FITTING DIAMETER DISTRIBUTION FOR *Terminalia ivorensis* STANDS IN SAKPONBA FOREST RESERVE, EDO STATE, NIGERIA

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ABSTRACT

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Models are important forest management tools that ensure sustained forest management principles. This study was carried out to fit diameter distribution for Terminalia ivorensis stands with a view to building predictive models. Simple random sampling was used for sample collections. Twenty (20) Temporary Sample Plots (TSP's) were randomly established in the Terminalia ivorensis stands. In each plot, the outside bark diameter at breast height (dbh) of 244 trees were all measured using measuring tape. Kolmogorov Smirnov, Anderson Darling and Chi-Square goodness of fit were used to fit the diameter data. The results indicated that the skewness value was -0.17983 while the value of the excess kurtosis was -0.78398. This means there are fewer trees in the lower dbh class which are not sufficient enough to replace trees in the upper dbh class in the future. Out of several distribution models tried 34, 30 and 18 distribution models tested with Kolmogorov Smirnov, Anderson Darling and Chi–Square respectively were able to fit the diameter data. However, the three test statistic showed different distribution model as the best model that can provide a good fit for the diameter data. Kolmogorov Smirnov statistic test showed Johnson's S_B as the best model while Anderson Darling indicated that Gen. Extreme Value was the best model. And on the same diameter data, Chi-square statistic showed a different distribution model (Burr distribution) as the best model. This implies that different test statistic for the same diameter data can indicate different distribution as the best model.

Keywords: *Distribution models, Diameter at breast height, Terminalia ivorensis, Stands, Sakponba Forest Reserve*

INTRODUCTION

Terminalia ivorensis (Combretaceace) is a tree that is widely distributed throughout the tropics (Keay, 1989). It is found in lowland rainforest zone of Nigeria. It is an important economic tree species that is suitable for palings and mostly used for shingles (Aigbe and Oyebade, 2012). Other uses are for house building, canoes building, planks, cabinetwork, ceilings, flooring and interior work (Danziel, 1968). The benefits of *T. ivorensis* have led to increasing demand of its timber. But meeting this increasing demand is always a challenge due to poor management practices, unregulated logging operation and excessive exploitation. As a result, adopting sustainable management practice is imperative. Sustainable management practice requires such tools as diameter distribution models for providing more detailed knowledge on the forest structure, product value, and forest operations costs for forest managers' and researchers, without additional inventory costs (Nord-Larsen and Cao, 2006).

Diameter distribution model is useful in assessing stand stability, estimating age distribution and calculating the number of trees in each diameter class with a view to planning silvicultural treatments (Carretero and Alvarez, 2013). It can also be used to indicate relationship between the density of smaller trees in a stand and replacement sufficiency for the current population of larger trees and prognosis for potential forest sustainability (Aigbe and Omokhua, 2013). The distribution of diameter can be useful in predicting the growth and yield of stands in long term management planning using tree wise growth models (Siitonen, 1993). Different theoretical distributions such as Weibull and Johnson's S_B functions have been widely used to describe tree stock in mathematical form (Loetsch *et al*., 1973; Bailey and Dell 1973; Hafley and Schreuder 1977). The size of diameter is a measure of the industrial use of the wood and thus useful in ascribing price value to the various products (Okojie 1981). It is a managerial technique for even-aged stands in which the number of tree per unit area in each diameter class is estimated through the use of mathematical functions (Ajayi, 2013). This study is therefore conducted to predict diameter distribution models of *Terminalia ivorensis* stands in Sakponba Forest Reserve in order to ensure effective management.

