Parkia biglobosa(Jacq.) G. Don	723	75
Prosopis africana (Guill. And Perr.) Taub	36	44
Detarium senegalensis (J.F) Gmel	79	16
Tamarindus indica(L)	236	32
Vachellia nilotica (L.) Delile	1241	67
Vachellia seyal	967	71
Senegalia Senegal	521	3
Dichrostachys cinerea (L.) Wight & Arn,	88	18
Senegalia polyacantha	924	10
Vachellia hebeclada Dc.	875	11
Albizia chevalieri Harms	51	8
Burkea africana Hook.	35	4
Entada africana Guill. & Perr.	198	9
Albizia coriaria	88	17
Senegalia ataxacantha (D.C) Kyal	122	14
Vachellia sieberiana (D.C) Kyal	201	32
Adansonia digitata (L)	1008	24
Ormocarpum pubescens Hochst. Ex A. Rich)	67	12
Pterocarpus erinaceus Poir.	71	17
Isoberlinia doka Craib & Stapf	19	6
Senna singueana (Delile) Lock	102	57
Senegalia macrostachya Rchb. Ex. DC.	129	9
Pericopsis laxiflora (Benth.) Meeuwen	62	7
Senna siamea (Lam.) H.s Irwin & Barneby	82	21
Albizia lebbeck (L.) Benth,	89	12
Dichrostachys cinerea (L.) Wight & Arn,	77	16
Burkea africana Hook.	49	4
Ormocarpum sennoides Willd.	51	12
Pterocarpus santalinoides Dc.	55	13

Bauhinia reticulatum (Schum.) Milne Redhead	3845	51
Bauhinia rufescense (Lam)	176	22
Ficus congenis Engl.	88	16
Ficus platyphylla Del.	91	30
Pericopsis lexiflora (Benth.) Meeuwen	35	5
Dalbergia sissoo Roxb.	55	18
Vitex doniana Sweet.	98	16
Khaya grandifoliola	450	3
Khaya senegalensis	867	2
Azadirachta indica A. Juss	30905	5
Ficus thonningii Bl.	241	48
Eucalyptus camaldulensis Dehnh	1678	81
Ziziphus spina-christi (L.) Desf.	261	55
Vietllaria paradoza C.F. Gartn	72	21

Invasive species are increasing in number, extent, and influence worldwide. They are both passengers (symptoms) and drivers of change and interact synergistically with many other facets of global change. In many cases,, they cause rapid and dramatic ecosystem degradation, biodiversity loss, and regional biotas homogenization. Many other, more subtle effects also have profound (usually negative) implications. Invasion ecology has exploded as a field of study, and thousands of publications are generated yearly on an increasingly broad range of themes. Scientific studies focusing on impacts and practical solutions to problems caused by invasions initially lagged behind case studies and those describing and elucidating bio-geographical patterns and ecological mechanisms but are now becoming well-represented in the literature. There are marked geographical and taxonomical biases in the study of invasions and invasive species, but there have been major advances in understanding invasions for most taxonomic groups and major biomes in recent years. New technologies, notably molecular methods, remote sensing, and computers, have radically improved our ability to assemble accurate inventories, map and model distributions and interventions' effects, and explore invasive species patterns. Such insights improve our ability to plan, assess, and monitor control operations. The harmful effects of invasive species are recognized worldwide, and integrated strategies have been implemented to reduce current and future impacts.

Increasing demands are put on the land to provide the means for survival, and farmers will need to intensify production by either increasing labor inputs or integrating trees into farms. Trees provide marketable products, reduce dependency on outside sources, and diversify the farm while adding ecological benefits to the production base (Judd, 2004).

Increasing demands are put on the land to provide the means for survival, and farmers will need to intensify production by either increasing labor inputs or integrating trees into farms. Trees provide marketable products, reduce dependency on outside sources, and diversify the farm while adding ecological benefits to the production base (Shirish, 2010).

Neem is being managed for two purposes: growing two to three-meter poles used in construction and small sticks for fencing and furniture. Otherwise, farmers are cutting the trees and burning them in hopes of killing the trees, with limited success. At present, none of the farmers are propagating the tree.

Neem is a prolific seeder, characteristic of invasive species. One tree can produce eight to thirty kilograms of seed per year; each kilogram yields 2000 to 3000 seedlings (Nandal and Bahdur 2004). The fruit ripens at the onset of the rainy season. They then germinate and establish themselves while soil moisture is available (C.A.B. International 2004). Maragathavalli *et al.*, (2012) describe this process and calls for the control of its expansion. He States that Neem is taking up the most fertile locations, under trees, where yields are the greatest. Many other sources mention the prolific nature of Neem (Reddy *et al.*, 2013; Faneska *et al.*, 2004). Neem is also reported to displace native vegetation, intolerant of other plants (Girish and Bhatt, 2008; Pokhrel *et al.,* 2015).

