International Journal of Geology, Agriculture and Environmental Sciences
Volume – 3 Issue – 1 February 2015
Website: www.woarjournals.org/IJGAES *ISSN: 2348-0254*

Impact of the establishment of a unit of alcohol production on the basic of juice of sugar cane on the flora of Sikensi a locality of southern forester of Côte d'Ivoire

[1]KOUASSI Kouadio Henri, [1]SORO Didiomon [2] N'GUESSAN Koffi

[1]Université Jean Lorougnon Guédé, UFR Agroforesterie ;
BP 150 Daloa (Côte d'Ivoire) ;

[2]Université Felix HouphouetBoigny, Laboratoire de Botanique
UFR Biosciences
22 Bp 582 Abidjan 22;

Absract: ***This study was conducted at Sikensi, a city located at the south of Côte d'Ivoire. It relates to the identification and the evaluation of the impacts of the project of a production unit of biological alcohol resulting from sugar cane construction. The main objective was to identify, to evaluate and to characterize the impacts related to the phases of prospection, construction, exploitation and the end of the project. The methods of inherent inventory and these of the small squares were associated during floristic inventories. The results showed that the impacts the destruction of the woody flora (DFL) and the destruction of the potential of regeneration (DPR) were the major impacts during the phase of prospection and construction. During the production phase, the proliferation of herbaceous (PRO) was the major impact when the evolution of the aspect of the vegetations was strongly perceptible at the end of the project. However, the ecological disturbances were the minor impacts during the project realization.***

Keywords: impacts, flora, production, Alcohol, Sikensi, Côte d'ivoire

1. Introduction

The flora of Côte d'Ivoire, formerly, rich and diversified in species is poor in forest formations today. Indeed, of more than 15 million hectares at the beginning of independences, the surface of the forests of Côte d'Ivoire has passed to less than 2 million hectares in 1990 (Chatelain *et al* [1]). This situation is the direct consequence of itinerant agriculture and/or an anarchistic exploitation of the natural resources of these large biomes. This long agricultural past coupled with the land pressure due to the strong demography was the major cause of the destruction of the remaining vestiges. The post-electoral crisis promoted the exploitation of the woody species beyond the 8è parallel sometimes compromising the regeneration of the degraded flora of certain agricultural zones. In addition, many public awareness campaigns were not enough to slow down the action of destruction of the forest surfaces by many rural populations in cultivable ground searches. Face to many difficulties which encounter the authorities and the structures in charge of natural heritage management, the researchers and the actors of the field are directed more and more worms of the management durable or integrated solutions of this rich heritage. One of methods security and durable management of the vestiges is the identification and the evaluation of the activities causes, of impacts within the environment in order to put forward measures of attenuation or corrective (Kouassi *et al*. [2]). The present study aims at the identification, the analysis and the evaluation of the impacts related to the establishment of a manufacturing plant of natural alcohol (Alcohol produced starting from sugar cane) on the flora of Sikensi. The identification and the evaluation of the impacts of the above-mentioned activities are an important phase subsequent to the project realization and operation of this factory. The present study identifies and determines the positive and negative impacts known on the flora and the environment of the site of the project. It proposes moreover elements being able to be used as a basis of data for the orientation of future work and in decision makings.

2. Materials and Methods

From the floristic point of view, the site of the project belongs to the Guinean field and to the mesophilous sector (Fig. 1). The vegetation of the site was formerly dominated by an ombrophilous forest with the presence of hydromorphic formations in certain place. This forest was made of three principal layers (Guillaumet and Adjanohoun, [3]) and was characterized by the woody species such as the *Khaya ivoirensis*, *Lophira alata* and *Tarrieta utilis*. The hydromorphic formations were made up of marshy forests and mangrove swamps and were located in the northern part of the sector. The mangrove swamps are located as for them on the edges of the estuaries and of the lagoons. These forests luxuriant in the past, have given way to fragments of fallow completely in waste lands which shelter that and there many pieces of cultures of revenues (*Hevea brasiliensis*), some pieces of food crops, many fallow and marshy zones.