METHODOLOGY

Sakponba Forest Reserve is situated in the humid tropical rainforest zone of Nigeria. It lies on latitude 6° 04´ N and longitude 5° 32' E. (Fig. 1). The *T. ivorerensis* plantation occupies an area of 10.12 hectare in the forest reserve (Aigbe and Oyebade, 2012) which has a size of 502.5km^2 (Isikhuemen, 1998). The forest reserve is located in Orhionmwon Local Government Area of Edo State. Sakponba Forest Reserve is divided into two main areas by River Jamieson, Area BC 29 and BC 32/4. It is gridded into 176 compartments. Out of these, 101 are located in BC 29 and 75 in BC 32/4 (Isikhuemen, 1998). The geologic timescale is of tertiary age of the post middle eolian period called the Benin Sands (Oguntala, 1980). The topsoil is fine sandy loamy, reddish in colour and a less than 30 cm in depth. Down the profile at depths greater than 30 cm, the soil becomes coarser and darker reddish chroma and becomes brick red as the depth increases (Oguntala, 1980). The mean annual rainfall is 2162 mm. The wettest period is between July and September while the driest is between December and January; the relative humidity is generally high averaging 71% in the afternoon. The maximum and minimum temperatures are generally low from 26 – 16 °C (Oguntala, 1980).

Twenty (20) Temporary Sample Plots (TSP's) were randomly established in the *T. ivorensis* stands. In each plot, the outside bark diameter at breast height(s) of 244 trees were all measured using measuring tape. Various distribution methods were tried using Kolmogorov Smirnov, Anderson Darling and Chi-Square goodness of fit to rank the data collected. Best ranked distributions were chosen and fitted to the diameter data. The distributions used for the fitting of diameter at breast height data include Johnson S_B, Gamma (3P), Beta, Burr (4P), Weibull (3P), lognormal (3P), Gen. Extreme Value, pert, Weibull, Log-Pearson 3, Triangular, Error, Gen. Gamma (4P) etc. Parameters for diameter distribution model were estimated using Easy Fit 5.6 professional software package.

RESULTS AND DISCUSSION

Distribution of stand diameter breast heights within the study area

A total of 244 individual trees were measured in 20 temporary sample plot from the plantation area marked out in the Sakponba Forest Reserve. The results indicated that at 50% percentile, the value of dbh falls below 145 cm and at 75% percentile, it falls below 152 cm (Table 1). Mehtatalo *et al.* (2007) stated that percentile based approach is one of the numerous approaches for describing the diameter distribution of stands. Percentiles are better understood in terms of their relationship with stand characteristics and, therefore, are regarded as easier to predict from other stand characteristics (Knoebel and Burkhart 1991; Gobakken and Næsset 2004).

The skewness and kurtosis value were -0.17983 and -0.78398 respectively (Table 1). Low negative skewness and peakedness means that considerable numbers of trees are concentrated in the upper diameter classes. This pattern of distribution shows that there are fewer trees in the lower dbh class which are not sufficient enough to replace trees in the upper dbh class in the future. The implication is that the *T. ivorensis* stand is in a verge of loss. Gadow (1983) reported that platykurticity and symmetry is indicated by flat-topped distribution. Positive skewness and high peakedness shows that sizeable numbers of trees are concentrated in the lower diameter classes while mesokurticity and zero skewness shows a normal distribution of the observations around the mean (Gadow, 1983).

The average number of trees per hectare was 305 per ha (Table 1). The tree stock per hectare in this study area is high when compared with 71 trees per ha for *Terminalia superba* stand in Onigambari Forest Reserve (Akinyemi *et al.,* 2012) and 33 trees per ha for *Terminalia superba* plantation in Mayombe Forest, Democratic Republic of Congo (De Ridder *et al.*, 2010). The value was however lower than the 496 trees per hectare reported for *Nauclea diderrichii* plantations in the humid tropical rainforest zone of southwestern Nigeria (Onyekwelu *et al*., 2008) as well as the 5328, 2551, 1189 and 638 trees per hectare reported by Ola-Adams (1993) in south-western Nigeria. Other densities reported for various plantation forest include 1515 trees per hectare for *Eucalyptus globulus* plantation in Australia (Forrester *et al.*, 2004), 3086, 1276, 567 and 269 trees per hectare for Limba plantation in south-western Nigeria (Ola-Adams 1993) and 1000 trees per hectare for *Eucalyptus saligna plantations* in Cameroun (Fonweban and Houllier, 1997).

