IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Human Journals
Research Article
April 2018 Vol.:9, Issue:2

Characterization of the Cultivation System Based on Replanted Cacao-Trees in the Dynamic Agroforestry in the Regions of Belier and Marahoué of Côte d'Ivoire

IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

***Kouassi Kouadio Henri, Akou Bechie, Kouamé Djaha**

(1) Université Jean Lorougnon Guédé BP 150 Daloa (Côte d'Ivoire)

(2) Ecole Normale Supérieure d'Abidjan

Submission: 22 March 2018
Accepted: 29 March 2018
Published: 30 April 2018

HUMAN JOURNALS
www.ijsrm.humanjournals.com

Keywords: Cacaoculture, Dynamic Agroforestry, Cultivation System, Crops Association, Regeneration, Côte d'Ivoire

ABSTRACT

The study relating to the characterization of the cultivation systems based on replanted cacao-trees in dynamic agroforestry was carried out in four agroecological zones. This study aimed to analyze and to evaluate the cultivation system based on cacao-tree based on the technique of replanting in dynamic agroforestry proposed as palliative measures to solve certain major constraints which threaten cacao culture in Côte d'Ivoire. The systemic method based on the concept of "system" was used as tool for characterization of the structural elements. To this method based on investigations in rural zones visits of plots of culture were associated. In the practice, forty-five (45) plots were sampled in 17 villages belonging to these localities. These investigations revealed that the elements characteristic of this systems are primarily; farming calendars, cultivation associations, technical routes and farming constraints. In its operation, this cultivation system makes it possible in the short or medium term to regenerate the old orchards of cacao-trees.

INTRODUCTION

Agriculture constitutes an engine of economic growth for many developing countries. It is subdivided for most these countries, in industrial crops and food crops (Chaléard, 1988). In Côte d'Ivoire, the production of the Cocoa accounts for approximately 30% of the export earnings and takes part in more than 10% of the gross domestic product (Assiri *et al*., 2012). However, the producers meet many difficulties related on the weak economy and the climatic change. In spite of the multiple efforts authorized to reduce and/or attenuate these difficulties, the parasitic pressures are accentuated and the orchards become increasingly growing old (Assiri, 2010). This degradation of the orchards is dependent on the weaknesses of the traditional systems of production of the cocoa known before independence, but which unfortunately are always practiced. The more widespread practice is the itinerant agriculture, which with the climate changes integrates more and more input to correct the increasingly perceptible falls of outputs over the years. Face to this fact, the public awareness campaigns to diversification of the cultures and by the increased of the agricultural incomes becomes increasingly recurring to guarantee food self-sufficiency and potentially important financial revenue. However, the experts estimate that between 2020 and 2025, one will need a million additional tons of cocoa to cope with the world demand (ICCO, 2014). According to the same source, the risk of shortage of the cocoa is high by 2030. It is thus urgent to increase the production on the long run and to satisfy the producers with high prices. In addition, strong demography involves a strong land pressure over the years. In such a context, the adoption of novel methods agroforestières is one of the palliative solutions to the many probable disturbances. The main aim of this work is to characterize the cultivation system based on the technique of replanting of the orchards of cacao-tree in the cultivation system containing cacao-trees as a dynamic agroforestry, the objective being to promote this system for a sustainable agriculture.

I-MATERIALS AND METHODS

1-1-Site of the study

The study was conducted in the areas of the Belier and Marahoué region, with the touwns chiefs of Department: the towns of Yamoussoukro and Bouaflé (Fig. 1).

1-2-Method

Many methods exist and are used to characterize the agrosystems which are defined according to Jouve et Tallec (1994) like a vegetable population cultivated in a medium under the influence of the climate and the cultivation techniques. Methodology used is "the systemic approach" of which the basic concept is the "system". This method is founded on some basic principles used by Dupriez and De Leener (1993). This approach goes from the general to the individual or the overall picture precedes the analyses by detail; it is systemic (it restores each particular element as a whole, by taking account of the multiple interrelationships); it is inductive because it, takes as a starting point the nature truths (Kouakou, 2002).