This wide forest is very threatened in Côte d'Ivoire, since it comprises several exploited species. The contiguous flora of the site and the flora of the ecosystems were inventoried. Two methods were associated to conduct this study. These methods were: the itinerant inventory of the flora by the enumeration of the species on layouts and the method of the small squares of Gautier *et al.* [4], which consists in describing the vegetation (enumeration and classification of the species) on plots of approximately 20 m on side according to the four cardinal points, with a precise spacing (Fig. 2). To be done, 4 plots of 20 side m were delimited in the bordering vegetations of the site, of kind to regard the site of establishment of the factory as central plots. The plots of 20 m side were subdivided in plots of 5 m side (Fig. 3). All woody species were inventoried. These are those endemic, rare, with particular status etc.

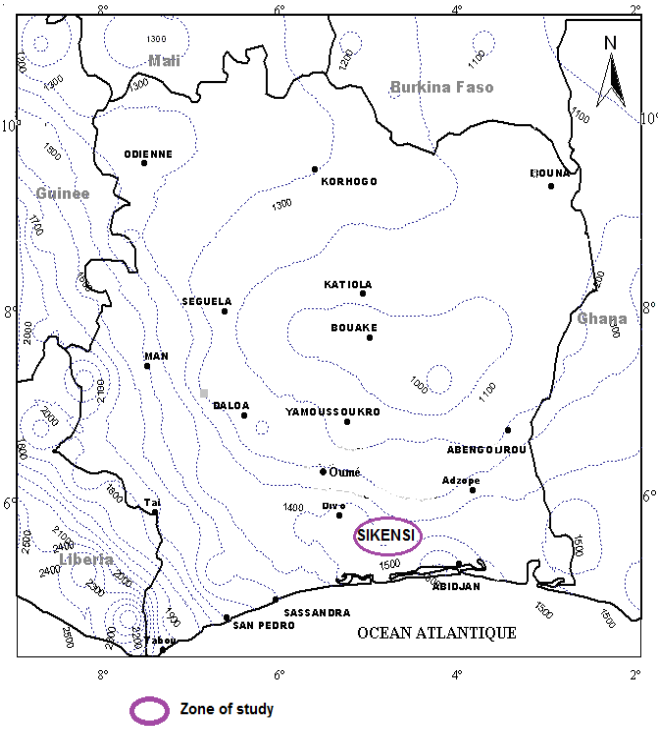

Fig. 1: Zone of study

2-1-Flora analyzes

The current diversity of the flora was expressed starting from the index of diversity of Shannon-weaver [6]. It expressed itself as: H = - pi (Log pi). {With, pi = Fr/N, N being the full number of inventoried species; Fr = F (a)/i, with, i = full number of statement and F (a) = number of appearance of a species during the inventory. The homogeneity and the level of stability of the medium was estimated by Equitability (E). This index is deduced from the index of diversity of Shannon and is expressed itself as follows: E = H/Log (N), with, H (index of diversity of Shannon and N the full number of sample or individual). For the analyses, the identified impacts were coded and treat in a matric table. Then figures were assigned to each code. Thus, value 3, 2 and 1 were respectively affected to the forts, means and weak impacts

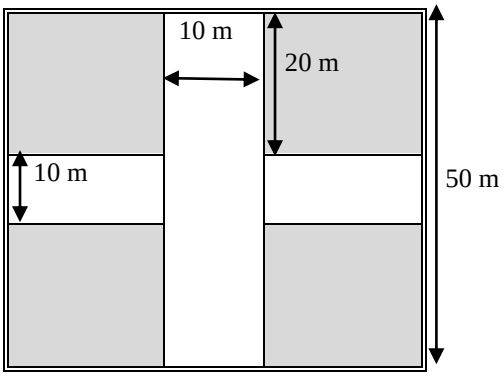

Fig. 2: Configuration of the large plots of relieve

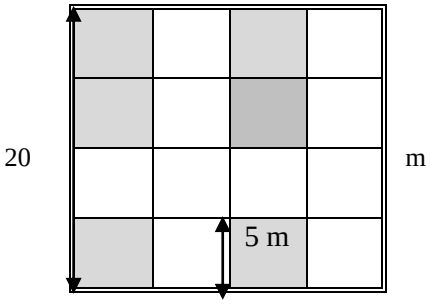

Fig. 3: Configuration of the small plots of relieve

3. Results

3-1-Typology of the flora of the site

The original flora is replaced today by a sparse agrarian landscape comprising plots of cultures (Fig. 4), the plots of the food crops (Fig. 5), fallow and underworld (Fig. 6, 7). Also, the remaining surfaces of vestiges were already seriously started.

