No. 49

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE REPUBLIC OF CAMEROON
SOCIETE NATIONALE D'ELECTRICITE DU CAMEROUN

FEASIBILITY STUDY
ON
MEMVE ELE HYDROELECTRIC POWER DEVELOPMENT PROJECT

FINAL REPORT
APPENDIX Ⅳ
ENVIRONMENTAL ASPECTS

OCTOBER 1993

NIPPON KOEI CO., LTD.

M P N
J R
93 — 147

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE REPUBLIC OF CAMEROON
SOCIETE NATIONALE D'ELECTRICITE DU CAMEROUN

FEASIBILITY STUDY
ON
MEMVE ELE HYDROELECTRIC POWER DEVELOPMENT PROJECT

FINAL REPORT
APPENDIX Ⅳ
ENVIRONMENTAL ASPECTS

OCTOBER 1993

NIPPON KOEI CO., LTD.

FEASIBILITY STUDY
ON
MEMVE ELE HYDROELECTRIC POWER DEVELOPMENT PROJECT

FINAL REPORT

List of Report

FEASIBILITY STUDY
ON
MEMVE ELE HYDROELECTRIC POWER DEVELOPMENT PROJECT

APPENDIX IV ENVIRONMENTAL ASPECTS

Table of Contents

ANNEXES OF APPENDIX

INTRODUCTION

The general coordination of the socio-environmental studies, the drafting of the synthesis report, and the August 1991 preliminary report, as well as Annex I have been ensured by Mr. Christian Potin, Environmentalist of JICA Study Team. SONEL contributed its quarters notably at the level of SERAH and DAB, both services under the Directorate of Equipment. Annex II was compiled by a team of researchers of CUSS, Yaoundé, spearheaded by Professor Same-Ekobo, while Annex VII was the task of SEDA, a semi-governmental organization espesialized consulting company for agricultural developments.

The present document constitutes the final synthesis report on the socio-environmental impact studies of the Memvé Elé hydroelectric power project on the river Ntem (Ma'an district, Ntem Valley Division, South Province). Impact studies have been carried out alongside with the technical and economic feasibility study of the project, from its technical options and variants. The future Project owner if it were decided, would be SONEL. The study of the project and its impacts have been financed and carried out by JICA - Japan International Cooperation Agency, as sub-contracted to Nippon Koei study team, with the collaboration of SONEL.

Study on the Memvé Elé Hydroelectric Project is situated within the context of meeting up with energy demand growth of the future at the level of the South Interconnected Network, which is presently the main interconnected network in Cameroon with an installed capacity of 648.5 MW (hydro) in 1992. Compared to the above mentioned objective, the Memvé Elé Project seems to be an alternative project to that of the Nachtigal Hydroelectric Project on river Sanaga. Its first execution study was realized in 1970, and its readjustment studies in 1988. Studies on the Nachtigal project should henceforth be actualized in order to consider the new data for the reservoir project of Lom-Pangar with its feasibility study that has just begun and which has a primary objective to rise the position of the installed capacity at the level of the Edéa and Song-Loulou powerhouse. The technical characteristics of the Memvé Elé Project are synthetically presented below:

- Dam on the Ntem - Catchment area 26,350 km2 - Average annual flow: 398 m3/s
- Full supply level: 392 m (Crest of the dam 395 m).
- Minimum operating level: 391.5 m
- Area of reservoir: 19 km2
- Gross storage volume of reservoir: 130 m3 million
- Effective storage volume of reservoir: 8 m3 million
- Design discharge of spillway: 3,450 m3/s

- Maximum turbine discharge: 450 m3/s
- Installed capacity: 201 MW in 4 units
- Length of the dam: 1,850 m; volume of the dam: 884,000 m3
- Total cost of the project (compensatory measures excluded): F.CFA 112.7 billion (US $417 million)
- Economic internal rate of return: 19.3%
- Unit energy cost: 7.6 F CFA (2.8 US ¢) per kWh

At this stage, the detail on the organization of the site and related works (paths, roads, camps, land acquisition etc...) is not defined. These infrastructures should be fitted into the detail impact studies which will accompany the APD (Detailed Design) studies. Meanwhile the new transmission electric lines that will link the Memvé Elé powerhouse to South SONEL network should be subject to a specific impact study on the environment.

The qualifying of "socio-environmental studies corresponds to a concept of the environment which must be understood in all its extents: physical and natural environment, social and cultural, economic and institutional. Concerning the economy, the impact study is limited to taking into account the local economy, analysis and the economic justification of the project (national collectively level) as well as its financial analysis (Level of SONEL) classically being an integral part of the feasibility study of the project.

The present synthetic report lies on three thematic annexes which are more detailed and which deal respectively on the legal and institutional context, the natural environment and the anthropological characteristics (Annex I); the health and nutritional conditions of the population (Annex II); the infrastructures and economic activities (Annex III). After a reminder of the institutional and legal context of the environment in Cameroon, the report comprises of an analysis of the initial state of the project zone of influence according to the themes, an evaluation of the impacts according to the technical variants and proposals on direct and indirect compensatory measures.

For the impact studies, field investigations were carried out from July 1991 to November 1992. They notably comprised of:

- an exhaustive anthropological reconnaissance of the 56 hamlets in the project zone and their natural environment (July / August 1991).

- a systematic inventory of the human infrastructures (houses and cultivated lands) situated below the maximum variant elevation of the project, within the framework of the topographic surveys of the 1/10,000 scale (from March to June 1992)

- an agro-economic investigation of 50 heads of family and 50 active women with an additional plots inventory to the preceding one for cocoa plantations, and particular interviews of hunters and of fishermen (40). (October/November 1992)

- an epidemiological investigation with blood taking testing on roughly 1/3 of the concerned population (521 persons; October/Nov. 1992).

PART I

NATIONAL INSTITUTIONAL AND LEGAL FRAMEWORK OF THE ENVIRONMENT

I. MULTIPLICITY OF SECTOR LAW TEXTS

The general concept on the environment, as it has been definitely accepted by the International Community, is not among the priority concerns of the Cameroon Government as well as its population. Consciousness of the environment in Cameroon is recent, partial and punctual as reflected through a few concrete actions in the field. Moreover, the National political and economic conjuncture mobilizes social actors towards priorities other than the environment. In this context, it is not surprising to find that the environment issue is somewhat dissolved, atomized and marginalized through various institutions and through many legal texts without general cohesion on this question.

A repertoire of many texts dealing on law in the subject of the environment protection (land occupation, human infrastructures and including mineral resources) is given in the appendix of Annex I.

The following characteristics should also be noted:

(i) Lack of a code or a general charter for the environment which would bring about coherence in sector texts.

(ii) Productivity spirit of the land laws system that provides for the granting of private land with the condition of its reclamation on the one hand, and favors well off individuals as compared to small producers whose lands are not protected on the other hand.

(iii) On-going revision of the forests, the fauna and the fishing legal framework with the aim of achieving a better integration of the new conservation and management objectives of the long term resources with their short term exploitation.

(iv) Lack of a general code or a guide-law for water

(v) Existence of traditional jurisdictions still in force (particularly in East Cameroon) officially recognized by the state, with a customary law that at times can clash with the modern law (family law and succession rules, law on hunting and picking notably...).

II. INSTITUTION CONCERNED

Up to the end of 1992, the Ministry of the Plan and Territorial Development (MINPAT) was in charge of the environment problems in Cameroon through the sub-department of the

Environment and Human Infrastructures which depended on the Department of Territorial Development and the Environment (DATE).

This sub-Department had limited means, and within the DATE, environment protection missions on the one hand, and the territorial development, on the other hand, seemed a little bit contradictory and difficult to be at the fore front of the same technical department.

Since the beginning of 1993 a new Ministry of the Environment and Forests (MINEF) has been created. This Ministry is on the way of being organized and the Consultant has not had ample information at this stage. The target for this new Ministry will equally be, among others, the conciliation between the objectives of conservation of forest resources and their exploitation as it was the case with the former Department of Forests in the Ministry of Agriculture (MINAGRI).

Many other Ministries directly or indirectly, have formal or practical competence on the environment issue in line with the subject of the present report. Below is a list of the main Ministries, with precision on particular themes of responsibilities if necessary:

- Ministry of Territorial Administration (MINAT): administrative management of the population and "Migration"/resettlement
- Ministry of the Plan and Territorial Development (MINPAT)
- Ministry of Mines, Water and Energy (MINMEE) tutelage of SONEL
- Ministry of Health (MINSA)
- Ministry of the Environment and Forests (MINEF)
- Ministry of Agriculture (MINAGRI)
- Ministry of Fisheries and Animal Husbandry (MINEPIA)
- Ministry of Tourism (MINTOUR): Fauna, hunting, preserved areas, resources and tourists development.
- Ministry of Public Works and Transport (MTPT): roads.
- Ministry of National Education (MINEDUC): education and schools
- Ministry of Town Planning and Housing (MINUH): expropriations, migrations, resettlement.

It is worthy of note that most of the above-mentioned technical ministries have provincial and divisional representative offices with sector structure identical to that of the central administration. At the level of districts (Sub-prefecture), the administrative structure is not complete: the Health, Education, Agriculture, Stock Farming and Hunting Ministries are systematically represented.

PART II

INITIAL STATE OF THE LOCAL ENVIRONMENT OF THE PROJECT

III. LOCATION AND DEFINITION OF THE INFLUENCE ZONE CLOSE TO THE PROJECT

It should be recalled that the project site is situated South West of the South-Cameroun forestry plateau, at 50 km bird flight and less than 40 km from the boundary with Equatorial Guinea (see Fig. 1).

Considering the direct influence of the project on the natural environment (the northern and southern uninhabited zones) on the one hand and the socio-economic environment directly concerned on the other hand. The influence zone close to the project, everything being equal [1], and taking into account the maximum variant, [2] can be schematically defined by a circle of 12 km radius centered on the Ntem South of Melen II (45,240 ha of general area). The administrative set-up and the unit structure for housing are shown in Table 1.

The study zone corresponds to two Cantons : the Mvaye-West and the Ntem I Boucle (the Ngo Abang hamlet at the Equatorial Guinea border is not included) + the Ebenmeyong in the right bank of the Biwome and the Ntem which depends on the Campo district. In all there are 56 hamlets for 14 administrative villages (3rd degree chieftaincies are discontinuous and are composed of inserted hamlets as corresponding to traditional anthropological structure per clan.(see Chapter V below and details in Annex I).

---

1 Each theme defines a particular influence zone.

2 Ntem dam, Ndjo'o and Biwome, and crest of the dam at elevation 405m (maximum water level of thereservoir: 402m).

Table 1 Administrative set up of the socio-economic influence zone close to the project

Division	District	Canton	Administrative Village	(no. of hamlets)
Ntem	Ma'an	Mvaye-West	Nyabessan	(6)
			Abem	(5)
			Ntebezok	(3)
			Alen II	(2)
			Melen I	(3)
			Nhemeyong	(4)
			Nsebito	(8)
			Akom	(1)
			Tom	(2)
			Asseng	(2)
			Alom I	(3)
		The Ntem I Bend	Melen II	(8)
			Aya Amang	(4)
Ocean	Campo	Nkolelon	Ebenmeyong	(5)

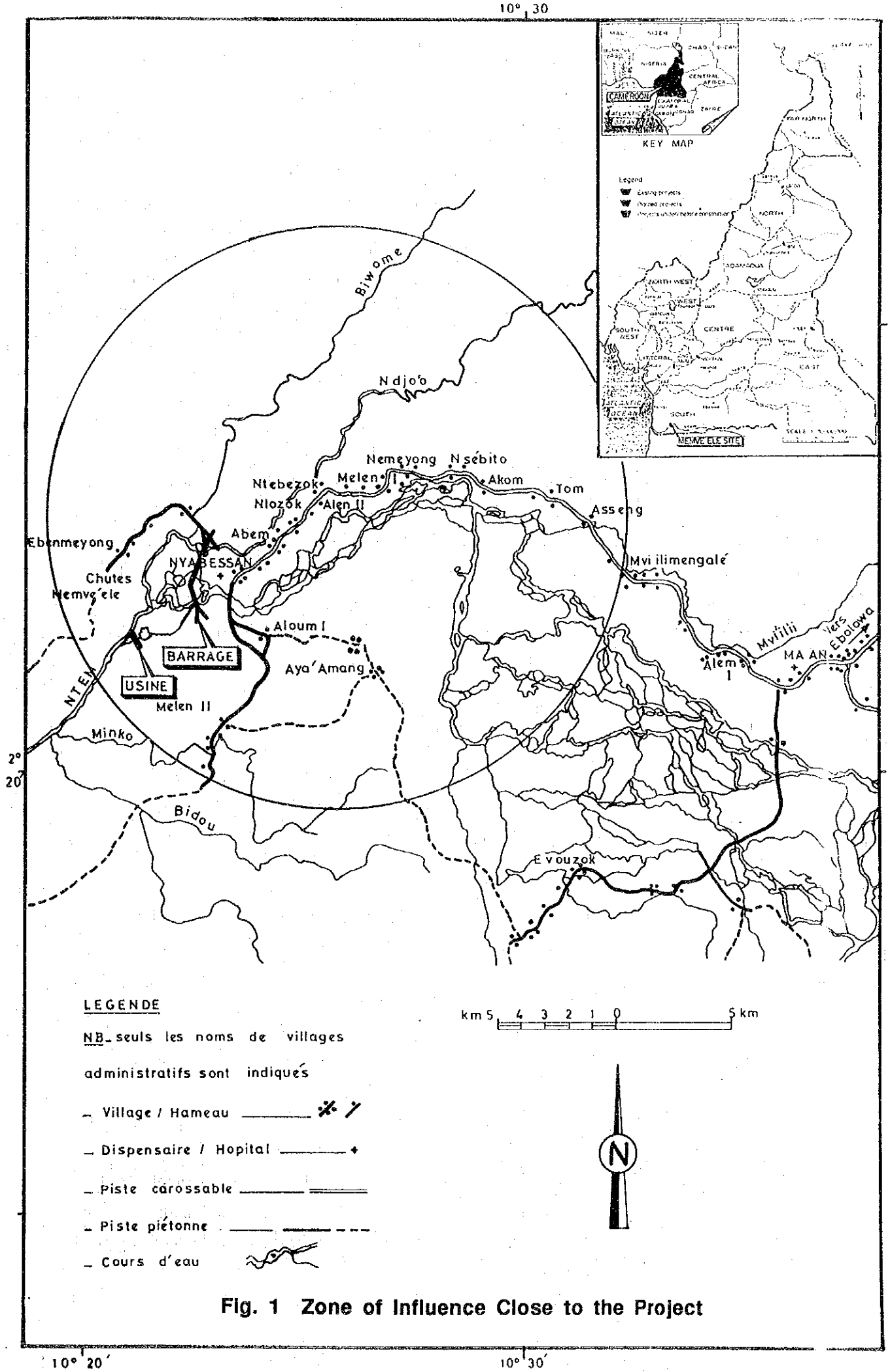

Fig. 1 Zone of Influence Close to the Project

IV. RICH NATURAL ENVIRONMENT

4.1 Recall of the Physical Factors of the Natural Environment

The survey conditions of the project site, local and regional geological structures, the climatological data and the hydrology of the Ntem are fully treated in the feasibility study. However we would recall the main characteristics below, as being the determining factors of the natural environment.

