International Journal of Science Academic Research
Vol. 02, Issue 04, pp.1360-1367, April, 2021
Available online at http://www.scienceijsar.com

ISSN: 2582-6425

Research Article

IMPACTS OF LOGGING ON THE VEGETATION OF THE FOREST MANAGEMENT UNIT (UFA) IPENDJA, LIKOUALA DEPARTMENT

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Received 13th February 2021; **Accepted** 08th March 2021; **Published online** 30th April 2021

Abstract

The estimation of the impacts of forestry operations, in particular on felling, logging and in timber yards, takes place in the Republic of Congo, more precisely in the Department of LIKOUALA, UFA IPENDJA of the Annual Cup 2020 Plate. its realization, forestry equipment was necessary. The results were processed using Excel 2013 software to achieve the expected results. For 1,149 trees felled, a useful surface area of 277,292.05 m2 had to be degraded, or 27.73 ha. The damaged young stems of the future were estimated at 827 stems destroyed during logging operations. These destroyed stems are represented by diameter class (I, II, III, IV, V and VI) and according to species (Main, secondary and others). When the skidding tracks were opened, we recorded 1,610 stems destroyed depending on the type of skidding track. For the main tracks, we observed a workforce of 1193 rods destroyed, while on the secondary skidding tracks we have 25.90% of the rods destroyed, corresponding to a workforce of 417 impacted rods. Five (5) parks are recorded with an average park length of 62.22 m, while 48 m represents the average park width. The impacted area is approximately 2.7 ha. The damage to the residual stand resembles the damage from road construction and the stems were uprooted, broken or debarked. For this operation, an exploitation damage rate of 33.94% on the initial stand for a sample of 1.5 stems / ha.

Keywords: Forest species, Area damaged, Future stem destroyed.

INTRODUCTION

Congo's forests cover an area of approximately 22.5 million hectares, of which two thirds (2/3) are concentrated in three main main sectors:

- The Kouilou-Mayombe sector with 1.5 million hectares of which the main species sought are Limba (Terminalia superba) and Okoumé (Aucoumea klaineana);
- The Chaillu-Niari Sector with 3.5 million hectares with the main most exploited species Limba (Terminalia superba) and Okoumé (Aucoumea klaineana;
- The largest North Congo sector with 15 million hectares with Sapelli (Entandroprhagma cylindricum) and Sipo (Entandrophagma useful) as species.

The exploitation of the Congolese forests dates back to colonial times and was mainly deployed in the two southern sectors of the country. Nowadays, this massif has experienced overexploitation due to various reasons, in particular:

- Proximity to the Atlantic Ocean coast;
- The existence of floating rivers in the North-Western part;
- The presence of the port of Pointe-Noire;
- The crossing of these forests by the Congo Ocean Railway (CFCO) and the Ogoué Mining Company (COMILOG);
- The forestry policy of the still experimental period with a less rigorous legal framework on the fundamental principles of the sustainable and rational management of tropical forests (MBETE, 2014).

The timber potential estimated from more than thirty species currently exploited is estimated at more than 1.5 billion cubic meters.

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Overall, the Congo still has considerable forest resources that are still little known (Fréquelin 1998). The forest policy governed by a forest code provides for the establishment of forest management units (UFA), the objectives of which are:

- Guarantee the permanence of forestry activity by introducing the concept of rotation in operation, thus obliging forestry companies to carry out their activities in such a way as to ensure the regeneration of the woody potential;
- Regularize production at the national level while preserving valuable species from overly intensive exploitation;
- Promote sustainable logging throughout the country.

