

Assessment of the presence of *Boswellia dalzielii* Hutch in some Selected Northern States: A Potential Foreign Exchange Earner for Nigeria.

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ABSTRACT

The importance of Non Timber Forest Products can never be overemphasized in the conservation of forest resources. This study assessed the presence of Boswellia dalzielii Hutch in some selected locations in Northern Nigeria in view of its foreign exchange earnings potential from the resins it produces. The study was conducted between February – April, 2019 in different natural habitats of Falgore Game Reserve in Kano State, Jahun in Jigawa State, Gaya in Adamawa State, Bayo in Borno State and Biliri in Gombe State of Nigeria. The work involved intensive survey and several visits to the sample sites for plant identification and enumeration exercises. Simple random sampling technique was used to select the species; the diameters and height of trees with dbh ≥ 10 cm and the geographical coordinates were measured using Global Position System. Data were analyzed using student T-test, tables, charts and map. The result shows that there is a significant relationship in diameter sizes among the species distribution across the different locations in the following order; The mean tree diameter found in Jahun LGA of Jigawa State > Gaya, Hong LGA in Adamawa State > Bayo LGA of Borno State > Falgore Game Reserve in Kano State > Billiri LGA in Gombe State. The result also shows insignificant relationship in mean height among the species distribution across the different study areas and also insignificant relationship in height between species in the sampled locations. We recommend strict conservation and controlled exploitation of the species in the studied locations as well as other areas of the country where they are in abundance. We also recommend concerted research into propagation, field establishment and management of Boswellia dalzielii Hutch plantations because of its global economic potentials.

Keywords: *Boswellia dalzielii* Hutch, Frankincense, Non Forest Timber Product, Resin, Northern Nigeria.

INTRODUCTION: *Boswellia dalzielii* Hutch (Burseraceae) commonly known as the frankincense tree is found in the savannah region of north western Nigeria (Fig 1). It has the potential of being a veritable source of foreign exchange through the exploitation and export of its Non Timber Forest Product, resin (NTFP).

The tree is regarded as a veritable source of natural medicine (Etuk, Agaie, Onyeyili and Ottah, 2006a). The local names include “Ararrabi”, “Basamu” and “Hanu”. The genus *Boswellia* has about twenty five (25) species spread all over the world but the specie *B. dalzielii* is basically found in the West-African

region, concentrating more in Nigeria (Burfield, 2009). *B. dalzielii* is a tree plant of about 13m high of the wooden savanna. It has a characteristic smooth papery patch which on tapping exudes a whitish fragrant resin. It is found in savanna region often in rocky situations (Burfield, 2009).

The gum resin gotten from *B. Dalzielii* is used along with other medicines as a stomachic and for the treatment of venereal diseases (Nwiyi, Binda, Ajoku, Aniagu, Enwerem, Orisadipe, Kubarawa and Gamaliel., 2004).