Table 1: Distribution of dbh data for *T. ivorensis in the study area*

Statistic	value	percentile	Stand dbh (cm)
Sample size	244	Minimum	125
Range	41	5%	127.25
Mean	144.28	10%	130
Variance	91.874	25%	138
Standard deviation	9.5851	50%	145
Coefficient of variation	0.06643	75%	152
Standard error	0.61362	90%	157
Skewness	-0.17983	95%	159.75
Kurtosis	-0.78398	100% maximum.	166
Minimum number of tree ha^{-1}	125		
Maximum number of tree ha^{-1}	525		
Average number of tree ha^{-1}	305		

Source: field work 2016

Distribution predicting parameters and models

The prediction parameters are shown in Table 2. The distributions were tested with Kolmogorov Smirnov, Anderson Darling and Chi Square as shown in Table 3. Out of the several distributions tested 34, 30 and 18 distribution models tested with Kolmogorov Smirnov, Anderson Darling and Chi–Square respectively were able to fit the diameter data (Table 3). The models that could fit the diameter data were selected based on their ranking after comparison with critical values of the three test statistic at 5% significant level (Table 4).

The observed statistic for the three test (Table 3) were all less than the tabular critical values as shown in Table 4, which makes the null hypothesis to be accepted. The implication is that the data followed the specified distribution. However, the three test statistic showed different distribution model as the best model that can provide a good fit for the diameter data. Kolmogorov Smirnov test showed Johnson's S_B as the most flexible model (Fig. 1) while Anderson Darling indicated that Gen. Extreme Value is the most flexible model (Fig. 5). And on the same diameter data, Chi-square statistic showed a different distribution model (Burr distribution) as the most flexible model (Fig. 9). This implies that different test statistic for the same diameter data can indicate different distribution as the best model. According to Wang and Rennolls (2005), it has not been proven as to which model is the most suitable for diameter distribution because different test statistic can indicate different distribution models as the best model. A distribution model can be regarded as the most flexible model instead of best model (Aigbe and Omokhua, 2014). Different authors have reported different distribution model as the most frequently used model. Scolforo *et al.* (2003) and Wang and Rennolls (2005) have all reported Johnson's S_B distribution as the most frequently used while Akindele, (2002) and Cao, (2004) have demonstrated the suitability of Weibull probability distribution functions for fitting the diameter distribution in even–aged forest stands.