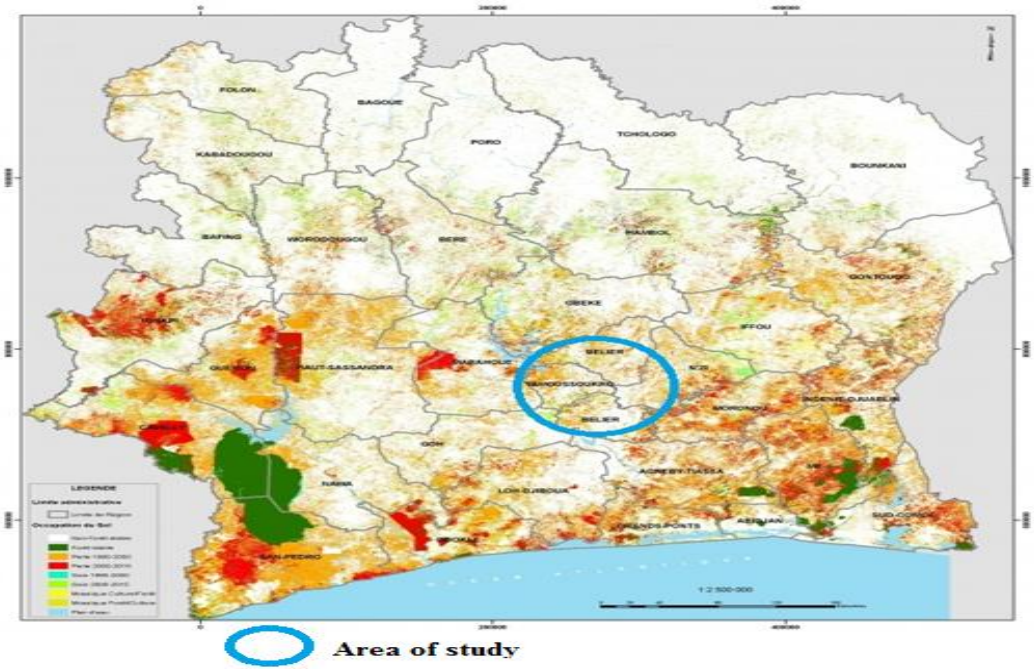

Fig. 1: Location of the area of study

The study proceeded in two (2) phases and lasted three months. The first phase was devoted to made contact and with the sampling of the producers. Then, reasoned sampling is one of the unprobabilistic methods which was used for the choice of the plots. This sampling was based on the size of the plantations, the size of the households the technique farming and the practiced cultivation system. Sampling lasted one month and made it possible to inventory seventeen (17) villages adding up fifteen (15) plots of cultures where the technique of replanting was applied.

The second phase was devoted to the investigations near the producers. To these investigations, visits of plots were associated to check the information collected during investigations. Also, these simultaneous visits made it possible to minimize the margins of error. The investigations and the visits of plots lasted two (2) months and proceeded in crossed and sometimes in the evening with the farmers. Then a guide of investigation was used as guide during talks. The elaborate questionnaire was addressed to the growers individually. The questions, in majority half-open, aimed at the search for relative information to the above-mentioned characteristic elements.

1-3-Treatment and data analysis

The data analysis is descriptive and inferentielle. It related to quantitative variables and qualitative variables. The dynamic crosstable was used to gather information by center of interest. The information collected on the ground was recorded, stripped and the values of Khi ² were calculated. Those of theoretical Khi ² was obtained by the opposite function Khi ². Comparisons of averages were made according to the general linear model with the Software Statistx 8.1 All these tests statistical were carried out with the threshold of 5%. The bars of errors were obtained starting from the standards errors. The mathematical formula of the test of independence of Khi ² is the following one:

$$\chi^2 = \sum_{i=1}^{n}\sum_{j=1}^{m}\frac{(Fo_{ij} - Fe_{ij})^2}{Fe_{ij}}$$

In this mathematical expression, Fo represents the frequency observed of the variable and Fe, the theoretical frequency. The latter is obtained from:

$$Fe_{11} = \frac{\sum_{j=1}^{m} Fo_{1j} \cdot \sum_{i=1}^{n} Fo_{i1}}{\sum_{i=1}^{n}\sum_{j=1}^{m} Fo_{ij}}$$

One calculates all Feij in the same way. The rule is the following one: If calculated theoretical Khi ² est< Khi ², it is known as that the variables observed are not dependent. If Khi ² calculated is > theoretical, it is known as that there is dependence between the two

expressed parameters. ddl = $(\sum_{i=1}^{n} i-1)X(\sum_{j=1}^{m} j-1)$ with ddl= degree of freedom and threshold of significance = 0,05).

II-RESULTS

2.1. Practiced cultures

Many cultures are practiced in the 15 selected plantations. Four (4) groups of cultures were identified. They is the industrial crops, the food crops, the fruit-bearing plants, the plants of biomass (forest trees, herbaceous) and the woody plants.

2.1.1. Industrial Crops

The industrial crops or cultures of revenue identified in the replanted plots are, the coffee-tree (*Coffea canephora*), cashew nut, hevea (*Hevea brasiliensis*) and palm tree with oil (*Elaeis guineensis*) which are associated with the basic culture which is the cacao-tree at the beginning of the regeneration of the plantation. Then, as the field takes age, the producer eliminates certain cultures to the benefit of the cacao-tree.

2.1.2 Food crops

The food crops are: cereals, plants with roots, plants with fruits, vegetables, plants with tubers and leguminous plants.