CONCLUSION

Invasive species are increasing in number, extent, and influence worldwide. They are both passengers (symptoms) and drivers of change and interact synergistically with many other facets of global change. In many cases, they cause rapid and dramatic ecosystem degradation, biodiversity loss, and regional biotas homogenization. Many other, more subtle effects also have profound (usually negative) implications. Invasion ecology has exploded as a field of study, and thousands of publications are generated yearly on an increasingly broad range of themes. Neem is a prolific seeder, characteristic of invasive species. One tree can produce eight to thirty kilograms of seed per year; each kilogram yields 2000 to 3,000 seedlings. The fruit ripens at the onset of the rainy season. They then germinate and establish themselves while there is available soil moisture. In Katsina, and from casual observations in the study areas, we have found that Neem is spreading in a way characteristic of an invasive species. They are spread by birds and other animals, becoming numerous under native trees. The trees themselves may become 'weeds. They spread widely

under favorable site conditions since birds and other animals distribute the seeds. For the same reason, natural regeneration under old trees is often abundant. Since farmers in Katsina do not like Neem in their fields, it can be considered a weed, and because it can reproduce in large quantities at a considerable distance from the parent plant, it is, by definition, an invasive plant.

New forestry initiatives need to take place that reflect the needs and attitudes of small farmers by assessing the situation at the village level. Often, initiatives take a top-down approach by policymakers in the big city who are not in touch with village life. Perhaps one new initiative that should be given more attention is encouraging farmers to protect volunteer wildings in the farm fields. Many farmers in this study were found to be protecting *Faidherbia albida*, *Prosopis africana*, *Adansonia digitata, Ficus spp.*, *Parkia biglobosa, Daniella oliveri, Cambretum macrantum, Vietllaria paradoza, Ficus congenis, Tamarindus indica, Acacia senegal, Acacia nilotica, Acacia sieberiana, Albizia chevalieri, Cassia arereh, Senna singeuma, Ficus platyphylla.*

The Ministry of Forestry would do well to avoid the bias against native trees by transferring ownership of native trees in farm fields to the owners of the farms so that no confusion over ownership occurs. *Prosopis africana* and *Faidherbia albida,* have many uses. *Prosopis africana* is a very strong wood; it makes the best charcoal for brewing tea, and the wood is said to last 100 years. It is used for building fences. Standing trees could represent substantial savings for a compound. As farming systems evolve in Katsina, trees, including Neem, will play a more important role in farm productivity.

-

RECOMMENDATIONS

Based on this research, the following recommendations should be considered:

- The government and all afforestation agencies should avoid using Neem for shelter belts and encourage the plantation and conservation of the native species.
- People should avoid cutting down native trees for domestic use (fuel wood, mortar pestles, etc.) because some trees, like *Prosopis africana,* are now difficult to find since blacksmiths have already destroyed most of them. They claimed that the charcoal from the tree lasted longer while burning.
- Governmental and non-governmental agencies such as the Ministry of Agriculture should create awareness of the impact of planting native trees instead of exotic ones.
- Farmers should nurture the seedling stage of the native trees.
- Further research should be conducted to ascertain the effects of different management methods of Neem on farms.

REFERENCE

Abaje, I. B., Ati, O. F., and Iguisi, E. O. (2012). Changing climatic scenarios and strategies for drought adaptation and mitigation in the Sudano-Sahelian Ecological Zone of Nigeria. Climate change and sustainable development in Nigeria, 99-121

Abaje, I. B., Ndabula, C and Garba, A. H. (2014) Is the Changing Rainfall Patterns of Kano State and its Adverse Impacts an Indication of Climate Change? European Scientific Journal, 10 (2), 192-206.