The national forest estate is divided into sectors, sectors into zones, zones into forest management units (UFA) and UFA into forest exploitation units (UFE) (Forest Code, 2000). For many tropical countries, the forest industry remains one of the main sources of income for their economies. In fact, the forest and the industrial sector contribute an average of 2.7% (Frequelin, 1998). One of the consequences of this logging is the creation of gaps in the canopy. Within certain limits, the ecological consequences of these gaps are similar to natural windfall and the scarring phenomenon that follows. Under optimal conditions, selective harvesting of a few large trees per hectare does not significantly change the structure of the forest. However, the damage to the stand is directly linked to the mode and intensity of logging operations but also to the phenomena of successive passages for new operations (MBETE, 2014). These new exploitations can bring about disturbances and important modifications in the stand, among other things in its floristic composition with a depletion of species of great commercial value, the disappearance of certain rare species used for uses other than timber. Technical studies in tropical forests have shown that it is possible to halve the damage caused by mechanized logging (Bertault and Sist. 1995, 1997). These harvesting methods commonly known as "low impact harvesting techniques" are considered today as a major tool for the sustainable management of tropical forests. According to these researchers, Kwopi (2000), De Madron (2004), Bayol and Borie (2004), Domsi (2011) and Sonkoue (2011), the rampant deforestation of tropical forests is a danger for the survival of the human species, and the challenge of preserving these forests confronts many researchers with the study of parameters that could help control the damage caused by logging. As we can see nowadays, the operation which aims to be sustainable over nearly 30 years has shown that almost the same species would be exploited for the same volumes in the same Annual Cutting Plate (AAC). The value of 7% adopted as the rate of damage caused by logging by the forestry administration cannot guarantee the sustainability of the forest resource. This value is much lower than it should be, thus leading to genetic skimming of the forest and we also note the low involvement of loggers in reforestation. To help resolve this problem, several studies have been carried out on the assessment of damage caused by logging, it appears that the damage caused by logging on the residual stand is variable by forest operation, by species. and by diameter classes. In the Central African sub-region (RCA, CONGO, GABON, CAMEROON), the damage rate varies between 7 to 10% and by default, a rate of 7% is applied (SDIAF, 2007) in the case of Cameroon. In the dense forest of southern Cameroon, Durrieux de Madron et al. (1998) found a damage rate of 12.5% for a sample of 2 stems / ha. In eastern Cameroon, for example, Kwopi et al. (2000) found a damage rate of 8.63% for a sample of 0.512 stems / ha. Domsi (2011) found a damage rate of 24.6% for a harvest of 3.2 stems / ha in the center of the Cameroon coast. Sangaré (1990) found a damage rate of 31.4% on future stems for a harvest of 1.4 stems / ha in the region of southwest Cameroon. It can be seen that the damage rates caused by logging are well above the standard 7%. It is in this context that this study was carried out in the Forest Management Unit of IPENDJA in the department of Likouala (AAC-2A of UFP2) whose main objective of this work is to identify the damage collateral from logging in an Annual Cutting Plate. To achieve this objective, three specific axes have been retained, namely:

- ✓ Quantify the types of damage to slaughtering, skidding and to gasoline loading yards;
- ✓ determine the impacted rods by diameter class;
- ✓ Evaluate the impact rate of this exploitation.

MATERIALS AND METHODS

Material

The main material by logging operations that was used to collect the data for the evaluation of the impact of logging on the residual forest stand is as follows:

- For technical equipment we have:
  - A computer ;
  - A notepad ;
  - A sorting card;
  - A machete,
  - A 64S GPS map and batteries,
  - A planchette;
  - A double decameter. The plant material used remains the lumber figure 1

Figure 1. Material for taking impact data (GPS, Compass, Compact forestry and Double decameter)

- The plant material which is the sum of the species exploited in this annual cut presented in table 1

Methods

Regarding the felling operation, our work is based on main aspects, in particular the quantification of the hits at the felling level and the categorization of the young stems affected by types of species (Main, Secondary and others) ; by diameter class and by type of damage and skidding tracks as well as in lumber yards.

Method used for felling gaps

We sampled a total of eleven (11) plots, each of which had an area of 50 ha or 550 ha where it was also necessary to calculate the sampling rate set at 1.5 stems / ha. A total of 137 felled plants was retained, an average of 12 plants per plot. Next, it was a question of evaluating the logging gaps and then identifying the damage to the destroyed stems caused on the residual stand according to the impact categories: (broken, uprooted and injured or peeled). These destroyed stems were categorized by diameter classes. Concerning the felling gaps (Figure 2 and 3), we carried out the measurements of the following main species: Sapelli (Entandrophragma cylindricum), Mahogany (Khaya ivorensis), Doussié (Afzelia bipindensis), Iroko (Entandrophragma) cylindricum), Sipo (Entandrophragma useful) and Tali (Erythropheum ivorensis) and the main measurements carried out are:

- Diameter at the base of the bole or large end diameter (m);
- Diameter at the top of the bole or small end diameter (m);
- Length of the shaft (m), determined in relation to the cuts;
- Crown length (m);
- Crown width (m).