Fig. 4 : Plot of palm tree

Fig. 5 :Plot of cassava

Fig. 6: Underworld near the site

Fig. 7: Fallow near the site

3-2-wealth and specific diversity

The flora of the site is rich of approximately 60 species. The estimates of the index of diversity of Shannon and Equitability (table 1) are respectively about H = 3.6 and E = 0.61

Table I: matrix of estimate of the indices of diversity and Equitability

N	**Species**	**Fa**	**Fr**	Pi	Hi
1	*Adenia rumicifolia*	1	0,33	0,0055	0,041285
2	*Ageratum conyzoïdes*	2	0,67	0,011167	0,072412
3	*Albizia adianthifolia*	3	1	0,016667	0,098448
4	*Albizia zygia*	2	0,67	0,011167	0,072412
5	*Alchornea cordifolia*	3	1	0,016667	0,098448
6	*Allophyllus africanus*	1	0,33	0,0055	0,041285
7	*Alstonia boonei*	2	0,33	0,0055	0,041285
8	*Anthocleista nobilis*	2	0,67	0,011167	0,072412
9	*Antiaris toxicaria*	2	0,67	0,011167	0,072412
10	*Aspilia africana*	2	0,67	0,011167	0,072412
11	*Baphia nitida*	2	0,67	0,011167	0,072412
12	*Blighia sapida*	1	0,33	0,0055	0,041285
13	*Cecropia peltata*	1	0,33	0,0055	0,041285
14	*Centrosema pubescens*	1	0,33	0,0055	0,041285
15	*Chromolaena odorata*	3	1	0,016667	0,098448
16	*Cleome ciliata*	2	0,67	0,011167	0,072412
17	*Clerodendrum buccholzii*	1	0,33	0,0055	0,041285
18	*Cnestis ferruginea*	2	0,67	0,011167	0,072412
19	*Cocos nucifera*	1	0,33	0,0055	0,041285
20	*Cola nitida*	2	0,67	0,011167	0,072412
21	*Combretum racemosum*	1	0,33	0,0055	0,041285
22	*Commelina benghalensis*	2	0,67	0,011167	0,072412
23	*Commelina sp*	1	0,33	0,0055	0,041285
24	*Croton hirtus*	2	0,67	0,011167	0,072412
25	*Cyathula prostrata*	3	1	0,016667	0,098448
26	*Dioscorea similacifolia*	2	0,67	0,011167	0,072412
27	*Dissotus rotundifolia*	1	0,33	0,0055	0,041285
28	*Elaeis guinensis*	2	0,67	0,011167	0,072412
29	*Ficus exasperata*	2	0,67	0,011167	0,072412
30	*Ficus sur*	1	0,33	0,0055	0,041285
31	*Ipomoea* sp.	2	0,67	0,011167	0,072412
32	*Lantana camara*	2	0,67	0,011167	0,072412
33	*Mangifera indica*	1	0,33	0,0055	0,041285
34	*Manihot exculenta*	2	0,67	0,011167	0,072412
35	*Mariscus cylindristachus*	1	0,33	0,0055	0,041285
36	*Mitracarpus villosus*	3	1	0,016667	0,098448
37	*Millettia zechiana*	1	0,33	0,0055	0,041285
38	*Mimosa invisa*	1	0,33	0,0055	0,041285
39	*Morinda lucida*	2	0,67	0,011167	0,072412
40	*Motandra guineensis*	3	1	0,016667	0,098448
41	*Musa sp*	2	0,67	0,011167	0,072412
42	*Musanga cecropioïdes*	2	0,67	0,011167	0,072412
43	*Nephrolepis biserrata*	2	0,67	0,011167	0,072412
44	*Newbouldia laevis*	1	0,33	0,0055	0,041285
45	*Palisota hirsuta*	1	0,33	0,0055	0,041285
46	*Panicum maximum*	2	0,67	0,011167	0,072412
47	*Persea americana*	1	0,33	0,0055	0,041285
48	*Phisalis micranta*	1	0,33	0,0055	0,041285
49	*Phyllanthus amarus*	1	0,33	0,0055	0,041285
50	*Phyllanthus sp*	1	0,33	0,0055	0,041285
51	*Psydium guajava*	1	0,33	0,0055	0,041285
52	*Pueraria phaseoloïdes*	1	0,33	0,0055	0,041285
53	*Pychnanthus angolensis*	1	0,33	0,0055	0,041285
54	*Rauvolfia vomitoria*	2	0,67	0,011167	0,072412
55	*Secamone afzelii*	1	0,33	0,0055	0,041285
56	*Sida acuta*	2	0,67	0,011167	0,072412
57	*Sterculia tragacantha*	2	0,67	0,011167	0,072412
58	*Trema orientalis*	1	0,33	0,0055	0,041285
59	*Triumpheta pentandra*	1	0,33	0,0055	0,041285
60	*Zea mays*	1	0,33	0,0055	0,041285
				H	3,598253
				E	0,609162