4.1.1 Equatorial Climate

The climate is the Equatorial Guinea type with four seasons and annual average rainfalls ranging from 1500 and 2000 mm. If it rains all year long, two peak periods could however be distinguished : From September to November, the long rainy season and the short rainy season from March to May. The long dry season is from December to February, while the short dry season stretches from June through August. The average of 28^0C and minimum of 20^0C. The relative humidity is high and varies according to the months of the year and hours of the days : between 62% and 98%.

4.1.2 Precambrian Geology

The project area lies on a metamorphosed Precambrian Shelf referred to as the Ntem complex, composed of various crystalline rocks : migmatite, microgranite, granite, gneiss and pyroxemite.

The present relief which has formed on geological structures is the hilly type with high points ranging from 500 and 600m and bottom valleys below 400m. It is cut out by a thick hydrographic hair and the slopes are quite abrupt and brief.

4.1.3 Equatorial Forest Hydrology

The average discharge of Ntem river is about $400m^3/s$ with seasonal variations ranging from $240m^3$/sec to $610m^3/s$. The average discharge of Ndjo'o and Biwome rivers together would hardly exceed 35 m^3/sec. The water is of "clear" type, yellow to green in color with important development of phytoplanktons and is relatively poor in mineral elements. The pH value is natural (See results of analysis in Appendix III - Hydrology and Meteorology).

4.2 Fragile Forest Soils

The soils formed on metamorphic crystalline rocks are ferrous forest soils, yellow, zonal, and not well developed. The texture is sandy-clayey to clayey-sandy. These soils are poor in nutritive elements (hydrolysis of minerals and leaching of bases) and the exchange capacity is limited by content and type of clay (kaolinite). The potential agricultural fertility of these soils is also restricted by the structural instability of the absorbing complex as soon as the forest cover is cleared off, (weakness of the humus horizon), and by an acid pH. These soils are therefore fragile, and degrade and erode rapidly as soon as they are cleared off forest.

On the crests of hills and the upper parts of slopes the soils are lithosols and regosols lying on geological shelf. In lower parts of slopes in lowlands are areas which are regularly flooded and swampy, the soils are characterized by a permanent or occasional hydromorphy (humid, acid, swampy; forest soils, and pseudo-gray soils subject to temporary flooding at the foot of slopes). The cropping aptitude of the soils (See Annex III) before anything, is dependent on the following characteristics : the depth, fertility (determined by the rates and types of clay and humus) and hydromorphy.

4.3 Zone of Thick and Humid Forest[3]

The natural vegetation in the project area is the Guinean-Cogolese dense and humid evergreen forest, in the Nigerian-Cameroonian-Gabonese or Atlantic evergreen forest sector of the Atlantic Biafran District. The project area is located at the border (Ntem and Biwome) of the Campo wildlife reserve, where large forest area is being exploited by the Campo lodging company up to Nko'elon, 35 km west from Nyabessan. From the phytogeographical point of view it is a transitional zone between the typical Atlantic Biafran evergreen forests of Cesalpiniaceaes and the more continental semideciduous forests with continuous disappearance of Cesalpiniaceae as shown in the 1/100,000 simplified map in the appendix of this report.

The Atlantic Sempevirian humid and dense forest of Cesalpiniaceae is composed of the following typical species : Sacoglottis Gabonesis Lophira Alata (Azobe), Gilbertiodendron Derxevei, Baillonella Toxi Sperma, Brachystegia Sp. It presents a very large biodiversity as

---

3 The chapters referrs mainly at this stage to the phytogeographic map of Cameroon prepared by Rene Letouzey on a 1/500,000 scale and its attached notice.

shown in the description made from the notice attached to the vegetation map given in Annex I. The humid and dense forest composed predominantly of elements of deciduous forest has however the following typical species : Celtis sp, Oloptecles Grandis, Triplochliton Scleroxylon (obéché), Terminalia Superba (Fraké), Mansonia Altissima, Entendrophragma Sp.

Secondary forests (logging and clearing for cropping) are characterized at the young stage by Musanga Cecropioides and Albizia Sp, at the mature stage by Allbizia Sp, Terminalia Superba, Triplochiton Scleroxylon, Pycnanthus Angolensis. In the Biafran district, the degradation of secondary forests is marked by the invasion of continental semi-deciduous species over the Cesalpiniaceae.

Besides the large forest formations which are evolutionary under the effect of exploitation by man, one can notice here and there the presence of forests in humid lands which are periodically or constantly flooded (riparian forests, raffia forests and swampy forests). The typical floral composition by biota of these forests remains to be clarified by scientific authorities.

4.4 Forest Fauna Still Abundant and Diversified

In spite of an increasing synergetic pressure from riverside dwellers, worsened among others by the cocoa crisis, the wildlife is still diversified and abundant outside inhabited areas. By comparing the results of surveys and field observations (free, captured and shot down wild animals) with published literature (a list of the main or noticeable fauna of the neighboring zone to the project is given in appendix I, and summarized below, with indication of the Endemic or vulnerable species (EM)

- Simiidae : more than 6 species, including gorilla and chimpanzee (4 EM)
- Carnivore : more than 5 species (2 EM)
- Hyraxes : Tree hyrax (Dendrohyrax arbors)
- Suidae : 2 species among which River hog is vulnerable
- Elephant : vulnerable
- Ruminant : more than 10 species (2EM)
- Rodent : more than 5 species
- Tubulidentata : Aardvark (Orycteropus afer)
- Edentate : 3 species at least of pangolins including Giant Pangolin (EM)

- Saurian : 2 species including false gavial (crocodiles cataphractus) : (EM)
- Reptiles : more than 3 species of big reptiles
- Batrachia : Giant frog (courauana Goliath) : (E)
- Chelonians : 2 species of water turtles, both (EM)
- Birds : more than 6 rapacious species (including 3 noticeable) ; 2 species of parrots vulnerable ; 2 species of King Fishers/hunters ; more than 2 species of calaos more than 2 species of barbicans and barbsus ; 4 species of woodpeckers, 2 species of soui-mangos ; 3 species of weavers.
- Fishes : 12 species identified (the popular ones include : Bagridae, charicidac, Mochokidae, Cyprinidae) with more than 30 species in all.
- Insects : Numerous and diversified ; some lepidopterist are sarce and Endemic.

In all a list is drawn up for (noticeable species) : more than 35 species of mammals, more than 10 species of reptiles-batrachia-Chelonians and more than 30 species of birds.

V. ORIGINAL DEMOGRAPHIC AND ANTHROPOLOGICAL FEATURES

5.1 History Affected by Colonial Period

The population of the study area belongs to two ethnic groups : the Mvaye (Mvaye West Canton and Ebenmeyong village) and the Ntoumou (Boucle du Ntem I Canton). These two groups are descendants of a larger group called Pahouin[4] which has a general history of migration from North/East/South/West, towards the ocean. Without entering further into details and trying to separate the myth from the legend and history, it can be said that the present groups settled in this area at the end of the 19th Century under German colonization and following the development of cocoa plantation. The Mvaye population of Mvaye-West Canton was, on the contrary, distributed along the road constructed by the Germans which linked Campo to Akom II via Nko'elon, Ebenmeyong, Nyabessan, Abem and Messama

4 French pronunciation of the color at German name "pangwe"

(this road crossed the Ndjo'o river several times). The section of the road between Abem and Messama was later abandoned in 1936-1937, and the Mbaye population was obliged by French colonial authorities to move and to settle along the new road, which became the road linking Nyabessan to Ma'an and Meyo-Centre.

5.2 Sparse Population in a Demographic Depression Zone

An exhaustive counting of the 56 hamlets in the socio-economic zone of influence close to the project has given a total of 1599 inhabitants for 281 families (5.7 persons per family). Brought to the area of the whole circular zone of influence close to the project (see chap III above) it gives a very low average density of 3.5 inhabitants per km^2. In reality the population is unevenly distributed in the space (see Fig. 1). This population is mainly concentrated along the main road ending at Nyabessan (1232 inhabitants) on the one hand, and is secondarily scattered in a score of enclave huts (367 inhabitants in all) in the left bank of river Ntem, and at the North/North-West of the waterfalls on the other hand. Brought to the spaces containing cultivated lands and old fallow, the densities of peopling would be respectively around 17 inhabitants/km^2 scattered here and there along the road, and 6 inhabitants/km^2 in the enclave areas.

Comparison of the estimates of the 1976 census (more reliable than that of 1987) and the 1991 estimates of the mission shows a general average annual growth of the population at +0.8% for the project zone only. The demographic behavior is diversified according to villages and cantons in relation to their level of enslavement and their socio-economic dynamism (1.3% for the Mvaye-West canton ; but -0.6% for the enclave canton of the Boucle of Ntem I for which if Melen II is distructured, Aloum I and Aya amang have continued to grow up to date)

In general, the project study area is a demographically depressed zone where the labor force is compelled to emigrate as a result of the lack of non-farming jobs, on the one hand, and the loss of interest of young people in agriculture, aggravated by the present cocoa crisis on the other hand.

Socio-demographic structures are based on the restricted family or home (simple family) which forms the unity of family relationship and socio-economic solidarity, composed of a family head (generally a male adult), his monogamous or polygamous household, with a number of dependents (children, grand-children under his care unmarried mothers, young couples, elderly persons etc.···). With the general average of 5.7 persons, the site of the families varies with extremes from 1 to 20, according to the degree of nuclear/restructuring

of the restricted families (See paragraph. 5.3 below and detailed data per hamlet and clan in annex I).

The exhaustive reconnaissance of the hamlets of the study area has given an average socio-demographic structure of the families as follows (See details in annex).

- Widowed or divorced men, family heads: 5%
- Single women family heads: 13%
- Polygamous households in % of married men: 13%
- Dependent households in % of married men: 5%
- Unmarried mothers in % of married women or family heads: 14%
- Number of illegitimate children in % of dependent persons: 8%

It is worth noting the relatively large number of single women family heads (often widowed and divorced) and unmarried mothers. Polygamy is, on the contrary, quite reduced in general ; this reflects among others the low economic level of the society, on the one hand, and probably the influence of old Christianity on the other hand. It should be noted also that if the illegitimate child-bearing has become frequent and socially admitted, a large number of cases of eventual sterility are observed on both men and women during field surveys ; would there be a sort of implicit socio-demographic compensation between these two phenomena ? We should also know that in this society a married son rapidly becomes independent from his father, contrarily to some more patriarchal societies. In fact the eldest son assumes power on the family core as far as he is apt and fully controls his intellectual faculties.

5.3 Evaluative Anthropological Constitution

5.3.1 Tribe

The tribe (Mvaye, Ntoumou) constitutes the top linguistic identity reference of the populations. However, the tribe is not so highly important within the larger Pahouin group, and it may sometimes be confused with the clan, both being called by the same name (ayon). Whatever the case these two tribal groups (Mvaye and Ntoumou) in the project zone are distinguished without any ambiguity in time (The Ntoumou seem to have arrived later than the Mvaye and pushed away the latter and/or went beyond in the South-Cameroon) and in the space (district lands).

5.3.2 Clan

The clan (ayon) certainly remains the fundamental structure of the Pahouin groups in general, and of the Mvaye and Ntoumou groups in the study area in particular. It is through this structure that the society "most spontaneously reveals itself and communicates with the outside". The clannish identity of individuals is still strongly marked as it is observed during field surveys. In the project area, 6 Mvaye clans and 3 Ntoumou clans are listed. These clans have diversified strength and demographic dynamism (See details in annex I). They are strictly patrilineal and patrilocal clans with, almost as a general rule, one clan occupying one hamlet. Villages, chieftancies are also generally monoclannish. However, one clan may, according to its size, cover many village-chieftancies with sometimes, scattered hamlets. A hamlet, a village are thus identified at first by the clan of people résiding in it and according to an absolute rule of inter-clannish exogamy and virirolocality.

5.3.3 Lineage and Biological Kinship, Marriage System and Status of the Individuals

The extended family or minor lineage is a sign of some level of brotherhood and co-residence. In the most simple case, minor lineage makes up a unique hamlet which in turn builds up a village family (Ndabot). Anthropologically speaking, it corresponds to a "pratilineage" involving 4-5 generations at most.

The family lineage or major lineage or clan fraction (Ndzan) is an intermediary bridge between the village family and the clan which at present is unstable and imprecise. This group corresponds to a family lineage making up more than five generations (4 major lineage-hamlets were identified during field surveys and they comprised of many extended families).

As far as marriage is concerned, the rule of clannish exogamy is strictly respected. In this light some clans (like Essambira and Essambak notably) supply more women to other clans of the study area than the way they are patriarchy represented. There are two types of local marriages in force : "abduction" marriage (abom) quite frequent, and the regular marriage (eyala). Dowry is important in any of the cases (from 50,000 to 400,000 F. CFA). This money is paid in installments and could lead the boys parents into indebtedness. Besides the religions and official marriages that are practiced accessorially, the traditional marriage still prevails.

Lastly, from the biological kinship (uterine and patrilinear filiation) to the clannish relationship, the systems of kinship are complex, relative and at variable events. People are classified by age, sex, and generation : they could be brothers (bobenyan), half-brothers,

german, cousins, nephews of the same clan, the father can appoint the biological father, the guardian-brother, the uncle the grand father etc····. In this way anthropological relation is expressed differently with regard to the circumstances, family structural affinities and social opportunity (status).

The woman's status is characterized by a relative autonomy rendered possible by cultivation of food crops and heavy daily domestic and farm tasks. On the contrary, socially speaking, the woman is a minor, dependent in turn either on a father, a husband, a brother or on a son. There is often dispute on the ownership of children who are usually passed over to and kept by the husbands in case of separation after the departure and return of the woman to her father's village (in such a case the dowry must therefore be refunded by the woman's family). It is only at a certain mature age that a widowed or divorced woman (remarried or not) can attain a recognized social majority status and become economically autonomous or even become head of family if she still has little children under her care.