2.1.3. Plants with Fruits, foresters and species of production of green manure

Besides the food crops and cultures of revenue, other cultures are met in the plantations. These plants are classified in three categories. They are the forest trees composed of *Ceiba pentandra*, *Milicia exselsa*, *Tectona grandis*, *Acacia mangium*, *Terminalia superba*, *Mansonia altissima*, *Terminalia ivorensis*, *Albizia zygia*; food plants made up of: *Ananas comosus*, *Persea americana*, *Citrus* sp, *Carica papaya*, *Cola nitida*, *Mangifera indica* and plants of biomass which are; *Panicum maximum*, *Pennisetum purpureum*, *Ricinus communis*, *Tithonia diversifolia*,….

2.1.4. Crops associations

Farming associations are a combination of two or several cultures on the same piece. This practice is common in the surveyed villages. Two types of farming associations were identified. In the type of farming association (standard association of savanna), the producers adopt two strategies of sowing in the same year. During the installation of the plot, they make the first leguminous plant sowing (*Arachis hypogaea*, *Glicine max*, *Phaseolus vulgaris* Vouandzea subterranea), which they in particular associate with various plant species, ***Tithonia diversifolia***, *Zea mays*, *Anacadium occidentale*. Thus, following these sowings, they install the basic culture which is *Theobroma cocoa* (the Cacao trees). Three even four months after this association, the associated leguminous plants and cereals are eliminated from the plot. This phytomasse is then used to fertilize the ground on the production line. The second sowing intervenes during the small rainy season. It is devoted to the vegetables (*Capsicum frutescens*, *Solanum melongena*) under the canopy of the trees with rapid growth left in the fields such as: *Ceiba pentandra*, *Acacia mangium*, *Tectona grown*, etc. During the second year of culture, *Thitonia diversifolia*, *Phaseolus vulgaris*, *Arachis hypogaea* and *Vouandzea subterranea.*

Thus, following these sowings, they install the basic culture which is *Theobroma cacao* (the Cacao trees). Three even four months after this association, the associated leguminous plants and cereals are eliminated from the plot. This phytomasse is then used to fertilize the ground on the production line. The second sowing intervenes during the small rainy season. It is devoted to the vegetables (*Capsicum frutescens*, *Solanum melongena*) under the canopy of the trees with rapid growth left in the fields such as: *Ceiba pentandra*, *Acacia mangium*, *Tectona grandis*, etc. During the second year of culture, *Thitonia diversifolia*, *Phaseolus vulgaris*, *Arachis hypogaea* and *Vouandzea subterranea* are resown. Also, *Vouandzea subterranea* finishes its cycle of production at the end of the third year. From this period it remains in the piece only *Theobroma cacao*, *Musa paradisiaca*, *Anacardium occidentale*, *Tectona grandis* and the forest arborescent woody trees.

2-1-5-Typology of the techniques of replanting

Three (03) standard of replanting was identified. It is the sowing or the replanting a fallow, the replanting of a sick orchard and the replanting of the degraded holy orchards (slightly represented). During the phase of preparation of the fallow for sowing, the itinerant farming

technique on clearing-denshering is proscribed. Figure 2 gives a model of sowing of a fallow of less than 5 years, with a not very fertile ground. The line spaces are the spaces arranged for the production of biological manure (green). Later, this manure will be widespread around the young cacao-trees and on the production lines. This technique makes it possible to improve the physicochemical properties of the ground and by rebound the output of the cacao-tree.

Fig. 2: Sown fallow

2-2-Modeling of the technical routes followed during the installation of the replanted fallow

In the plots to replant the great activities are the soil preparation, the installation of the cultures and crop maintenance until harvest. The first operation carried out is the choice of the plot to be cultivated or regenerate. The peasant performs his choice according to his priorities. The choice of the plot is followed by its clearing. The producer passes then to the staking and the trouaison. These two activities are done simultaneously. After the clearing, the remains of plants (biomass) obtained are used for the manufacturing of the organic matter. The production process of the organic matter is schematized on Fig. 3.