Abba Halima Mohammed, Sawa Fatima Binta Jahun, Gani Alhassan Mohammed, Abdul Suleiman Dangana (2015). Herbaceous Species Diversity in Kanawa Forest Reserve (KFR) in Gombe State, Nigeria. American Journal of Agriculture and Forestry. Vol. 3, No. 4, 2015, pp. 140-150. **[Crossref]**

Abdullahi, M.B (2010). Phytosociological Studies and Community Rural Appraisal Towards Biodiversity Conservation in Yankari Game Reserve, Bauchi State, Nigeria. An unpublished Ph.D Thesis. Abubakar Tafawa Balewa University, Bauchi, Nigeria, pp 99

Atiku, M, and Bello, A.G (2011). Diversity of herbaceous plants in Wassaniya Forest Reserve of Sokoto State, Nigeria.Forestry Association of Nigeria, Conference paper. pp 438-443

Bationo Bello A., Khan A.A., Umaru A.M., Aliero A.A., Shinkafi B.Y. (2010). Effect of Neem (Azadirachta indica) leaf litter on growth of cowpea and millet. Katsina Journal of Natural and Applied Sciences, 2(1):152- 155. B

Bello, A., Jamaladdeen, S., Elder, M. T., Yaradua, S. S., Kankara, S. S., Wagini, N. H., and Muasya, M. (2019). Threatened medicinal and economic plants of the Sudan Savanna in Katsina State, Northwestern Nigeria. Bothalia-African Biodiversity and Conservation, 49(1), 1-17. **[Crossref]**

Bergner, R. (1998). Agroforestry Manual: A Field Guide to Agroforestry Extension Workers, Fifth Edition. Peace Corps, the Gambia. 132pp

Bernard, H. R. (1994). Research Methods in Anthropology: Qualitative and Quantitative Approaches (2nd ed.). Thousand Oaks, CA: Sage.

Borokini TI (2011) Invasive alien plant species in Nigeria and their effects on biodiversity conservation. Trop Conserv Sci 4: 103-110. **[Crossref]**

Christian JM, Wilson SD (1999) Long-term ecosystem impacts of an introduced grass in the northern Great Plains. Ecology 80: 2397-2407. **[Crossref]**

D'Antonio CM, Hughes RF, Mack M, Hitchcock D, Vitousek PM (1998) Response of native species to

the removal of non-native grasses in a Hawaiian woodland. J Veg Sci 9: 699-712. [Crossref]

Elizabeth AK (2011). Patterns of Woody Plant Species Richness, Diversity and Structure along a Disturbance Gradient in the AtiwaRange Forest Reserve, Eastern Region, Ghana. Thesis Presented to the Department of Theoretical and Applied Biology, College of Science, Kwame Nkrumah University of Science and Technology. pp. 22-23.

Elteraifi, Ahmed and Hassan A. (2001). Oil Azadirachin contents of Neem (A. indica) seed kernals collected from trees growing in different habitat in sudan

FAO (2006) Global Forest Resources Assessment 2005. FAO Forestry paper 147, Rome, Italy

Girish K and Bhatt S: Neem - a green treasure. Electronic Journal of Biology 2008; 4: 102-11.

Iheyen, J., Okoegwale, E.E., and Mensah, J.K. (2009). Composition of tree species in Ehor Forest Reserve.

Ikyaagba TE, Tee TN, Dagba BI, Anncha UP, Ngibo KD, Tume C (2015). Tree composition and distribution in Federal University of Agriculture Makurdi, Nigeria. Journal of research in Forestry wildlife and Environment 7(2):147-157.

John N, Demel T, Wellington M, Keotshephile K (2013). Diversity, Population Structure and Regeneration Status of Woody Species in Dry Woodlands Adjacent to Molapo Farms in Northern Botswana. Open Journal of Forestry 3(4):138-151. [Crossref]

Judd, M. P. (2004). Introduction and Management of Neem (Azadirachta Indica) in Smallholder's Farm Fields in the Baddibu Districts of The Gambia, West Africa (Doctoral dissertation, Michigan Technological University).

Kithure, R. K., Muchugi, A., Jamnadass, R., Njoka, F. M., & Mwaura, L. (2015). Genetic diversity of Faidherbia albida (Del.) A. Chev accessions held at the World Agroforestry Centre. Forests, Trees and Livelihoods, 24(4), 219-230. [Crossref]

Mack RN, Simberloff D, Lonsdale WM, Evans H, Clout M, Bazzaz, FA (2000) Biotic invasions: causes, epidemiology, global consequences, and control. Ecol Appl 10: 689-710. [Crossref]

Maragathavalli S, Brindha S, Kaviyarasi NS, Annadurai B and Gangwar SK: Antimicrobial activity in leaf extracts of Neem. International Jour Sci and Nat 2012; 3(1): 110-13

Mathieu, G., and Meissa, D. (2007). Traditional leafy vegetables in Senegal: Diversity and medicinal uses. African Journal of Traditional, Complementary and Alternative Medicines, 4(4), 469-475. [Crossref]

