APPROACHES OF FOREST SUSTAINABLE MANAGEMENT AND ECONOMIC ARBITRATION IN AFRICA

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ABSTRACT

The legal instruments on which are based the assistance to the decision to the forest management at present permit neither the efficient participation of the actors nor the sustainable management of forest. As a matter of fact, these legal instruments internalise poorly the preoccupations in terms of populations' welfare, poverty alleviation, income gained and the protection of forest ecosystems and resources. The objective of this paper is to explain the importance of economic tools in the construction of an analytical framework of the participative process of assistance to the decision-making of forest sustainable management. To achieve this, the example of Cameroon forest management is considered. The paper reintroduces the costs-benefits analysis to identify the options of sustainable management. It turns out that the use of economic instruments reinforces the judiciousness of administrative and juridical tools. However, the effectiveness of the so constructed analytical framework requires an environment in which all the involved actors collaborate, plan and choose together, in order to use resources to satisfy present needs of all partners, including to the benefit of the environment and the needs of the future generations.

Keywords: assistance to the decision, costs-benefits analysis, appropriation, forest sustainable management, participative management, economic tools.

INTRODUCTION

Since the colonial periods, different theoretical approaches on the management of the tropical forest have been implemented in tropical Africa by the administration. Nevertheless, forest degradation still continues accelerating in this continent (Food and Agriculture Organization (FAO), 2010), owing to the persistence of conflicts and unsustainable utilizations. For the World Bank, the degree (stage) of forest deforestation in Cameroon has passed from 0.4% per year between 1976 and 1980 to 0.6% per year between 1981 and 1996. Since the year 2000, the rate of deforestation would stand at least at 222,000 hectares per year, corresponding to a deforestation rate of 0.88%. On the present basis of the deforestation and of annual population growth rates, the FAO estimates that the rate of the forest destruction in the country will be at 300,000 hectares per year between 2010 and 2015 and at 400,000 hectares per year between 2030 and 2040.

But on the theoretical scheme (plan), owing to the vast number of logics of appropriation and of forest ecosystems allocation, the divergences are kept alive by the advocates of the complete protection of the richest natural spaces in biodiversity on one side and, the supporters of the participative and rational utilization with a view to the local development on the other side (Carrere & Bravo, 2004; Chapin, 2004). Taking into consideration the poor results obtained in the sustainability of forest resources, how the different approaches of forest management have evolved? And

what is the place of economic instruments in the promotion of forest sustainability? We postulate that resorting to economic instruments is capable of ameliorating the indefensible situation of forest.

As a matter of fact, the use of these instruments should help to limit conflicts between the present time utilization and the preservation (protection) of ecosystems and forest resources. The choice of utilization given to the stakeholders of this renewable resource, integrates in itself the preoccupations (concerns) of poverty alleviation. The decision method relative to this choice respects the principles of the costs-benefits analysis. The objective of this article is to show that the forest planning (developing) choices to be made in order to be sustainable should at the same time rely on the support of the appropriation of projects by all the stakeholders and the help of the economic decision.

To achieve this objective, the example of the Cameroon forest management has seemed relevant to us. As a matter of fact, Cameroon forest stretches out as far as Gabon, Congo, Democratic Republic of Congo, Equatorial Guinea and the Central African Republic. In terms of fauna and flora, Cameroon forest is very heterogeneous. The heterogeneousness is partially due to the great variability of resources, the ecological interactions and the variability of the climatic conditions. This wealth and the great heterogeneousness of ecosystems are such that some peoples do not hesitate to qualify this country as ''Africa in miniature'' (Ngo Nonga, 2002).

This analysis which is especially a documentary one is organised into two parts: the evolution of forest planning approaches (section 1) and the contributions of the economic approaches (section 2).

THE EVOLUTION OF FOREST DEVELOPING (PLANNING) APPROACHES IN THE TROPICAL FOREST MANAGEMENT

Three important periods are to be differentiated: the protective protection before the 1980s, the methods of the planned management of the 1980s and the participative management since the 1990s.

The protective protection and the methods of the planned management of the 1980s

It is first of all important to mention here that since the end of the 1980s, the terms ''preservation'' and ''protection'' refer to two different practices, even though many milieus of thinkers use them indistinctly. The idea of protection, which is a static conception (notion) conflicts with any form of intervention whatever nature it may be on the natural environment. The human activities (agriculture, forestry development, collection of firewood, breeding, etc.) on the protected site are strictly prohibited. As to the preservation, it is a notion which is at the same time static (strict protection) and dynamic (rational and/or sustainable development of resources and environments). The forest preservation is an old practice. The African oral tradition relates and relays many stories and anecdotes on the sustainability of forests and on the '' forest powers'', to which one should swear allegiance to get many children, health, to build a bridge and/or to construct a road, etc. In this tradition, men, ''managers'' of many natural goods and services lived in total harmony with the forest. The negative impacts inflicted on the forest stock remained very low and limited in time and in space.