The diameters at the base and at the top were measured using a 7.5m graduated tape, while the length of the bole and the width of the crown were measured using a double decameter. The log volume (m3) and the degraded area (m2) occupied by each felled tree were calculated from the previous variables using the following formulas:

$SD = L_h \times l_h$ $V = \frac{\pi}{4} D_m^2 \times L$	Avec :	L_h =Crown length l_h =Crown width SD =Gradient Surface V = Volume D_m =Average diameter L =Length $\pi = 3,1416$

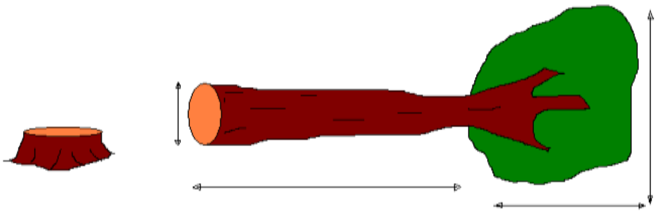

Figure 2. Main measurements of a felled tree, including the measurement of the stem and crown (Mbete, 2014)

Figure 3. Main measurement of the length of a felled mahogany bole

Method used to estimate the area of skidding tracks

Following the opening of the skidding tracks, it was necessary to apply the measures along all the skidding tracks and to record the GPS points in the skidding map (Figure 4).

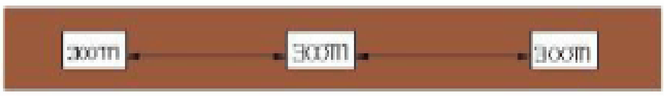

Figure 4. Width measurement interval on the skidding track (Pierre Mbete, 2014)

Likewise, the length and width of all the tracks while respecting the interval of 200 meters in order to bring out the average surface disturbed by this operation. Subsequently, all impacted stems with a diameter greater than or equal to 10 cm at DBH in this operation were categorized as follows: (Stems: injured, broken, crushed and uprooted) (Figure 5).

Figure 5. Taking a GPS point on an injured rod

To assess the degraded area and the impact rate on skidding tracks, we used the following formula:

$SD = L_P \times l_p$	Avec :	L_h =Track length l_h =Track width SD =Gradient Surface

Method used to estimate the area of parks

The method consisted of hanging four GPS points in each park. The processing was carried out as follows

- Downloading waypoints using the DNR (Relative Digital Data) software of the GPS
- The use of Arc Gis 10.4.1 software for the materialization of points on a map.
- The last step was to determine the degraded area when these parks opened.

Data processing and analysis

The following abbreviations I, II, III, IV, V and VI were used during the entry, the calculation of the data in the Excel software as well as for the materialization of the destroyed stems all along the skidding tracks, the diameters of the young impacted stems were classified as follows:

✓ Let Ifor the class[10, 20[; II for the class[20, 30[; III for the class[30, 40[; IV for the class[40, 50[; V for the class[50, 60[; and VI for the classde diamètre ≥ 60
✓ On the other hand, the damage of the impacted young stems was determined according to the following notations:

Damage classes: (Stems: barked or injured, broken, crushed and uprooted). The following codes have been assigned to the different damage classes: Ec (Wheat) for barked (or injured) stems, Ca for broken stems, Ecr for crushed stems and Dice for uprooted stems.

RESULTS

All the species inventoried in the different plots sampled as well as the commercial, scientific and local names of the species are listed in Table 1.

Table 1. Distribution of UFA IPENDJA species (distribution des essences principales impactées dans les opérations forestières)