Table 2: Distribution Predicting Parameters

Distribution	Parameters	Distribution	Parameters
Beta	$a=122.83$ $b=166.67$ $\alpha_1=2.039$ $\alpha_2=2.1642$	Kumaraswamy	$a=125.0$ $b=166.0$ $\alpha_1=1.0$ $\alpha_2=1.2$
Burr	$\alpha=18.432$ $\beta=165.04$ $k=7.5725$	Laplace	$\lambda=0.14754$ $\mu=144.28$
Burr (4P)	$\alpha=3.3856E+9$ $\beta=1.7851E+9$ $\gamma=-1.7851E+9$ $k=0.02914$	Levy	$\sigma=143.64$
Cauchy	$\mu=145.41$ $\sigma=6.2781$	Levy (2P)	$\gamma=123.78$ $\sigma=11.899$
Chi-Squared	$\nu=144$	Log-Gamma	$\alpha=5486.8$ $\beta=9.0572E-4$
Chi-Squared (2P)	$\gamma=93.679$ $\nu=50$	Log-Logistic	$\alpha=25.811$ $\beta=143.88$
Dagum	$\alpha=21.013$ $\beta=142.53$ $k=1.2109$	Log-Logistic (3P)	$\alpha=4.1999E+8$ $\beta=2.3739E+9$ $\gamma=-2.3739E+9$
Dagum (4P)	$\alpha=0.6052$ $\beta=1.324$ $\gamma=125.0$ $k=0.98289$	Log-Pearson 3	$\alpha=45.274$ $\beta=-0.00997$ $\gamma=5.421$
Erlang	$\beta=0.63677$ $m=226$	Logistic	$\mu=144.28$ $\sigma=5.2846$
Erlang (3P)	$\beta=0.91436$ $\gamma=41.082$ $m=113$	Lognormal	$\mu=4.9695$ $\sigma=0.06695$
Error	$\mu=144.28$ $\sigma=9.5851$ $k=3.8341$	Lognormal (3P)	$\gamma=-116.57$ $\mu=5.5632$ $\sigma=0.03682$
Error Function	$h=0.07377$	Nakagami	$\Omega=20909.0$ $m=57.753$
Exponential	$\lambda=0.00693$	Normal	$\mu=144.28$ $\sigma=9.5851$
Exponential (2P)	$\gamma=125.0$ $\lambda=0.05186$	Pareto	$\alpha=7.0804$ $\beta=125$
Fatigue Life	$\alpha=0.06698$ $\beta=143.96$	Pareto 2	$\alpha=113.81$ $\beta=16968.0$
Fatigue Life (3P)	$\alpha=0.00643$ $\beta=1484.6$ $\gamma=-1340.4$	Pearson 5	$\alpha=221.85$ $\beta=31867.0$
Frechet	$\alpha=17.545$ $\beta=139.29$	Pearson 5 (3P)	$\alpha=258.02$ $\beta=39665.0$ $\gamma=-10.075$
Frechet (3P)	$\alpha=1.6731E+8$ $\beta=1.5471E+9$ $\gamma=-1.5471E+9$	Pearson 6	$\alpha_1=1190.7$ $\alpha_2=272.48$ $\beta=32.901$
Gamma	$\alpha=226.59$ $\beta=0.63677$	Pearson 6 (4P)	$\alpha_1=15.562$ $\alpha_2=5.0811E+7$ $\beta=1.3273E+8$ $\gamma=103.71$
Gamma (3P)	$\alpha=148.81$ $\beta=0.7892$ $\gamma=26.82$	Pert	$a=118.42$ $b=167.82$ $m=144.8$
Gen. Extreme Value	$\mu=141.28$ $\sigma=10.132$ $k=-0.37559$	Power Function	$a=125.0$ $b=166.0$ $\alpha=0.88788$
Gen. Gamma	$\alpha=225.4$ $\beta=0.63677$ $k=0.99903$	Rayleigh	$\sigma=115.12$
Gen. Gamma (4P)	$\alpha=69.539$ $\beta=42.149$ $\gamma=-66.167$ $k=2.6361$	Rayleigh (2P)	$\gamma=125.0$ $\sigma=15.215$
Gen. Pareto	$\mu=126.64$ $\sigma=38.999$ $k=-1.2103$	Reciprocal	$a=125.0$ $b=166.0$
Gumbel maximum	$\mu=139.97$ $\sigma=7.4735$	Rice	$\sigma=0.8769$ $\nu=150.84$
Gumbel minimum	$\mu=148.6$ $\sigma=7.4735$	Student's t	$\nu=2$
Hypersecant	$\mu=144.28$ $\sigma=9.5851$	Triangular	$a=121.03$ $b=166.56$ $m=147.0$
Inverse Gaussian	$\lambda=32693.0$ $\mu=144.28$	Uniform	$a=127.68$ $b=160.88$
Inverse Gaussian (3P)	$\gamma=-963.76$ $\lambda=1.4839E+7$ $\mu=1108.0$	Weibull	$\alpha=18.245$ $\beta=148.43$
Johnson SB	$\gamma=-0.26204$ $\lambda=47.683$ $\delta=1.0376$ $\xi=117.93$	Weibull (3P)	$\alpha=3.8884$ $\beta=35.843$ $\gamma=111.92$