With the industrial revolution, the exploitation practices of forest resources have changed a lot. From a very remote period, the issues of preservation of the forest capital stock have started to arise mobilizing many intellectuals, artists,

politicians, etc. The impulse (movement) is launched in Europe by the end of the 18th century. But the conservatism (considered as a movement for the complete protection) started expanding only in the 19th century in the United States, where the progressive scarcity of forests urged some artists and some scientists to appeal to a fight against the felling of trees without restriction and for the creation of ''some sanctuaries of the nature'' in the West of the country.

Between the 1970s and the 1980s, the preservation (protection) is recommended within the context (framework) of the ''deep ecology'' or the eco-centered approach of the forest preservation. This approach considers that no human activity is tolerated in the natural environments (milieus). For its implementation, the advocates of this approach required the formation of vast network of protected zones (small islands of biodiversity) and the exclusion of any human presence in the neighbourhood of these protected areas.

Practical aspects of forest management in Cameroon

In Cameroon, the consideration of the environment in the development strategies is marginal and comes up in the logic of the resources stock increase. This period is marked by the creation of several parks and reserves (reserve of Makak, reserve of Dja, park of Waza, park of Benoué, reserve of Mbalmayo, reserve of Kienke South, reserve of Douala-Edéa, etc.). Started in Makak in 1936, the forestry activities have reached their highest point with the ''Green Sahel Operation''.

The assistance to the decision in the forest management is exclusively legal. The legal framework governing the forest management during this period is made up of the forest code of the colonial period. The latter is reviewed in order to be adapted to the new technical concepts and to the socioeconomic requirements. Thus many ordinances (edicts) have been taken. It is a question of the ordinance n° 73/18 of 22nd May 1973, focussing on forest code of Cameroon and its application decree n° 74/357 of 17th August 1974 and the ordinances n°s 74/0, 74/1, 74/2, 74/3 of 6th July 1974 relative to national (state) land system and their decrees of application. All these ordinances distinguish the collective national heritage, the private domain of the State and the personal heritage. These laws and regulations are completed at the international level by conventions to which the country belongs. Among others, the convention on the preservation of the nature and natural resources (Alger, 1968) ; the convention of the protection of the natural and cultural world heritage (Paris, 1972); the convention on the international trade of flora and fauna endangered species (CITES, Washington, 1973); the laws and regulations focussing on the creation of the Wood African Organisation (WAO, 1976); the agreement on the joint rules (regulations) on flora and fauna in the Lake Chad Basin (1977), etc. This juridical arsenal imparts to the State the monopoly of the forest management. The organisation of this management is from then on of the ''top-down'' interventionist type, in the sense that the management control is solely exerts by the administration, repressive for, integrating sanctions for those who break the law, and exclusive, because the decision-making was centralised at the level of the administration without any consultation of the local populations.

On the whole, the management of forest during this period has remained deficient. "The inadequacy of performances of the administration in the forest matter is first of all the result of inadequacy between the available means (material, human and financial) and the tasks to be handed down by the administration […]. Moreover, this situation is equally attributable to an inefficient and complex administrative organisation, characterised by a lack of clarification of

attributions of some administrative components and especially some intrusions and the overlaps in the scopes of activities of the different involved institutions" (National Plan of the Management of the Environment (NPME), vol. II, 1996).

The forest planned management of the 1980s

The new forest law is adopted in 1981. The law n° 81/13 of 27th November 1981 and its application decree n° 83/169 of 12th April 1983 abrogate all previous provisions of international scope. The 1980 decade begins from 1981 with forest surveys. And up to the beginning of the 1990s, four stages of surveys have been organised on a total surface of humid thick forest of 14,011,065 hectares. These surveys have paved the way for the environmental planning in Cameroon, copied exactly from inter sector-based and sector-based environmental plans.

The first, the Tropical Forest Action Plan (TFAP) of Cameroon is elaborated as far back as 1985. This plan has been realised through the impetus given by the Food and Agriculture Organization (FAO), the World Bank (WB), the United Nations Programme for Development (UNDP), and le World Resources Institute (WRI). The objective of the TFAP in Cameroon and in all the tropical countries is to reduce the annual deforestation rate in the tropical countries and to lead to the rational development of forest resources.

A certain number of projects are integrated in the TFAP. That is the case for the Api Dimako, Tropenbos Cameroun, So'o Lala, Oku, Korup projects and the Edéa pilot project, etc. Furthermore, the backers provide an institutional support (project Support I and project Support II) and the reinforcement of the management capacities to forest services (Forestry Capacity Project).

Unfortunately, almost all these projects have not given the expected results. Consequently, we can say without any exaggeration here that, at the end of the 1980s and the beginning of the 1990s, there is an acknowledgement of failure on the results of the forest planning. Two determinants permit to analyse these results: the evolution of the rate of deforestation and the involvement of the populations.

❖ The increase of the rate of deforestation in the country

In spite of the existence of the TFAP, the rate of deforestation of the forest in Cameroon has passed from 0.4% per year between 1976 and 1980 to 0.6% per year between 1981 and 1996. These data are confirmed by the document of TFAP Cameroon (Volume II, p. 55) in which it is shown that between 1976 and 1986, the forest regression rate has been of 100,000 hectares per year. At this period, the acceleration of deforestation was the result of some new creation of food-producing fields following the drop of the world prices of some crops such as cocoa and coffee and the overexploitation of woody resources. Some researchers identify the exogenous causes of the increase of the deforestation rate. For Humphreys (1996), even though the main objective of the TFAP was to reduce the rate of deforestation, this aim has never been achieved. This plan has particularly sustained the exploitation of tree trunks cut down.