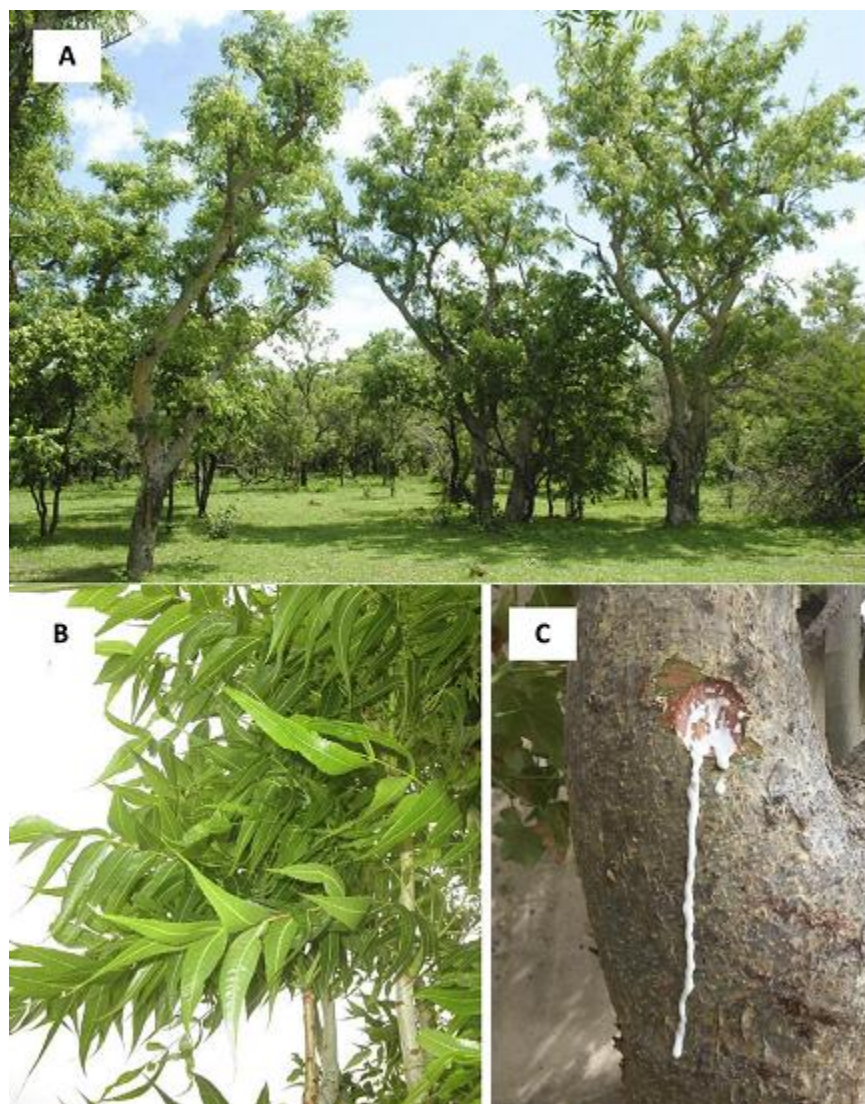


Fig 1: *Boswellia dalzielii* Hutch trees and resin

(Source: Decarlo. Johnson, Okeke-Agulu, Dosoky, Wax, Owolabi and Setzer, 2019)

The roots and barks are used for antidote to arrow poisons. The fresh bark is eaten in Adamawa to cause vomiting after a few hours and thus relieve symptoms of giddiness and palpitation. The extract from its leaves is used for the treatment of diarrhea in poultry (Aliyu, *et al*, 2006) and humans (Etuk, Agaie, Onyeyili and Ottah, 2006).

The resins gotten from *B. Dalzielii* in combination with *Steganotaenia aralicia* have anti-inflammatory activity due to the presence of Acetylketoboswellic acid (KABA) (Alemika, 2009).

The aqueous extract of *Boswellia dalzielii* was used to investigate its effect on the liver of albino

rats and found that there was no significant effect on total protein and albumin content within the short period of five (5) days the investigation was carried out (Aliyu, *et al*, 2006). Phytochemical screening of the extract of *B. Dalzielii* was investigated and tannin was detected, the result obtained shows that the extract probably contains active ingredient that could be developed for gastrointestinal problems (Nwiyi, *et al*, 2004).

A further investigation was carried out on the antidiarrhoea effect of *Boswellia dalzielii* stem bark extract in albino rats on castor induced diarrhea using graded doses of 100, 200 and 300mg/kg before induction in diarrhea with castor oil. The extract produced a significant inhibition of the castor induced diarrhea (Etuk, *et al*, 2006). The aqueous stem bark of *B. Dalzielii* possesses anti-inflammatory effect which may be related to anticholinergic mechanism (Etuk, *et al*, 2006). The Boswellic acid which is a component of the resin from the bark of *Boswellia dalzielii* have shown some promises as a treatment for asthma and various inflammatory conditions and in West Africa, the bark have been reported to be used for the treatment of fever, rheumatism and gastrointestinal problems. Furthermore, *Boswellia incense* may even serve as a relief to some of these problems. *Boswellia*

MATERIALS AND METHODS: Study areas:

Five northern states were randomly selected and sampled for this study between January and April 2019, namely: Kano, Jigawa, Adamawa, Borno and Gombe State. Falgore game reserve (FGR) formerly known as Kogin Kano Game Reserve is located between longitudes 8° 30' and 8° 50' East and latitudes 10° 46' and 11° 20' north, 150 km south of Kano city. It has an estimated area of 92,000 ha and borders Tiga artificial Lake to the north and Lame Burra Game Reserve in Bauchi State to the southeast (BirdLife International 2007). In a normal year, the mean annual rainfall in FGR is estimated at 1000 mm, and this decreases northwards to about 800 mm around Kano Metropolis (Olofin, 2000). The FGR is a gallery forest with a high density of tree species and high floristic diversity found within the open Northern Guinea Savannah woodland vegetation type, though with elements

dalzielii have been proven to be very effective (bacteriostatic) when the stem barks is ground and mixed with alcohol to heal lingua villosa (Herbal Granny, 2009).

The demand for Frankincense essential oil is growing by the day while in many areas the Frankincense trees are in sharp decline and estimates indicate we will lose them within the next 50 years (Riegler, 2019). *Boswellia dalzielii* Hutch. (Burseraceae) oleoresin samples that were taken from trees in five provinces in northern Nigeria: Adamawa, Jigawa, Borno, Gombe and Kano appears to have two chemotypes, one dominated by α -pinene and another, much rarer chemotype dominated by myrcene. This is similar to the chemical composition of other frankincense essential oils, particularly *Boswellia sacra*, but unique in the dominance of monoterpenes and limited sesquiterpenes (Decarlo, 2019). The essential oils are in very high demand in the international market and have been estimated to reach \$11.19 billion, globally, by 2022 (Verma, 2019). There is paucity of information on the existence of this goldmine in Nigerian forests and in other cases, in the backyards of poor households that own these trees. This study will fill this yawning knowledge gap.

of the Sudan Savannah in the northern tip (BirdLife International, 2007).

Jahun is located in Jigawa State, the state is situated in the north-western part of the country between latitudes 11.00°N to 13.00°N and longitudes 8.00°E to 10.15°E. Kano State and Katsina State border Jigawa to the west, Bauchi State to the east and Yobe State to the northeast. To the north, Jigawa shares an international border with Zinder Region in The Republic of Niger, which is a unique opportunity for cross-border trading activities (NPC, 2006). The Climate of Jigawa state is semi-arid, characterized by a long dry season and a short wet season. The climatic variables are erratic and vary considerably over the year. The annual mean temperature is about 25°C but the mean monthly values range between 21°C in the coolest month and 31°C in the hottest month. However, the mean daily temperature could be as low as 20°C during the months of December and January

when the cold dry harmattan wind blows from the Sahara Desert.

Wet season is roughly four months (June to September) and dry season is seven to eight months (October to May). The rainy season sometimes starts in May but early rains in April are not unusual while the bulk of the rainfall comes in June through September. Violent dust storms, followed by tornado and lightening, usually herald the onset of the rains in May and June and their retreat in September or early October. The total annual rainfall ranges from 600mm in the north to 1000mm in the southern parts of the state (DFID, 2012).

Gaya, Hong local government area in Adamawa State, lies between Latitude 7° – 11° N and longitude 11° – 14° E of the Greenwich Meridian (Adebayo, 1999). The area falls within the Northern Guinea Savannah Zone and has a tropical wet and dry climate. Dry season lasts for a minimum of five months (November – March) while the wet season spans April to October. Mean annual rainfall is about 700 mm. The area is bounded by Askira/Uba Local Government Area of Borno State to the North, Mubi to the East, Song to the South and Gombi Local Government Area to the West. The area has a land mass of about 117,240 square kilometers. The area has an estimated population of about 169,183 people and predominantly agrarian (National Population Commission, 2006).

Bayo is a Local Government Area of Borno State, Nigeria. Its headquarters are in the town of Fikayel. It has an area of 956 km² and a population of 78,978 at the 2006 census. It is bounded by Yobe State in the north, Kwaya Kusar local government area in the east and Shani local government area in the south-east. It has a physical setting which arises from an amalgam of factors relating to location, geology, climate as well as the intensity of resources exploitation in the area. The State lies between latitude 10° N and 13° N and longitude 12° and 15° (Nigeria, 2000; NIPOST 2009). Billiri (or Biliri) is a Local Government Area of Gombe State, Nigeria. It is located between latitudes 9° 30" to 11° 30"N and Longitudes 9° 30" and 11° 35" E, and occupies a total land area of about 17,258 km², with a projected population of

2,857,042 (N.P.C, 2010). It is bordered by Bauchi State to the west, Yobe State to the north, Borno State to east and Adamawa State to the south.