The dbh distribution pattern of trees in the study area was negatively skewed (Fig. 1, 5 and 9). According to Gadow (1983) substantial numbers of trees are concentrated in the lower diameter classes if it is positively skewed while zero skewness shows a normal distribution of the values of observations around the mean. This implies that negative skewness indicate considerable numbers of trees are concentrated in the upper diameter classes. The best adjudged models show that there is no difference between theoretical and empirical cumulative functions. Figures 2, 3, 4, 6, 7, 8 10, 11 and 12 of the P-P plots, Q-Q plots and probabilities difference graphs respectively showed the correctness of the three diameter distribution models which is approximately linear if the specified theoretical distribution is the correct model. The probability difference graph was used to determine how well the theoretical distribution fit the observed data and compare the goodness of fit of several distributions (Aigbe, 2014).

Table 3: Goodness of fit of the dbh sample using three different model fitting techniques

Distribution	Kolmogorov smirnov	Rank	Anderson darling	Rank	Chi square	Rank
Beta	0.07359	25	1.1026	6	9.5473	7
Burr	0.05629	4	0.92125	3	5.2808	1
Burr (4P)	0.23266	49	20.799	47	106.9	46
Cauchy	0.10697	39	4.8448	38	17.454	24
Chi-Squared	0.14756	48	14.107	46	84.487	45
Chi-Squared (2P)	0.10245	38	3.3225	34	27.004	35
Dagum	0.06998	15	2.1899	29	13.856	18
Dagum (4P)	0.61734	56	168.41	57	476.01	50
Erlang	0.08512	34	2.1638	28	13.681	15
Erlang (3P)	0.06751	12	1.7157	18	13.167	14
Error	0.06647	11	0.96596	5	5.9608	3
Error Function	1.00	60	N/A		N/A	
Exponential	0.57952	55	97.712	55	2427.2	52
Exponential (2P)	0.24452	50	25.907	48	127.92	47
Fatigue Life	0.07335	24	1.8738	22	13.724	17
Fatigue Life (3P)	0.06886	13	1.4971	11	18.227	27
Frechet	0.13478	47	8.2754	43	42.569	39
Frechet (3P)	0.11275	41	4.5147	37	26.634	34
Gamma	0.07166	20	1.7405	19	9.5785	8
Gamma (3P)	0.073	22	1.8054	20	11.047	10
Gen. Extreme Value	0.05381	2	0.6654	1	8.7419	4
Gen. Gamma	0.07109	17	1.7068	17	10.953	9
Gen. Gamma (4P)	0.07112	18	1.5176	13	9.1196	5
Gen. Pareto	0.07367	26	49.476	52	N/A	
Gumbel maximum	0.12366	43	9.6682	45	50.67	43
Gumbel minimum	0.0742	29	3.1216	33	12.714	13
Hypersecant	0.10242	37	3.6857	35	28.026	36
Inverse Gaussian	0.0721	21	1.8362	21	21.938	32
Inverse Gaussian (3P)	0.06541	9	1.4435	10	18.326	28
Johnson SB	0.04764	1	4.4091	36	N/A	
Kumaraswamy	0.12132	42	6.3896	41	48.525	42
Laplace	0.12776	46	5.7864	39	47.234	41
Levy	0.64803	58	118.95	56	3811.0	54
Levy (2P)	0.41496	52	42.768	50	289.24	49
Log-Gamma	0.07413	28	1.9425	24	14.134	19
Log-Logistic	0.0886	36	2.4679	30	29.825	37
Log-Logistic (3P)	0.07137	19	1.6363	15	16.203	23
Log-Pearson 3	0.06169	6	1.1549	8	19.231	30
Logistic	0.08701	35	2.5842	32	34.51	38
Lognormal	0.07334	23	1.8746	23	13.72	16
Lognormal (3P)	0.07103	16	1.6669	16	9.4451	6
Nakagami	0.06988	14	1.6333	14	18.756	29
Normal	0.06574	10	1.3952	9	18.072	26
Pareto	0.25778	51	34.903	49	131.43	48
Pareto 2	0.56627	54	94.435	54	2440.2	53
Pearson 5	0.07558	31	2.0638	26	14.268	21
Pearson 5 (3P)	0.07727	32	2.1064	27	14.274	22
Pearson 6	0.07403	27	1.9679	25	14.179	20
Pearson 6 (4P)	0.08441	33	2.5542	31	17.542	25
Pert	0.05428	3	0.84539	2	11.486	11
Power Function	0.12534	45	8.8128	44	58.098	44
Rayleigh	0.44539	53	71.523	53	1164.6	51
Rayleigh (2P)	0.10774	40	6.0238	40	24.805	33
Reciprocal	0.12517	44	7.4765	42	46.951	40
Rice	0.63607	57	2147.0	58	N/A	
Student's t	0.99997	59	2331.6	59	2.1099E+7	55
Triangular	0.06265	7	0.9549	4	5.7624	2
Uniform	0.07469	30	46.613	51	N/A	
Weibull	0.06159	5	1.5069	12	12.389	12
Weibull (3P)	0.0639	8	1.1333	7	20.362	31