❖ The poor involvement of the local populations

If one of the concerns of forest planning was to involve the local populations in the elaboration and the implementation of the TFAP, at the beginning of the 1990s, this plan has had a serious crisis of legitimacy (Cabarle, 1992). As a matter of fact, as well as for the elaboration of this master plan than for the whole related projects, the

participation of the populations is often limited to their attendance to information meetings (never-ending discussions sittings) in which administrative officials (persons in charge) informed them about the decisions taken (granting of licenses, classification of forests, etc.).

As it is pointed out by many works such as Brown (2003), Revéret and Webster (2002) and Smouts (2001), in the reality, the approaches of the top-down type for the establishment of parks and other protected areas, which aim at "compelling" the populations to leave the lands considered by them as being part of their ancestral heritage, satisfy less efficiently the objectives of a rational resources management for several reasons: the impossibility to enclose the protected zones, the limited means of control of reserves staffs, the fraudulent exploitation of tree trunks cut down, the frustrations generated by the exclusion of local forest side resident populations or not which maintain secretly some of their activities, the non consideration of the aspirations of the forest side resident populations and their forest representations, etc.

As from the1990s, the thought on the sustainable development, the generalised indebtedness crisis, the persistence of poverty and the poor means used in the creation of parks and protected areas have led the Cameroonian government (in accordance with the external backers) to support new participative approaches of tropical forest preservation. Have these new approaches also insisted on the state regulations and left aside the help of the economic decision?

The forest preservation: the participation of stakeholders in the forest in Cameroon
The paradigm of the participation comes from the official statement that poverty is one of the main causes of forest deterioration. Hence the improvement of the living conditions of the poor populations becomes a requirement in the search for forest sustainability. Besides the regional, African and international conventions to which Cameroon belongs to, the new legal framework of strategies and environmental priorities is made up of the laws 94/01 of 20th January 1994 and 96/12 of 5th August 1996 and the decree of application of the law 94/01. Within this framework, several plans and/or policies of development have been adopted in view of sustainable development: the national plan of the management of the environment (NPME), the emergency action plan (EAP), the document of strategy of the poverty reduction (DSPR, axes 1 and 2), the document of strategy of the rural sector development (DSRSD), the forest environment sector-based programme (FESP), the sector-based strategy of breeding, fishing, and factory farming, the strategy and the national plan of action on the biological diversity, the Cameroon Vision "industrialising country in 2035" and the document of strategy for growth and employment (DSGE).

The development (planning) of concessions
The law 94/01 and its application decree give an important place to forest planning and to the transformation within the national territory of the woody resources. There are three forms of forest planning or development: the planning through big concessions, the community forests, and the communal forests. The last two forms fit better into the participative approaches.

As it is provided by the law, the forest concession (or planning forest unit) is stretched out on a maximal surface of 200,000 hectares; it is granted (conceded) for a period of 15 years renewable once. The planning through the concessions focuses on a planning plan approved by the government.

More than the preservation of the forest, the forest planning by favouring the production of tree trunks cut down is a practice which generates budgetary revenues necessary for the financing of socioeconomic development. Forestry development generates an annual income, which the appropriation is source of corruption and leads moreover to the overexploitation of woody resources. The exploitation of tree trunks cut down is moreover one of the first activities at the origin of the degradation of the biodiversity, of the release of the carbon dioxide (which takes part in the increase of the greenhouse effect) and the social destruction. From that point of view, the forest planning hardly participates to the protection of the forest (protection of the biodiversity). As a matter of fact, the state availability to transform a forest concession into a protected area, that is to say to abandon the induced revenue through forestry development, is insignificant (Niesten and Rice, 2004). This is not the case for the other activities on the forest. Hence the call made by French environmental non-governmental organisation (NGO) in 2004, for a public support to the involvement of local populations in the preservation of forest.

Multiplicity (plurality) of the participative approaches of the forest management

The purposes targeted by the new strategies are twofold: to protect the quality of the common heritage of the humanity particularly in the domains of climatic change, biological resources, water resources, etc. and to improve (by implicating all the stakeholders in the environmental management) the living conditions of the poor populations who especially survive on the exploitation of the natural resources. The new participative strategies of forest management have three main directions: the strategies of the integrated management through the creation of protected areas; the decentralised management: the community management; the communal management and the market strategies.

