Journal of Agriculture and Ecology Research International
4(3): 140-150, 2015; Article no.JAERI.2015.060
ISSN: 2394-1073

SCIENCEDOMAIN *international*
www.sciencedomain.org

Impact of the Layout of a Line of High Voltage (HTA) on the Flora of the Locality of Agboville in the South-East of Côte d'Ivoire

Kouassi Kouadio Henri[1*], Barima Yao Sadaiou Sabas[1] and Soro Dodiomon[2]

[1]Unit of Formation and Research (UFR) in Agroforestry, University of Jean Lorougnon Guédé, BP 150 Daloa, Côte d'Ivoire.
[2]Unit of Formation and Research (UFR) in Biosciences, Laboratory of Botany, University of Felix Houphouet Boigny, 22 BP 582 Abidjan, Côte d'Ivoire.

Authors' contributions

This work was carried out in collaboration between all authors. Author KKH designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors KKH, BYSS and SD managed the literature searches, analyses of the study and discussed the results. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAERI/2015/16154
Editor(s):
(1) Maria Panitsa, Department of Environmental and Natural Resource Management, University of Patras, Greece.
Reviewers:
(1) Hugo Bezuidenhout, University of South Africa, South Africa.
(2) Anonymous, Kumaun University, India.
Complete Peer review History: http://sciencedomain.org/review-history/10100

Original Research Article

Received 12th January 2015
Accepted 15th June 2015
Published 8th July 2015

ABSTRACT

Aims: The aim of this work is to identify and evaluate the impacts related to the traced of high voltage on the flora of Agboville in order to put forward measures of attenuation or correctives.
Study Design: The vegetations were delimited into small squares plots or pieces. These small squares plots were distributed in all the flora of the study.
Place and Duration of Study: This work relates to the identification and the evaluation of the negative impacts of the layout of the line of high voltage on the flora of the study zone. It was conducted in Agboville, a locality in the south of Côte d'Ivoire, during July to September 2013.
Methodology: The itinerant inventory and the method of "quadrat" were associated during floristic inventories.

**Corresponding author: Email: atoumanikouadiokan@yahoo.fr;*

Results: The results showed that the flora is approximately rich 81 species. However, it is little diversified and more homogeneous. The destruction of the woody flora (DFL), the destruction of the floristic potential of regeneration (DPE), the evolution of floristic diversity (EDF) and the aspect of vegetation (EPV) were the major average impacts during the study, the exploitation phase and at the end of the project. These impacts, brought out all along the phases of the project contributed to weaken the flora of the site and stated it to the risks of the biological, ecological and climatic imbalances.

Keywords: Impact; flora; Agboville; high voltage; line; traced.

1. INTRODUCTION

The natural resources available on planet become exhausted over years. The recrudescence of activities cause of impact is partly related to the growth of the demography of many countries throughout the world. In many African countries, in particular, those whose economy is based on the exploitation of natural resources, the preservation of these resources and biodiversity is from now on a priority. In addition, the problem of rural land, sometimes source of fatal conflicts, is one of the emergent causes of biodiversity destruction.

The leading causes of this evolutionary destruction are among others, inherent to agriculture, forestry holding, bush fires, etc. During these last years, some additional causes in particular, the fast urbanization, with its corollaries: the real estate transactions, the construction of the large production and transformation units; and creations of industrial plantations [1] have been activities, sources of impacts. Besides, in many African countries, the pressure exerted on the natural resources grows inordinately [2]. Face to these inquiries, some sustainable management measures or integrated management of the natural resources are mostly recommended to prevent possible biological imbalances. One of these safety and preventive environmental measures before any activity which can cause a huge disturbance of the ecosystems is the identification, the evaluation and the correction of environmental impact. Indeed, the destruction of many components of nature requires the taking into account of corrective measures or compensation aiming at minimizing the damage caused (impact of the projects) on this space. Actually, human beings and animals are the components which pay the full price of the consequences of high destruction caused within nature. That is why, any activity, source of impacts must be done in a reasoned way, in order to be in adequacy with the dynamics of the natural resources. The management of the environment must thus from now o n integrate realities of the medium of kind to support the life in all its forms. For this purpose, this report highlights and evaluates primarily the impacts of the opening of the layout of the line of high voltage (HTA) on the flora of the ecosystems crossed by the layout.

2. MATERIALS AND METHODS

2.1 Study Area

From the floristic point of view, the site (Fig. 1) of the project belongs to the Guinean field. In this locality, one notes the presence of many hydromorphic vegetation closed in places. This forest was made of three principal layers [3,4]. In addition to the hydromorphic formations, one meets there the wet dense forest, the marshy forests of the enclaves, the raphiales, etc. The layer of the large trees was dominated by specimens of 50 to 60 m high and was characterized by woody species such as *Khaya ivoirensis*, *Lophira alata* and *Tarrieta utilis*. The hydromorphic formations were made up of marshy forests and mangrove swamps. This wide forest is today very threatened in Côte d'Ivoire since it comprises several exploited species [5].