Sample Collection: This study involved intensive survey and several visits to the sample sites for plant identification and enumeration exercise. Surveys and direct field observation were randomly carried out on the tree species that are not less than 10cm trunk diameter only. The following measurements were carried out on each tree stand in the different locations:

- Diameter at breast height (DBH) (1.3m above ground level) using Vanier caliper (cm)
- Total height of trees using Haga altimeter (m) and
- Geographical coordinates using global position system (GPS).

DATA ANALYSIS: Data generated were analyzed using student T-test, descriptive statistics with the aid of tables, charts and maps.

RESULTS AND DISCUSSION:The study carried out shows distribution of *Boswellia dalzielii* in different locations in the sampled Northern states of Nigeria (Figure 1 & Table 1).The number of trees discovered in the different study areas with diameter \geq 10cm were recorded and classified into DBH and height as shown in table 2, figure 2and 3. The result based on average diameter indicates that 40.19cm was recorded in the forest in Jahun LGA of Jigawa State 31.86cm in the forest in Gaya, Hong LGA in Adamawa State, 31.81cm in Bayo LGA of Borno State, 29.07cm in Falgore Game Reserve in Kano State, 10.60cm in Billiri LGA in Gombe State and the order of decrease in diameter of *Boswellia dalzielii* across the Northern States include: Jahun LGA of Jigawa State > Gaya, Hong LGA in Adamawa State > Bayo LGA of Borno State > Falgore Game Reserve in Kano State > Billiri LGA in Gombe State. The result thus shows a significant relationship (0.000) in diameter among species (*Boswellia dalzielii*) distribution across the different locations in the sampled states (Table 4).

The implication of this result is that probably the rate of destroying the species is highest in the locations where the mean DBH is lowest while

the locations with highest DBH has lower rate of the species destruction. The result based on mean height of *Boswellia dalzielii* indicates that 5.86m was recorded in Bayo LGA of Borno State, 4.61m in Jahun LGA of Jigawa State, 3.86m in Falgore Game Reserve in Kano State, 2.63m in Gaya, Hong LGA in Adamawa State, 2.57m in Billiri LGA in Gombe State and the order of decrease in height (m) of *Boswellia dalzielii* across the Northern States include: Bayo LGA of Borno State > Jahun LGA of Jigawa State > Falgore Game Reserve in Kano State > Gaya, Hong LGA in Adamawa State > Billiri LGA in Gombe State. The result thus shows none significant relationship (0.097) in height among species (*Boswellia dalzielii*) distribution across the different locations and also none significant relationship (0.897) between species in the sampled locations (Table 6). The increase in diameter may be due to the increase in spacing and other environmental factors like soil and climate. This supports findings from two old-growth forests in Malaysia which have corresponding different height to diameter allometry, suggesting a general trend (King *et al.*, 2009) where widely spaced trees growing in open

Recommendations: We recommend strict conservation of the *Boswellia dalzielii* Hutch in the studied locations as well as other areas of the country where they are in abundance. We recommend controlled exploitation of Non Timber Forest Products for sustained benefits to

environments have thicker trunks than those of forest-grown trees of similar height. Hummel (2000) working with *Cordia alliodora* plantation spacing trial in Costa Rica, found that trees that were more widely spaced tended to have a greater diameter than those that were more closely packed, but with no effect of stem density on height.

Conclusion: This study has shown that *Boswellia dalzielii* Hutch is present in the selected locations in Northern Nigeria, hence could be a veritable source of foreign exchange if it could be appropriately harnessed. Presently, the exploitation is for insignificant and unorganized traditional medicinal use. Since the demand for Frankincense essential oil is growing by the day while in many areas the Frankincense trees are in sharp decline and estimates indicate that we will lose them within the next 50 years. Concerted effort could be made by policy makers to sensitize the communities that host these trees; of their foreign exchange earning potentials that could extricate them from the mire of poverty and more importantly teaching them the best practices for managing the trees and harvesting the resins for sustainable yields.

host communities and to the economy at large. We recommend research into propagation, field establishment and management of *Boswellia dalzielii* Hutch plantations because of its global economic potentials.