3-3-Identification and analyzes of the impacts

The impacts identified during the prospection, construction, the exploitation and at the end of the project, are numerous and varied. These impacts vary according to the linked activities with the various phases of the project. These impacts are: destruction of the woody flora (DFL), destruction of the potential of regeneration (DPR), disturbances ecological (PER), proliferation of herbaceous (PRO), the fragmentation of vegetations (FRV), the enrichment and the diversification of the flora (EDF) and evolution of the aspect of vegetation (EPV).

3-3-1- Phase of prospection and construction

The evolution of the curves (Fig. 8) shows the variation of the impacts related to the phase of prospection and construction on the vegetation, the flora of the site and on that of the contiguous vegetations. Thus, the destruction of the woody flora (DFL) was intense (3), extended (2), long (3) and have medium importance (2). The destruction of the potential of regeneration (DPE) was intense (3) and important (3), but it was medium extended (2) and short (1). The ecological disturbances were intense (3), extended (3) and have medium importance (2). They were however short (1). The evolution of the average impacts on the flora during this phase (Fig. 9), shows that the destruction of the woody flora (DFL) and the potential of regeneration (PRE) of the plant species were high (2.25) during this phase. On the other hand, the ecological disturbances were weaker (1.75).

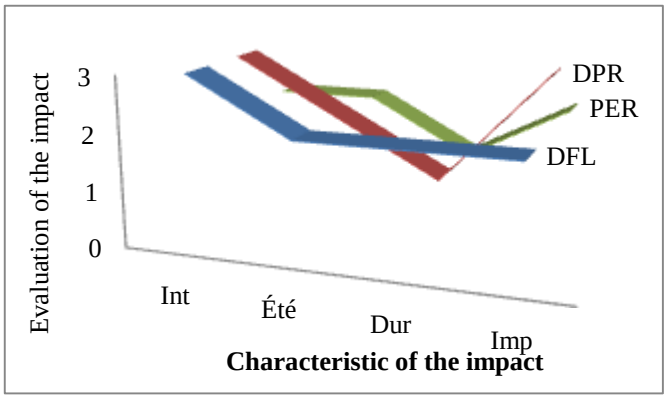

Fig. 8: Evolution of the impacts related to the phase of prospection and construction of the factory, with, Int= intensity, Ete = extended; Dur = duration; Imp = importance; DFL = destruction of the woody flora; DPR = destruction of the potential of regeneration; PER = Ecological disturbance

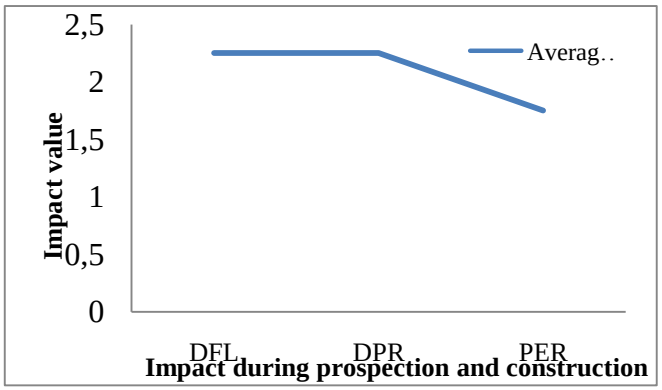

Fig. 9: Evolution of the average impacts related to the phase of prospection and construction, with, DFL = destruction of the woody flora; DPR = destruction of the potential of regeneration; PER = Ecological disturbance

3-3-2- Phase of exploitation

The evolution of the curves (Fig. 10) shows the evolution of the impacts related to the production phase on the flora, the vegetation of the site and on that of the contiguous vegetations. During this phase, the proliferation of herbaceous (PRO) was intense (3) extended (3), long (3) and important (3). The destruction of the woody flora (DFL) was fairly intense (2), extended (3), long (3) and important (3). The destruction of the potential of regeneration was fairly intense (2) and fairly important (2). On the other hand, it was extended (3) and long (3).