❖　　　The strategies of the integrated management: the networks of the protected areas

　　　The protected areas play a major environmental role. In Cameroon, 6.3% of the earth surface is protected (UNDP, 2003). As instruments of sustainable management of forests, the protected areas should be accepted by the main stakeholders, and so they should subsidiarily play some economic and social roles. That is what justifies that the forest preservation approaches developed as from the beginning of the 1990s do not totally exclude the presence of the forest side resident populations and the practice of activities which destroy the soil and relief as a result of the human being action around the protected zones (the buffer zones for instance, around the Korup park, the Ottomo reserve, etc.). For the advocates of these new approaches, it is a question of mobilising a great number of persons in the indirect preservation of the forest while improving the daily living conditions of the forest side resident populations. As a matter of fact, these approaches insist on the participation and the reinforcement of the capacities of these populations. A certain number of activities like projects of ecotourism or of development of sustainable channels of non woody forest products (examples in Cameroon: the channels of Pygeum africanum and of gnetum) compatible with the protection, interest these populations. As examples of integrated projects in Cameroon, we can enumerate: the Sikop project, the Mount Cameroon project, the South Bakundu project, the "GEF" biodiversity programme in its 9 components and the forest ecosystems of Central Africa (FECA). The programme of preservation and rational utilisation of forest ecosystems of Central Africa is the main regional programme (Cameroon, Congo Brazzaville, Gabon, Equatorial Guinea, Central African Republic and Sao Tome and Principe) which relies on the support of the regional coordination to programme the participative

management of the protected areas. The participation having as aim to involve the local populations in order i) to show them the necessity of the preservation of natural resources in the long term and ii) to improve their methods of management and their living conditions.

The indirect preservation approaches stem from the official statement that the poor living conditions of the rural populations which are largely dependent on the forest resources belong to the significant causes of the natural resources degradation. For their advocates, any project of preservation aiming at the sustainability of forest should at the same time relies on the support of the ways of life of the local populations and the determinants of their forest social demand, to lead to the improvement of the living conditions and so to participate to the poverty alleviation.

For Hulme and Murphree (1999), the integrated approaches of preservation innovate in as much as they lead:
-   to move from a state control and centralised governance to a local participative governance;
-   to conceptualise afresh the preservation based on the notion of sustainable development;
-   to incorporate liberal ideas and to resort to market forces to finance the preservation.

The participation of the local populations in these approaches is guaranteed by the availability of financings put at the disposal of people who accept to develop around the protected zones some profitable activities which are compatible with the protection of the forest (ecotourism, sustainable channels of non woody forest products), etc.

❖   The decentralised management: the community management and the communal management
As from the middle of the 1990s, the targeted purpose of the decentralised management is to increase efficiency in the natural resources preservation and to improve the justice and equality for the local populations. The community management is part of the logic of specialisation of forest spaces; define through the rules of zoning, that is to say the allocation of forest spaces into permanent and non permanent domains. In this logic, as Karsenty, Mendouga, and Penelon (1997) observe it, the consideration of the interests of the populations goes through the creation of community forests or "village forests".

As to Lazarev (1993), the participative management or the community management fully follows the sustainable development logic. And "the development can only be sustainable if and only if it is effectively dependent on the populations that it concerns; this assumes that there is a certain political liberalisation and an efficient practice of democratisation at the basis (foundation). There cannot be a sustainable development if the latter is done to the detriment of our environment; this official statement can fit or be applied to good management of natural resources on which is based most of the natural activities […]".

In Cameroon, the communal forest represents a type of forest planning which is between the planning forest units (PFU) and the community forests, having a maximum surface of 5000 hectares. The surface of the communal forest is contained between 10,000 and 30,000 hectares. Several particularities characterise this forest: i) the sophisticated techniques used in the PFU can also be used here; ii) once classified, the communal (local) forest becomes a property of the council, then the PFU is a property which the duration cannot go beyond 15 years; iii) the participation of the local populations is required to take a decision on the different types of uses of goods and services. To perpetuate the forest shelter, the legislation excludes any agricultural activity within the local (communal) forest. But in reality, the local forest is subdivided into several spaces taking into account the profitability of the viewed activities. "It is no more possible for the mayor to be satisfied with superficial socioeconomic surveys which only draw up a vague panorama of the resident

populations and their forest uses" (Lescuyer and Essiane, 2001). In this logic, the government authority regularly gives explanations on his/her management to the local populations. For the time being, there are about fifteen local forests in the country and among which the local forests of Dimako and Djoum.

CONTRIBUTION OF THE ECONOMIC APPROACHES OF FOREST MANAGEMENT

Limits of the participative approaches

The advantages of a participative management are certain. But presently in Cameroon, the results are poor. In addition to the problem of asymmetry of information, between the main forest actors (stakeholders), the public choices are poorly appropriate in as much as they seem to contradict those of poverty alleviation. As a matter of fact, it is very difficult to involve the poor in the search of sustainability.

Some of these limits are of general nature in the tropical countries; some others are specific to Cameroon.

Limits of general nature

For Buttoud (2001), the participative management can aggravate social inequalities through the exclusion of weak actors. For the author, "contrary to the State and the region, the local community which is in itself the expression of the balance of power, settle most of the time conflicts by exclusion of external actors of the customary functioning. It tends towards denying the rights of external users of the village or of the council, but equally to consolidate those of the founder families to the detriment of the non-native populations, and by extension to deny some demands coming from the not so good groups defended by the custom, like children and women". This opinion is entirely shared by Ribot (2003) who believes that "when the non representative personal interest or the autocratic institutions, such as the groups of interests, the non-governmental organisation (NGO), or the customary authorities are chosen in the absence of any representative organ of supervision, there is a risk of reinforcing their autocracy and a weakening of the democracy. The pluralism without representativeness favours the better organised and the most powerful groups. It favours the capture of the annual income by the elite".