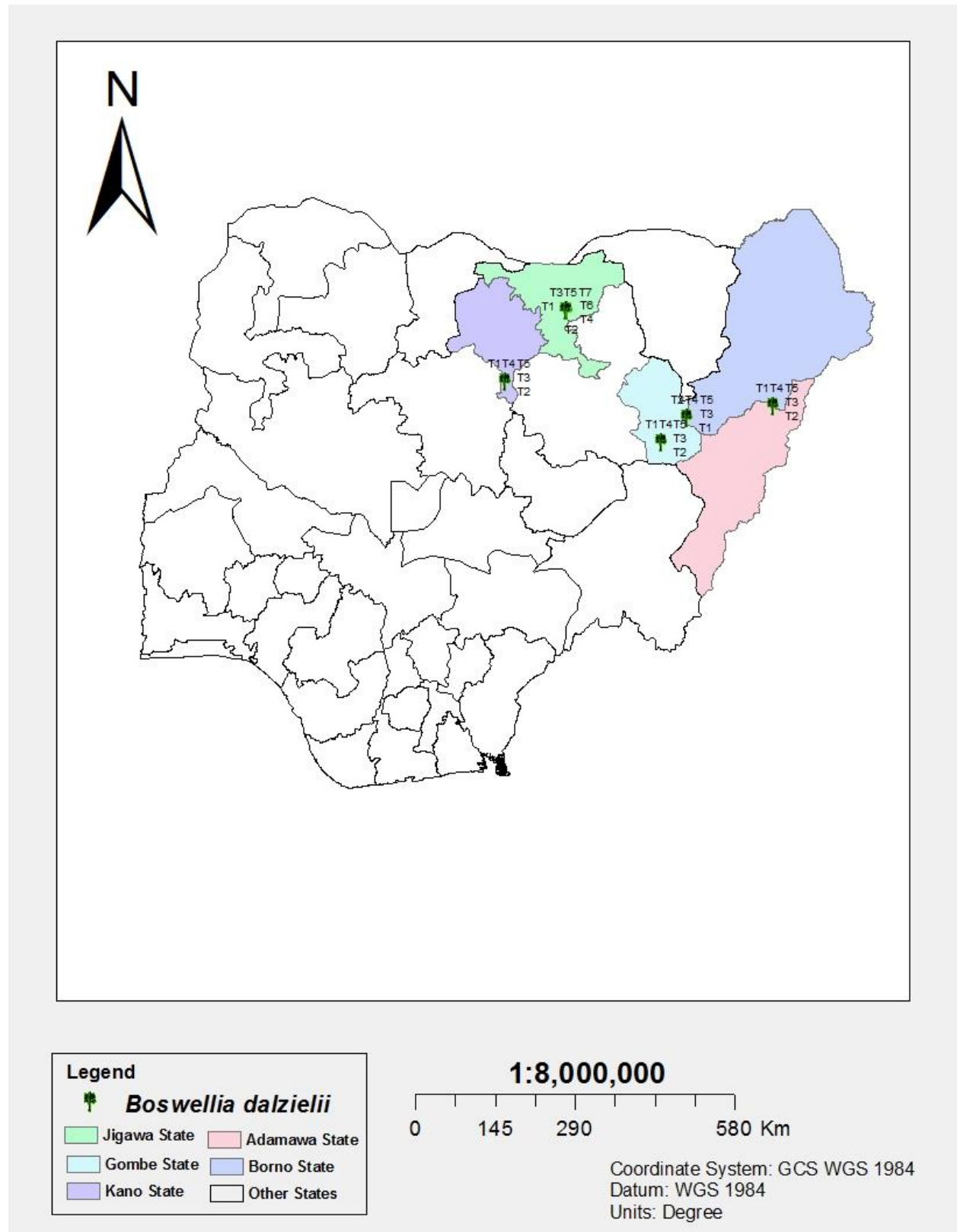


Figure 1: Map of Nigeria, showing the distribution/location of *Boswellia dalzielii* (Generated Map)