2.2 Actual Statute of the Vegetation

The vegetation of the site made up of dense forest always green dense forest at one time luxuriant, are seriously started and almost disappeared to the profit of the fragments of fallow (Figs. 2A and B). The plots of culture, the marshy zones (Figs. 3 and 4) and the well preserved vegetation.

2.3 Floristic Inventory

The flora of the whole area of the site has been inventoried. Two methods were associated to conduct this study. The itinerant inventory of the

flora by the enumeration of the species on layouts and the method of the small squares [6] which consists in describing the vegetation (enumeration and classification of the species) on surfaces of approximately 20 m on each side according to the four cardinal points, with a precise spacing. In this way, 10 small squares of approximately 400 m² of surface in each type of vegetation crossed by the line of high voltage have been inventoried. During inventories we noted the presence or the absence of each species. So, at the end of the inventories, the most regular species appeared with a frequency of 10 appearances. They are 5 types of vegetations which were crossed by the layout of the line: semi-deciduous forests, fallow comprising some trees, marshy zones comprising species such Rafia hookeri, plots of culture of Hevea and plot of food cultures (*Zea mays*, *Manihot esculenta*).

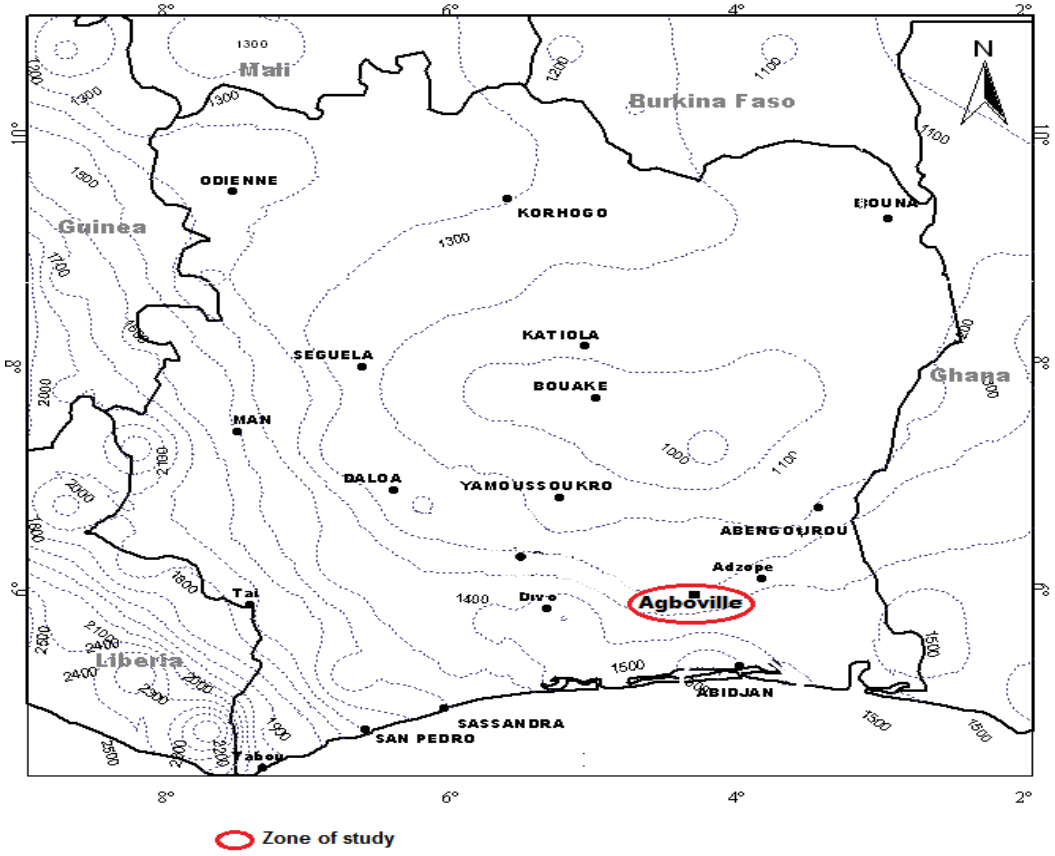

Fig. 1. Localization of the study area

A B

Fig. 2. Fallow in Agboville (near petit Yapo)

Fig. 3. Plot of Cassava (*Manihot esculenta*)

Fig. 4. Marshy zone with, *Bambousa vulgaris*

2.4 Analysis of the Flora

The methods analysis of the flora diversities are available today. In the present analysis, the index of diversity of Shannon and weaver [7] was used to estimate the diversity of flora. Its formula is H = Pi*log*pi, with pi = floristic contribution or relative frequency. This index varies from 0 (only 1 species) to Log N, (when all the species have same abundance). To this index, the Equitablity of pielou (E) is associated. This equitability is a relationship between floristic diversity observed and maximum theoretical diversity. The equitability of Pielou is written: E= H/log N, With, N= total staff complement of the studied station. The equitability varies from 0 to 1. It tends towards 0 when almost the whole effective is concentrated on only one (1) species and is equal to 1 when all species have the same abundance. For analysis and evaluation of impacts, the qualitative parameters which characterize the impacts were codified. Thus, with the three values: High, medium and low have been respectively associated to the numbers: 3, 2 and 1.