Specific constraints to Cameroon

The first limits are due to the institutional weaknesses. The administrative institutions in charge of the management of forests and environment remain much organised into a hierarchy and are not adapted to the decentralisation. These institutions lack cohesion, and this increases the number of declaration of intention, renders difficult the honour of the commitments taken by the government and limits the coordination of the activities of actors with different logics. In Cameroon, more than 40% of the protected areas created on paper are not materialised on the field. Since the colonial period, only 6.3% of the earth surface is protected. We are far from reaching the objective targeted by the law 94/01 and which consists of protecting 30% of the earth surface. As other constraints, we can talk of the insufficiency of the financings raised for the programmes and projects and the strong dependence vis-à-vis the external financings. For instance, the projected budget between 2011 and 2015 of the ministry of forest and fauna and of that of the environment and protection of the nature varies from 17.9 to 20.0 and from 5.9 to 6.7 billion of Cfa Francs respectively (Framework of Medium Term Expenditures, Cameroon, 2010).

This dependence leads the administration to make some choices which are often ill-adapted to the Cameroon context. Consequently, there is a problem of appropriation of these choices. That is the case for some choices of the community

management. The latter faces a lot of difficulties in particular in the financing, the carrying out of the simple management plan and the validation of this plan by the administration. Furthermore, as it is observed by Mvondo and Oyono (2002), on the legal framework, certain sections of the 1994 forest law contradicting the previous laws and regulations which are not repealed make incoherent (inconsistent) the objectives assigned to community forestry. To give an example, the law of 1994 does not particularly insists on the necessity of protecting some ecosystems endangered by the activities of the forest side resident populations. But owing to constraints related to the economic development of the community forest, and due to the poorness of the benefits that the community activities provide (Lescuyer et al., 2003), the involved populations are only marginally worried by the negative impacts caused by some activities on the forest biodiversity.

Finally, the invasion of parks and other protected areas has continued. All the protected areas experience a high rate of invasion. If the invasion rates of the permanent forest by the local populations is relatively low in the forest plantations (about 4% according to the NPME (1996)), it is quite different in the fauna preserve. In the latter, these rates vary from 35% (in the Dja fauna or wildlife reserve) to 100 % (in the Douala-Edéa wildlife reserve).

On the whole, the local stakeholders (actors) are poorly involved in the State commitments and in the decisions of the preservation of the forest. At first because the financings which are allocated to them in the framework of ''integrated'' projects are insufficient, then because the participants to the different meetings organised in the country are not sufficiently representative of the forest traditional owners, and finally because the poor forest side populations consider that the decisions of the preservation of the forest coming from the central authority, are ignorant of their social demand of the forest (N. Nonga, 2002).
In conclusion, the problems of forest sustainability and development are still put forward.

Forest sustainability: return on a decision-making based on the costs-benefits analysis
The sustainable forest management requires the adaptation of the actions to be implemented to the priorities and local environmental traditions, the involvement (adhesion) of the local populations to the process, the appropriation and the applicability of the programmes and other viewed actions. The expression of the different logics of authors through the four "A" leads to a better determination of the diversity of the forest assets demand functions, and it also leads to the elaboration of specific management strategies in the country.

Resources allocation and populations welfare
It is a question of starting right from the identification of the different alternatives of the forest resources utilization and to determine through the help of decision tools, the optimal scenario of forest management, which allocates efficiently the resources and maximises the social welfare (Bohn and Henry, 1979). This supposes that the advantages and the damages related to the utilization of the resources could be expressed in the monetary form. To achieve this objective, we are going to construct the economic arbitration. But we know that the consideration of poverty issues implies to call for a help to the slightly subjective decision (Barde, 1991), but leading to the economic efficiency in the utilization of the resources by the stakeholders (actors).

Among all the methods helping for the decision-making, the costs-benefits analysis is a technique which directly follows from the welfare economics principles: its objective is to maximise the social welfare function calculated from the sum of the individual utilities. This contribution is estimated in monetary terms and it corresponds to the net benefits (that is to say the total benefits minus the total costs) which generate any action of the utilization of resources. There is then an optimal allocation of resources when the costs-benefit analysis permits to retain the actions/projects/programmes which offer (give) the maximal net benefits (Ray, 1986). In the reality, this process follows four steps:

- the identification of costs and benefits derived from the realisation of the action/project/programme;

- the monetary quantification of costs and benefits;

- the choice of the discounting rate;

- the construction of a one-dimensional indicator which brings together the totality of costs and benefits. This indicator is used to show whether or not the sum of the discounted earnings (profits) obtained from a project is higher than the sum of its discounted costs.

It is very important to point out here that several other decision-making assistance methods can be used in the context where the costs-benefits analysis is not adapted or insufficient: the costs-efficiency analysis, the risks-advantages analysis, the multi criteria analysis and the estimation of the environmental impact which constitute the main alternative methods (Garrabé, 1994; Pearce & Markandya, 1989). Their characteristic is to combine the economic rationality to other types of rationality and to integrate into the decision-making some non economic variables. So they do not have the same object of study than the costs-benefits analysis and they bring new information to the decision-maker. That is the case presented above, of the costs-efficiency analysis and the multi criteria analysis.