The evolution of the average impacts on the flora during this phase (Fig. 11), shows that the proliferation of the herbaceous species (PRO, 3) and the destruction of the woody flora (DFL, 2.75) were the highest impacts during the production phase. The destruction of the potential of regeneration was the weakest impact (2.25).

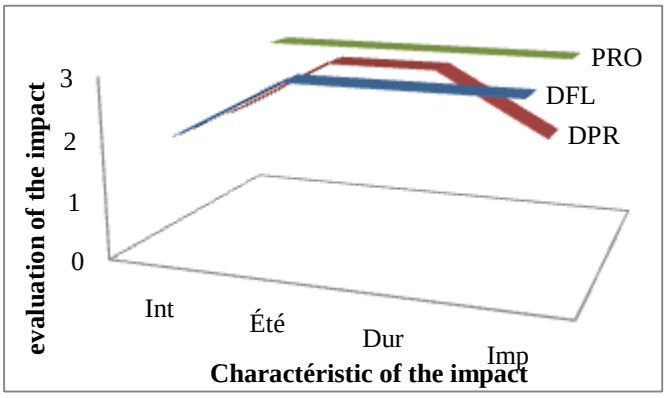

Fig. 10: Evolution of the impacts related to the phase of exploitation, with, Int= intensity, Ete = extended; Dur = duration; Imp = importance; DFL = destruction of the woody flora; DPR = destruction of the potential of regeneration; PRO = Herbaceous proliferation

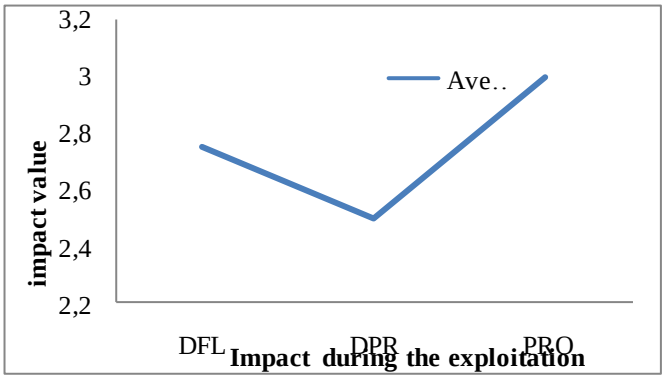

Fig. 11: Evolution of the impacts related to the phase of exploitation, with, DFL = destruction of the woody flora; DPR = destruction of the potential of regeneration; PRO = Herbaceous proliferation

3-3-3- The end of the project

The curves (Fig. 12) shows the evolutions of the impacts related to the end of the project on the flora, the vegetation and on that of the contiguous vegetable formations of the site. During this phase, the evolution of the aspect of vegetation (EPV) was intense (3), extended (3), long (3) and important (3). The fragmentation of the vegetation of the exploited zones (FRV) was intense (3), extended (3) and important (3). But it was of medium duration (2). The enrichment and the diversification of the flora (EDF) were average intense (2) and average extended (2). On the other hand this impact was to long (3) and important (3).

The evolution of the average impacts (Fig. 13) shows that the evolution of the aspect of the vegetations (EVD, 3) and the fragmentation of the vegetations of the exploited zones (FRV, 2.75) were the higher impacts. On the other hand, the evolution of the diversity of the plants was the weakest impact (2.5).