3. RESULTS

3.1 Lushness and Specific Diversity of Agboville Sector

The flora of the site is rich of approximately 81 species. The values of Shannon index (H) and Equitability (E) estimated are respectively, H = 3.6; E = 0.57 (Table 1).

3.2 Species with Particular Status Inventoried in the Zone

Five (5) species with particular status have been registered. Among them, four (*Antrocaryon micraster, Cordia platythyrsa, Entandrophragma angolense and Milicia excelsa)* are vulnerable and one (*Triplochiton scleroxylon*) present risks of extinction according to IUCN (2013).

3.3 Identification, Analysis and Evaluation of Impacts of Project

3.3.1 Prospecting stage

The curves (Fig. 5) show the variation of the impacts related to the phase of prospection on the flora and the vegetation under the line. The destruction of the woody flora (DFL) was intense (3), extended (3) and last long (3). The impact of this activity was fairly important (2). Duration and extent of destruction of the regeneration potential of flora (DPE) were on the average (2). But it was slightly intense (1) and important (1). The ecological disturbances (EP) caused by activities were fairly intense (2), important (2), and wide (2). They were insignificant and short-lived (1).

The evolution of the average impacts on the flora during this phase (Fig. 6) shows that the destruction of the woody flora (DFL) was more significant (2.75). The ecological disturbance (EP) and the destruction of the regeneration potential (EPD) were fairly high (1.5).

3.3.2 Exploitation stage

The evolution of the curves (Fig. 7) shows the variation of impacts related to the phase of exploitation on the vegetation, the flora of the site and on that of the contiguous vegetation. During this phase, the woody flora destruction (DFL) and the regeneration potential destruction (DPR) were deeply intense (3), very long (3) and highly important (3). But they were fairly spread (1). The herbaceous proliferation were highly significant (3) and long (3). It was moderately wide (2) and medium importance (2).

The Characterization of the average impacts on the flora (Fig. 8), shows that the destruction of the woody flora (DFL) and the destruction of the regeneration potential (DPR) were intense (2.75) during this phase. The herbaceous proliferation was less intense (2.50).

Table 1. Estimate of the values of the indices of diversity (H) and homogeneity (E), with Fa= absolute frequency, Fr = relative frequency, Pi = floristic contribution, H = Shannon index

N°	Species	Family	Fa	Fr	Pi	H
1	*Abrus precatorius*	Fabaceae	1	0.333	0.004	0.032
2	*Adenia cissampeloides*	Passifloraceae	3	1	0.012	0.078
3	*Ageratum conyzoides*	Asteraceae	2	0,666	0.008	0.056
4	*Albizia adianthifolia*	Mimosaceae	3	1	0.012	0.078
5	*Albizia zygia*	Mimosaceae	3	1	0.012	0.078
6	*Alchornea cordifolia*	Euphorbiaceae	3	1	0.012	0.078
7	*Alstonia boonei*	Apocynaceae	1	0.333	0.004	0.032
8	*Ananas comosus*	Bromeliaceae	1	0.333	0.004	0,032
9	*Anthocleista djalonensis*	Loganiaceae	1	0.333	0,004	0.032
10	*Antiaris toxicaria subsp africana*	Moraceae	1	0.333	0.004	0.032
11	*Antrocaryon micraster*	Anacardiaceae	2	0.666	0.008	0.056
12	*Aspilia africana*	Asteraceae	1	0.333	0,004	0.032
13	*Baphia nitida*	Fabaceae	1	0.333	0.004	0.032
14	*Blighia sapida*	Sapindaceae	1	0.333	0,004	0.032
15	*Carica papaya*	Caricaceae	1	0.333	0.004	0.032
16	*Cassia hirsuta*	Caesalpiniaceae	1	0.333	0.004	0,032
17	*Cassia siamea*	Caesalpiniaceae	3	1	0.012	0.078
18	*Cecropia peltata*	Cecropiaceae	2	0.666	0.008	0.056
19	*Ceiba pentandra*	Bombacaceae	2	0.666	0.008	0,056
20	*Centrosema pubescens*	Fabaceae	2	0.666	0.008	0,056
21	*Chromolaena odorata*	Asteraceae	3	1	0.012	0.078
22	*Cissus aralioides*	Vitaceae	2	0.666	0.008	0.056
23	*Cnestis ferruginea*	Connaraceae	2	0.666	0.008	0.056
24	*Combretum zenkeri*	Combretaceae	2	0.666	0.008	0.056
25	*Cordia platythyrsa*	Boraginaceae	1	0.333	0.004	0.032
26	*Croton hirtus*	Euphorbiaceae	1	0.333	0.004	0.032
27	*Cyperus sp.*	Cyperaceae	1	0.333	0.004	0.032
28	*Desmodium adscendens*	Fabaceae	1	0.333	0.004	0.032
29	*Delonix regia*	Caesalpiniaceae	2	0.666	0.008	0.056
30	*Dioscorea smilacifolia*	Dioscoreaceae	2	0.666	0.008	0.056
31	*Dissotis rotundifolia*	Melastomataceae	1	0.333	0.004	0.032
32	*Elaeis guineensis*	Arecaceae	2	0.666	0.008	0.056
33	*Entandrophragma angolense*	Meliaceae	1	0.333	0.004	0.032
34	*Erigeron floribundus*	Asteraceae	2	0.666	0.008	0.056
35	*Ficus exasperata*	Moraceae	1	0.333	0,004	0.032
36	*Ficus sur*	Moraceae	1	0,333	0,004	0.032
37	*Hevea brasiliensis*	Euphorbiaceae	1	0.333	0.004	0,032
38	*Hoslundia opposita*	Labiatae	1	0.333	0.004	0,032
39	*Ipomoea sp*	Convolvulaceae	1	0.333	0.004	0.032
40	*Lantana camara*	Verbenaceae	1	0.333	0.004	0.032
41	*Leucaena sp*	Mimosaceae	1	0.333	0.004	0,032
42	*Mallotus opositifolius*	Euphorbiaceae	2	0.666	0.008	0.056
43	*Manihot esculenta*	Euphorbiaceae	2	0.666	0.008	0.056
44	*Manniophyton fulvum*	Euphorbiaceae	2	0.666	0.008	0.056
45	*Mareya micrantha*	Euphorbiaceae	1	0.333	0.004	0.032
46	*Margaritaria discoidea*	Euphorbiaceae	1	0.333	0,004	0,032
47	*Mezoneuron benthamianum*	Caesalpiniaceae	2	0.666	0.008	0.056
48	*Milicia excelsa*	Moraceae	1	0.333	0.004	0.032
49	*Millettia zechiana*	Fabaceae	2	0.666	0.008	0.056