5.4 Christianity and Invisible Forces

Christianity of the study area is old and dates back to the beginning of the century. It began with the coming of Presbyterian missions into this area through the Campo-Eferan axis. The catholic mission of Ngobayon (LoLodorf) came next and settled directly at Abem during the French era, at the start of the 1920s. What is striking is the diversity of religions represented in the study area and relative luxury in number and quality of the churches compared to the economic level of the population. (13 churches and chapels for a total population of 1,600 inhabitants : 7 catholic establishments, 6 Protestant establishments ; See details in annex I)

The reader must note that Christianity was (partially) established on a monotheistic Pahouin religious background based on :

- a three-planet cosmogony (earth + water, moon, sun) ;
- a four-component human personality (body matter and "corporal spirit" soul matter and "soul spirit")
- a ternary cycle of life and death (on earth, the intermediary world, the World beyond)
- an elaborate founding mythology of the world (with variants) invoking a unique God, "organizer of the organized matter" (but not the creator of the unorganized world) on the one hand, and an original mother of the human beings, on the other hand. These fundamental traditional and ideological structures of the Pahouins Partly allow to explain

the individual and collective mystical behaviors, and the very rich structuring and composition of the sacred. Thus the "soul spirit" of an individual reflects the moral religions laws and the rites and cults, meanwhile the "corporal spirit" is the base of social relation and of witch craft/magic (to be well distinguished thus from religion). In this way there is split personality and moral responsibility of the individual.

Presently the rituals and traditional religions cults[5] attached to the "soul spirit" seem to have fallen into disuse, the Patter having been attracted by either Christian ideology or Lay state ideology. On the contrary food taboos and traditional medicines are still practiced here and there as a means to modify external divine forces. Witchcraft that touches particularly the corporal spirit of the individuals is still reigning. There are 6 witch doctors (two are official and famous) in the project area.

- each person is carrying along within him (in his "corporal spirit") a witch force (evuhz). It can be potential or effective.

- this witch force can hide three states of social evil which can determine a general sociology with three categories : the good common people ; the leaders and elites who exploit economically and politically by a harmful evuhz ; those who derive their strength from killing through witchcraft (highest evil state of evuhz). In this manner, each unnatural death, illness, physical handicap or accident etc···; can be attributed to actions of witchcraft forces of individuals.

5.5 Individualistic and Wait-and-See Attitudes

The entire anthropological and evaluative structures quickly outlined above (also see economic activities below) as a last resort, determine the mental behaviors of the population towards the state and external associated actors. Within the context of psycho-social disputes (inter and intra family) between the anthropological structures of witchcraft, it would appear there is little organized mutual assistance and traditional associations among the families, as compared to other regions of Africa. There are indeed some traditional forms of women groups doing farm works together (Ekama) or land cultivation at a man's request for claiming a new farmland (also Edam), but these forms of mutual assistance and

---

5 (1) Traditional Pahouin rituals were initiating rituals to pass through and/or divided sacrifices in harmful rituals (So: lunar ritual, symbole: antilope, bokung: lunar symbole: owl; schok: ritual for water; symbole: elephant), and useful rituals (Ndong-Mba: solar ritual; Elong: solar ritual, symbole: cock; Ngi: fire ritual, symbole: gorilla.) The ancestors' cult had as objective the magic and ritual management of ancestors' souls separated from their spiritual immediately after death.

collective work seem to be given a secondary importance nowadays. By contrast, individualism and wait-and-see attitudes seem to be more prevailing, especially with the men (youngster and adults). There is lack of interest in the cultivation of cocoa, the only agricultural crop that actually mobilized the male work force. Now everybody expects either through migration and education of children or, more recently, through the dam project, which is expected as the coming of a god sent manna, which recalls the founding myth of the Pahouin migrations based on the search for a maritime and solar Eden.

5.6 Anthropology of the Political-Administrative Set-up of the Space

Reconnaissance of the 56 hamlets of the project area permits to establish the following anthropological typology of the hamlets (See Annex I for details.) :

Table 2 Hamlet and Population

Type of Hamlet	Number of Hamlet	% of total Population
Family-hamlet (HF)	9	5
Extended family hamlet (HFE)	24	36
Major lineage hamlet (HL)	4	12
Monoclanic composite hamlet (HC) (none group with Significant extended relation)	10	19
Mixed hamlet (HL+HC or HFE+HC)	8	24
Pluriethnic centre (pre urban type)	1	4
Total	56	100

Administrative villages (3rd degree administrative chieftancies) are, as a general rule, equally monoclinic (10 3rd degree chieftancies) pluriclanish or pluritibal in the case of 4 third degree chieftancies as follows :

- Aloum I : 3 Ntoumou clans,
- Melen II : 2 Ntoumou clans,
- Ebenmeyong : 3 Mvaye clans
- Nyabessan : 2 Mvaye clans+1 Ntoumou clan+"external" clans

VI. SANITARY AND NUTRITIONAL STATE

6.1 Rampant and Various Parasitic Diseases

6.1.1 Parasites

Out of the 17 types of pathogenic parasites detected during field samplings (carried out on 1/3 of the population) five main kinds of parasitic illnesses are listed ; by decreasing rate of frequency, they are : diverse intestinal parasites in the study area. The five major species (by decreasing order of sampling) are : frichocephale (66%), ascaris (56%) ; amibe (25%) and flagellate (intestinal Giardia : 9%). Intestinal parasites provoke very serious biological and social worries (discomfort, weakness, opportunist illnesses...). They are favored by the environment factors as well as social behaviors and practices (lack of proper hygiene and the population's low level on sanitary education.

Malaria is caused by Plasmodium falciparum in the study area ; this is a biologically and socially serious malady that affects children under 5 years, 60% ; combined with malnutrition and intestinal and digestive problems, malaria is the cause of half of infant mortality and the primary cause of anemia in children. With adults, its morbidity is equally complex and goes in pair with various pathologies (gastro-enteritis, rat pathology and of liver etc...).

Filaria are mainly caused by microfilaria, Loa Loa (16% of sampling) in the study area ; they are endemic. On the contrary, the zone has not yet been affected by Onchorcercose in spite of the remarkable presence of similes (non infested) around river Ntem.

Candidoses and Trichomoroses are genital parasites that are sexually transmissible (STD). Scabbies is a well known skin.

Parasite caused by an acarian (sarcopte). Just like in the study zone and there are no vector molluscs of the disease.

Lastly, it should be noted that there is a most terrifying aspect ; the association of parasites which is quite frequent : 98% cases of parasites correspond to the association of two parasites (with malaria being frequently associated with another parasite).

6.1.2 Different Categories of Vectors

The privileged biotops of vectors (insects and molluscs) which are potential intermediary hosts for pathogenic parasites of man, are aquatic, peri-aquatic or with hot and humid forest coverage.

Out of five species of mosquitoes (culicides) identified, two types (Anophele) can be carriers of malaria. Two other types, Aedes and aulex are possible vectors of yellow fever and Bancroft filaria respectively.

A specie of simulie, potential vector of onchocercose, is rampant around the Ntem, the rapids and the waterfalls which form suitable Larval homes for this fly.

Two species of tsetse fly have been identified, but no captured sample is carrier of trypanosomias (sleeping sickness). It should be noted that there is a home for trypanosomias in the Campo district which lies west from the project area. Another specie of forest insect of the chrysops is abundant ; this is the main vector of loa loa filariose in the zone.

Malaco-fauna (mollusc) is the only unharmful specie of the Lanistes type which has been identified. No potential mollusc vector of distomatoses and bilharzioses (bulin, planorbe, limnee, potadoma) has been identified.

6.2 Alarming Infant Nutrition

The infant bed nutritional state is paradoxical with this forest zone, rich in games and where the vegetation is fertile. Following investigations on 102 children of less than 5 years, 31% of the number are suffering from lack of food with almost a half of them under severe condition[6]. Detail analysis on balance status by sex and by sub-category of age shows the following :

- the balance growth of children under 1 year (breast fed) is almost normal.
- A balance status inferior to the normal one for children of both sexes generally girls present more severe deficient forms than boys.

The state of infant malnutrition are coupled with other states of morbid which are mainly (by decrease order of frequency) : intestinal parasites (62%), malaria (34%), infections of the lungs (20%) and ORL infections (12%).

---

6 Distinction between the states of protein-energetic malnutrition was done after compared measure of arteny perimeter and skull perimeter.

Another fundamental cause of malnutrition is due to deficiencies in vitamin and food linked to social conditions (more rampant in large families, for young mothers and when there is early wearing ;

In the final analysis, the main causes of infant malnutrition observed in the project area are multiparity, family size, economic activities of the mothers, behaviors, and food taboos as well as the poor vaccination of the children and, parasites.

6.3 Diversified Infectious Diseases

The following, in order, are the most frequently identified infectious sicknesses : Pulmonary infections : (21%), intestinal infections (18%), STD (18%), ORL sphere (17%). The major Lungs infections are formed by acute bronchitis (especially with children), and secondarily by influenza syndromes in all the age groups.

Microbial intestinal infections can be caused by various pathogenic germs and are a cause for the multiform diarrhea observed in 1/4 of the population and in half of the children (after parasites, malnutrition and lungs infections.

The endemic evolution of STD is a particularly big concern in the project area and its environs. In the influence area close to the project, more than 20% of youths of under 15 years of both sexes suffer from venereal disease. By decreasing order, the following are the entire venereal diseases detected in the zone : gonococci (10%), general parasites (16%), syphilis (2%), soft dunce (2%).

67 cases of AIDS were detected in 1992 in the south Province (as against 20 in 1991). None of these cases is a person of this origin but we must note that at present there is no statistic for seropositives due to lack of a systematic detection.

Infections of the ORL sphere-these affect 50% of the children ; at the beginning they are formed by rhino-pharynges syndromes and secondly by otiose.

Contagious diseases :

- 16 cases of tuberculosis; this disease is on the incline, despite the BCG vaccination campaign since 1990

- 3 cases of pian (serious disease with a similar germ to that of syphilis)

- 7 cases of leprosy (old patients more or less on the way to stop therapeutic check ups at the Edivise leprosy centre near Ma'an, and new lepers···).

Cholera, typhoid, meningitis cerebra-spiral : There have been, some cases, noticed in the ex-division of Ntem, among which some cases have been deadly, but detection during field surveys proved negative.

Infant diseases in the PEV (Vaccination Extension Program)

Other than tuberculosis (measles, tetanus, poliomyelitis, coqueluch) were detected during fields surveys. Measles continues to threaten, through serious break out from time to time in the Nyabessan and Ma'an which have poor vaccination coverage, which is lower to the average rate for the South Province which itself is quite low : 30%. In general, statistics are not encouraging. These insufficiencies are the responsibility of local and regional public health services.

6.4 Other Pathologies

The other noticeable pathologies in the area are, in decreasing order of frequency as follows:

- buccal-dental pathologies : 52% of patients (caries 42%)
- Articulator pathologies : 28% ; due to many causes (arthroses : 86% ; malaria : 77% ; Loases in aged people : 37% ; polyarthrite rhumatism : 13% ; acute articulator shamanism : 13%)
- Dermatitis (24%) ; prevailing according to type : Mycosis : 32%, impetigo and prurigo : 23% ; seraphic scabies and filarian : 8%
- Icteres : ("Jaundice") in many forms : 14% with malarial :7% undetermined 5%, hepatitis : 2%
- Ocular diseases : (keratites) and blindness (not caused by onchorcercose) : 6%

It should be noted that the number of cases of difficult deliveries observed at the Ma'an hospital is quite high (91 cases); the rate of maternal mortality is low but prenatal mortality is high. (56% for the Nyabessan Health Centre). The rate of sterility with adult women is high (22.4% in the area as against 17% for the entire country) ; this rate is comparable to those of other African forest zones. This can partly be due to the high rate of STD that are poorly treated, or chronic (even with the men) but sterility is generally unexplained. For a better understanding of this phenomenon, it would be advisable to carry out a joint medico-biological and anthropological research.

6.5 Insufficient and Failing Health Services

There is a primary health center at Nyabessan, in the area close to the project, meanwhile there exists a secondary health center of Ma'an, which is the District hospital.

6.5.1 Nyabessan Health Centre

Without any misunderstanding of the word, the Health Center at Nyabessan is developed only by name. The buildings with 6 rooms are decayed and poorly maintained; the equipment for treatment and minor surgery as well as drugs are in their most elementary status. The Center has neither drinkable water reserve, a generator, nor a pit for cabbage. Its immediate surroundings and mitigating toilets are not catered for.

The Center has 3 health agents: a Center chief (and chief of the administrative village of Nyabessan), who is a State registered nurse; a nursing aid and a matron. Besides these conditions of equipping the Center, training and hierarchy of staff, and the population's behaviors towards health, there is the tendency of no motivation, absenteeism and inefficiency. No steps have been taken towards preventive medicine (namely vaccinations), nor on an organized sanitary education by the staff. This is probably why, based on psycho-sociological structures and witchcraft as earlier mentioned (par. 5.4 and 5.5), we would understand shy people prefer self medication (buying of drugs available from traders in Ma'an, traditional medicines, consulting traditional cures etc...). When this self-medication reveals not effective, it is most often "very late" for the Nyabessan Centre to take action, and the last resort is to order evacuation of the patient to the District Hospital at Ma'an at the expense of the patient, if his family has the means and the will.

6.5.2 District Hospital at Ma'an

The buildings are new, large and in a relatively good condition. A surgery bloc is even under construction (works are however being suspended at present due to lack of fund). The hospital personnel dropped from 10 in 1991 to 7 in 1992, but there is no doctor and no mid wife. Drugs are not much better that in Nyabessan and treatment equipment is also quite limited. Only a stock of Vaccines is kept in a refrigerator for use in children vaccination operations. Under these conditions it is not surprising to find that the hospital is not operating fully as well as its pharmacy, in spite of its theoretical capacity of 54 beds (26% of the rate of occupying the 10 effectively existing beds).

The services of this hospital have the tendency to operate like a city dispensary whereas the objective is to serve as a rural hospital. Only vaccination operations and consultation of pregnant women are carried out normally. The Hospital has no mobile team to support the actions of the Nyabessan DHC which is isolated.

We would summarize by saying that the Ma'an hospital lacks efficiency to satisfy the population either in curative medicine or in preventive medicine. Health education is reduced to the most elementary level: thus the fecalourimary danger is not controlled in the immediate neighborhood of the Hospital.

VII. OTHER SOCIO-ECONOMIC INFRASTRUCTURES

The other socio-economic infrastructures of the project area, are under-developed like the health centers.

7.1 Public Road

The trunk B road that comes from Ma'an, stops at Nyabessan. It is practicable throughout the year and is somehow well maintained. All the villages of the Mvaye-Ouest Canton are living along this road. By contrast, the hamlets of the area of Canton Boucle of Ntem and the Ebenmeyou village are respectively enclave by the Ntem and the Ndjo'o and the Biwome which must be crossed by canoe (one has to pay a passing-boatman going to Ntem). Access into the hamlets, and crop area is done through forest paths that have been more or less marked according to the degree of regular passing.