Thus, any action having a positive net discounted value is assumed to generate an increase of the social welfare. The implementation of these actions having a positive net discounted value respects the efficiency criterion of "Pareto", in the sense that the net discounted value indicates the potential capacity of the polluters to compensate the victims. And according to the Hicks-Kaldor hypothesis, the fact that the compensation is not real (actual) but only potential is not opposed to the Pareto efficiency criteria and to the maximisation of the social welfare function. Globally, the costs-benefits analysis has an undeniable interest in all the cases where the economic efficiency is the objective, or one of the objectives of the policy carried out. It aimed at guaranteeing an economically efficient allocation of resources in the sense that it brings important information to the decision-making.

This approach, which respects the principles of the welfare economics, has as main effect to reinforce the influence of economics on the political decision-making. The costs-benefits analysis becomes a decisive criterion for justifying a policy or any other action on the reality on the one hand. This method is so pertinent, that is to say that it provides much more information on the economic efficiency of the policy conducted when the benefits and the costs of each option are correctly evaluated: the decision-maker is then disposed (inclined) to translate the set of variables of a project into quantifiable variables, that is to say being able to be integrated into the costs-benefits analysis. It is equally this implicit logic which has presided over the integration of the environment into the economic analysis. Having presented generally the costs-benefits analysis, it becomes interesting now to look into its specificities when applied to the forest management.

Specificities of the costs-benefits analysis applied to the forest management: utilization or preservation?

An action of the utilization of the forest is characterised, on an accounting point of view, by the benefits which it generates and by the costs of its implementation and its functioning. The costs-benefits analysis allows, through a comparison of the net discounted values to determine the most profitable actions for the society. Insofar as the impacts on the natural milieu can be evaluated, the costs-benefits analysis can prevent some investments which would lead to a drop of the social welfare by undermining the environment. Hence the preservation of the natural milieu (environment) constitutes a scenario of utilization of the resources in the sense where an environment which is not disturbed by the activities of development takes part in the collective welfare. It is sometimes delicate for an economist to distinguish clearly the options of development, that is to say the options of the productive utilization of the ecosystems and those of its protection. As a matter of fact, the protection of an ecosystem is defined by the upholding of the essential characteristics of a natural habitat, but of which some characteristics can disappear in aid of the benefits of the resources utilization. We can, for instance, talk of protection when the local populations take advantage of the forest products without undermining significantly the massif. This is not the case for the notion of preservation which corresponds to the absence of any utilization and is the opposite situation of that of development.

It is no more only a question of comparing some scenarios of utilization which minimise their negative impact on the environment, but equally to integrate in this arbitration a scenario of the preservation of the ecosystem. For clarity purpose, the literature emphasises most of the time on the discrete choice between utilisation and preservation as the simplistic but useful basis of the costs-benefits analysis. These two options provide some benefits and make the society to endure some costs, which should be compared in order to determine the one which maximises the collective welfare. We shall choose, for instance, the option to use if:

$$PV(BU) - PV(CU) > PV(BP) - PV(CP)$$

Where PV stands for the discounted value of benefits or costs, BU and CU stand for the benefits and the costs associated to the utilization (development project), BP and CP stand for the benefits and costs associated to the preservation. The preservation option will be preferred (chosen) if the inverse equality holds (is verified).

Generally, it is relatively easier to estimate, in a monetary form, the benefits and costs of the proposed development project as well as the costs of a programme of preservation. So, the decision rule to which the decision-maker should face is as follows:

$$PV(BU) - PV(CU) + PV(CP) > \text{or} < PV(BP)?$$

The application of the costs-benefits analysis and its pertinence as an assistance method in the decision-making in the environmental management then depends to a great extent on the monetary evaluation of the benefits of the preservation.

Construction of the assistance to the decision of the tropical forest management

The problem being the maximisation of the collective utility under constraints, we admit that a minimum of degradation is tolerated per period of a given time.

To help the actors to organise the forest sustainable management, we assume that certain uses disturb the ecosystems without deteriorating them. We enter them in the option of "protection". Other uses disturb and lead to a certain degradation, we classify them in the option of "utilization or development". In this option, we record the stubble-burning itinerant agriculture, cash crop and industrial agriculture, forestry development, intensive and factory farming, etc. The spaces allocated to the "utilization or development" option will be subdivided into spaces proprieties of the forest side resident populations, in areas of practice of the diverse traditional activities and in areas reserved to other activities. For the spaces allocated for utilization, the choice of use will be made at two stages. At the first level, the choice will be made between the present uses and the protection. At the second level, we shall choose the use which permits to fulfil the highest net benefits, while minimising the negative impacts. The choice will be made for example on intensive agriculture as long as the annual farm income will remain greater or equal to the marginal annual income of the exploitation of tree trunks cut down.

Finally, some other uses deteriorate the ecosystems in an irreversible manner, and we classify them into the "preservation" option. As an example, we have the spaces on which are located human populations zones. Once the different options are identified, it is advisable, for the chosen uses, to be able to follow the evolution of their impacts over time. Considering the available information, the monetary evaluation of the total costs and the total benefits helps to determine the less polluting management options. The choice of sustainable management (choice between several options/management projects) for the tropical forest could then be made by taking into account the mathematical expected value of the inter temporal net benefits for each period as follows:

Let us consider the following:

P stands for protection,

U stands for utilization,

R stands for preservation, T_0 stands for the present while T_1 and T_2 stand for the future.