Essence				Classe de diamètre						Dégâts			Totaux
Nom autochtone	Nom pilote	Nom scientifique	Famille	I [10-20[	II [20-30[	III [30-40[	IV [40-50[	V [50-60[	VI ≥ 60	Blessées	Cassées	Déracinées	
Essences principales													
Déké	Acajou	Khaya anthotheca	Meliacea	5	1	6	0	1	2	8	7	0	15
Edzemboyo	Kosipo	Entandrophragma condollei	Meliacea	12	13	5	2	3	2	17	18	2	37
Embema	Padouk	Pterocarpus soyauxii	Fabaceae	14	5	10	3	1	3	23	9	4	36
Ekéyi	Doussié	Afzelia Bipendensis	Caesalpiniaceae	4	3	4	0	1	0	7	4	1	12
Mopaka	Bubinga	Guibourtia tessmannii	Caesalpiniaceae	1	0	0	1	0	0	1	1	0	2
Goye	Sipo	Entandrophragma utile	Meliaceae	8	6	4	1	0	0	10	9	0	19
Mokesso	Tiama	Entandrophragma angolense	Meliaceae	2	4	1	0	0	1	4	4	0	8
Dilenge	Etimoé	Copaifera mildbraedii	Caesalpiniaceae	5	6	2	2	2	0	11	2	4	17
Kambala	Iroko	Milicia exselca	Moraceae	1	2	0	1	0	0	1	2	1	4
Empégné	Bossé	Guarea cedrata	Meliaceae	6	4	3	0	0	0	8	0	5	13
Molossi	Ayous	Triplochiton scleroxylon	Sterculiceae	1	4	3	2	1	1	2	6	4	12
Mbuyu	Aniégré	Aningeria robusta	Sapotaceae	0	0	2	1	0	0	0	1	2	3
Mokanga	Limba	Terminalia superba	Combretaceae	0	2	0	1	1	1	2	0	3	5
Molanga	Niové	Staudtia stipitata	Myristicaceae	13	12	14	2	1	1	25	14	4	43
Mopoyo	Sapelli	Entandrophragma cylindricum	Meliaceae	52	15	6	5	2	2	41	34	7	82
Mossé	Bilinga	Nauclea diderrichii	Rubiaceae	4	0	0	1	0	0	1	4	0	5
Nganda	Tali	Erythrophleum ivorense	Caesalpiniaceae	28	9	8	1	1	0	15	28	4	47
Nguima	Dibétou	Lovoa trichilioides	Meliaceae	4	2	3	1	0	2	9	1	2	12
Totaux essences principales				**160**	**88**	**71**	**24**	**14**	**15**	**185**	**144**	**43**	**372**

Table 2. Distribution of stems destroyed by diameter class according to species

Diameter class	Essences				Percentage (%)	Cumulative percentage (%)
	Major	Secondary	Other	Totals		
I [10-20[	160	33	205	398	48,13	48,13
II [20-30[	88	25	65	178	21,52	69,65
III [30-40[	71	42	41	154	18,62	88,27
IV [40-50[	24	12	16	52	6,29	94,56
V [50-60[	14	6	4	24	2,90	97,46
VI ≥60	15	4	2	21	2,54	100
Totaux	372	122	333	827	100	-
Percentage(%)	44,98	14,75	40,27	100	-	-

Distribution of areas degraded in relation to species

The essentially degraded area of a felled tree varies according to the size of the tree (from 15 to 25 m for the Iroko, 50 m for the Ayous, from 15 to 20 m for the Doussié, and up to up to 40 m in height depending on the density of the stand), its diameter because, (the DMEs vary from 50 to 150 cm, which can go up to 180 cm), but this area can also change depending on the direction of fall chosen by the feller. Oriented and controlled felling techniques limit the impact of a falling tree on the residual stand. Figure 6 shows a degraded area of 23,110.15 m2 opened by the Sapelli crown during felling, we recorded 562 destroyed stems distributed as follows: (i.e. 264 injured stems, 236 broken stems and 62 uprooted stems) thus representing a percentage of 67.96% on the residual stand. Mahogany, on the other hand, damaged a total of 126 stems (i.e. 62 injured stems, 56 broken stems and 8 uprooted stems) for an area of 4,614.26 m2 corresponding to 15.24%. The Tali and the Sipo, whose degraded area is (2,169.66 m2 for the Tali and 2,156.22 m2 for the Sipo), damaged a total of 103 stems distributed as follows: (50 damaged stems, 40 broken stems and 13 uprooted stems) corresponding to 12.46% of the damage caused to the initial stand. The weakest damage represented in terms of surface area are those caused by Doussié with (709.44 m2) and iroko (419.55 m2). The number of stems destroyed by Doussié and Iroko is as follows: 26 stems impacted during felling of Doussié (i.e. 10 stems injured, 13 stems broken and 3 stems uprooted) for a damage rate of 3.14 %; And for Iroko we have: 10 stems (i.e. 5 injured stems, 5 broken stems and 0 uprooted stems). Iroko gasoline has an impact rate of 1.21%.