7.2 Insufficient Schools (See Annex III for details)

In the area close to the project there is a total of 5 primary schools with one that is closed down for lack of pupils (at Aloum I) and that of Nyabessan, the only one constructed by the State (in 1973). The others are private and mission schools. The buildings are at times ramshackle, the number of classrooms not enough as compared to the number of classes (2 simultaneous classes in one room and per teacher, in average) and didactic material hardly exists and the rate of repeating a class is high. Teachers usually have accommodation and salary problems; State subvention is not awarded to mission schools and the parents hardly pay in the school fee (has been cut down from 7,000 F CFA to 2,000 F CFA).

For the 1992 - 1993 academic year the number in roll for school children in the area is 338, representing a high schooling rate of (about 86%; with a higher rate for the girls). Parents are quite in favor of the public education of their offspring, but this attitude of theirs a little bit contrasts with their other psycho-sociological behaviors vis à vis hygiene and health, food taboos for the children, their religious convictions and witchcraft practices of all kinds...

The rate of passing to the college is high (66% average for the Ma'an district). The nearest secondary school is at Ma'an.

7.3 Poor Water Supply

In spite of the numerous and varied hydraulic resources in the area, the practical water supply conditions of the people are terrible. Supply is done from natural points (pools and streams) either from some fifteen wells (see details in Annex III); these are open wells where water is manually drawn with a bucket; they are very deep and are partially fitted with pipes. These wells, constructed in 1988 by the French Association for Volunteers of Progress (AFVP) were poorly conceived. They get dry in the dry season. Considering the water supply conditions of the populations, it is not surprising to notice the high rate of various parasitic diseases earlier identified.

VIII. ECONOMIC ACTIVITIES: LIMITED TO THE PRIMARY SECTOR AND ITS DECLINE

8.1 Agriculture: Cocoa Crisis and Women's Engagement in Farming

Agriculture, primarily cocoa cultivation, constitutes the main economic market activity in the study area. Unfortunately this activity is on the decline since some years because of the drops in world prices and the suspension of SODECAO's support since the 1989 - 1990 cacao season (its main activity was to provide plant protection products, selected seedlings and secondarily, technical guidance).

8.1.1 Cropping Systems

From a general agronomic viewpoint, the regional climate determines two food cropping cycles per year (2 rainy seasons), the practice of associated food crops with shifted cycles endless in fact to harvest food crops throughout the year. In this sense, food crop fields are indeed a real living larder. All the crops are planted on cleared forest lands under fragile fertility condition as aforementioned. There are three main types of corp field:

(i) Cocoa fields; half-shaded by forest trees (tall trees are left during clearing), with caring and weeding of under planted cocoa trees being done by men;

(ii) Food crop fields; on more open cleared forest land (more heliophile crops) cultivated mainly by women (men are mainly engaged in the first clearing). In these fields, there are various inter cropping systems according to a certain number of associations and successions of crops.

The food cropping patterns are outlined in 2 main types:

- Groundnuts, at the beginning of the rotation (on short and medium term fallow from 3 to 9 years), followed by various associated food crops with shifted cycles (cocoyam, maize, plantain, banana, yam, eggplant, squash) and cassava (which is a crop difficult to plant) at the end of the planting cycle, before the return of the fallow period.

- Squash planted on cleared forest in log fallow period (locally called cucumber) at the beginning of the rotation, associated with plantain and/or mainly with cocoyams, then cassava at the end of the cycle as same as in the above pattern. Details on the cycles, technical follow-up and cropping calendars is given in Annex I.

To give a schematic summary we can say that each woman plants and reaps on 3 types of farms instantaneously:

- the new fields of the year where she harvests annual crops spread through the 2 cycles of the rainy seasons (squash, groundnuts, maize, yams, eggplant and cocoyam of the 1st cycle)

- the fields of 2nd year where she harvests 2nd cycle cocoyam, cassava and plantain planted the previous year.

- the fields of 3rd year that is being invaded by the bushes and where a few heads of cassava planted by the end of the 1st year and of plantain, can still be harvested.

From the 4th year the fields become difficult to penetrate. The field must be newly cleared between the 7th year earliest and the 10th year latest following the availability of cultivable land and the evolution of related social practices and cropping techniques.

(iii) Home vegetable gardens with various vegetables planted in small areas (cocoyams, pepper squash, eggplant, etc.) and a belt of familiar fruit trees (banana, safout, mango, pear, citrus trees) sandwiched between and behind dwelling houses (on the "garden" side as opposed to the "street" side of the village). The smaller livestock (pigs, small ruminants, fowls) are at stay and cause sometimes, damages on the micro-lands which derive a good quantity of organic matter from (animal wastes, vegetal and domestic wastes). To this table we can add the presence here and there of natural palm oil trees down the slope, or multiplied by man (see estimation below) which is the essential local source of vegetal oil.

8.1.2 Role of Tasks and Working Time between Men and Women

Distribution of responsibilities and main tasks according to sexes can be summarized as follows:

- For men: deforestation of women's food crop fields, cocoa cropping, hunting, and secondarily fishing;

- For women: maintenance and harvesting of food crops, maintenance of home gardens, participating in cocoa harvesting; Rustic processing (difficult) of cassava and palm nuts; tapping of palm wine (100 F CFA a litter) and palm liquor through distillation (1,200 to 1,500 F/l); fetching for water and wood; cooking for the family and breast-feeding and caring for the young children. Like in any other part of Africa, the woman's responsibility and tasks are heavy.

After a survey of 50 homes, without considering the processing of food products and domestic ties, the investigation on working time only shows a partial overload of the working timetable and the difficulties incurred by the women.

The following results were obtained (see details in annex III):

- Men: 185 to 210 days of diverse work per year (4.2 to 5.5 hrs/day)

- Women: 200 to 240 days of farm work per year (between 5 and 6 hours per day in average, spent in the farm, with peak hours during field preparation and at the beginning of crop cycle).

8.1.3 Quantitative Approach of Land Occupation for Production

A quantitative approach of the agricultural sector is based on the socio-demographic structure of the population, SODECAO's statistics (up to 1987/88), agro-economic surveys carried out within the framework of the present study (see annex III), the report on the exploitation of the Ambam region (SEDA - MINPAT 1986).

Cocoa cropping: its expansion in the area close to the project would be:

- 182 ha in all for plantations with 148 ha in actual production
- total production estimated: 41 tons (277 kg per ha in production, 225kg per ha for all categories)
- number of farmers: 153 (54% of homes); 1.2ha/farmer; 268 kg in average production/farmer.

Food crops: Their dimensions are more difficult to determine as they are not framed on the one hand, and that the systems in question are complexes of multiple cropping associations on the other hand.

The agro-economic survey carried out besides 38 women holds that an area used for food cropping each year by every active woman (at times with the assistance of young girls) is on an average 0.6ha (average per hamlet varying from 0.33ha to 1.2ha). The area harvested per year (field of the year, field of preceding year and field for 2 years) would be 1.8ha. Based on the 307 active women who are autonomous (having a kitchen) the total harvested area, with up to 2/3 years fields, would be 553ha in the whole area close to the project (that is 2ha per family).

Agro-economic surveys have permitted to have an approach on the yields and the total production per measured specific cropping density. See synthetic results in Table 3 that follows:

Table 3 An Approach of Food Production and Type of Field

Food crops in associations	R.e.p cycle kg/year	% per/ cycle	% zone	Field of the year (1ha) Product kg/year	% of land occupation	1 year field (1ha) Total Prod./yr.	% of land	2 yrs. field (1ha) Total occupation
Groundnut	30.0	45	90	1,080	-	-	-	-
Maize	14.5	3	3	87	-	-	-	-
Squash	30.0	45	-	1,350	-	-	-	-
Others	30.0	1	1	30	5	150	-	-
Cocoyam	27.7	1	1	28	5	139	-	-
Plantain	100.0	2	2	200	30	3,000	10	1,000
Cassava	120.0	3	3	255	35	2,975	15	1,275

Notes 1) R.e.p.: Yields in equivalent crop taken per ha
2) For annual crops the yield in equivalents are the averages.
3) For the year, percentages of land occupation per crops are given per cycle.

Table 4

	Total Annual Production of the project area (tons)	Average Annual Production per Capita (kg) (5.7 persons average per family)	Available strength
Groundnuts	199	125	-
Maize	16	10.0	-
Squash	249	156	-
Others	66	42	-
Cocoyams	62	39	-
Plantain	774	484	-
Cassava	831	520	- -
Palm nuts (heads)[7]	511	320	- -
Palm oil	14,600 l	9 l	- -
Palm wine	64,000 l	40 l	- -

For familial fruit trees around the inhabited areas, investigation gave the following results:

Table 5

Type of fruit tree	Average no./ family	Average production/ head	Total Production/ Year (t)	Average Production./cap
Banana	31.7	5	43	108
Pear	3.4	35	33	42
Mango	3.1	100	87	109
Safout	2.2	100kg	70	44
Citrus	2.1	30	18	37
Kola nut	0.7	700nuts	138,000nuts	86
Coco nut	0.5	85nuts	12,000	7

7 On the basis of 9 palm trees per family and 200 kg of heads of nusts per stem averagely 2,557 palms in all.

8.1.4 Small Livestock

Animal husbandry is limited to poultry (fowl, duck) in wandering condition and to goats and sheep (introduced by the missions) also in wandering condition. The economic weight of the latter is not high, as they are kept as prestigious animals and are only sacrificed or offered at feasts and ceremonies.

Estimate drawn from agro-economic survey gives a total of about 120 goats , 120 sheep, 600 fouls, and 240 pigs; 43% of some families breed other animals than poultry.

8.1.5 Weak Support to Agriculture

Extension services for cocoa by SODECAO are suspended since 1989; they used to do the technical coverage of this profitable crop. There still exists a theoretical agricultural post at Nyabessan with an agent in place (normally two budgetary posts). Due to no concrete objectives, means, incentive and technical know-how, extension actions are dying out and money unavailable: the system must be revised all over.

As far as the agronomic research is concerned, the research center at Nkoevone (Ebolowa) is representative of the study area. Some acquisitions have been made in the selection of variety and cropping techniques for food crops on weeded fields (see details in annex III). Although these results only partially involve the complex technical and socio-economic dimensions of the food cropping associations, they could hence forth bring about some improvements, but these do not reach the peasants due to the ineffective education system.

8.2 Brisk Secondary Activity: Hunting

Hunting is a real economic activity of the population in the project area. It is the main source of animal protein in food ration; it also provides substantial income through the sales of animals in larger villages, Nyabessan and Ma'an centers and also to "passing people"...

8.2.1 Hunters and types of hunting

With regard to the time given in for hunting activity and the economic value of the catches, the hunters in the project areas can be divided into two categories: the big hunters and the small hunters. (45% of male, heads of families), estimated at 11 in number, constitute the big hunters. For them, hunting is the main activity all year long, and they spend one to

weeks in the forest where they set up more than two hundred traps each. The small hunters, about 90 in number in the project area (28% of male adults), are principally farmers. Their main hunting period is the rainy season (which is the best time for trap hunting and they set 50 to 150 traps within 5km radius around the villages. Hunting is made either by gun [8] (for monkeys and big animals) or by different kinds of traps (neck traps for small monkeys and squirrel; ground neck traps for rodents and small carnivorous animals, ground foot trap for hares, antelopes and suidae, bar traps, ekoumou which is traditional and still in use, for rat moles and porcupines

8.2.2 Species of Game and an Approach of the Hunting

It is well known within the forest area that "anything that moves could be an animal" with the exception of traditional food taboos for certain categories of individuals (women and children especially). Among the games previously identified (chap V) the following groups of animals are either particularly appreciated by the population for their taste, or these animals are subject to high demand for city consumption.

---

8 According to the authorities of the control post at Maan, there are some 23 guns (mainly caliber 2) in good state in the project zone; and 50 cartridges are shot averagely per gun per year.

Table 6 Classification of animal by the level of socio-economic interest

	Local consumption	City demand
Big Monkeys (gorilla, chimpanzee)	3	3
Small Monkeys	2	1
Carnivores (flesh)	3	3
Carnivores (skin)	3	1
Small cephalopods (hares)	1	1
Antelopes (big cephalopods, situtongu etc)	1	1
Aulacode (hedgehog)	2	2
Other rodents	3	3
Pangolins	2	1
Crocodiles	3	1
Vipers with horns, Python	1	1
Birds	3	3
Proc-epine	1	1
Suidas	1	1

(NB 1: Very appreciated; 2: appreciated; 3: on an average appreciated)

The above classification does not reflect the scarcity of the animal in question (see details on prices of the kinds of animals in annex III).

Following the field surveys, the tables on hunting/types and means would be:

- During the rains:
  - o Big hunters: 28 animals/week (7 hares, 3 antelopes, 5 porc-epines, 3 hedgehogs, 2 pangolins, 5 rat moles, 3 diverse)
  - o Small hunters: 10 animals/week (2 hares, 2 porc-epines, 2 pangolins, 2 rat moles, 2 diverse)
- During the dry season: for both types of hunters): 4 animals in average per week. (1 hare, 1 porc-epine, 2 rat moles)

Animals are less frequently captured; but however, they are regularly caught as seen by (number of catches per year): 7 for big monkeys (Gorillas and chimpanzees), 3 crocodiles in average per hunter. As for a total of 12 could be killed per year. The other big scarce games (panthers, gilded cat, hylocher, elephant, buffalo, forest antelope) were formerly killed under exceptional conditions. The total number of animals killed annually in the zone would be 36,750, that is 181 tons fresh weight an equivalent of 78 tons dried weight. For a

maximum surroundings of 900,000ha, the minimum sampling of 2kg/ha is high for forest zone.

8.2.3 Economics and Income from Hunting

The ratios of auto-consumption have been estimated per season and per type of hunters:

- Rainy season: big hunters: 20%; small hunters: 90%

- Dry season: big and small hunters: 60%

Total annual auto-consumption for the entire zone would be 115 tons (fresh) making a daily ratio of 197g (fresh) or 90g of meat with bones per capita.

The annual incomes derived from the sales of animals have been estimated at (see details on estimates in annex III): 460,000 F CFA for big hunters with guns; 260,000 F CFA for big hungers without guns; 70,000 F CFA for small hunters. Thus hunting has a remarkable economic potential in the project area, from this natural resource which needs to be managed rigorously in the future if there is need to preserve it.