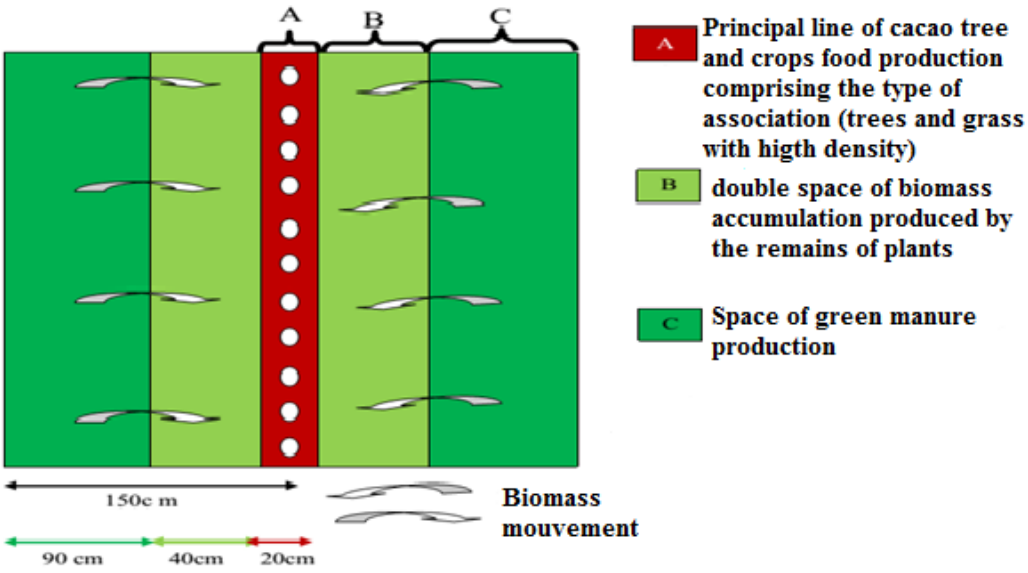

Fig. 3: Production process and of management of the organic matter around the production line

The staking is exclusive to the replanted pieces. This stage is followed by the installation of the cultures. During the period of the installation of the cultures, the cacao-tree, the banana tree and the cassava are planted online. Indeed, three cuttings of cassava (one meter length) are planted around each foot of cacao-tree (Figure 4). The banana tree is planted between two feet of cacao-tree. The vegetables, the cereals and the leguminous plants are sown either online or in bulk. In the plots of culture, the hillocks of yams are made between the production lines. The plants of biomass are sown in bulk. The fruit-lofts and the forest plants are planted online. Thus the species are organized according to a method of sowing, with specific densities (table) but, the plantation of the young cacao-trees is done after the demolition of the trees. The branches of the shot down trees are cut out to cover the planted seeds and them hillocks of yam.

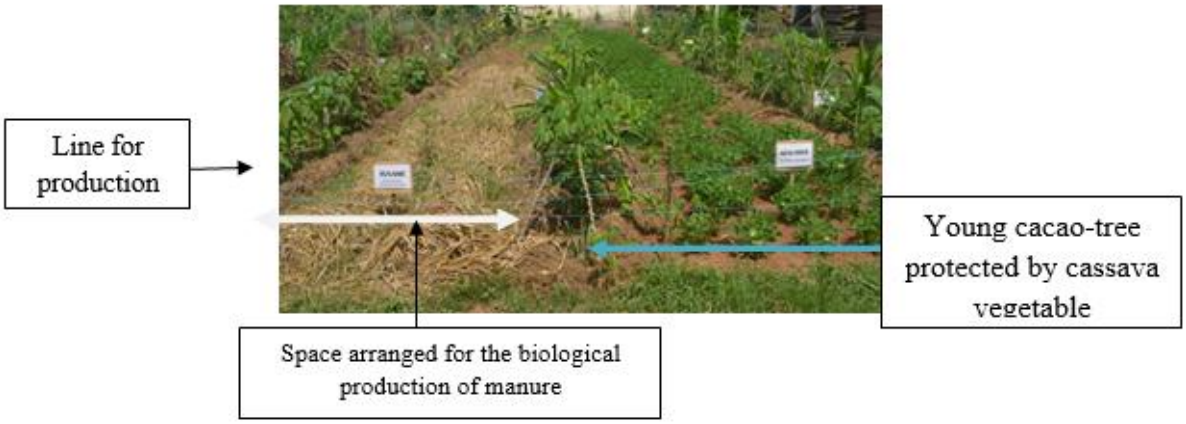

Fig. 4: Technical of replanting in fallow

Farming calendars in the replanted plots

The periods of intense activities proceed between June and December. The farming calendar of the replanted plots appear in table 1. In this table, the period of the installation of the replanted plots starts in March and finishes in June.

Table I: Farming calendar and technical route used for the installation of the replanted plots

Farming calendar	**Month**											
	Jan	Feb	Mars	Ap	Mai	Ju	Jul	Au	Sep	Oct	Nov	Dec
Choice of the plots	←	—	→								←	→
Seedbed	←	→									←	→
Bush clearing	←	—	→									
Cutting of the stump			←	—	—	→						
Staking							←	→				
Trouaison							←	→				
Sowing				←	—	—	—	—	→			
Repiquetage									←	→		
Ridging			←	—	—	→						
Cocoa tree planting		←	—	→					←	→		
Demolition of the trees		←	—	→								
Management of the vegetable biomass				←	→							
Weeding and selective cleaning				←	→						←	→
Harvest	←	—	—	→						←	→	

2-2-2- Charge of production

Each factor of production conditions the performance of the cultivation systems. One of these factors is the charge of production. This charge is relating to the tasks of preparation of soil, the installation and crop maintenance. It is also the purchase of the selected seeds. The charge of production concerns also the physical efforts and intellectuals deployed since the preparation of ground, the installation of the cultures until the production.