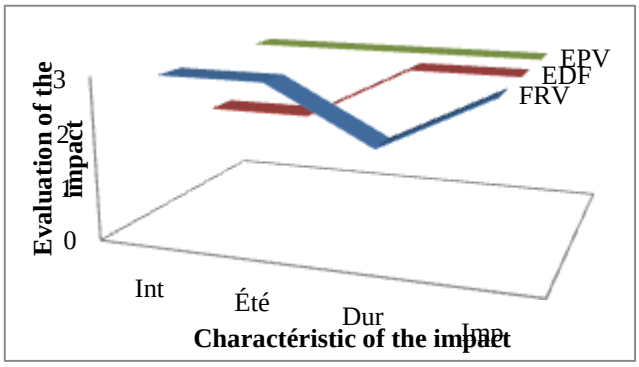

Fig. 12: Evolution of the impacts related to the end of the project, with, Int= intensity, Ete = extended; Dur = duration; Imp = importance; FRV = Forest fragmentation; EDF = Flora diversity evolution, destruction of the potential of regeneration; EPV = Vegetation aspect evolution

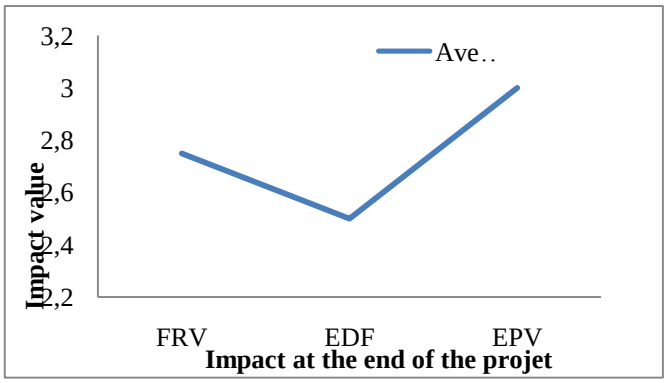

Fig. 13: Evolution of the average impacts related to the end of the project, with, FRV = Forest fragmentation, EDF = Forest diversity evolution; EPV = Vegetation aspect evolution

4. Discussion

4-1- Floristic inventory

The floristic inventory allowed to characterize the flora of the site. Indeed, the knowledge of the characteristics of the flora (composition, specific diversity, ecological diversity,…) and of its evolution under the effect of the natural or environnemental factors is a precondition to any planning or search for measurements of attenuations of negative impacts on the flora of a locality (Le Bourgeois and Merlier, [6]). From the floristic point of view, the ecological and biological disturbances recorded at the phase of the construction of the factory created an imbalance (destruction of numerous species of the flora), within the species communities. This beginning of destruction was accentuated during the phase of exploitation. This exploitation generated several human activities (regular frequentation and maintenance, supply in forest resources in the contiguous vegetations…,). These activities were potential sources of negative impacts on the flora of the site and by rebound that of the surrounding mediums. During the infrastructures installation, the nuisances caused by the machines, were the causes of ecological disturbances. Moreover, the actions conducted during the project caused a dynamics within the contiguous vegetation of the site like it was showed by the indices of diversity of Shannon (H) and Equitability de Pielou (E).

4-2- Evolution of the indices of diversity and homogeneity

The analysis of the flora of the site shows that it is low diversified (H= 3.6) and homogeneous (E = 0.61). The various activities undertaken in this zone were ecological sources of disturbances; these perturbations can be regarded as major disturbances of the ecosystems. Indeed, the site inherited a very intense agricultural past. Moreover, much destruction of the vegetations related to the anarchistic and abusive exploitations. The impacts related to the installation of the infrastructures of the factory, were caused by the machines through scouring and compaction of the soil of the site, the woody species destruction and the hiding of the seeds of certain species of the original flora. These causes also created ecological and biological disturbances (destruction of the ecosystems). In spite of these many disturbances, the locality remains homogeneous and stable from the floristic point of view. It is what the high value (0.61) of the index of Equitability of Pielou attests.