8.2.4 Problematic Control of Hunting and the Captures of Living Animals

Hunting and the capturing of living animals are subject to a theoretical regulation in Cameroon (see detail in annex III). The Control Post of Ma'an has 3 agents with 1 motorcycle in a poor state. The main task of these forest-guards are in principle:

(i) Prevention of Poaching: Consumption of wild animal meat is permitted to riverside inhabitants but its sale is forbidden; their main activity is indeed to seize animals transported in vehicles passing through Ma'an Center.

(ii) Check of Hunting arms and insurance of permits: Only two permits for limited hunting were issued in 1990 in the Ma'an District for a total of 139 guns officially registered by the authorities.

It is to be noted also that capture of living animals is also observed in the study area (especially catching of living parrots, and also young monkeys). Four captures are officially licensed in the Ma'an District. They have theoretically catching quotas and must pay taxes, but it is difficult here again to control them.

8.3 Secondary Activity of Fishing in the River

Traditional fishing is practiced here and there during the long dry season mainly (December -February) on river Ntem, Ndjo'o and the Biwome; and secondarily in the period of rising waters (October - November). The Mvaye and the Ntoumou in the study area are by tradition neither big fishermen, nor big boatmen, so fishing is a sub activity to them as compared to hunting when the supply of animal proteins to the population is concerned.

8.3.1 Types and Haul of Fish Caught

Hydrobiological conditions and the ichtyological wildlife are synthetically defined above (see details respectively in annexes III and I). After the first field survey in October - November 1992 the fishes caught (in this season) usually belong to 4 groups (Bagridae, Characidae, Hochokidae, Citharinadae) in order of main genres and importance respectively: Auchenoglamis, Bricynus, Synodontis, Citharinus. Secondarily, other 5 families are represented in the captures namely with the following genres: Mormyrops, Tilapia, Hermichromis, Clarias and Eutropius. Since its introduction three years ago, there has been, among others, a multiplication of the electric fish (Malapterus electricus) to the displeasure of fishermen. The natural waterfalls of river Ntem form a natural barrier preventing the easy migration of the fish.

Surveys carried out in the Campo district within the framework of food anthropological project of ORSTOM/CNRS (provisional report mentioned in the bibliography in annex I) estimated that the daily ration in fish would be 40g per capita for the Mvaye forest dwellers in this district, with part of the sea fish bought from the local market. Based on the hypothesis of 30g of continental fish per capita in the project area, and bearing in mind that sales to other areas is made by 11 big fishermen who sell 70% of a catch of fish, the volume for the total annual catches would be around 24 tons, and this would mean an average of 24 kg/ha of water surface area (average area for Ndjo'o + Biwome + Ntem estimated at: 1,000 ha).

8.3.2 Fishermen and Fishing Techniques

There are some forty adult men (1 out of 8) who regularly practice fishing as part time activity following field surveys reports (but children and adolescents who do fishing for leisure or lack of job are not included here).

The main productive techniques used are:

- sleeping nets of 8 to 15m long set in the evening and visited at dawn.

- line hooks: 30 to 50m long with hooks at every 50cm to 1m. They are also set in the evening and visited at dawn. There are also some traditional techniques which consist of rudimentary blockages (collective fishing) and of hoop nets, castnets and hand fishing lines and fixed pegs for leisure time fishermen. The canoes are single-wood-made and single-seat (3 to 4m long). Most often, they are carved in parasols (Musanga Cecropoiedes); they are quite rudimentary and don't last long (2 to 3 years at most)

Considering that there is about 5 months of fishing season a year and 4 days of fishing weekly, the average yields, everything being equal with the regular fishermen, would be 600 kg per year and 7 kg per day of fishing.

8.3.3 Small Economic Value

On the basis of a 500 F CFA value for a kilogram of fresh fish (on the market) the fishing activity represents a gross total of 12 millions F CFA for the entire project area. With the assumption that the roughly forty regular fishermen supply the rent of the population and that family auto-consumption is about 50 g per person and per day, their gross annual financial income would be about 217,000 F CFA and the net income would be 195,000 F CFA at most, after an average cost for the renewal of material.

8.4 Other Minor Economic Activities

8.4.1 Traditional Lumbering and Picking of Natural Plants

For the time being, there is no actual forest exploitation activity in the project area. For the riverside populations the forest is an appreciable (free) resource of supply for all sorts of products: construction wood, firewood, various picking products. For the traditional housing, the following are the main building material fetched from the forest: Raffia "mats" waved for roofing; lattice of perch leaves and poles for framing (3 main types are used; see annex III).

For more elaborate constructions, the mechanical cutting of timber is also done traditionally on the spot (5 small chain-saws in the project area). The timbers are cut out into slate laths, planks and rafters. Four major trees are used for that purpose and 5 others are mainly used for firewood (see annex III).

The forest is rich in bush fruits (5 main kinds): mushrooms, snails, etc... They play an important role in the feeding habits of the people. The traditional pharmacy (more or less attached to the witchcraft practices) is based on a very diversified collection of forest products which have not been given particular attention within the framework of this study but which needs to be examined by scientists.

8.4.2 Commerce, Handicraft and Tourism

Apart from agriculture, hunting, fishery and picking, other economic activities remain very secondary up to the present and are restricted to artisan activities (mason, carpenter, tailor) and small businesses(there are 5 shops and 1 drinking spot in Nyabessan) and other sales spots scattered in Ntebezok, Melen, Nsebito, Nhemeyong. Beer as well as palm wine consumption is high and seems important, essentially among the men.

8.5 Inventory of Local Production and Family Incomes

8.5.1 Agricultural Production

A study on the simplified evaluation of the total agricultural production (PAT) (net value) and of the financial agriculture income is given in annex III at local prices of the factors and products and is presented synthetically in the following (Table 7).

Table 7 An approach of the total agricultural production and agricultural financial income

Component	Production in volume (tons)	Gross value of production	Coefficient of Interim cons.	Net value of production	% of gross production commercialized	Financial Agric. income Million CFA	%
		Million CFA		Million CFA			
Cocoa	41	9.0	10	8.2	100	8.2	
Groundnuts	199	39.8	20	31.8	60	19.1	
Maize	16	0.4	20	0.3	0	- -	
Squash	249	62.2	25	46.7	60	28.0	
Cocoyam	62	1.6	5	1.5	0	-	
Plantain	774	77.4	5	73.6	60	44.1	
Manioc	831	41.6	5	39.5	10	3.9	
Other foodstuffs (full farms/garden)	66	3.3	5	3.1	0	-	
Palm oil	14,600 l	2.9	0	2.9	0	-	
Banana	43	2.1	5	2.0	0	-	
Mango	87	4.3	0	4.3	0	-	
Pear-citrus	51	2.6	0	2.6	0	-	
Safout and others	100	2.5	0	2.5	0	-	
Sheep	300kg	0.2	0	0.2	0	-	
Caprimes	300kg	0.2	0	0.2	0	-	
Pigs	6	3.3	0	3.3	0	-	
Poultry	900kg	0.9	0	0.9	0	-	
Palm wine/alcohol	64,000 l	6.4	0	6.4	20	1.3	
				230.0		104.6	

8.5.2 Production by Sectors

The net value of annual agricultural production would be 819,000 FRS on an average, per family and the financial agricultural income is 312,000 F CFA per year/family.

Considering the entire economic activities and the whole of the project area, assessment of the internal local product will be as shown below; Note should be taken on the very restricted output of cocoa cropping in the local agricultural economy (less than 8% of the financial agricultural income) and the essential role of the food crops in the same financial line. The total value on auto consumption would be 126.7 millions F CFA (217 F CFA/day/capita or 0.8 US $: this is near object poverty for Cameroon.

Table 8 Production by Sector

	Net value of total production		Financial revenue (commercialized production)	
	Millions F CFA	%	Millions F CFA	%
PRIMARY SECTOR	286	94.1	124.7	87.4
o(Strictly) Agriculture	230	75.7	104.6	73.3
oHunting	2.5	8.2	11.4	8.0
oFishing	11	3.6	8.7	6.1
oTimber exploitation/picking	20	6.6	-	
TERTIARY SECTOR				
(added values)	18	5.9	18	12.6
oArtisan, Commerce, Tourism	6	2.0	6	4.2
oAdministration (salaries for civil servants and equivalents)	12	3.9	12	8.4
TOTAL	304	100	142.7	100

The net value for total annual production would be 304 million F CFA, that's 190,000 F CFA per capita (or 690 US $) and financial income of 508,000 F CFA/family on an average per year 42,300 F CFA/month.

Besides the revenue disparities connected to the type of activities, there is the problem of the size of the families and the number of children to be fed and given education. These conditions dictate on the economic situation of the family which generally has an active male and an active female persons. In effect, agro-economic investigations show that expenditures on feeding (purchase of food, plus auto consumption), clothing and education would represent nearly 60% of the family's global expenses, health expenses 11%, social relationship nearly 20% and savings hardly 2%. All this gives a total annual expense of about 267,000 F CFA/family.

IX. LIMITED FUTURE OR ON-GOING PROJECTS AND REGIONAL PROGRAMS

The project area does not enjoy any on-going project on the economic and social development, management of the environment or development of the territory. The

following can be listed as main projects more or less important in the environment of the Memve Ele zone (see annexes I, II, III, for more details).

a) On-going projects:

- Forest exploitation of the Campo Logging Company (formerly private)

This company exploits the forest right up to Nko'elong at the end of the path, without any concern for the management of the environment, in a theoretical reserve fauna. The company hopes to reach right up to Ebenmeyong and even up to attain the Canton of Ntem Boucle if its permit is renewed, after 1994.

- The USAID - SESA 'American - Cameroon Cooperation for Primary Health Care Project

(Its main components consists of medical and pharmaceutical supplies, providing means of transport, family planning, health training and education).

The project, for the time being, only covers the district of Ma'an. The sine qua non condition of its extension to the district of Ma'an is the assigning of a resident Physician by the MINSA (Ministry of Health) to its hospital.

- SODECAO Restructure Project with the deployment of technical district team to Ma'an for a new system of support for this crop based on the groupings of producers.

(ii) Other Planned regional or national projects or under study of the Memve Ele project (these projects are often clashing and lack coordination).

- Forestry and National Development Master Plans studied respectively in a unilateral manner by the Department of forests of the new MINEF and the Department of Territorial Development of MINDAT (Canadian Bilateral Assistance in the first case, and German in the 2nd case).

- World Bank Project for the reinforcement of the Compo wildlife reserve with preliminary condition of non renewal of Campo Forest permit.

- Valorization project of the Ambam region (main objective, development and equipment of the border zones in infrastructures.

- National research program and agricultural Extension plan (reinforcement of the Ekona Research Center and a setting up of the "T" and "V" systems on food crops, with local and regional extensions.

- Food security Project FIMAC: Financed by the World Bank - micro food and agro-alimentation projects based on small solidarity groups of beneficiaries ensuring initial contribution of 30 to 40%.

PART III

ASSESSMENT OF PROJECT IMPACTS

X. IMPACTS ON THE NATURAL ENVIRONMENT

The main characteristics of the project are presented in the introduction for the low variant which is the optimal option proposed by JICA Study Team at this stage (maximum water level at EL. 392 m; dam crest at 395 m for the assessment of the impacts on human infrastructures; submerged area: 1,900 ha). In addition to this main variant, the evaluation of impacts has been done for two other variants at the request of JICA/SONEL as seen below:

Table 9 Development Plan Alternatives (Variants)

Variant No.	Elevation of Crop Submerge	Elevation for Infrastructure Submerge	Submerged Area (ha)
1) Main Variant (Ntem only)	392 m	395 m	1,900 ha
2) Medium Variant (Ntem only)	395 m	400 m	2,800 ha
3) Maximum Variant (Ntem + Ndjo'o + Biwome)	400	405 m	7,600 ha

10.1 Hydrology and the Memve Ele Falls

Data on the hydrology, especially those on the high waters and low waters discharge will be earmarked down the power house due to lamination effected by the dam. These effects need precision during the execution studies (weekly management program of the reservoir according to months), and the eventual impacts on already assessed natural and socio-economic environment.

The most affected part by the dam will be the site of the dam itself around the bays situated between the dike of the dam and the way out for turbine water in the hydro-electric power house after being brought by penstock (see Fig. 6.3 of the Main Report). Apart from conservation measures, the following are potential impacts on the Memve Ele falls:

- maximum variant: the Ntem, the Ndjo'o and the Biwome dam; draining and complete stop of the falls in their three channels apart from flood periods.
- The dam variant on the Ntem alone: this has similar consequences to the former on the 2 southern channel of the falls with an over flow from 450m3/sec (110 days per year on an average). By contrast, the northern channel of the falls would still be supplied by the Biwome and the Ndjo'o all year long (average annual discharge 35 m3/sec), and the remaining discharge of the fall would be around 15 - 20% of the present average flow in

this channel

Meanwhile one of the variants (W1) of the penstock goes along with a small secondary head pond. In any case as the turbine discharge comes out of the power house, it will pass through a basin of energy dispersion which would restore the Ntem in the south under its natural prerequisites of speed, discharge and the rivers.

Impacts on the Memve Ele falls according to the variants and the seasons will seriously modify its biotop conditions, as well as its tourist interest. Eventually, there will be problems of security during the episodic re-establishment of the falls. All these points need ample analysis during execution studies.

10.2 Inundation of the Forests and the Flora

The areas of the stretches of water per variant are given above. The present average area of the streams in the project area are 700 ha for the Ntem and 300 ha for the Ndjo'o + Biwome respectively. Estimate of loss in forest area and capacity would be as follows (see details in annex III).

Table 10

	Total submerged forest area (ha)	nos. of category A trees>40 cm	nos. of category. B+C trees>40 cm	Volume of construction wood and local use (1,000m3)	Net value of lost wood Million Frs.
Main Variant 1	1,200	2,400	6,000	1,200	2,638
Medium Variant 2	2,100	4,200	10,500	2,100	4,967
Maximum Variant 3	6,600	13,200	33,000	6,600	15,609

N.B * Norms: Commercial trees, category A: 2 trees per hectare; commercial trees category B + C: 5 trees per hectare. Volume of construction wood and for local fire use: 1,000m3/ha

* net value for wood = market or consumption price for wood minus costs of exploitation, processing and starting according to categories (added value for the concerned economic agent; Exploitable wood 30,000 F. CFA/m3, service and local fire wood 1,000 F. CFA/m3 in average.

Thus the loss in value is far from being negligible.

Meanwhile vegetation that will be submerged will cause serious navigation problems and on the selling of fishing engines in the area of the lake on the one hand; on the other hand there would be negative modifications of the physic-chemical conditions of water during the first years (see paragraph 10.3 and 12.3.3 below).

Lastly, the dam site and the resettlement areas of part of the population will provoke complete deforestation, and partial agricultural deforestation which will increase and loss in botany linked to the flooding of the forest for which an inventory must be made on very rare eventual species, notably on and around the site of the falls and in the rapids.