Presentation of the destroyed stems according to the diameter classes according to the categories of species at slaughter

We counted a total of 827 stems destroyed during logging operations. These sampled destroyed stems are represented by diameter class (I, II, III, IV, V and VI) and by species (Main, secondary and others) (Table 2). It emerges from table 2 that out of a number of 827 stems, we have a percentage of 44.98% for the main species, i.e. a total of 372 stems destroyed, for the secondary species which represent a number of 122 stems we have 14.75 %, and for other species (protected, non-exploitable), we have: 40, 27% .

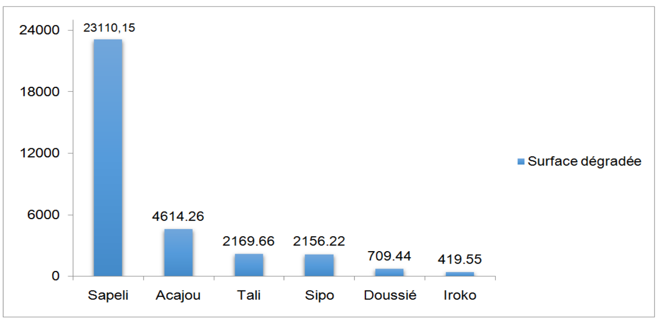

Figure 6. Distribution of areas affected by species

Presentation of destroyed stems according to species categories and diameter classes during felling

Figure 7 below shows that the densities of the rods vary according to the diameter classes. Table 3 shows that 69.65%

of the stems of this forest stand have an average diameter of between 10 and 30 cm, i.e. (29.99% of the destroyed stems are main species, 7.01% are secondary species and 32 , 9% are other species). For species with a diameter between 10 and 40 cm, it is noted that 88.27% are counted (38.58% corresponds to the percentage of main species, 12.09% to secondary species and 37.8% of other species). On the other hand, for species whose diameter is between 50 and 60 cm, we have: 9.19% of the stems destroyed from the forest stand and for species whose diameter is greater than 60cm, we have only 2.54% of the stems destroyed.

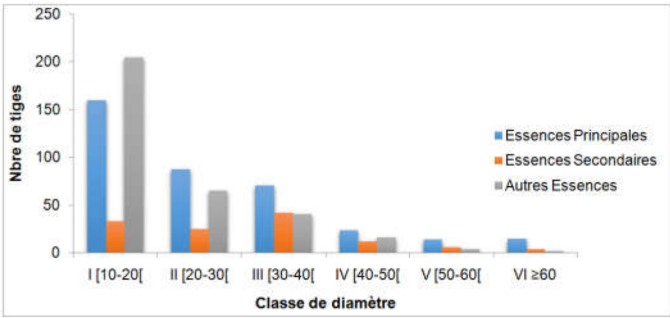

Figure 7. Distribution of stems destroyed by species and according to diameter classes

Les figures 8 et 9 illustrent la présentation des tiges détruites lors de l'abattage en fonction des types de dégâts, et les figures 10 et 11 montrent les tiges déracinée.

Figure 8. An injured stem

Figure 9. A broken Niové gasoline rod

Figure 10 and 11. Representation of stems uprooted during felling

The results in Figure 12 below show in detail the types of percent damage caused to the residual stand after felling. We counted a total of 827 stems divided into three types of damage (392 damaged stems, 349 broken stems and 86 uprooted stems). The most represented damage in the studied florule is classified in decreasing order: 47.40% of injured stems, 42.20% of broken stems and 10.39% of uprooted stems. The large proportion of injured and broken stems results from the pruning of the tree during its fall.

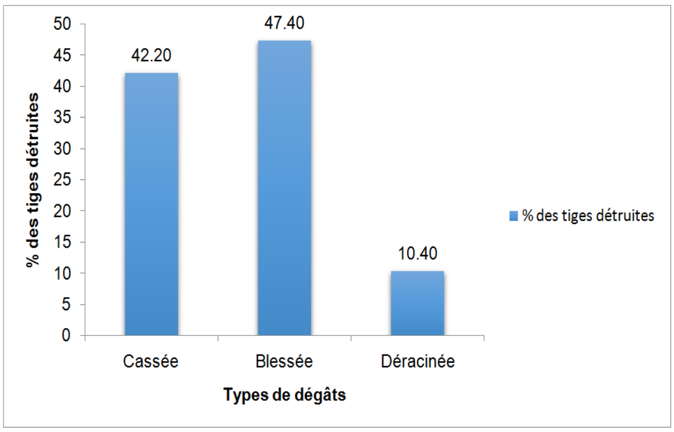

Figure 12. Percentage of stems destroyed by type of damage

Quantification of damage caused to skidding

Skidding by creating the openings causes a very visible impact on the residual forest stand, especially on the stems of the future (Figures 13 and 14).