2-2-3-Time of work

The working time varies according to work and from the days. Figure 8 shows the time devoted to work during one work day. Section A represents the period devoted to the beginning of work until the rest generally located at the mid-day. Section C represents the period of rest and the section B, the period of the restarting of work after the rest. Thus, A+B represents the effective day of work of the producer which is of approximately 8 hours on average.

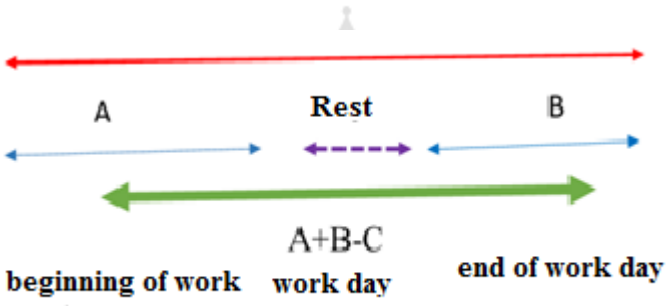

Fig. 5: Work time

2-2-4- Workers

Four types of workers were identified in the zone: the family workers, the mutual aid, the paid workers and the sharecroppers. But the family worker is the task force most used in the cultivation system containing replanted cacao-trees.

The workers evaluated in the number of man/day/ha carries out all the linked activities with the cultivation system containing replanted cacao-trees. The workers necessary for the activities varies according to the stages. The statistical test of the general linear model showed that the manpower need for the preparation of the soil does not depend on the type of

regeneration (P<0,005). But the manpower needs on the level for maintenance (P= 0.68) and harvest (0.997) depend on the type of regeneration.

2-2-5-typology of the producers according to the work charge and the working time

The work charge and the working time are discriminating factors whose combination makes it possible to distinguish the types of producers in the surveyed villages. The women adopted the technique of replanting mainly. But the men contrary to the women adopted the techniques of rehabilitation and restoration apart from replanting (Fig. 5). In addition, the results of the investigations showed through the test of the general linear model a significant difference between the sexes with regard to the adoption of the techniques (P=0,0001) < 0.005.

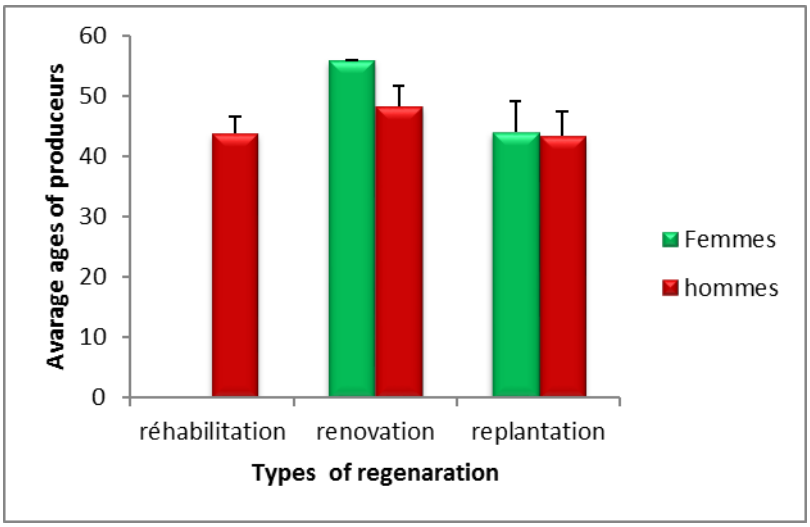

Fig. 6: Distribution of the standard sexes according to the type of regeneration

2.3. Dynamics of the cultivation system containing replanted cacao-trees

The evolution of the cultivation system containing cacao-tree was observed on three levels. These levels are: the introduction of woody biomass in partnership with the basic culture, the specificity of the farming successions and the guided management of the species during the periods of culture. Indeed, in the replanted orchards, the post-farming successions are observed until the stage of production of the cacao-tree. With this intention, when the seedlings form a closed canopy (located around 30 years), the herbaceous heliophilous are eliminated with the profit from the woody species. In the investigated plantations, the average of density of the ligneous family is around 50 even 100 trees/ha. Also, many changes are recorded in the farming successions in the course of time (Fig. 6). In this system, the density

of the cultures is known and fixed at the beginning of countryside. But this density varies in the course of time. These changes are induced by the external factors such as the climate changes and its corollaries (prolonged drought, disease of the plants, fires criminal, conflicts between populations etc). This system is thus opened with the external influences.