50	*Momordica charantia*	Cucurbitaceae	1	0.333	0.004	0.032
51	*Morinda lucida*	Rubiaceae	1	0.333	0.004	0.032
52	*Motandra guineensis*	Apocynaceae	1	0.333	0.004	0.032
53	*Musa paradisiaca*	Musaceae	1	0.333	0.004	0.032
54	*Musanga cecropiodes*	Moraceae	2	0.666	0.008	0.056
55	*Myrianthus libericus*	Moraceae	1	0.333	0.004	0.032
56	*Nauclea latifolia*	Rubiaceae	1	0.333	0.004	0.032
57	*Nelsonia canescens*	Acanthaceae	1	0.333	0.004	0.032
58	*Panicum maximum*	Poaceae	1	0.333	0.004	0.032
59	*Passiflora foetida*	Passifloraceae	1	0.333	0.004	0.032
60	*Paullinia pinnata*	Sapindaceae	2	0.666	0.008	0.056
61	*Phyllanthus amarus*	Euphorbiaceae	1	0.333	0.004	0.032
62	*Phyllanthus muellerianus*	Euphorbiaceae	1	0.333	0.004	0.032
63	*Phyllanthus sp.*	Euphorbiaceae	2	0.666	0.008	0.056
64	*Piptadeniastrum africanum*	Mimosaceae	1	0,333	0.004	0.032
65	*Pouzolzia guineensis*	Urticaceae	1	0,333	0.004	0.032
66	*Psidium guajava*	Rutaceae	1	0,333	0.004	0.032
67	*Pueraria phaseloides*	Euphorbiaceae	2	0,666	0.008	0.056
68	*Pycnanthus angolensis*	Myristicaceae	3	1	0.012	0.078
69	*Raphia hookeri*	Arecaeae	1	0.333	0.004	0.032
70	*Rauvolfia vomitoria*	Apocynaceae	2	0.666	0.008	0.056
71	*Ricinodendron heudelotii*	Euphorbiaceae	2	0.666	0.008	0.056
72	*Sida acuta*	Malvaceae	1	0.333	0.004	0.032
73	*Secamona afzelii*	Asclepiadaceae	1	0.333	0.004	0.032
74	*Solanum erianthum*	Solanaceae	1	0.333	0.004	0.032
75	*Solanum turvum*	Solanaceae	1	0.333	0.004	0.032
76	*Sterculia tragacantha*	Sterculiaceae	2	0.666	0.008	0.056
77	*Tabernaemontana crassa*	Apocynaceae	2	0.666	0.008	0.056
78	*Tragia benthamii*	Euphorbiaceae	1	0.333	0.004	0.032
79	*Trema orientalis*	Ulmaceae	1	0.333	0.004	0.032
80	*Triplochiton scleroxylon*	Euphorbiaceae	2	0.666	0.008	0.056
81	*Xanthosoma maffama*	Araceae	1	0.333	0.004	0,032
					I =	3.595
					E =	0.567