Table 3. Distribution of stems impacted during skidding according to the types of tracks and diameter class

Diameter class	Tracks Main		Tracks Secondary		Grand total	Percentage(%)	Percentage Cumulated (%)
	Workforce	%	Workforce	%			
I [10-20[	682	42,36	169	10,50	851	52,86	52,86
II [20-30[	261	16,21	126	7,83	387	24,04	76,89
III [30-40[	73	4,53	76	4,72	149	9,25	86,15
IV [40-50[	30	1,86	17	1,06	47	2,92	89,07
V [50-60[	27	1,68	10	0,62	37	2,30	91,37
IV ≥60	120	7,45	19	1,18	139	8,63	100
Totaux	1193	74,10	417	25,90	1610	100	-
%	74,10	-	25,90		100	-	-

Figure 13. Skidding track after the tractor has passed

Figure 14. Skidding of two Sapelli logs creating the opening of a track

Presentation of the impacted rods according to the types of skidding tracks

When the logging tracks were opened, we recorded 1,610 stems destroyed. These destroyed rods are represented by the diameter classes (I, II, III, IV, V and VI) according to the types of tracks (Table 3). Table 3 shows that a number of 1610 stems with a percentage of 74.10% of stems destroyed when the skidding tracks were opened. For the main tracks, we observed a workforce of 1193 rods destroyed while on the secondary skidding tracks we have 25.90% of the rods destroyed corresponds to a workforce of 417 impacted rods.

Quantification of the damage caused by the opening of parks

The damage caused by the opening of log yards in the forest could be compared to the damage created by roads. The ground is stripped and strongly disturbed by the passage of loaded machinery. In the zone (AAC 2A), the parks are presented in terms of pocket (Park A and B).

We compiled the data to determine the degraded area for each park. In total five (5) parks are recorded in the whole of the annual cut, the average length of a park is 62.22 m, on the other hand 48 m represents the average width of the parks. The impacted area is approximately 2.7 ha (Table 4).

Table 4. Distribution of degraded area for each park

Park	Length (m)	Width(m)	Area (m^2)	Area (ha)
Park 3	91,5	38,5	3522,75	0,35
Park 2A	57,5	74,5	4283,75	0,43
Park 2B	42	31,5	1323	0,13
Park 1A	67	51,5	3450,5	0,35
Park 1B	48	30	1440	0,14
Park 4B	65	46	2990	0,30
Park 4A	49	55	2695	0,27
Park 5A	84	52	4368	0,44
Parc 5B	56	53	2968	0,30
Grand total	560	432	27041	2,70

Figure 15. Stem uprooted

Figure 16. Stem injured

Figure 17. Stem broken

During the construction of the loading yards in the forest, the damage to the residual stand is the same because the stems uprooted, broken or debarked can be seen. exploitation damage of 33.94% on the initial stand for a sample of 1.5 stems / ha

DISCUSSION

The number of plants taken is very low compared to that provided for by the EFIR standard which amounts to saying that the average sampling would be considerable according to the EFIR standard, because the normal value of the sampling rate is between the interval of 2 , 5 to 3 stems / ha. According to Letouzey (1968), in dense tropical forests, 53 to 73% of the stems inventoried have a diameter between 10 and 30 cm, 16 to 25% between 40 and 100 cm and 1 to 2% of these have a diameter greater than 100 cm. The class most represented in Table 6 is the class of rods whose diameters vary between 10 and 20 cm and the numbers are decreasing. The number of class IV [40-50 [is lower than that of class III [30-40] Figure 3, shows that the passage from one diameter class to another class the number of rods continuously decreases. This is to say that the larger the diametral structure the more the number of rods decreases and on the other hand the smaller it is, the more the number of rods increases. Since the diametrical structure of the species inventoried has given us a curve which has a decreasing rate, presenting itself in the shape of an inverted "J" or in a very similar form. This form is typical for species or forests which have good regeneration over time but poor recovery. This is what characterizes a forest stand still in equilibrium because there is an abundant presence of young stems of small diameter and few stems of large diameter Letouzey (1968). From all of the above, it emerges from the summary of the results that the harvest is a very important parameter in forestry.