Maydell, H. J. (1990). Trees and Shrubs of the Sahel. Verlag Josef Margraf

McGeoch MA, Butchart SHM, Spear D, Marais E, Kleynhans EJ, et al. 2010. Global indicators of biological invasion: species numbers, biodiversity impact and policy responses. Divers. Distrib. 16:95-108 5. [Crossref]

McNeely JA, Mooney HA, Neville LE, Schei P, Waage JK, eds. 2001. Global Strategy on Invasive Alien Species. Gland, Switz./Cambridge, UK: IUCN on behalf of Glob. Invasive Species Program

Meiners SJ, Pickett STA, Cadenasso ML (2001) Effects of plant invasions on the species richness of abandoned agricultural land. Ecography 24: 633-644. [Crossref] . [Crossref]

Millenn. Ecosyst. Assess. 2005. Millennium Ecosystem Assessment Synthesis Report. Washington, DC: Island

Mukhtar. F. B. (2003): Introduction to Biostatistics. 1sted. Samrid Publishers, Nigeria Pp 152.

Musawa B.B., Bello A. and Tukur A. M. (2019) NEEM (Azadirachta indica A. JUSS): A potential invasive threat to savanna vegetation in Katsina State, Nigeria. Katsina Journal of Natural and Applied Sciences VOL. 10 No. 2 September, 2021 (ISSN: 2141-0755)

Nandal, D. P. S., and Bahadur, R. (1997). Tree Management. Neem in Sustainable Agriculture, Scientific Publishers, Jodhur, India. 266pp, 33-49.

National Research Council (1992). Neem: A Tree For Solving Global Problems. National Academy Press, Washington D.C. 141pp

Nwoekeabia, O. D. (1994): Annual Reports, Federal Department of Forestry, Federal Ministry of Agriculture, Abuja, Nigeria. 45pp

Ogbuewu, I. P., Odoemenam, V. U., Obikaonu, H. O., Opara, M. N., Emenalom, O. O., Uchegbu, M. C., and Iloeje, M. U. (2011). The growing importance of Neem (Azadirachta indica A. Juss) in agriculture, industry, medicine and environment: A review. Res J Med Plant, 5(3), 230-245. [Crossref]

Onyekwelu, J. C., Adekunle, V. J and Adeduntan, S. A (2005). Does the Tropical rainforest Ecosystem possesses the ability to recover from severe degradation? In: Popoola L, Mfon P & Oni PI (eds) Sustainable forest management in Nigeria: lessons and prospects. Proceeding of the 30th Annual conference of the Forestry Association of Nigeria, Kaduna, 7th - 11th Nov. 2005, pp. 145-163.

Parker IM, Simberloff D, Lonsdale WM, Goodell K, Wonham M, Kareiva PM, Williamson MH, Von Holle B, Moyle PB, Byers JE, Goldwasser L (1999)

Impact: toward a framework for understanding the ecological effects of invaders. Biol Invasion 1: 3-19. **[Crossref]**

Pokhrel Bharat, Sagar Rijal, Sulav Raut and Ankit Pandeya: Investigations of antioxidant and anti-bacterial activity of leaf extracts of Azadirachta indica. African Journal of Biotechnology 2015; 14(46): 3159-63. **[Crossref]**

Reddy YRR, Kumara KC, Lokanatha O, Mamtha S and Reddy DC: Antimicrobial activity of Azadirachta indica (Neem) leaf, bark and seed extracts. International Journal of Res in Phytochemistry Pharmacology 2013; 3(1): 1-4.

Richardson DM, Pysek P, Jaro ˇ sˇık V. 2006. Who cites who in the invasion zoo: insights from an analysis of the most highly cited papers in invasion ecology. Preslia 78:437-68

Sharma GP, Raizada P, Akhilesh S, Raghubanshi A (2009) Hyptis suaveolens: An emerging invader of Vindhyan plateau, India. Weed Biol Manag 9: 185-191. **[Crossref]**

Shirish PS: Hepatoprotection study of leaves powder of A. indica A. juss. International Journal of Pharmaceutical Sciences Review and Research 2010; 3(2): 37-42

Singh, B. B., Chambliss, O. L., & Sharma, B. (1997). Recent Advances in Cowpea Breeding. 30-49 in Advances in Cowpea Research.

Togola, A. T., Diallo, D., S., Barsett, H., and Paulsen, B. S. (2005). Ethnopharmacological survey of different uses of seven medicinal plants from Mali. (West Africa) in the region Doila, Kolokani and Siby. Ethnobiology and Ethnomedicine, 1: 7. **[Crossref]**