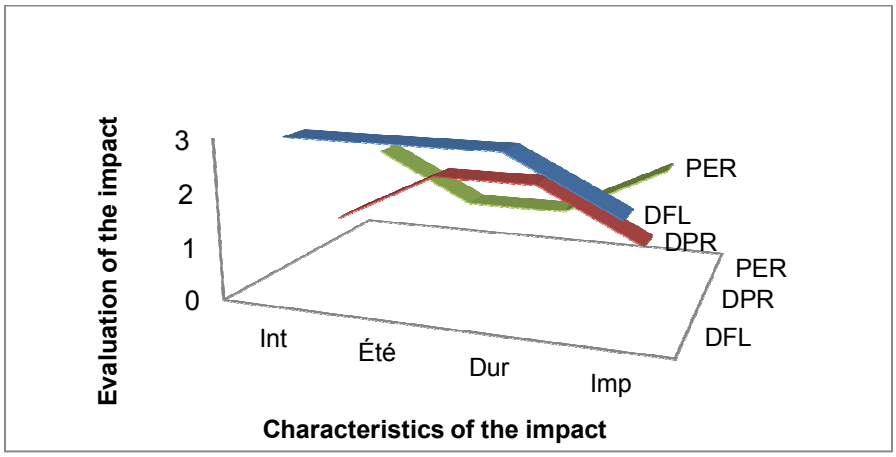

Fig. 5. Evolution of impacts related to the phase of prospection with, Int = intensity, Ete = wide; Dur = duration; Imp = importance; DEV. = destruction of the plant species; DPR = destruction of the regeneration potential; EP= ecological disturbance

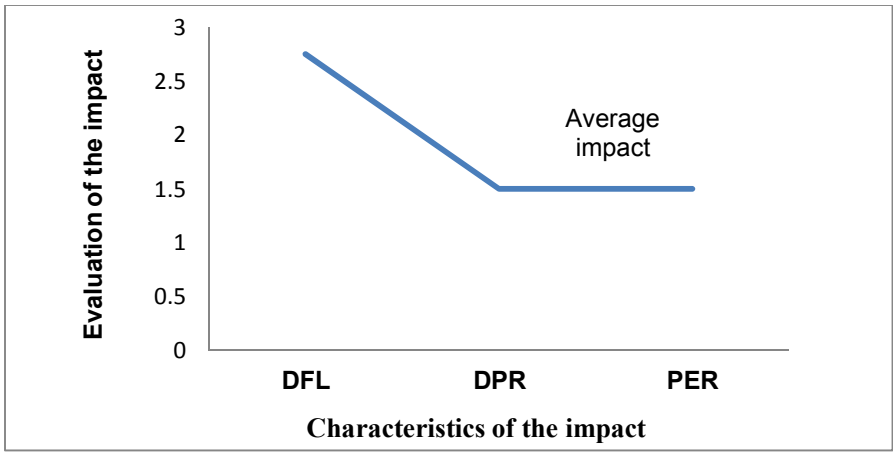

Fig. 6. Evolution of the average impacts related to prospection and construction phases, with; DFL = Destruction of the woody flora species; DPR = destruction of the regeneration potential; PER = ecological disturbance

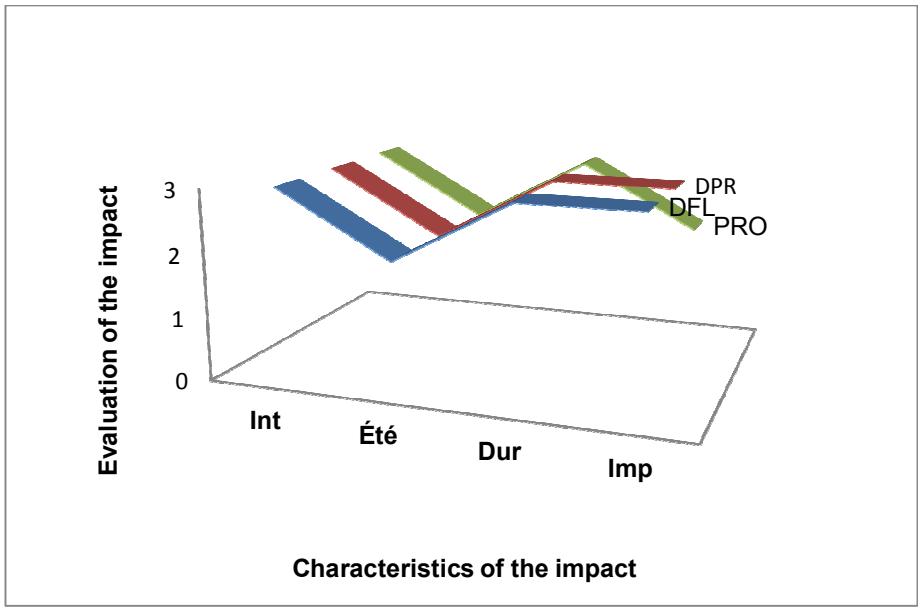

Fig. 7. Impacts evolution related to the exploitation phase, with; Int = intensity, Ete = wide; Dur = duration; Imp = importance; PRO = herbaceous proliferation; DFL = woody flora destruction, DPR = destruction of the regeneration potential