2-3-modeling of the cultivation system based on replanting Cocoa trees

In its operation (Figure 6.), the cultivation system containing replanted cacao-trees is influenced by natural environment. This system being open, its operation is dependent on the endogenous factors which are: the quality of the seedlings, types of farming associations (2), chronograms of completion of the work (Calendar farming (3) and especially the cultivation techniques (4). The good structuring of the components of the system led to an optimal operation which leads to a good production. However, this operation is strongly influenced by the charge of work (5) and the constraints (6) with the production which are inter alia: intraspecific and interspecific competitions, the climate changes, the socioeconomic, the sociocultural, the diseases, criminal fires, which can be perceived like exogenic factors.

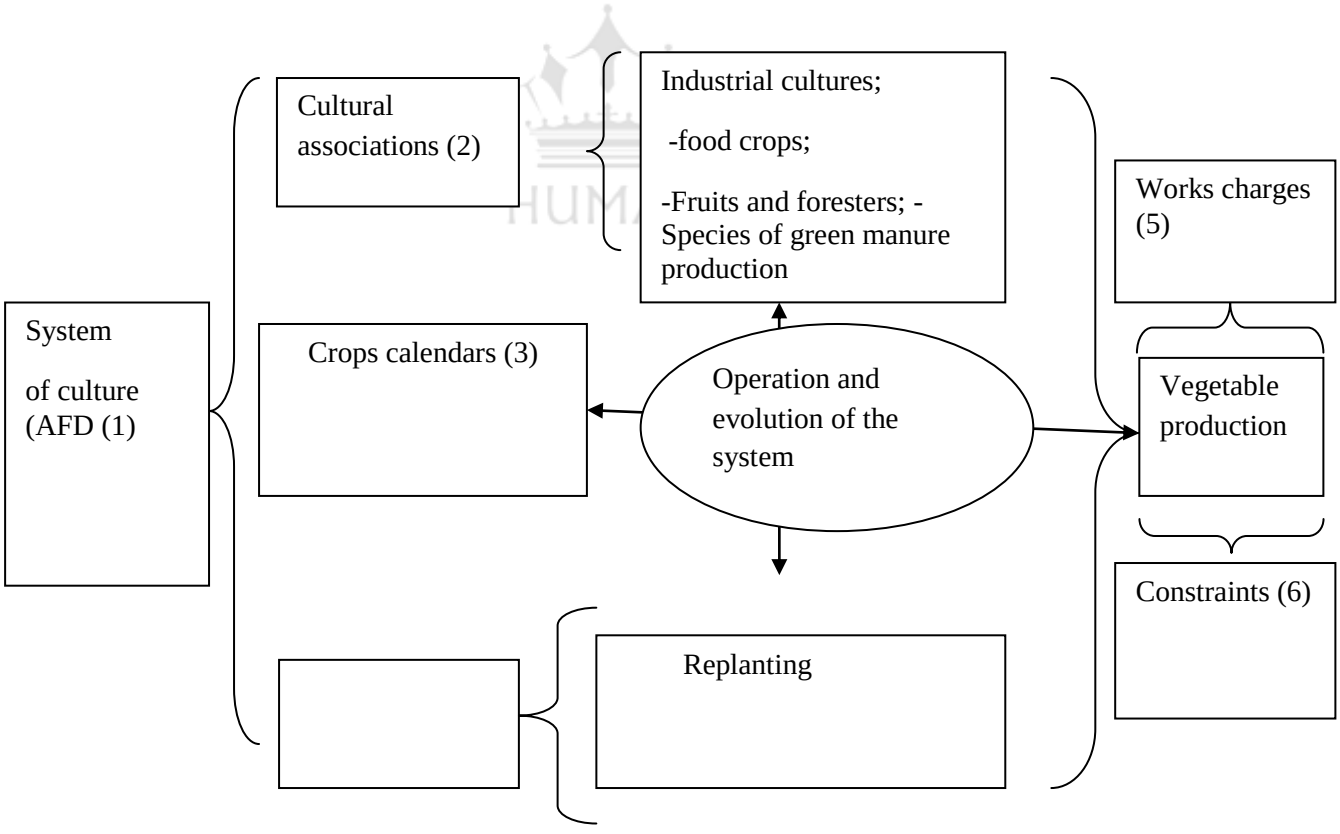

Fig. 7: Simplified model of operation of the cultivation system based on replanted cacao-trees

2-4-Performance of the cultivation system based on the technique of replanting

Various crops production proceeds of the operation of a cultivation system. This production is a source of motivation and encouragement of the producers. Indeed, a good part of the food products either is sold or consumed and another part (small portion) is preserved and constitutes the stock of seed for the following countryside. The food products are sold only at critical periods (return to school, period of welding, etc) or to cope with an unforeseen expenditure. The industrial crops and fruit-bearing are primarily intended for the sale. It takes place between April and October. Its receipts are used for the refunding of the appropriations contracted by the households. This organization makes it possible to the producer to cross all the periods of the year without major economic constraints.