The evaluation and the comparison between the inter temporal net benefits allows by each of the sustainable option lead to the determination for the present and the future, of the surfaces to be allocated to the utilization, those to be protected and those to be converted in the present time. Knowing that with time the protected spaces can continue to be protected, put under exploitation or converted, and that the exploited areas can also keep their status, change their status and be either converted or protected, all the possible scenarios over the three periods of time T_0, T_1, T_2 are given below:

Diagram n° 1: *diagram giving the different scenarios over the three periods of time*
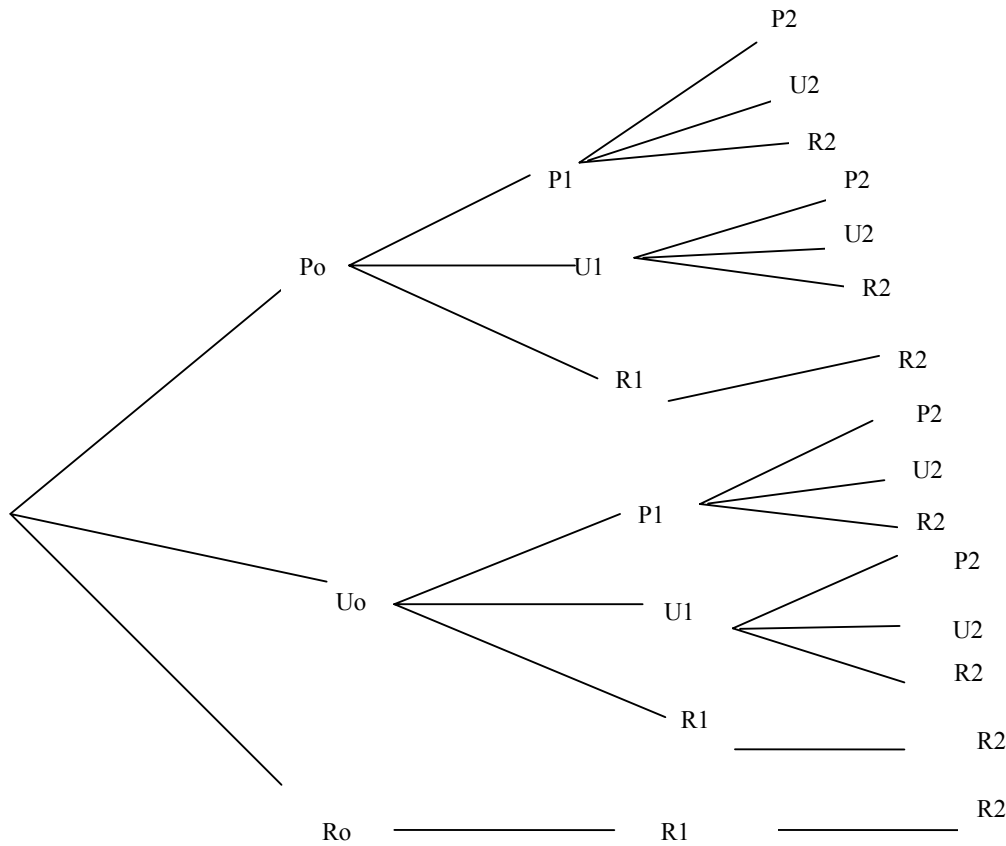
Negotiated problem: problem of the decision-makers

To allow the existing indefensible situation to evolve, to reduce the externalities and the sustainability gap which can be defined as being the distance between an obtained situation during a given period and the degree of sustainability corresponding to this given situation with respect to a targeted norm, the management choices of the tropical forest to decide for the T_0 period (the present generation), will be made by taking into account the comparison between the discounted benefits of the different options. Economically, the options selected have the highest net present value of the expected net benefits in T_0, T_1 and T_2.

The expected net benefits of a protected site are given by:

$$VAN_P = Po + \max [E(P_1) + \max \{E(P_2), E(U_2), E(R_2)\}, E(U_1) + \max \{E(U_2), E(R_2)\}, E(R_1) + E(R_2)]$$

P_0 is the mathematical expectation of the protected forest. P_1 and P_2; R_1 and R_2; U_1 and U_2, stand respectively for the inter temporal net benefits of the protection, of the conversion and of the uses.

E (.) is the mathematical expectation of the benefits.

The inter temporal net benefits expected from the utilization of the spaces is given by:

$$Vu = Uo + \max [E(U_1) + \{\max E(P_2), E(U_2), E(R_2)\}, E(R_1) + E(R_2)].$$

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Vu stands for the present net benefits; they integrate the external costs represented by the efforts put in to limit the negative impacts on the forest and for others.

As to the preservation expected benefits, they are given by:

$Vr = - Ro + E(R_1) + E(R_2)$

(- Ro) is the estimated value at the T_0 period of the forest spaces converted or completely lost for the forest.