3.3.3 End of the project

At the end of the project (Fig. 9), the fragmentation of the vegetation (FRV) was highly significant (3), very important (3), fairly wide (2) and short-lived (1). (EDF) The flora of the site has been moderately diversified (2) and fairly wide (2). This impact was very long (3) and very important (3). The appearance of the vegetation (EPV) has changed significantly (3) and was very important (3). But it was fairly wide (2) and have had short-lasting (2). The evolution of the average impacts (Fig. 10) showed that the evolution of floristic diversity (EDF) and the appearance of the vegetation (EPV) were high (2.5). The fragmentation of the vegetation (FRV) was less (2.25).

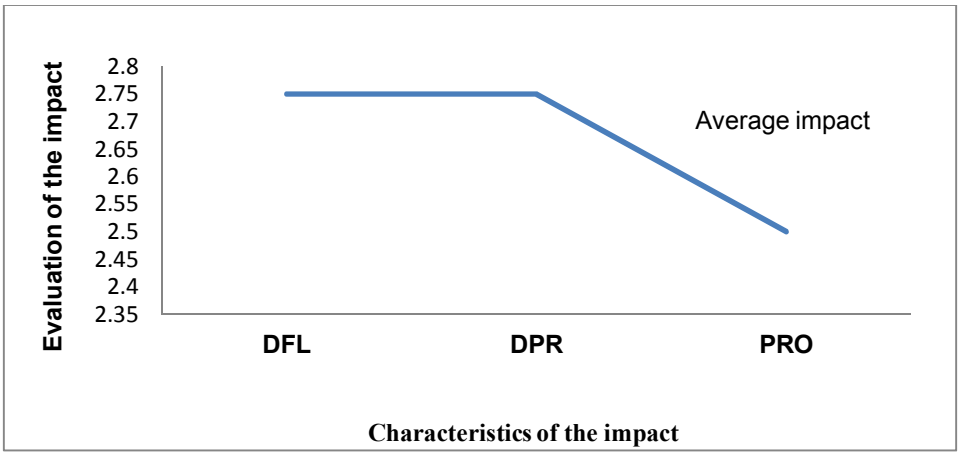

Fig. 8. Evolution of the average impacts related to the Exploitation phase, with; DFL = destruction of the woody flora; EPD = destruction of the potential of regeneration; PRO = the herbaceous proliferation

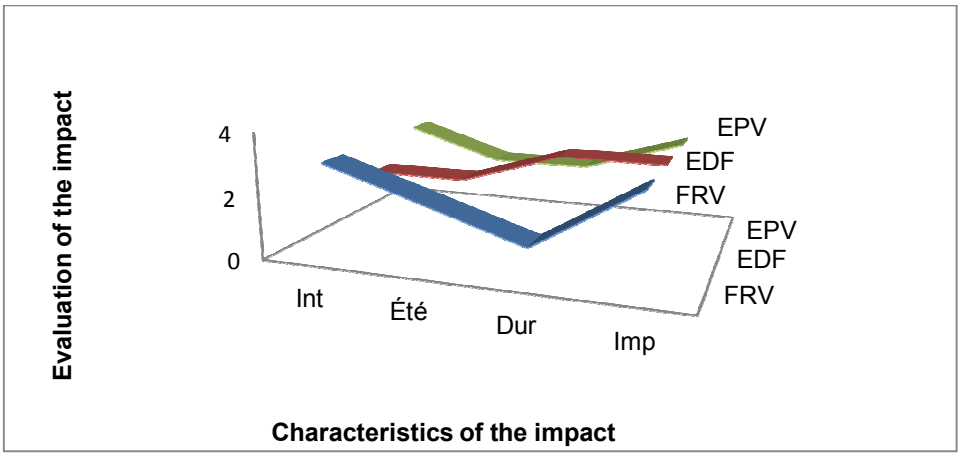

Fig. 9. Evolution of impacts related to the end of the project; with Int= intensity, Ete = wide; Dur = duration; Imp = importance; EDF = evolution of the diversity of the flora; EPV = Evolution of the aspect of the vegetation; FRV= fragmentation of the vegetation

4. DISCUSSION

4.1 Evolution of Floristic Diversity

The evaluation of the impacts on the vegetations of the flora showed that these vegetations were less diversified (H= 3.60) and rather homogeneous (E = 0.57). The various activities undertaken in this zone can be regarded as major causes of the disturbances and vegetations fragmentation. Indeed, the vegetations crossed by the path of the line are mainly the plots of culture or fallow which are intensely put in culture. This setting in permanent crop influenced the floristic diversity of the site. Also, with the agricultural practices based on the traditional systems of farming, much deforestation is associated. These destructions were related to the anarchistic and abusive exploitations of the trees species. The impacts related to the path of the line were caused by the machines through scouring and ground compaction, woody species cutting and the hiding of the seeds of certain woody species of the original flora. These destructions have also involved ecological and biological disturbances (destruction of the ecosystems). Moreover, these actions caused the dynamics of the contiguous vegetation of the site.