III-DISCUSSION

3-1-characterization of the cultivation system based on replanted cacao-trees in dynamic C

3-1-1-sampling of the plantations to be characterized

Reasoned sampling, not probabilist is the technique adopted at the time of the choice of the plots. According to Kouakou (2002), this kind of sampling has certain weaknesses but it is objective intransigent and made it possible to sample the producers having the best profiles for the characterization of the system.

3-1-2-Dynamic agroforestry system

The dynamic agroforestry system based on the technique of replanting allows obtaining a multiplicity of agronomy resources in a short time on the same space. Its evolution contributes to improve or optimize the requirements for the development of other species (more demanding). However, each associated culture occupies at short, mean or long run a given space. In this system, farming associations are guided by the needs of the producers to reduce the tasks related to the maintenance work. It is what Nkapnang (2001) in Cameroon noted where farming associations are used as solution with the land pressure face to the reduction of the cultivable soil. In addition, the dynamic agroforestry system offers the advantage to the producers of laying out sowings online and consequently makes it possible to the producers to respect the densities of sowing. Ultimately these cultivation methods

make it possible to maximize the land use cultivable and to increase the outputs of the cultures to the hectare; what is contrary with husbandries of the producers in the mountainous West of Côte d'Ivoire according to (Kouakou, 2002).

3-2-Modeling of the cultivation system based on replanted cacao-trees

The elements which compose the cultivation system based on replanted cacao-trees are: farming associations, the farming calendars, the factors of production (forced, work charge, economic means, etc) and the technical routes. All these elements are organized, structured and hierarchized in order to have an optimal operation. The dynamism of this system is conditioned by the changes which take place in nature in the course of time and especially endogenous and exogenic factors that Kouakou (2002) evoked in mountainous area. This dynamics can influence the performance of the system in time.

3-3-performance of the cultivation system based on replanted cacao-trees

The difference between the traditional systems of culture and the dynamic agroforestery system based on replantedcacao-trees can be perceived through, the shrubby leguminous plant introduction (*Cajanus cajan* and *Canavalia ensiformis*). Indeed, Kouadio and al. (2011) had shown that the leguminous plants played a significant role in the adoption of the techniques agroforestières. *Cajanus cajan* makes it possible for example to fight against the attacks of the harmful insects when it is used as plant traps. Indeed, the locusts prefer to nourish sheets of Cajanus cajan instead of those of crop plants. Moreover, this leguminous plant preserves all its foliage even during the dry season. Its life cycle lasts approximately 3 years. During this period it protects the plantation against the attacks of insects. Beside the parts played by leguminous plants in these farming associations, there are also the plants of biomass such as *Titonia diversifolia* which contributes to the maintenance of the moisture of the soil. Indeed, its rapid growth enables him to occupy empty spaces. Also, this system proposes the use of the trunks of banana tree to protect the young seedling from cacao-tree. All these practices make it possible to maintain the favorable conditions with the optimum development of the cacao-tree like noted by Milz (2013). Nowsday, this system seems to be very promising since it presents a solution to the durable culture of the biological cocoa. In farming associations the recourse to arborescent leguminous plants makes it possible to reduce the use of the nitrate fertilizers of syntheses likely to pollute the water tables like mentioned by Ruf (1979). The arborescents leguminous plants (Fabaceae) are appraisals in

these plots because of their agronomic performance related to their capacity to fix the atmospheric Nitrogen (NR) in the symbiotic association of the Rhizobium kind. Moreover, these arborescents have multi-purpose and contribute to compensate for example the unavailability of wood energy. It is what Kouakou (2002) and Kouassi (2003) underlined in mountainous area. In addition, associations are sometimes directed towards other objectives. It is the case of *Canavalia ensiformis* wich has the property to move away the snakes in the plots where they associated with the other cultures like noted by (Milz, 2013). Also, *Ricinus communis* (Castor bean) attracts the pests of the cacao-tree (Mirides).

3-4-Constraint with the production in the cultivation system based on replanted cacao-trees

Many constraints were identified in the cultivation system based on replanted cacao-trees. It is for example the charge of work which is often the factor limiting the production. The preparatory work of the plots of culture requires an important labour. Also, the family labour and the mutual aid are not always available to achieve these tasks especially, because of rural depopulation. In addition, the women are more interested to the food crops in the replanted plots. One of the major constraints in the traditional systems of culture is the weak economy of the producers. It is also the incapacity of the producers to adapt their production or their system of production to the climate change of which the effects are perceptible through the too prolonged droughts which cause the proliferation of the diseases of cultures. All these constraints are the discriminating factors which direct the operations and/or the activities in the cultivation systems in Agroforestry in particular, the cultivation system based on replanted cacao-trees.