Table 1: Distribution of *Boswellia dalzielii* across different States in Northern Nigeria

State	Code	Coordinates		Elevation (m)
		Longitude (E)	Latitude (N)	
Kano State	T ₁	008.64737	10.86593	681
	T ₂	008.64731	10.86595	673
	T ₃	008.64732	10.86594	675
	T ₄	008.64710	10.86683	688
	T ₅	008.64712	10.86688	674
Jigawa State	T ₁	009.66729	12.03714	381
	T ₂	009.66732	12.03667	382
	T ₃	009.66740	12.03619	389
	T ₄	009.66737	12.03617	391
	T ₅	009.66738	12.03617	391
	T ₆	009.66739	12.03618	385
	T ₇	009.64814	12.03957	382
Adamawa State	T ₁	013.02151	10.46421	488
	T ₂	013.02182	10.46406	490
	T ₃	013.02194	10.46409	484
	T ₄	013.02173	10.46371	484
	T ₅	013.02122	10.46388	487
Borno State	T ₁	013.7095	10.16550	118
	T ₂	011.37067	10.16537	110
	T ₃	011.37686	10.16570	120
	T ₄	011.37467	10.16854	111
	T ₅	011.37685	10.16475	112
Gombe State	T ₁	011.12386	09.52322	504
	T ₂	011.12374	09.52331	503
	T ₃	011.12375	09.52342	500
	T ₄	011.12374	09.52342	495
	T ₅	011.12383	09.52350	501

Source: Field Work, (2018)

Table 2: Number of Trees (*Boswellia dalzielii*) per Location with different DBH and Height

LOCATION	SPECIES	DBH (cm)	HEIGHT (m)
FALGORE LGA, KANO STATE	T ₁	38	5
	T ₂	34	6
	T ₃	31	4
	T ₄	58.5	6
	T ₅	42	6
JAHUN LGA, JIGAWA STATE	T ₁	51	5
	T ₂	61.5	5.3
	T ₃	37	6
	T ₄	32	5
	T ₅	30.8	4.4
	T ₆	44	4.4
	T ₇	25	2.2
GAYA, HONG LGA ADAMAWA STATE	T ₁	43	3.3
	T ₂	39.5	4.4
	T ₃	58	3.3
	T ₄	38.5	4.4
	T ₅	44	3.0
BAYO LGA, BORNO STATE	T ₁	45.7	9
	T ₂	42	7
	T ₃	52	8
	T ₄	45	9

BILLIRI LGA, GOMBE STATE	T ₅	38	8
	T ₁	23	4
	T ₂	14.6	3.5
	T ₃	8.5	3
	T ₄	12.8	3.5
	T ₅	15.3	4

Source: Field Work, (2018)