10.3 Hydrology of the Reservoir and Fishing Potential

Besides the physical obstacles that will be caused by the flooded trees and lianas, decay of the flooded biomass will lead to a sensitive modification of the quality of waters. From this viewpoint, the future reservoir is considered through a high annual intakes (storage capacity) of renewal of 96.5, which will ensure a usual renewal and a good mixture of water. After some months during which time there will be a fall in the rate of oxygen and anaerobic fermentation in the medium and bottom layers of water, the situation would rapidly become normal (ph neutral, the rate of dissolve oxygen will be correct, 3 mg/l minimum) in the medium and superficial layers.

The phytoplankton and the ichthyological fauna can thereafter develop afresh (in less than 1 year). The dam will no longer restrict the diversity of the ichthyological fauna than the natural barrier of the falls did it, everything being equal. Lastly, after an eventual restocking of fish that will permit to enhance the reconstitution and the development of the stock of fish in the extension of the new lake, the fishing potential (in terms of annual productivity) could be 50 kg of various species (8 main ones, see annex III) caught per ha/year.

10.4 Impact on the Fauna

Three categories of negative impacts are to be considered:

(i) Impacts related to the site and project works

The deforested and tracked areas will create opportunities to set up productive traps and catch more games, as track activities have proven for topographic survey study.

The residing population in the project area will be more than double during the work period ("foreign" labor for the site accompanying immigrations: families, traders, diverse services, informal sector). If no specific efficient measure is taken, the wildlife will sustain a hunting pressure quite above the annual possibilities (its seems already restricted presently), and this call for a fast disappearance of games in the synergetic influence area extended by the project influence (about 90,000 ha).

(ii) Impacts related to the filling of the reservoir

The disappearance of the biotops of the present banks of the rivers will have negative effects on the reproduction of reptiles (mainly crocodiles) amphibians for which they form laying and growth grounds for laws and juveniles. Some species of the litter and the particular wildlife of the raffia will be flooded on disappear due to lack of a new ecological nest. Mammals and some birds will be isolated on the islands or will have to migrate towards the unbalanced areas. They will be particularly menaced by predators (rapacious animals, horn vipers, python, carnivorous...) that will multiply themselves in the first place.

The young ones and future generations will be killed (abandon of modification, zones, burrows and lairs, which are more serious vulnerability for the young ones).

(iii) Final impacts on the loss in forest space:-

As a last resort, submersion of the forest will represent a quantitative loss in the forestry ecosystem and its animal biomass. For illustration purpose, we can consider very roughly that the animal presently examined (2 kg of living weight per hectare) represents 1/3 of the total game stock required by the population, and 1/5 of the total animal biomass of vertebrates.

In all, the financial loss in wildlife will be as follows, according to the variants:

Table 11

	Disappearance in hunting fauna			Disappearance in vertebrate fauna	
	Tons alive	nos.. of animals	Value in Millions F CFA	Tons alive	nos. of animals
Main Variant 1	7.2	1,800	1.0	12.0	12,000
Medium Variant 2	12.6	3,150	1.7	21.0	21,000
Maximum Variant 3	39.6	9,900	5.5	66.0	66,000

N.B These very rough data are indicated here for illustration sake and are subject to revision and precision. The main wildlife composition has however been given in chapter IV above (paragraph. 4.4).

XI. IMPACTS ON THE HEALTH OF THE DWELLERS

The 3 variants of the project as defined do not generally modify the evaluation of the sanitary impacts of the project which are more in qualitative than quantitative terms.

11.1 Impacts on Vectors

The waters of the dam as well as the deforestation activities of the environment works play an important role in the distribution, and the special and temporal transmission of parasites, virus and bacteria diseases. Thus the project should take into consideration the modalities of transmission of vectorial diseases and the ecology of vectors, in a way to restrict the causes of their proliferation.

The partial deforestation with a thin vegetation coverage, or alternation of tracks or empty areas and forest islands, (favoring the development of the existing species of mosquitoes, vectors of malaria (the Anaphele type) and the spreading of new species (Anopheles funestus in particular). The reserve water could bring about the spreading of mosquitoes like Aedes and culex in its immediate surroundings. These two species are potential vectors of yellow fever and bancroff filaria respectively and even if their bites are still not parasitic as of now, they still remain a nuisance through their high of presence. The larvae and nymphs of simulies are abundant on aquatic plants in rapid flowing and well oxygenated waters.

These conditions presently prevail on the Ntem up and downstream to the falls. The construction of the dam and the fountain of the reservoir upstream will decrease the running and turbulent flows, and by this will reduce the homes and number of simulies.

Similarly, the estimated contribution of the labor force of the Campo area, where there is presently a home for typanomias, constitutes a risk of an outbreak of sleeping sickness in the project area where there is an influx of tsetse fly which can be favored by a partial forest coverage. An increase in hygrometry linked to the lake will favor the development of talons and of the nuisance provoked by their painful bites. If the surroundings of the future lake and the reduction in the running water can bring some positive conditions to the development of mollusc, then the risks of bilharzioses and distomatoses appearing in the area are low (absence of present potential vectors and homes of bilhanziose in the South

province).

11.2 Impacts on Parasites

Considering the already high level of malaria present in the project zone, and the intensive persistence of Plasmodium falciparum in all seasons, the intensity of transmission of this disease will not be generally modified by the project.

The absence of onchocerca presently in the project area, and the distance of the nearest homes (Dja and Lobo divisions) form a good number of factors that minimize the risk of an outbreak of this parasitic disease. This risk is however not void as seen through the populations' contribution for the dam works and the development of fishing. Some of the individual could be carriers of the disease and thus agents of contamination.

The frequency of filaria flies (chrysops sp.) and culicoid vectors respectively of Loa Loa filariose (loases) and Mansonella (mansonelloses) as well as the relatively high prevalence of these two parasites, give the impression that the project and the mixture of the population favor their expansion.

With intestinal parasites we can retain that the raising of the ground water after the filling of the dam could increase transmission of ankylostomase which is already spreading.

By contrast, the effects on amebas and other intestinal nematodoises will not be increased by the project; they will even be on the decline if the dam water is adequately exploited.

In effect, mastering of the water resources formed by the reservoir lake for the future dam could be followed by a sound management of water through any supply network, by it elementary. The prime advantage of intestinal parasites and other bacteria which are essentially transmitted in the region through the consumption of dirty stream or wells waters and food contaminated by dirty waters.

11.3 Impacts on the Other Health Infrastructures

Vis à vis other health infrastructures, the construction of the Memve Ele dam can be a primordial advantage for the life style of the riverside populations, this is possible if the construction goes along with improved measures on drinkable water supply, general hygiene, and the education and health infrastructures of the population.

In effect, the expected socio-economic situation can be viewed from the improvement of the two types of data:

(i) Availability of water in the villages and a good use of the wells which will be easily developed within elementary norms of hygiene: Curbing and/or covered wells. The water that will be brought near living homes will help construct pipes in the villages.

(ii) Health and traditional water supply: "Water is Life". Since the population would no longer use doubtful water for drinking and cooking, the risks of falling prey to infectious disease of the origin of water (dysentery and others like diarrhea, cholera, typhoid fever paratyphoid fever will be slim).

The project site and the sudden increase of the residing population will lead to the development of the tertiary sector and an important increase in the circulation of money. The food systems will be diversified through imported food. But we still need to know whether the outcome will be positive on the present population as regards stable economic activity and amelioration, especially on the feeding condition of children.

The short term attraction of commerce in the site may divert the autochtone population from agriculture, and notably the women from their food cropping.

This represents a risk for under-development and a backward agro-alimentation deficit through a well-known depressive and brutal phenomenon of the aftermath of the site for such a project, which will neither hamper any local activity nor will mobilize a permanent personnel.

Meanwhile, socio-demographic changes during the work phase will favor social promiscuity and make way for the contamination of STD and infections sicknesses both for the local and immigrated population. The latter, according to their zone of origin, may also be seriously infected by the string of parasites that presently prevail in the project area...

These are good reasons to set up efficient education system and health extension program during and after works.

11.4 Conclusion: Restricted Impacts and New Parasitic Dangers

In spite of the poor health and nutritional status of the population in the sector, the negative impacts of the project on morbidity and mortality should be generally limited, as dictated by the compensatory measures of health development.

The presence of simulies and tsetse flies, though not infected by parasites, represents a non negligible danger because the influx of the population that will be attracted by the economic development during the construction of the dam, could constitute a source of contamination of vectors while bringing subjects of onchocerca and/or trypanosomes; by this, there will be

an outbreak of onchocerca and/or sleeping sickness in the sector' the seat of trypanosomes at Campo constitutes a real danger.

XII IMPACTS ON INFRASTRUCTURES AND ACTIVITIES

12.1 Impacts on Housing and the Population to be Resettled

An inventory of the various hamlets to be decamped according to the elevation of variants considered has been systematically made in the field during the agro-economic survey of October 1992. Detail on the evaluations per type of building is given in annex III, and the impacts are summarized as follows:

Table 12

	nos. of building affected	nos. of housing unit affected		Pop. concerned			nos. of administrative villages	nos.. of hamlets	nos. of hamlets to be
		Total	per m.f unevenness	nos. of families	nos. of housing	% Family	affected	completely	decamped
Variant 3 (maximum)	147	134	22	63	373	22	8	18	14
Variant 2 (median)	31	27	4	13	77	5	4	5	1
Variant 1 (main)	9	9		5	30	2	1	1	0

N.B Total influence area of the project: 281 families, 1,599 inhabitants, 14 administrative villages, 56 hamlets. We notice that the main variant 1 is less delimental on housing and that the prospective resettlement will be restricted. On the contrary, between the median variant 2 and the maximum variant 3 considered, the negative quantitative gap is quite important, because in this case there would be 22% of housing affected, 32% of hamlets would be affected at the housing level and 14 hamlets would be completely decamped.

12.2 Impacts on Cultivated Lands and Agriculture

Evaluation of impacts on the cultivated lands according to the 3 variants of the project has been done through a double inventory, during topographic surveys on 1/10,000 on the one

hand, and in complement during agro-economic surveys on the other hand.

12.2.1 Assessment on Cocoa Farms

Can be obtained directly without any doubt from field inventory; they are summarized below:

Table 13

	nos. of parcels	nos. of proprietors		% total of farmers	Area in ha			% total area cocoa trees in zone
		total	per m. of unlevelling		total	per farmer	per m. of unlevelling	
Variant 3 (maximum)	96	82		54	53.2	0.65		29
			13				3.5	
Variant 2 (median)	28	18		12	35.9	2.0		20
			4				5.8	
Variant 1 (main)	8	8		5	18.5	2.3		10

N.B Cocoa trees situated just above the height considered by the variant, that may have rooting problems due to rising water, have also been counted. It should be noted that similarly to housing, increase in the number of farmers affected is exceptional with the stretch of water, by contrast, an increase in the areas concerned with the elevation is less proportionate.

This would mean that the big farmers are more often concentrated in the areas at the foot of the slopes (shades and best soils), whereas the small farmers (more recently) more often are on the highlands, but also concentrated near the road axis, probably under less productive conditions.

This interesting phenomenon reveals the extensive (in terms of productivity) economy of cocoa in relation to the socio-economic destruction of the traditional lands. Lastly, we observe that there is a high correlation between the percentage of affected families for housing and the percentage of cocoa crops in the 3 variants (54% of families are cocoa farmers over the entire zone concerned).

12.2.2 Assessment on Food Crop Lands

Assessment on flooded crop lands will be affected following the 3 variants taken into account is more delicate. A more or less exhaustive inventory of the food crop parcels for

the year has been carried out during topographic surveys on 1/10,000. An estimate is thus made available for food crop fields for the year.

In multiplying by a factor 3 (see chapter. VIII; paragraph. 8.1.1 previously) we have an estimate of food fields of 1 to 3 years jointly harvested during the year.

The results are as follows:

Table 14

	Area for food crop harvested during the year-ha		% of foodstuff area-total-in the zone affected	Estimate of nos. of affected homes (1.6 ha/home)*		Ratio of food crop area/ Cocoa area
	Total variant	Per in of unevenness		number	% total	
Variant 3 (maximum)	264.3		47.8	162	58	5.0
		10.6				
Variant 2 (median)	211.5		38.3	130	46	6.3
		32.0				
Variant 1 (main)	115.5		20.9	71	25	7.6

N.B Hypothesis: all the families affected through their housing are also affected in their crop farms.

From the above data and indicators, we can notice that the distribution of food crop fields is different from that of cocoa farms. Food crops are concentrated in the lowlands with fertile soil than cocoa (notably the most recent crops). Consequently there are more affected families in food crop fields and at the level of housing in variants 1 and 2.

12.2.3 Home Vegetable Gardens and Familiar Fruit Trees

Estimates of impacts at this level has been made only for fruits in relation with the impacts on housing. Results are as follows (see table 5; paragraph. 8.1.3 of proceeding chapter. 8).

Table 15

Fruits; nos. of stems per category	Variant 3 (maximum)	Variant 2 (median)	Variant 1 (main)
Banana	1,997	412	159
Pear (avocado)	214	44	17
Mango	196	41	16
Safout	139	29	11
Citrus	133	28	11
Kolanut	44	9	4
Coconut	32	7	3

It is worth noting that the number of natural palm oil trees that would be affected, will be respectively about 1,220, 980 and 530 according to variants 3, 2 and 1. (Rough estimate obtained from a pro-rata related to the areas of food crops.)

12.2.4 Summary of Impacts on Agricultural Production

The table below summarizes the annual agricultural production lost and that, to be reestablished.

Table: 16

An inventory of annual agricultural production corresponding to the lands affected by the project

	cocoa		Full farms Food crops		fruits		Net total
	% production affected	net corresponding	% of affects production	net value	% Products affected	net value	product affected
Variant 3 (maximum)	29	2.4	47.8	102.3	22.4	2.5	107.5
Variant 2 (median)	20	1.6	38.3	82.0	4.6	0.5	84.1
Variant 1 (main)	10	0.8	20.9	44.7	1.8	0.2	45.7

(unit = million F.CFA)

The additional loss in agricultural production per additional meter of water level is 4.6 million F CFA between variant 2 (395m) and variant 3 (400m) ; by contrast, it is 12.8

million F CFA between variant 1(392m) and variant 2.

12.2.5 Summary of Impacts on Houses/Cultivated Land

Table 17

Recapitulative table of impacts in the families in terms of housing and cultivated lands per variant :

	nos. of families affected through houses/cultivated lands		Families affected through land only		Families affected in one way or the other	
	nos.	total %	nos.	total %	nos.	total %
Variant 3 (maximum)	63	22	162	58	162	58
Variant 2 (median)	13	5	117	42	130	46
Variant 1	5	2	66	23	71	25

N.B *By cultivated lands, we mean here, cocoa and food crops ; gardens and home fruits are affected at the level of housing zones.