3-5-Operation of the cultivation system based on cacao-trees replanted in dynamic agroforestry

The operation of the cultivation system based on cacao-trees replanted in dynamic agroforestry rests on the dynamic structuring and interactions which take place between the elements of the system. Indeed, the characteristic elements of this system are animated and coordinated by the manager whose objective is to lead to a crop production. Thus, the combination of the structural elements of the system made it possible to give a model of operation which cannot claim to correspond to all complex reality. In its operation, this system is open. Indeed, this operation is influenced by natural environment, the sociocultural

environment and economic environment. This open character is favorable to the introduction of new species. For example, besides *Cajanus cajan*, the producers could also introduce *Gliricidia Sepium* that the positive effects were shown by Kouadio *et al.,* (2011) at the east of Côte d'Ivoire. On the other hand, the constraints identified in the operation of the system constitute a genuine brake of the production. For example the weak economy is one of the reasons which justify the small surfaces of the plots sampled. In addition, the cultivation systems in dynamic agroforestry just like the traditional systems of production are influenced by their environment. This reality is confirmed by the model of operation of the systems of production suggested by Kouassi (2003) and Kouakou (2002). However it should be retained that the innovations of regeneration of the orchards of cacao-trees in the agroforestery systems are always confronted to the realities of their environment. Their performance always depends on their capacity to overcome the constraints.

CONCLUSION

The present study underlines the contribution of the dynamic system agroforestry based on the technique of replanting in the regeneration of the orchards of cacao-trees. The cultivation system based on replanted cacao-trees is an open system. Its operation is thus at the same time dependent on the endogenous and exogenic factors. That is an asset for the introduction of new species (*Gliricidia Sepium*) vegetable. Its open character is also favorable to innovations based on the adoption of technical routes improved and/or adapted to the various changes which take place in the culture media over the years in order to improve husbandries. But actually, the characterization of this cultivation system being very complex, this exercise requires a multi-disciplinary approach.

REFERENCES

1. **Assiri AA.,** Etude de la régénération cacaoyère en Côte d'Ivoire : impact des techniques de réhabilitation et de replantation sur le développement et la productivité des vergers de cacaoyers (*Theobroma cacao* L.) en relation avec l'état du sol **(2010) ;** Thèse de Doctorat Unique, UFR STRM, Université de Cocody, Abidjan, Côte d'Ivoire, 170p.
2. **Assiri AA..** Manuel de formation. Projet WCF-CNRA « Formation des producteurs au diagnostic et à la prise de décision de régénération des vieux vergers de cacaoyers en Côte d'Ivoire », **(2010) ;** 30P.
3. **Dupriez H. et De Leener P.** Arbres et agricultures multi étagés d'Afriques. **(1993).,** collection « terre et vie » 1994 ; 208p.
4. **ICCO**. Quarterly Bulletin of Cacao Statistics **(2014).,** Vol .XL, No.3, Cacao year 2013/14-
5. Published: 29-08-2014
6. **Jouve PH.** Le diagnostic du milieu rural ; de la région de la parcelle. Approche systémique des modes d'exploitation agricoles du milieu. In l'appui aux producteurs : démarches, outils domaines d'intervention. Centre national d'études Agronomiques des régions chaudes Paris France **(1992**)., 39p.

7. **Jouve PH. et Tallec M.** Une méthode d'étude des systèmes agraires en Afrique de l'Ouest, par l'analyse de la diversité et de la dynamique des agrosystèmes villageois in Recherche-Systèmes en agriculture et développement rural **(1994)**., Symposium international du 21 au 26 novembre 1994 à Montpellier, France P185-1992.
8. **Kouadio KKH. Doudou DT. ,Tschannen A., Dao D., Girardin O.** Techniques agroforestières à base de *Gliricidia Sepium* à l'Est de la Côte d'Ivoire : impacts et perspectives **(2011)**.,. Journal of Animal & Plant Sciences (JAPS), 2011.Vol.11, Issue 1:1374-1379.
9. **Kouakou KPM.** Caractérisation des systèmes de production du Canton Go dans le département de Man (Région semi-montagneuse de l'Ouest ivoirien **(2002).,** Mémoire de fin d'Etudes présente pour l'obtention du Diplôme d'Agronomie Approfondie (D.A.A) option Agronomie –Productions-Végétales. Institut National Polytechnique Félix Houphouët Boigny (INPHB), 61p.
10. **Kouassi KH.** Caractérisation des systèmes de production de la région semi-montagneuse de l'Ouest : cas des villages riverains du Mont Tonkpi. **(2003).,** Mémoire du Diplôme d'Etudes Approfondies de Botanique option Ecologie Végétale. Université de Cocody, Abidjan, Côte d'Ivoire ,62 p.
11. **Milz J.** Etude sur les espèces d'ombrage et dispositifs agroforestiers adaptés à la cacaoculture dans la zone périphérique du Parc National de Tai, en Côte d'Ivoire **(2013).,** Rapport final mars 2013, 71p
12. **Ruf F.** Le vivrier dans l'économie de plantation du Sud-ouest ivoirien. Quelles perspectives de stabilisation ? **(1979)**., Abidjan, CIRES, Document de travail n°21bis, 16p.