N/A – Not available

Table 4: Critical values of test statistic in selecting the distribution model

Statistic	Critical value ($\alpha = 0.05$)
Kolmogorov Smirnov	0.08694
Anderson Darling	2.5018
Chi-Square	14.067

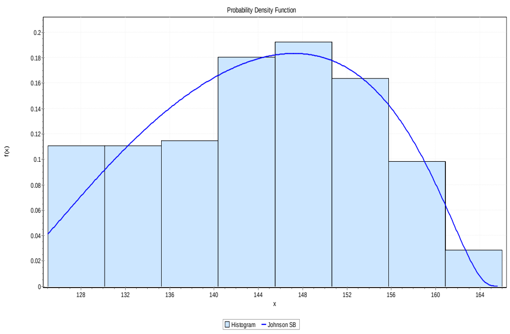

Fig. 1: Johnson's S_B observed and estimated probability function of dbh class for *Terminalia ivorensis* in Sakponba Forest Reserve

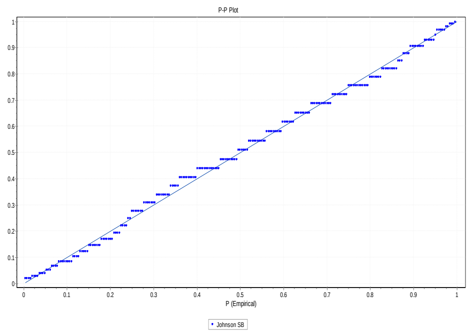

Figure 2: Johnson's S_B graph of P-P plot

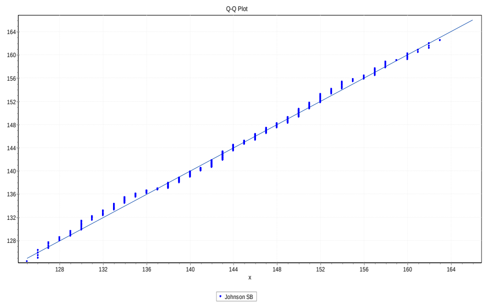

Fig. 3: Johnson's S_B graph of Q-Q Plot

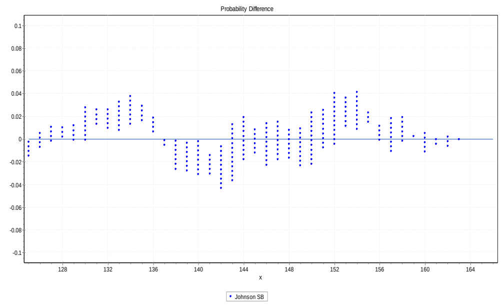

Fig. 4: Johnson's S_B graph of probability difference

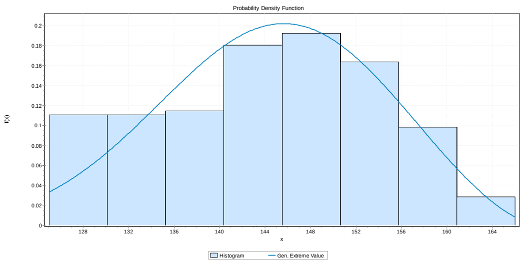

Fig. 5: General Extreme value observed and estimated probability function of dbh class for *Terminalia ivorensis* in Sakponba Forest Reserve