* This summary is based on simple hypothesis : any cocoa farmer that is affected also has affected food crop fields ;
In all, it should be noted that the additional homes affected (all damage mixed up, is 7 per additional meter of water level between Variants 2 and 3, and 12 between Variants 1 and 2.

12.3 Impacts on Other Production Activities

12.3.1 Hunting

Assessment of the impacts on wildlife has been presented above (paragraph 10.3), notably as regards increase in synergetic pressure on the fauna due to high local demand for meat, generated by an increase in the residing population especially during the works. Apart from palliative measures, this pressure will be unbearable by local resources, in as much as the formation of the lake will indirectly lead to a final loss of synergetic resources previously estimated in volume and number of animals and estimated in value as follows :

Table 18

Value of the loss in fauna due to the formation of the reservoir

(NB market value considered)

	Tonnage of Living animal disappearance	Corresponding Value in Millions F.CFA
Variant 3 (maximum)	7.2	1.0
Variant 2 (median)	12.6	1.7
Variant 1 (main)	39.6	5.5

12.3.2 Fishing

Impacts on the modification of hydrobiological conditions and the extension of water linked to the dam according to the variants are given above in chapter X (paragraph 10.3). The natural fishing potential, (that is the possibility of getting annual catches without distorting this potential ; not to be mistaken for total stock) is estimated at 50 kg of fish/ha. Following the variants, the additional fish potential would be : (after a return to a satisfactory state of oxygen for the reservoir, 1 year later after the filling) :

Table 19

	Area of an additional water level (m)	Additional fishing Potential Tons	(net value) Million F.FCA
Variant 3 (maximum)	6600	330	148.5
Variant 2 (median)	2100	105	47.3
Variant 1 (main)	1200	60	27.0

N.B Estimate of net value is made through : price per kg of fresh fish : 500 F.CFA ; cost of intermediary consumption (nets, canoes, other materials and equipment) : 50 F.CFA per kg of fresh fish. With or without any fishing organization component (see chapter XVI, IVth part below) there will be an increase in the number of fishing men, mainly through the immigration of fishermen from the coastal South (Campo, Kribi), from Equatorial Guinea, and even from Nigeria. Apart from controlling immigration and organizing the installation, the population may face abject socio-sanitary problems and

they will be supernumerary compared to the fishing potential in particular, and the economic development potential of the area during the post-dam period in general. The Mappe dam is a good example in that light.

12.3.3 Tertiary Activities

During the construction phase of the dam, which at this stage is set for 3 years at least, the tertiary sector of shop owners, drinking spots, artisans, and also the informal sector, will have a local economic "boom" with the relatively increase in the residing population. (see paragraph 13.1, chap XIII, below). But apart from long term development activities and employment (that is, industrialization) which for now is hardly envisaged in the project area itself) only the fishing activity and an agricultural component, which are not even quite advanced, car preconize the existence of the tertiary sector after the works this sector will be on the decline.

12.4 Impacts on Roads

The road axis from Tom-Nyabessan will be cut out into many sections by floods linking to the reservoir. These impacts are synthetically presented above per variant (see details in annex III)

Table 20

Impacts on the Tom-Nyabessan road axis

	nos. of sections affected	total length in km
Variant 3 (maximum)	7	5.2
Variant 2 (median)	5	2.1
Variant 1 (main)	4	1.0

Besides the road axis, the footpath from Ntem to Aloum I will be flooded in variant 3, and in each variant the forest paths leading to the cultivated lands below reference at elevations.

12.5 Impacts on Other Socio-economic Infrastructures

Other public (wells) and private (churches) infrastructures will be affected in the case of variant 3 only, namely (see details in annex III)

- the school at Nhemeyong
- the church at Nhemeyong + 3 chapels ; - 7 wells

XIII NON QUANTIFIABLE INDIRECT SOCIAL EFFECTS

13.1 Socio-demographic Effects and New Socio-economic Needs

At this level of the feasibility study, the definition of the organization of works and site is yet to be known. Following the hypothesis of a 3 year site with 1000 permanent workers on an average, and considering the population that accompany this salaried labor force (families, traders, artisans, mean jobs, job seekers ···) the project area may have a boom from the present 1600 inhabitants to roughly 5000 inhabitants immediately works begin. This brutal influx of the population will cause serious administrative management problem and socio-economic equipment, in as much as they, the population, will be concentrated in Nyabessan and its direct neighboring village (Abem, Ntebezo). Decamping and resettlement out of the new organized area will however increase the effects of concentration. The need for food by the additional population may be satisfied by the local food production of which 43% is presently exported.

But restoration of the food production potential will require about 20 months (80% of the affected areas for food crops on an average per family, decamping 6 months before the filling of the dam, and harvest before and considering the loss in fields for a year and for 2 years ; see paragraph 8.1 chap VIII). Roughly, food cropping, at its present productivity level could supply basic starchy food (cassava, plantain), groundnuts, vegetables and fruits, 2800 persons in all (immediately the lands are restored after 18 months). But the newly important demand for local foodstuff could on one side constitute a factor of agricultural development under minimum extension and assistance services (see chapter XVI paragraph 16.1 below). In any case, part of the starchy food would be imported (particularly in the first 18 months the site) under the forms of cereals (rice, maize, flow, millet) : this could in the long run help to modify the feeding habits of the people, at the detriment of local starch productions ...Oil, sugar, various spicy stuffs would be imported ; as well as fresh fish and red meat (main cattle), with the framing and support of public authorities, if there is need to

preserve the wildlife.

As regards basic socio-economic infrastructures the host villages for the immigrant population should be electrified (with a temporal thermal station) and a water supply system organized at the level of conformable water fountains. Lodging for the new population will cause a serious problem to solve at the level of town planning and health services on housing.

13.2 Evolution of Life Style and Cultural Patterns

With the announcement of the Memve Ele project, and the study works, the local population has nursed very high hopes, as they expect a lot from the project young men expect well paid salary jobs, and hope to give up agricultural activities and hunting which is just a palliative as compared to their mental world for new values. Adults hope to do business and benefit from the employment of their relatives. Certain girls and women will aim at commercial activities, Others hope to become housewives (sign of emancipation of women) and would not continue with cropping fields.

Everybody hopes that the project will bring about progress that is, a city life style, with new paths water and electricity supplies, good schools, a sound medico-sanitary service, leisure spots, and sports equipment ....

Enlightened people are also conscious of the new problems of social promiscuity to be brought by the project works : ethnic and political confrontations, the questioning of local customs, prostitution, alcoholism, disputes (already regular) etc. ...Lastly, here or elsewhere, the project will largely contribute to accelerate the liquidation of anthropological structures and locale traditional values which is quite advanced (see supra, chap V), to the advantage of modern city life based, at the forefront, on a short term profit and individualism. This will cause loss in local social cohesion and growth in social disparities on the economic as well as cultural domains.

PART IV :

COMPENSATORY MEASURES

XIV. GUIDELINES AND COMPONENTS FOR COMPENSATORY MEASURES

In view of identifying and assessing the quantitative, qualitative, direct and indirect impacts, two main categories of compensatory measures would be envisaged :

(i) Direct compensatory measures : these correspond to the direct impacts of the project (works, equipment, resection) and they have 7 components which comprise of direct technical dispositions, preventive health measures, economic indemnification, the re-establishment of infrastructures and the organization of resettlement.

(ii) Indirect compensatory measures : they are justified by the indirect impacts and effects of the project and the new socio-economic needs to be generated by the project. Indirect compensatory measures comprise of 6 components that embody ecological follow-up actions, regulation and control movements ; preventive measures of education and improvement on sanitation ; actions for the improvement on socio-economic infrastructures ; economic development component, and lastly, organizational measures for the coordinate and a follow-up of the entire compensatory measures.

The list and identification of the various components for compensatory measures is given below, whereas for each of them, the main guide-lines and particular objectives, as well as the recommendation and rules are presented in chapters X and XVI below. The summary of costs and of their bill is presented lastly in chapter XVII.

Direct compensatory measures comprise of the following components defined per objectives:

1) Reservation of a minimum permanent discharge for the maintenance of part of the Memve Ele falls.

2) Research on at least the partial realization (fishing paths) of the forest wood capital that will be submerged.

3) Protection of animals in the reservoir area before impounding.

4) Socio-sanitary preventive measures (technical dispositions around the water and installations ; a follow-up of the vectors).

5) Compensations for housing, fields and food crop farms ; as well as for collective private properties (schools, churches)

6) Re-establishment of public infrastructures (roads, path, wells)

7) Organization for resettlement (developing the resettlement areas and organizational and institutional infrastructures)

Indirect compensatory measures : they comprises of the following :

1) Conservation of the flora and fauna : inventory and ecological follow-up ; reinforcement of the control system on hunting ; declaration of the species and protected areas ; sensitization and education on the ecology.

2) Improvement on the education and health infrastructures of the population; reinforcement of the Nyabessan health center ; health education actions, health control of the migrating population ; exceptional health coverage for the site ; general coordination actions on health.

3) General improvement on the water supply system of the population

4) Extension program for agriculture with stress on food crops and guiding and animating the women and youths.

5) Organization of a fishing component for the rational and durable valorization of the additional fishing potential brought by the project.

6) General organization and institutional measures for the coordination, animation and a follow-up of the whole compensatory measures.

XV. DIRECT COMPENSATORY MEASURES

15.1 Conservation of the Memve Ele Falls

In order to partly preserve the exceptional site of the Memve Ele falls, considering the tourist interest and their landscape potential at the national level, there is need, no matter the variant admitted, to reserve a minimum discharge in the two channels at the upstream of the present falls. In first analysis, the flow to reserve could be about 10% of the annual average flow of the Ntem + Biwome + Ndjo'o that's 45m3/sec. This could be acceptable for the maintenance of sufficiently spectacular fall effect. This objective could simply be materialized in the construction of an automatic graded gate in a part of the dam and under the minimum water level. In the case of variant 3 (maximum), the discharge to reserve on the Ntem could consider the low water flow of the Ndjo'o and the Biwome by some m^3/s.

15.2 Forest Resources to be Submerged

The value of the wood capital that would be submerged in the future reserve is quite high, even in Variant 1 main (minimum). Meanwhile the superficial depth of the flooded zones, in variant 1 (5m maximum) will cause the tree vegetation to form a network of obstacles difficult to explain, navigation and the setting fishing nets.

There is therefore need for the department of forests of the new MINEF to organize the following two types of measures through its regional services, during the first year of the project :

- Allocation of the felling/cutting of marketable trees in the future submerged area to a forest exploiter.
- Awarding of contracts to peasant tree feelers for the opening and cleaning of fishing corridors of 20 to 50m large (according to their density), in a bid to have about 20% of the flood forest area thus opened.

In the two cases, the costs of exploitation (cutting, shaping, transporting, and unloading up to the Nyabessan-Ma'an road) should be largely covered by selling value of the different products obtained and bring in some substantial margins.(see first roughly estimated norms in Paragraph. 10.2 chapter X above). It should be noted here that there will be high demand for the local use of wood : (fire wood, wood for ordinary services and works) related to increase in the residing population on the one hand and to the needs of the project site on the other hand.

15.3 Protection of Animals in the Reservoir Area before Impounding

Considering the foreseeable impacts on the wildlife in these areas (see paragraph 10.3, chapter X above), it is recommended to :

(i) Carry out beatings (drums, gun shots in the air) regularly for many days before filling the reservoir, in order to drive away as much as possible the fauna out of the submersion zone to avoid them from drowning or from being isolated in the small islands.

(ii) On this occasion, certain animals could trap themselves in the natural obstacles, be worn out, have little physical strength to escape or loss their direction (young animals). The species that are remarkable, scarce or vulnerable could be caught a life (with cast nets, neck traps, wood forks ; or with the hands etc...) and released out of

the zone. Common animals could be killed and given to beaters as compensation. These operations should be very rigorously organized and controlled by the by services of the local Hunting-guards (to be created ; see paragraph. 16.1 below) with the cooperation of the Ma'an post.

15.4 Preventive Measures in Socio-sanitation (Annex II)

This concerns the recommended technical dispositions at the surroundings reservoir, on the one hand, and the follow-up measures of the vectors, on the other hand. The following technical measures are recommended :

(i) Sewage and cleaning systems should be established at the villages around the reservoir. These measures aim at protecting the lake (and the underground water level) from fecal-urinary pollution and house cabbages.

(ii) The spillway of the dam should be conceived in a way not to create homes for larvas and nymphs of simulies (inclined at 45°, smooth and without stairs, without standing waters at the foot except when it is functioning).

(iii) South to the power house, the following works, vis a vis the dangers of vectors should be provided : cleaning of the forest gallery around the plant site, regular cleaning of an eventual portage basin (variant 1) and of the basin for energy spreading after generation, eventual development of the Ntem bed at downstream and maximum reduction of the discharge speed retired to the Ntem (restriction of homes for tsetse flies).

The costs of technical measures will be taken into account in the project cost itself.

The epidemiological follow-up of the vectors will be ensured by the regional health services with the participation of local services. The following campaign follow-ups will be set up :

- before works begin : entomological and malacological surveys of the dry season (certain dynamics of the vectors and pathologies to be well determined) ;
- during the works : maintenance of supervision with insecticide treatments for the site workers and other immigrated populations ; control of jobs
- After construction : periodic controls in the project areas, a follow-up of the vectors and human parasites (notably, systematic detection of onchocerca, trypanosome and ankylostomias).

The costs of these actions are estimated, roughly, at this stage at 18.5 million F.CFA over 5 years (see annex II for details).

15.5 Compensations

15.5.1 Housing and Collective Properties

The assessment of the number of houses affected has been made from 5 types of buildings. The cost of resettlement is calculated following the norms of cost per m^2 per type, as shown below, estimated under the real constructions in the project area :

Type 1 (house in concrete) : 50000 F CFA/m^2

Type 2 (mud house + bricks + planks + zinc) : 13500 F CFA/m^2

Type 3 (traditional mud house, mat roof) : 2500 F CFA/m^2

Type 4 (Shelter, drying room, with zinc) : 2200 F CFA/m^2

Type 5 (shelter, drying room, "traditional guard" : 800F/m^2

Areas of the affected houses per type and per variant have been estimated in detail per hamlet, during agro-economic surveys (see annex III).

The total of compensations per variant would be :

- variant 3 (maximum) : 112.37 millions F CFA
- variant 2 (median) : 28.23 millions F CFA
- variant 1 (main) : 7.51 million F CFA

For variant 3 there is need to provide compensation for the school at Nhemeyong estimated at 4.37 millions F CFA ; the church as Nhemeyong and 3 chapels, costing together 17.07 millions F CFA.