4-3- Evolution and evaluation of the environmental impacts

The environmental impacts were observed during the phases of exploration, exploitation, and at the end of the project. During the phase of construction, the opening of the access roads and the earthworks involved the destruction of the flora of the site and that of certain bordering vegetations of the site of the project. 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 thus the species of the underwoods very sensitive to excesses of light. The epiphytes are found on the ground following the demolition of the large trees. All these movements involved an ecological imbalance within the vegetable formations concerned. During the phase of exploitation, the extent of the disturbances was accentuated. The destruction became more important in the flora of the contiguous vegetations. The numerous heliophilous herbaceous proliferation is due to the exposure of the underwood to the strong luminosities and the capacity of these herbaceous at the fast colonization of the degraded mediums like it was mentioned by Claude *et al*. [7]. In addition, the many frequentations of the workers in search of woody species for medical care and various needs had an additional effect on the impacts; especially with regard to the destruction of numerous species. At the end of the project, the original vegetation almost disappeared following the many destruction perpetrated in the zone. The aspect of the vegetation was modified. Numerous species endemic, rare, with particular status etc. which the flora of the site sheltered during long moments do not exist today in the zone. The rich and diversified primary vegetation disappeared and left on the spot new vegetation mainly made up by the herbaceous ones. The surrounding formations have been exposed to the human pressure that they are more degraded. On the whole, the zone lost its rich and diversified forest and biological

diversity regressed considerably under the pressures of anthropic origins. The characterization and the evaluation of the impacts on the flora of the site are supposed to bring a thorough lighting on the nature (intensity, extended, lasted and importance) of the impacts. Thus, the destruction of the woody flora (DFL) and the destruction of the potential of regeneration (DPR) very intense to the phase of prospection and exploitation were caused by mechanical destruction of woody species etc. The monitoring of the site which comprises intense demolitions of certain woody species have affected all the components of the flora, and its regeneration like it was announced by Gnahoua [8], Alexandre [9], Mitja and Puig [10], and Kouassi *et al*. [11] in forest zone. During the exploitation phase the intense impacts (PRO) were only the consequences of the activities which started since the phase of prospection; they are amongst other things the regular maintenance of the site, the flora destruction, the permanent presence of the workers on the site and the regular frequentation of the contiguous vegetations. The intense impacts at the end of the project: fragmentation of the forest (FRV) and the evolution of the aspect of vegetation (EPV) are related to the suspension of the activities; this suspension supported this renewal of diversity. The destruction of the potential of regeneration (DPR) and the ecological (PRE) disturbances which are the significant impacts during the phase of prospection were caused by the total destruction of the flora and the soil compaction at certain places by the machines during excavation work. This beginning of destruction contributed to involved the herbaceous proliferation (PRO) after the woody flora destruction (DFL) making these two impacts most important during the production phase. The evolution of the floristic diversity (EDF), the vegetation aspect (EPV) and the forest fragmentation (FRV) which all are of the significant impacts at the end of the project are the direct consequences of the durability and the extent of the activities undertaken during the phases of construction and exploitation. But this evolution is also related to the afforestation which started during this phase with woody species. These species have slow growth like it was mentioned by Ettien [12] and Kouadio *et al*. [13].

4-4- Evolution of the average impacts and main sources of impact

The evolution of the average impacts during various phases of the project showed that the destruction of the woody flora (DFF) and the destruction of the potential of regeneration (DPR) were the major impacts during the phase of prospection. That is related to the types of activity carried out during this phase. Indeed, the earthworks and the other building work were a potential source of impact like it has been showed by Kouassi *et al*. (2013). During the exploitation phase, the herbaceous proliferation (PRO) was the major impact. This expansion of the herbaceous ones is the consequence of the destruction of the woody flora which was up to that point the factor limiting to the development of these species mainly heliophilous. The evolution of the aspect of the vegetations which is the perceptible major impact at the end of the project is a natural consequence of the suspension of any source activity of impact as mentioned above. The ecological disturbance of the site was the weakest impact on the whole of the project; what attests the strong value of the index of Equitability of Pielou. This value with shown that the medium presents a floristic homogeneity. In addition, the main sources of impact are the regular maintenance of the sites, mechanical destruction of woody species, the land compactions. Also, the many cut in the flora have an additive effect on that of the regular cutting in the flora like it showed by Kouassi *et al*. [14]. However, of the bordering vegetation formations which comprise rich vegetation will be reservoirs of natural resources and a source of CO2 purification. In spite of the high value as of the index of Equitability, the balance of the ecosystems of the site requires the creation of green spaces comprising the trees species; this in order to create an environment favorable to soil protection against any form of degradation.