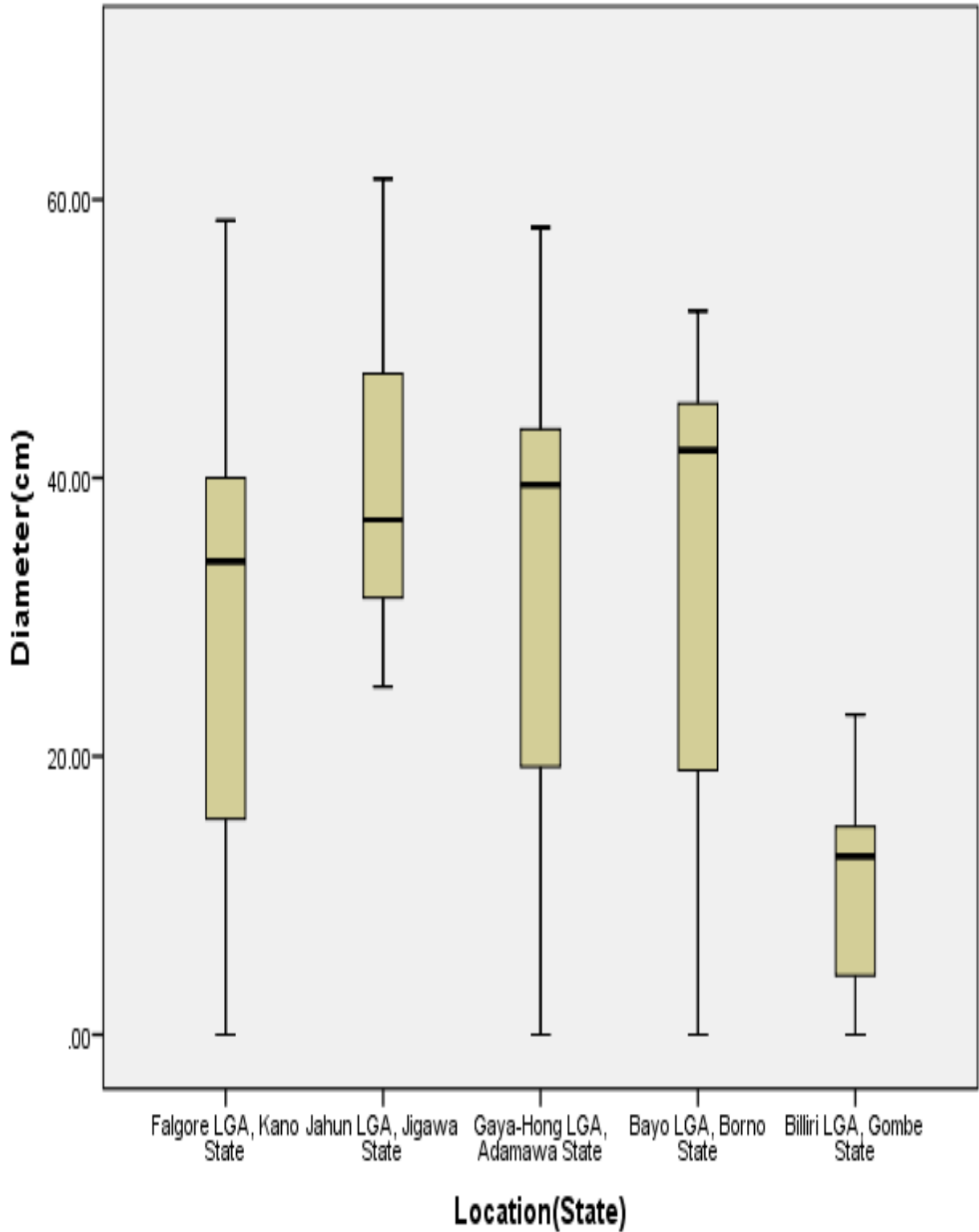


Figure 2: Diameter distribution of *Boswellia dalzielii* (> 10cm) in the different Northern State

Table 3: Paired Sample Statistics between species diameter across different locations

	Mean	N	Std. Deviation	Std. Error Mean
Location (State)	3.00	35	1.435	0.243
Diameter (cm)	28.7057	35	20.01605	3.38333
Species (<i>Boswellia dalzielii</i>)	4.00	35	2.029	0.343
Diameter (cm)	28.7057	35	20.01605	3.38333

Table 4: Paired Sample T-test Analysis on Diameter (cm) of Species (*Boswellia dalzielii*) across different States in Northern Nigeria

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Location (State) – Diameter (cm)	-25.70571	20.52705	3.46971	-32.75700	-18.65442	7.409	34	0.000**
Species (<i>Boswellia dalzielii</i>) – Diameter (cm)	-24.70571	21.30951	3.60196	-32.02579	-17.38564	6.859	34	0.000**