To maximise the collective utility, the problem of the decision-makers can be given by the following relation:

Max $\{VP, VU, VR\} = Vo + E \{max. (V_1 + V_2)\}$.

Knowing that the set of options $A_t^i = (P, U, R)$, by assuming a_t^i the chosen option at the period (t_i), V_t the forest total economic value is given by the following relation:

$V_t = \Sigma_1^2 V_t (a_t^i) = V_t (a_{t)}^\circ) + V_t (a_t^1) + V_t (a_t^2)$ (T_0, T_1 and T_2 periods)

$a_t^\circ = P$,

$a_t^1 = U$ and

$a_t^2 = R$

$V_0 = V(P_0) + V(R_0) + V (U_0)$

Max $V (a_t^i) = V(P_0) + V(U_0) + V(R_0) + E [max. \{V_1 + max. V_2\}]$

The maximisation of the expected benefits is constrained by:

1. The socioeconomic constraints

These constraints represent the evolution of the population growth rate, the evolution of the gross domestic product (GDP), and the elasticity (e_p) of poverty alleviation. This elasticity corresponds to the improvement of the poverty index. It is given by the variation of the poverty threshold on the variation of the survival income. (e_p) is calculated from the annual average incomes achieved by the poorest populations, made up in particular of the last quintile of the Cameroon population.

2. The constraints of ecological sustainability

These constraints are three in number and are applied to any component of the natural capital (Pearce and Turner, 1990, pp 44 -45).

R_1: the withdrawal rates relative to the renewable resources should be inferior to the natural regeneration rates of the said resources.

R_2: the worked out resources should be extracted at a rate which permits their replacement by renewable resources. Barbier and Markandya (1991) in insisting on this rule, rely on the fact that the withdrawal rates of the natural resources are limited by the technical progress and by the possibilities of substitution between the natural capital and the other forms of capital.

R_3: the disruptive negative impacts and the emission of pollutions should be inferior to the capacity of assimilation of the ecosystems.

It is important to point out that the conditions of sustainability defined above by the London school are exogenous to the economic system. The R_1 condition for instance is a condition essentially independent and physical,

which is not given by the economic tools. However, this definition of the sustainability constraints out of the economic system remains widely criticised by many authors.

3. The irreversibility constraints

-        If $a^i_t = R$ then $a^i_{t+1} = a^i_{t+2} \ldots\ldots a^i_{t+n} = R$

       For example, the converted ecosystems into human population zones or into industrial zones are completely lost for the forest. In other words, these deteriorated spaces in an irreversible manner require a tremendous cost of intervention to be reconverted to tropical forest ecosystems.

-        If $a^i_t = P$, or if $a^i_t = U$ and if $a^i_{t+1} = R$ then $a^i_{t+2} \ldots = a^i_{t+n} = R$

-        If $a^i_t = P$ or if $a^i_t = U$ and if $a^i_{t+1} \neq R$ then $a^i_{t+2} = U$ or P

       4. The constraints associated to the uncertainties

-        If $a^i_t = U$ then, $V^*_{t+1} = V_o - V(g(U))$, with $V(g(U))$ a function associated to the total costs of the activities carried out by human beings on the forest and which lead to the destruction of soil and relief (destruction of the biodiversity and the forest functions).

-        Being given that the mathematical expectation of P depends on the dynamic stability of the forest and on the reliability of the available information, we can allocate to P an achievement probability such as:

$Pr(V(p)) = 1$ if $E(P) = Max(P, U, R)$, and the uncertainty associated to the future values of P are given by:

$0 < Pr(P) < 1$.

CONCLUSION

Every one of the scenarios of the communal forest space allocation in our model has some advantages and also leads to some total costs. The utilization goes with some important losses of the local, regional and planetary populations' welfare (loss of the biodiversity, source of subsistence and source of new medicines, discharge of carbon dioxide and the disastrous consequences of this discharge on the climate and the evolution of socioeconomic activities, etc.). The protection of forest leads to welfare losses (related to the reduction of the present incomes) for the user populations. The opportunity costs associated to the "protection" option are all the more difficult to bear as: i) the current average income of the rural populations which are among the greatest users of the forest remains poor; ii) the protection of the tropical massifs in the tropical countries (underdeveloped countries) remains up to now very poorly compensated by the international community which calls for the complete prohibition on the felling of timbers of these massifs, for the protection of the ozone layer and against the greenhouse effect.

Considering the current rate of forest deforestation (loss of the biodiversity, losses of the functions of stocking of the carbon dioxide, etc.), the unavailability of the data of analysis and the non linearity of the benefits related to the present use, the principle of precaution should be applied. It is necessary to increase the preserved forest surfaces (compatible utilization with the protection) and/or a complete prohibition on the felling of timbers in the forest. Moreover, the allocation between P, U and R should take into consideration the fact that the value E(P) of the protected zones increases as the rate of forest degradation increases and that the loss in biodiversity evolves.

Whatever the case, in the framework of the negotiated decision-making between the different parts involved, legal instruments should be couple together to the social, economic and ecological tools to lead to a sustainable allocation of

spaces to assign to the exploitation of tree trunks cut down, those to be protected and those to be allocated to the traditional activities and /or to the setting up of zones of human population.

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