5. Conclusion

The flora of the site of the factory is fairly rich and fairly diversified. This diversity has been fairly influenced by the installation, and the execution of the project. The activities undertaken during various phases of the project caused major impacts of which destruction of the woody flora (DFL) and the destruction of the potential of regeneration (DPR) were most perceptible during the phase of propection. In the same way proliferation of herbaceous (PRO) and the evolution of the aspect of the vegetation was major impacts respectively during the production phase and at the end of the project. The ecological and biological disturbances recorded at the time of the construction of the factory created an imbulance (destruction of numerous species of the flora), within the flora community. This beginning of the destruction was accentuated during the exploitation phase; with several activities which were potential sources of negative impacts on the flora of the site and that of the surrounding mediums.

Reference

[1] **Chatelain C., Dao H., Gautier L. et Spichiger R., 2004**. Forest cover changes in Côte d'Ivoire and Upper Guinea *In*: **Poorter L., Bongres F., Kouame F. N'. et Hawthorne W.D. (eds).** Biodiversity of west African Forests Atlas of Woody Plant Species. CABI publishing: 15-32.

[2] **Kouassi Kouadio Henri, TRA-Bi Fezan Honora, Kouassi Roland Hervé (2013**). Impacts of the iron ore extraction on the flora of the localities of Bangolo and Logoualé west of Côte d'ivoire, *International Journal of Advanced Research* (2013), Volume 1, Issue 9, 167-176

[3] **Guillaumet J. L. et Adjanohoun E. (1971)**. La végétation. *in :* "Le milieu naturel de Côte d'Ivoire". Mém. ORSTOM, Paris, n°50 : 161-262

[4] **Gautier, L., Chatelain, C.V. et R. Spichiger, 1994**. 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. Vol. 2: 1339-1350

[5] **Shannon & Weaver (1948)**. The mathematical theory of communication, Urbaka un. Press Illinois.

[6] **Le Bourgeois T., Merlier H., 1995.** Adventrop. Les adventices d'Afrique soudano- sahélienne. Montpellier, France, CIRAD-CA éditeur, 640 p

[7] **Claude F., Floret Ch., Paul M. et Jean D., 1998**. Ecologie : Approche scientifique et pratique. ed : Lavoisier Tec., 4è éd., 102 p

[8] **Gnahoua G.M., 1997**. Analyse phytoécologique de la flore adventice des cultures post-jachères améliorées en zone de forêt semi-decidu de Côte d'Ivoire, D.E.A. Ecosystèmes terrestres et méditérannéennes, Université Aix-Marseille III, 34 p

[9] **Alexandre D. Y., 1989 a**. Dynamique de la régénération naturelle en forêt dense de Côte d'Ivoire. Etudes et Thèses, Orstom Paris, 102 p

[10] **D. Mitja and H. Puig, (1993)**. Essartage culture itinérante et reconstitution de la végétation de la jachère en savane humide de Côte d'Ivoire (Booro-Borotou). la jachère en Afrique de l'Ouest, collection : Colloques et Séminaires. Paris: ORSTOM

[11] **Kouassi K.H., Gnahoua G M. et Kouassi K.E., 2008**. Influence of the dynamic of *Albizia* : *Albizia adianthifolia* and *Albizia zygia* (Mimosaceae) on the covering off *Chromolaena odorata* (L.) R.M. King & H. Rob. (Asteraceae) in the post-farming Vegetations of Oumé in Semi-deciduous forest zone of Côte d'Ivoire. European Journal of Scientific Research, 1450-216X (20): 3 pp 677-687

[12] **Ettien DT. (2005)**. Potentiels de régénération des essences forestières commerciales par la germination des graines, dans la forêt classée du Haut-Sassandra (Centre-Ouest de la Côte-d'Ivoire). Thèse de Doctorat 3ème cycle, U.F.R. Biosciences, Université Abidjan-Cocody, Abidjan, Côte d'Ivoire, p. 259.

[13] **Kouadio K, Kouassi KE, Kouamé NF, Traore D**. **2007**. Impact of the clearance on the natural regeneration of the principal forest trees, in the classified forest of Bossematié (Côte d'Ivoiret). Sci. Nat. vol. 4 (1): 27-35.

[14] **KH K Kouassi, KH. Kouassi, K. Ayolié, and K. N'guéssan, (2014)**. "Evolution of floristic diversity according to altitude in the localities of Bangolo and Logoualé west of Côte d'Ivoire," *RRBS*, vol. 9, pp. 63-69, 2014