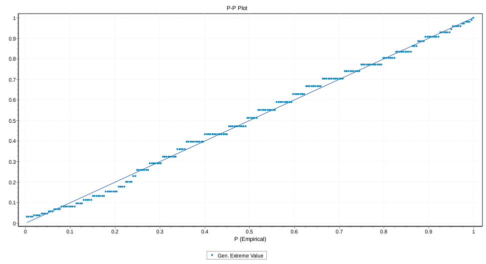

Fig. 6: General Extreme value graph of P-P plot

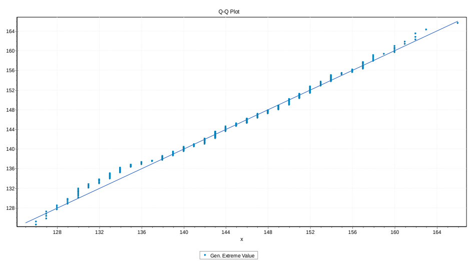

Fig. 7: General Extreme value graph Q-Q plot

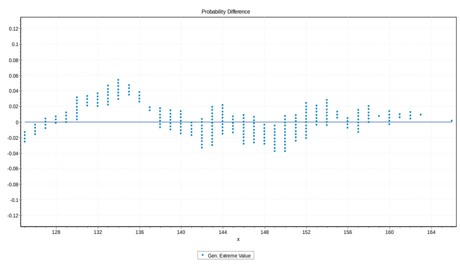

Fig. 8: General Extreme value graph of probability difference

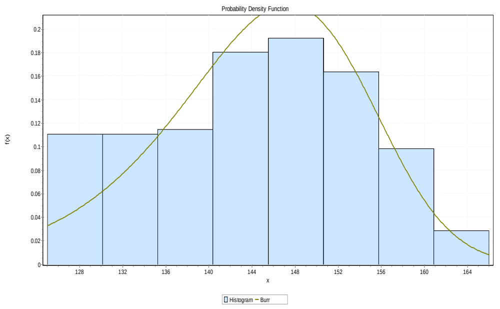

Fig. 9: Burr graph of observed and estimated probability function of dbh class for *Terminalia ivorensis* in Sakponba Forest Reserve