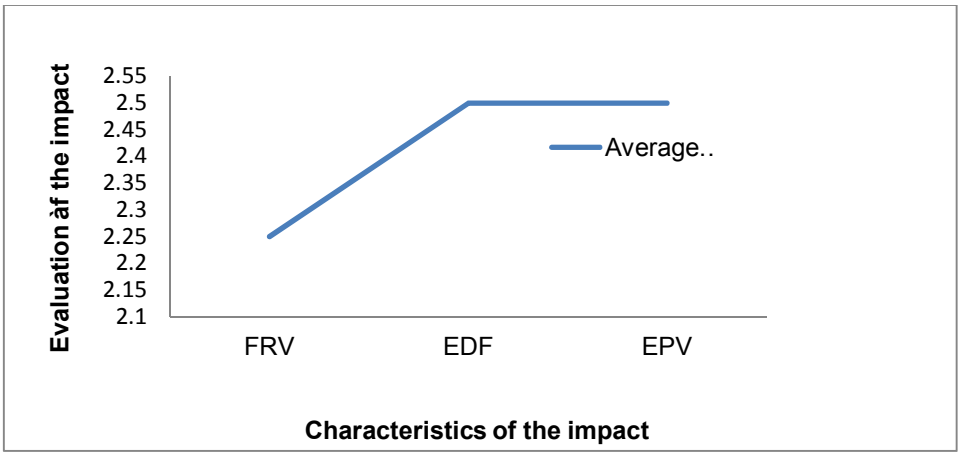

Fig. 10. Evolution of the average impacts dependent of the end of the project, with; EDF = evolution of the flora diversity; EPV = Evolution of the vegetation aspect; FRV = Fragmentation of the vegetation

4.2 Evolution of the Impacts on the Site Flora

The major impacts were observed at all project phases. During the phase of prospection, the openings of the access roads and the demarcations have caused the destruction on the path of the line and that of certain bordering vegetations of the line. Some specimens of trees, shrubs, lianas and herbaceous were destroyed. The openings carried out in the flora, contributed to increase to a significant degree the luminosity on the ground in these usually closed formations exposing the species of the underwoods very sensitive, to excesses light. The epiphytes are found on the soil following the demolition of the large trees. All these major impacts caused an ecological imbalance in many vegetation. The ecological disturbances caused by the linked activities with the projects involve changes within the flora. These changes are related to the characteristics of the flora. Kittur et al. [8] noted that these characteristics are evolutionary. But among the elements which condition this evolution, the factors anthropic are those which emergent nowadays with the anarchistic urbanisation of rural environment.

4.2.1 Evolution of the impact during the exploitation phase

The activities carried out during the exploitation phase contributed to increase the impacts generated during the previous phases. The destruction of the original flora is a factor which facilitated the installation of herbaceous which has a great capacity to develop itself; their proliferation is due to the opening of the vegetation canopy which was closed before the realization of the project. The exposure of the soil to strong luminosity of sun and rain erosion, are additional factors which involved the regression of the original flora to the profit of the adventitious, as it was mentioned by Claude et al. [9]. Also, the regular cutting of vegetation under the line of the high voltage (HTA) weakened the protection of the soil against erosion.

4.2.2 Impacts evolution at the end of the project

At the end of the project, the vegetations of the site were deeply impoverished by the project. Indeed, numerous species listed in the zone before the realization of the project disappeared from the site. The aspect of the vegetation under the lines was modified. The evaluation and characterization of the impacts on the site flora are supposed to bring a thorough lighting on the features of impact. Thus, the average impact most important during the phase of prospection was the woody flora destruction (DFL). The destruction of the regeneration potential (DPR) and the herbaceous proliferation (PRO) were less important. These impacts were caused by the undergrowth clearances, the regular cleaning of the line path, the regular maintenance of the site which comprises destruction of certain woody species have intensely affected all the components of the flora, sometimes compromising its total regeneration as it was

mentioned by Mitja and Puig [10] in forest zone; and Yossi [11] in savanna. During the exploitation phase, the average impacts most important (DFL, DPR) were only the consequences of the activities which started since the phase of construction; they are amongst other things the regular cleaning of the space, the woody species cutting, etc. The proliferation of herbaceous (PRO), less important during this phase was also related to the upkeep activities in this area.