WHERE ** = Significant difference; NS = Not Significant

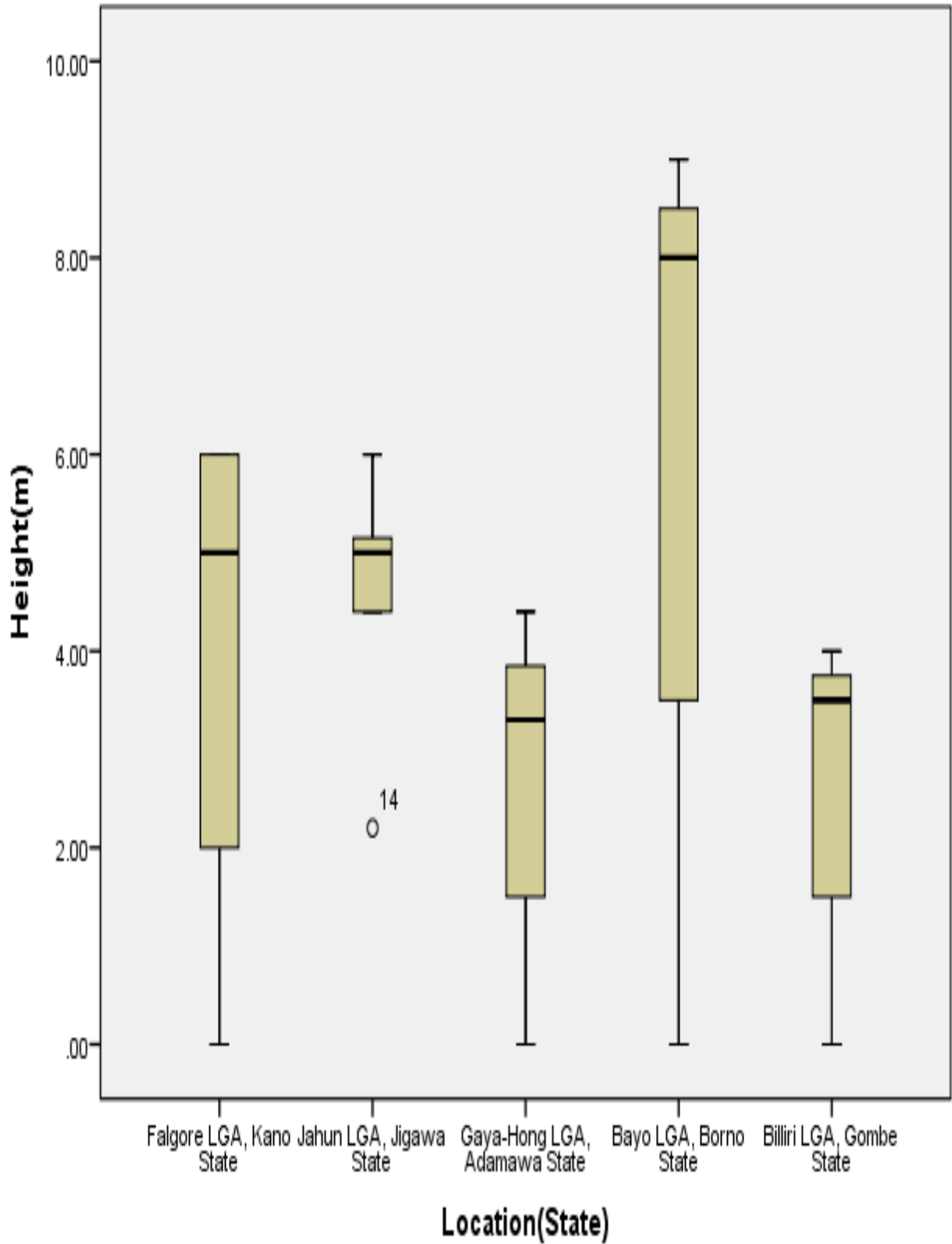


Figure 3: Height distribution of *Boswellia dalzielii* (> 10cm) in the different Northern State

Table 5: Paired Sample Statistics between species Height across different locations in Northern Nigeria

	Mean	N	Std. Deviation	Std. Error Mean
3.00		35	1.435	.243
3.9057		35	2.69389	.45535
4.00		35	2.029	.343
Height (m)	3.9057	35	2.69389	.45535

Table 6: Paired Sample T-test Analysis on Height (m) of Species (*Boswellia dalzielii*) across different location in Northern Nigeria

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
				Paired Differences				
Location (State) – Height (m)	-0.90571	3.14053	0.53085	-1.98452	0.17309	-1.706	34	0.097 ^{NS}
Species (<i>Boswellia dalzielii</i>) – Height (m)	0.09429	4.25765	0.71967	-1.36827	1.55684	0.131	34	0.897 ^{NS}

WHERE ** = Significant difference; NS = Not Significan

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