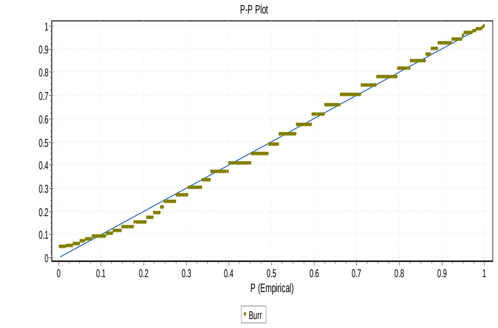

Fig. 10: Burr graph of P-P plot

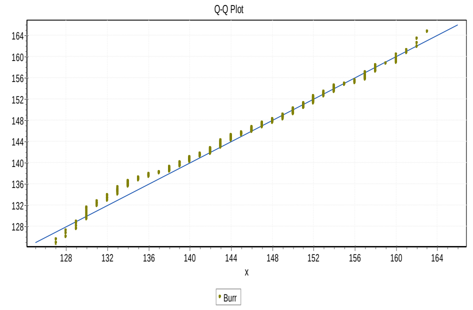

Fig. 11: Burr graph of Q-Q plot

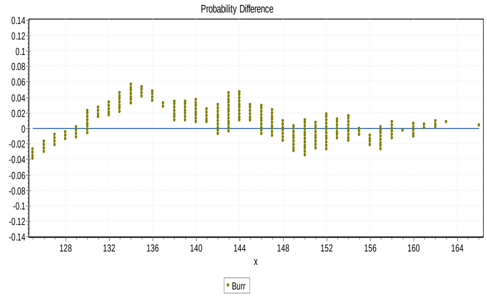

Fig. 12: General Extreme value graph of probability difference

Model Validity

Tables 5, 6 and 7 shows the dbh frequency distribution of the observed diameter class and their evaluation with Johnson;`s S_B, General. Extreme value and Burr probability distribution functions respectively at 6 cm dbh class interval. The predicted dbh frequencies showed that there are relatively more trees in the upper dbh class than in the lower dbh class which indicated negative skewness. The implication is that the guarantee for continuous supply of timbers is limited. The model validation test (t – test) proved that the observed frequencies are not significantly different (p>0.05) from the predicted frequencies. The correlation coefficient between the observed and predicted dbh frequencies shows high degree of agreement between the observed and predicted values (Tables 8, 9 and 10).

Table 5: Frequency distribution in the observed diameter class and evaluation with Johnson's S_B distribution in Sakponba Forest Reserve of *Terminalia Ivorensis* stand

dbh class	Observed	Predicted
125-130	27	17
131-135	27	28
136-141	28	37
142-147	44	43
148-153	47	45
154-159	39	39
160-165	25	26
166-171	7	6

Table 6: Frequency distribution in the observed diameter class and evaluation with Gen. Extreme Value distribution in Sakponba Forest Reserve of *Terminalia Ivorensis* stand

dbh class	Observed	Predicted
125-130	27	14
131-135	27	24
136-141	29	28
142-147	44	49
148-153	47	49
154-159	40	39
160-165	23	24
166-171	7	7

CONCLUSION

The study clearly showed that diameter distribution model was successfully generated using different techniques. Johnson's S_B, General Extreme value and Burr distributions were adjudged more flexible in fitting the *Terminalia ivorensis* diameter data in Sakponba Forest Reserve when analysed with Kolmogorov Smirnov, Anderson Darling and Chi-square respectively. The predicted distributions did not defer significantly from the observed distribution. The result showed that there was no clear distinction as to which model is the best instead the most flexible model is the appropriate term. The diameter distribution model developed for the *Terminalia ivorensis* stands provides a useful tool in planning silvicultural and harvest schedules.

Table 7: Frequency distribution in the observed diameter class and evaluation with Burr Distribution in Sakponba Forest Reserve of *Terminalia Ivorensis* stands

dbh class	Observed	Predicted
125-130	28	9
131-135	28	21
136-141	29	34
142-147	44	49
148-153	47	61
154-159	39	44
160-165	22	20
166-171	7	6

Table 8: Paired t-test analysis for Johnson's S_B Distribution Model

	Observed	Predicted
Mean	30.500	30.125
Observations	8.000	8.000
Pearson Correlation	0.924	
Hypothesized Mean	0	
Difference	0	
Degree of freedom	7.000	
t Statistics	0.205	
t Critical two-tail	2.365	

Table 9: Paired t test analysis for Gen. Extreme value Distribution Model

	Observed	Predicted
Mean	30.500	30.500
Observations	8.000	8.000
Pearson Correlation	0.916	
Hypothesized Mean	0	
Difference	0	
Degree of freedom	7.000	
t Statistics	0.000	
t Critical two-tail	2.365	

Table 10: Paired t test analysis for Burr Distribution Model

	Observed	Predicted
Mean	30.500	30.500
Observations	8.000	8.000
Pearson Correlation	0.900	
Hypothesized Mean	0	
Difference	0	
Degree of freedom	7.000	
t Statistics	0	
t Critical two-tail	2.365	

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