The importance of the flora diversity evolution (EDF) and the aspect of the vegetation (EPV) are related to the end of the works. This suspension of the activities is what supported this renewal of diversity and the vegetation transformation. But this transformation is slow because of the slow growth of the woody species like it was mentioned by Ettien [12] and Kouadio et al. [13]. The activities undertaken during this project were sources of significant impacts which will be one of the factors of the nature destruction. Indeed, these impacts contributed to weaken the homogeneity and the stability of the flora. This brittleness exposes the flora of the site to fire hazards like it was announced by Jhariva et al. [14]. According to these authors, the type of vegetation determines the fire hazard in forest area. In addition, the changes in natural and homogeneous forests are carried out slowly but; by preserving the biodiversity. But also, desasters sometimes related to the impact of the activities carried out during the realization phases of the specific projects involve the destruction of the structural complexity of the ecosystem like it has been showed by Schindele et al. [15] with the fires in forest area.

5. CONCLUSION

The flora of the path of the line is less diversified. This sector which inherited many years crop presents a floristic homogeneity. The floristic diversity was strongly influenced by the installation, and the execution of the project. Many impacts (destruction of the regeneration potential of the flora, the impoverishment of the flora in woody species and the proliferation of the herbaceous ones in the flora) were observed at certain places of the path of the line. However, mitigating measures such as; reafforestations with the legume trees and the protection of certain vegetation will strongly contribute to reduce the risks of ecological imbalances which could occur in the zone in the future. Moreover the integral protection of the fallow still present on the site will encourage setting up reservoirs of phytogenetic resources, tanks of carbon (CO2) and also as refuges for animals during their migration.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kouassi KH, Tra-Bi FH, Kouassi RH. Impacts of the iron ore extraction on the flora of the localities of Bangolo and Logoualé west of Côte d'Ivoire, Int Jour. of Adv. Res. 2013;1(9):167-176.
2. Kouassi KH, Kouassi RH, Ayolié K, N'guéssan K. Evolution of the floristic diversity according to altitude in the localities of Bangolo and Logoualé west of Côte d'Ivoire RRBS. 2014;9(2):63-69.
3. Reizer R. Installation of the artificial lake of Ayamé. Nº 30 Publication of the Tropical Forest technical Centre. 1967;108.
4. Guillaumet JL, Adjanohoun E. Ecology: scientific and practical approach. ED: Lavoisier the vegetation in: "the natural middle of Côte d'Ivoire". Memo. ORSTOM, Paris. 1971;50:161-262.
5. Aubréville A. In search of the forest in Côte d'Ivoire: wood and forests of the tropics. 1957;56(57):47.
6. Gautier L, Chatelain CV, R. Spichiger, et al. Presentation of a releve methode for vegetation studies based on high resolution satellite imagery In: comptes rendus de la treizième reunion plénière de l'A.E.T.F.A.T., Zomba malawi. Nat. Herb. Bot. Gard. Malawi. 1994;2:1339-1350
7. Shannon CE, Weaver W. The mathematical Theory of communication. University of Illinois press, Urbana. 1948;120.
8. Kittur BH, Swamy SL, Bargali SS, Manoj Kumar Jhariya. Wildland fires and moist deciduous forests of Chhattisgarh. India: divergent component assessment Journal of Forestry Research. 2014;25(4):857-866.
9. Claude F, Floret CH, Paul M, Jean D, et al. Ecologie : Approche scientifique et pratique. ed : Lavoisier Tec., 4è éd., 1998 ;102.
10. Mitja D, H. Puig et al. Itinerant essartage culture and reconstitution of the vegetation of the fallow in wet savanna of Côte

d'Ivoire (Booro-Borotou). In: CH. Floret and G Serpantié (eds), fallow in West Africa, Collection: Conferences and Seminars. ORSTOM, Paris. 1993;377-392.
11. Yossi H. Dynamics of the post-farming vegetation in Soudan zone in Mali. Phd, Population environment, ISFRA, University of Bamako. 1996;154 .
12. Ettien DT. Potentials of regeneration of the commercial forest trees by the germination of seeds, in the classified forest of Haut-Sassandra. Doctorate 3e cycle, U.F.R. Biosciences, Abidjan-Cocody University, Abidjan, Côte d'Ivoire. 2005;259.
13. Kouadio K, Kouassi KE, Kouamé NF, Traore D. Impact of the clearance on the natural regeneration of the principal forest trees, in the classified forest of Bossematié (Côte d'Ivoiret). Sci. Nat. 2007; 4(1):27-35.
14. Jhariya MK, Bargali SS, Swamy Sl, Kittur B, Kiran Bargali, Geeta v. Pawar. Impact of forest fire on biomass and carbon storage pattern of tropical deciduous forests in Bhoramdeo wildlife sanctuary, Chhattisgarh: International Journal of Ecology and Environmental Sciences. 2014;40(1):57-74.
15. Schindele W, Thoma W, Panzer K. Investigation of the steps needed to rehabilitate the areas of East Kalimantan seriously affected by fire. The forest fire 1982/83 in East Kalimantan. Part I: The fire, the Effect, the Damage and the Technical Solution; 1989.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/10100