In all the plots (AAC 2A) where we carried out our study there was a sampling of 1.5 stems / ha, the damage to the residual stand caused by felling is 33.94% or 827 stems. destroyed compared to the totality of all the impacted rods for all the operations (2437 rods), the recorded damage rate is 66.06% on the residual stand and for the opening of 85 tracks we observed a destruction of 1610 rods. We can deduce from these observations that the extent of the exploitation damage varies according to the intensity of the harvest and especially the density of the plants in the harvesting area. For all of the operations, an exploitation damage rate of 33.94% was observed on the initial stand for a sample of 1.5 stems / ha; this value is very different from that (6.7%) obtained by Mbolo et al. (1994) in South-East Cameroon in the Dimako API project. The harvest in the study area was 0.49 stems / ha, which may be proportionately equal to our results. Kwopi (2000) found a rate of 8.63% on the residual stand for a harvest of 0.52 stems / ha; he had carried out his work in a forest in south-central Cameroon in the So'o Lala project. Domsi (2011), in plate 2-2 of UFA 00 004 of Yingui in the Central and Coastal regions of Cameroon, and exploited by the company Transformation Reef Cameroun, finds that a harvest of 3.2 stems / ha on average for an exploitation damage rate of 24.8% of the residual stand. In view of these results, it can be concluded that the damage is greater when the sample is high. For the Six (6) plots which is equivalent to an area of 300ha, we obtained 6.31ha of degraded area, i.e. an impact rate of 2.10%, but by making the rule of three (3) in relation to the area exploited (1635ha), we obtain 32.7 plots from which the area degraded by skidding would be 103.24ha. Overall, we obtained an impact rate of 8.35% for all operations (logging, skidding and opening of parks). This percentage corresponds to a degraded area of 133.67ha but this value is very different from that) obtained by Mr Albert OPOUYA (2010) or (9.85% of the impact rate with 584.5472ha). Mirlo Méoli (2005), found a rate of 9.3% (without taking into account the percentage of the opening of the roads and the base camp) or 925m2 / ha. Mbete et al. 2018 found a damage rate of 4.014% or 541.77ha. The sustainable management of tropical forests therefore depends on the method of harvesting stems per hectare, the training of personnel, but also the type of forestry machinery used in a farm. In short, it is very difficult to remedy a logging operation where the impacts could meet the EFIR standards of 7.5%, it may then be necessary to make forestry companies aware of the need to reforest destroyed areas in order to protect them. forest recovery.

CONCLUSION

The present study, which focused on the assessment of the impacts of logging on vegetation at Société Thanry Congo (UFA IPENDJA) in plots of 50 ha in area, showed that:

The forest cover and its biodiversity decrease considerably in quality and quantity over time, due to repetitive logging, which in our opinion requires silvicultural interventions. Skidding is the most destructive operation and constitutes nearly 66.06% of damaged stems, for a density of 1,610 impacted stems. Felling follows skidding with practically 33.94% which corresponds to 827 of damaged stems; stems of small diameters are the most affected because they are the densest and most flexible; On one hundred percent (100%) of the stems destroyed and inventoried, we have a number of 827 stems, i.e. 44, 98% are the stems of the main species with a number of 372 stems destroyed and 14.75% of the secondary species which represent an effective of 122 stems, with 40.27% representing other types of species (protected, or not exploitable). Not all logging operations are well planned according to EFIR standards, and abuses are sometimes observed during the practice, in particular felling and skidding, where the tracks planned by the prospectors are sometimes diverted by the operators. conductors by creating loops. The damaged rods are distributed according to the tracks. This percentage corresponds to stems with a diameter between (10cm - 30cm) on the other hand for the same diameter class (10cm - 30cm). A diameter of between 10 and 40 cm of the impacted rods was obtained. We can summarize that all operations in the forest cause damage to the residual stand. That the impact rate corresponding to a given degraded area.

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