15.5.2 Farm and Orchards

For compensations of farm (cocoa, fruits), there are official norms, quite ancient, and were captioned within the framework of a ministerial artery in 1981 with its objective being the regulation of compensation conditions of annual and long life crops in the case of the decamping of the population or demolition of property for public utility.

Cocoa : The norms of compensation were fixed for three age groups : less than 5 years : 600 F CFA/stem ; from 8-15 years : 1500 F CFA/stem ; 15 years and above 1200 F CFA/stem. Meanwhile the bright compensation is 1600 stems/ha. From the structures of

estimated cocoa stems per village and the average farm density, (9% of less than 8 years, 19% between 8 and 15 years and 72% for more 15 years ; 2654 stems/ha on an average) The global amount for compensation per variant is :

No Variant	Compensation in Million F CFA
3 (maximum)	103.89
2 (Median)	72.45
1 (main)	35.94

The average compensation 80m per hectare is roughly 2 millions F CFA per variant, whereas the present annual net value for production is only 55000F CFA/ha. Compensation represents 36 years of the present production whereas cocoa has more the 20 years on an average. The use of the 1981 official compensation norms is favorable to the cocoa farmers under the present economic recession for cocoa. An estimate of compensation based on the future value of the farms will reduce the total estimated amount by nearly 60%

Other Fruits

The norms of compensation for fruit trees of the ministerial artery of 1981 are as follows :

- Banana : young : 200F CFA ; old 350F CFA
- Citrus, mango, kola nut, safout ; 1250F CFA for the young and 350F CFA for the adults.
- Other fruits : 375 F CFA for the young, 1720F CFA for adults.

No Variant	Compensation in Million F CFA
3 (maximum)	2.8
2 (Median)	0.6
1 (main)	0.2

It should be noted that compensations for fruit trees are by contrast, very low following the official norms used : they are hardly above the value of annual production of fruits, ass categories mixed up. If we refer to a future value of fruit trees, 10 years on an average, (excluding banana), compensations of fruits would be multiplied by a factor 7.

15.5.3 Foodstuff

The 1981 norms provide for the compensation of food crops per stem in case of soudain decamping which does not permit the farmers to harvest their annual or by-annual crops. But this will not be the case of the Memve Ele project for which a construction period of 3 years would give enough time to the authorities and Ministries in charge to organize

compensatory measures notably in the restoring of production and resettlement potential. On the contrary, as explained in chap XIII, par. 13.1) : 20 months are required to restore food crop productive potential.

The loss in production during the first 2 years due to lack of fields of 1 year and 2 years to harvest in parcel of fields of the year can be roughly estimated at this level at 80% of the nit value of harvest of a 1 year field, more than 2 fields of 2 years old (see par. 8.1.3 chap VIII above). All, over 20 months. Under these conditions the shortage per affected family would be 245000F CFA, roughly for 20 months with 207000F CFA the first year (58% of the total food production, without fruits, and 113% of the auto consumed food production). On this basis, total cost estimate for compensation for loss of food production would be as follows per variant.

Variant	Compensation for loss in food prod for 2 months		Amount to pay as food rations 1st year
3 (maximum)	64.8		54.7
2 (median)	52.0	million	43.9
1 (main)	28.4	F CFA	24.0

As earlier stipulated, these compensations would partly be paid in the forms of direct food rations in the first year and in many installments (equivalent of 316000F CFA per affected family) The balance in the second year is paid in cash after noting the restoration of food potential in the system of the "3 fields" per active woman.

Palm oil trees which are scattered here and there and in their natural state need not be compensated for. By contrast, the kitchen oil must be part of the food ration under foodstuff compensation.

15.5.4 Organization of Compensations

Organization of compensations should be extremely rigorous at the level of the stock-taking of the compensatory property, forms and bills of the compensation, as well as the follow-up of litigation and eventual problems. (Experience on the Mappe, notably) Details on the methods, scale and procedures should be precise at the beginning of the study phase of APD which would again comprise of a section of the impact study and the compensatory measures. Detail on the organization of indentations as well as compensatory measures elsewhere, should be drawn up only after an organized consultation of the population and

local authorities concerned. The basic principles on organization of compensations could be as follows :

(i) Inventory and evaluation of property to be compensated and the corresponding persons to be indemnified by a specialized expertise cabinet on the basin of detailed and precise bill book (for the realization of this inventory).

(ii) The creation of a Local commission for Compensation (LCC) that could be composed of the sub-prefecture, a Judge, SONEL, a representative of MINAGRI, a representative of MINUH, the chief of Canton, Chiefs of the administrative villages involved, plus a number of traditional "wise" men (2 to 6) co-opted by the population. A representative of the expertise cabinet could also participation in these works as a consultant.

The role of this commission would be to accept (with possible changes) the inventory and assessment of the property to compensate and the persons to indemnify, and make procedures for the liquidation of these compensations according to the principles and modalities drawn up previously per category of property : payment on installment housing ; compensation stretch throughout 3 years for cocoa and other long life crops after restoring remarks and the effective vegetation of the new fields. Compensations for loss of food production would be low as shown above. This commission should be created for 4 years at least, and should receive claims and litigation, and should play the role of a referee with possible friendly solutions to problems. In case of individual persisting problems, final solution should be found, as a last resort from the competent courts.

The costs of organizing the compensations can be estimated roughly to :

- Inventory and evaluation of property : 15 million F CFA
- Running of the local commission for compensation (presence and out of station allowance) : 3.2 millions F CFA (8 sessions at 400,000F/session)

15.6 Restoration of Public Infrastructures (Roads/Wells)

The principle is to outline the profile along the sections of the road, as previously identified in (chap. XII) at the elevation crest of the dam for each variant. It will suffice to set the profile, in each case, along the considered sections at the level of the spillway. Estimated costs for : the re-establishment per road are given as follows :

Table 21

	Length of road without crest level of the dam	Length of road to be raised to the level of the overflow	costs for the re-establish mend of the road (million CFA)
Variant 3 (maximum)	5.2	3.5	79.9
Variant 2 (median)	2.1	2.1	52.7
Variant 3 (main)	1.0	0.9	16.7

N.B The norms used is 2.54m^2 of refilling in m of long profile, and 1800F CFA per m^3 of refilling, including the finishing of the platform.

Reconstruction works on the road will form a particular portion to include in the different civil engineering works confided to companies that will work on the site.

Wells : the affected wells will be replaced upwards by better wells based and equipped with manual SWN pumps (2.5 millions F CFA each). This option is commanded by the general tendency of improving the hygiene and the health environment conditions of the populations, and in particular the water supply system (par. 16.2 and 16.3, chap. below).

According to the variants, compensation of the present wells would be :

	Variant 3 (maximum)	Variant 2 (median)	Variant 1 (main)
Cost of wells to be re-established (millions F CFA)	17.5	7.5	7.5

15.7 Resettlement

Each variant is considered under 2 types of resettlement :

- Resettlement of families with hamlets to be completely decamped and their cultivated lands ;
- Resettlement of crops fields alone.

Resettlement could be done spontaneously either in a vague manner in neighboring zones, on the initiative of the people themselves, or in an organized way led by the prefect (under compensatory measures)

The norms for resettlement are 1000m^3 per family for (a grouped) housing and familial fruits, and 32 ha of forest land with 16 ha (50%) of cultivable lands (long rotations of 12 years, possible). Considering the located needs for resettlement per variant, three zone of resettlement are identified and recognized during surveys and agro-economic prosecutions ; these are the sites of Aloum I bis, Nyabessan and Nhemeyong north (see map in appendices of the present report). Criteria for the agro-pedagogical selection, the environment and for socio-economic selections, have been considered in this identification (distant-farm-house, 2.5 km maximum, resources in underground water, clan limits, potential of layout services etc...) (see detail in annex III).

A programming of resettlement of the populations and crop lands per geographical zone is synthetically presented below :

Table 22

Identification and pre programming of the possible resettlement zones.

	Nhemeyong-north site			Nyabessan site			Aloum I bis site		
	nos. of hamlets concerned	nos. of families	Crops/ ha	nos. of hamlets	nos. of families	crops/ ha	nos. of hamlets	number of families	crops/ ha
Variant 3 (maximum)	9	33	181	1/2	4/8	36/43	3/4	11/15	22/29
Variant 2 (median)	-	-	152	1	4	8	-	-	-
Variant 1 (main)	-	-	80	-	-	-	-	-	-

* Vague (scattered Resettlement) Variant 3 : 11 families, 18 ha
Variant 2 : 9 families, 52 ha
Variant 1 : 32 ha

Construction and installations provided for the organized resettlement zones are as follows per variant (see details annex III)

(i) Variant 3

- Nhemeyong north site : 1 access road (6 km ; 24 millions F CFA costs)
  : 1 path (internal) (5 km ; 1.2 million)
  : 1 platforms for 40 families (9.5 millions)
  : 1 school (26 millions F CFA)
- Nyabessan site : 1 access path (0.7 millions F CFA)
  : 1 village platform (2 million F CFA)
- Aloum 1 site : 1 improved access path (4 km : 2 million F CFA)
  : 1 internal service path to the fields (2.5 km, 0.7 millions F CFA)
  : 1 platform (3.6 millions F CFA)
  : 1 school (26 million F CFA)
  : 1 collective well (2.5 millions F CFA)

(ii) Variant 2

- Nhemeyong north site : road and serving path only
- Nyabessan : same with platform reduced

(iii) Variant 1

- Nhemeyong north site : 1 simple improved path (6 km ; 3 millions)

The summary of costs for organized resettlement :

Table 23

Summary costs for resettlement per variant (million F CFA)

	Nhemeyong north site ;	Nyabessan site ;	Aloum I	Total
Variant 3	63.2	2.7	34.8	100.7
Variant 2	25.2	1.7	-	26.9
Variant 1	3.0	-	-	3.0

Organization of resettlement and its programming should also be done in a rigorous concerning manner with programs and procedures of compensation (supra). The local commission for Compensation can equally have competence of controlling the operations and a follows up : if could thus be named : "Local Commission for compensation and Resettlement. Alongside this, the local authorities, the MINUH, MINAGRI and the

Ministry of Transport should ensure the mastery of resettlement in their respective domains of competence, with the support of coordination and animation of the service set up with SONEL for the follow-up of the entire compensatory measures (par., 16.6 above).

XVI. INDIRECT COMPENSATORY MEASURES

16.1 Conservation of Flora and Fauna

This component comprises of a series of actions and regulation measures that should bring about awareness in the youths and adults on the natural environment and its preservation for future generations. These actions are summarized as follows :

(i) Scientific inventory of the flora and fauna in the zone of the future reservoir and in the influence zone close to the project. These inventories should go beyond systematic aspects and also integrate ecological, ecosystem, ethnological infrastructures and the dynamics of the population. By the end of these inventories (to be carried throughout the duration of the site with surveys and opinion pools at repeated seasons) on a list of species, vegetables, and animals, particularly scarce or vulnerable which would be subject to exceptional protection measures. In the same line, protected areas and natural reserve of controllable dimension could be decided in the socio-economic influence zone of the project. These surveys would be confided to national or international scientific institutions. The global budget of project contribution as regards compensations at this level is roughly estimated at 12 months of researching, 24 million F CFA, everything included.

(ii) Information and education of the population on the environment and management of natural patrimony, like a "good family head"

This program could comprise of mass information actions (village meetings, audio-visual sessions, prospectus, etc···) and education of the youths in schools (training of teachers specialized external participants, pedagogic support and material ···) A lump sum of 2.5 millions over 5 years should be set aside at this stage.

(iii) Reinforcement of control on hunting

To this end, the creation of a control post is recommended near Nyabessan with 2 agents ; One to live at the left bank of the Ntem at Aloum I, the other to live in Nyabessan and would also control the right banks of the Ndjo'o and Biwome. They will be equipped with adequate transport means (motorcycles, running cost budget) and would control hunters and poaching in the zone on their hunting territory, as well

as the commerce for animals. Finance for the motorcycles and the running cost would be inserted into compensatory measures of the project over 5 years. (global estimated cost at this stage : 5 millions F CFA over 5 years) The creation of posts, salaries, training (refresher courses for the Ma'an agents) should be ensured by the Ministry of Tourism on its own budget.

16.2 Improvement of Health Services and Sanitary Education

The general actions with the view of improving the health conditions of the populations is on the one hand a matter of the political willingness to valorize the health structures of the region, and on the other hand of the social conviction of the autochrones to participate in health education activities in the prevention of diseases and general hygiene of the milieu. If these success conditions are joint together, positive impacts will largely overshadow the negative ones for the general well being of the population of the socio-economic zone of influence close to the project.

Conditions of efficiency of the curative and preventive (fixed or mobile) of the Nyabessan Health Center and the Ma'an Hospital are basically in terms of infrastructures, equipment, and personnel in the quantitative as well as qualitative levels.

(i) Restoration and reinforcement of the Nyabessan H.C.

This action is justified to improve the permanent medical coverage in the project area before and after the site which will benefit from another exceptional medical coverage (see below). Rehabilitation ... are described in detail in annex II and summarized : They comprise of :

- the restoration and extension of the present building, it water supply system and electricity (autonomous generator), refrigerator.
- movements of staff per weak of refresher cruse + test eventual training ;
- reinforcement of staff (nurse + nursing-aid, additional, 2 education auxiliaries for health)

The entire cost for restoration and reinforcement of the Nyabessan Health Center to be carved as compensatory measures could correspond to the costs of rehabilitation-extension of buildings as well as equipping them and the means of transport, making up 29.0 millions F CFA in all (see detail annex II)

The other costs (staff, refresher census, training intervention material, drug stockings) would be financed by the MINSA.

Alongside, the reinforcement of the Ma'an Hospital, would be considered like an top operation, if the project is realized, within the framework of the MINSA :

It should be recalled that the development of the site will require an exceptional medical coverage (defined in annex II) but the costs are not to be considered as compensation measures, but as being classically an integral part of the cost of works (according to national and international labor low ; A synergy and economy of means should meanwhile be looked for, between the exceptional medical unit of the site and the reinforced Nyabessan Health Center, the reinforced hospital at Ma'an, would thus serve as a base hospital to receive non treated patients at Nyabessan.

(ii) Health education

This will be ensured by local health services and particularly the reinforced Nyabessan health center, a support which could be brought by NGO and the SESA project. The information terms-sensitization-education could mainly dwell on : (see annex II) :

- hygiene and pathologies linked to lifestyle, attitudes and traditional behaviors (fecal-urinary dangers, corporal hygiene and feeding, sexual behaviors, management of waste water and garbage, protection against vectors in the space.
- Pathologic, consequences of beliefs and traditional practices food taboos for children, nutritional practices, auto medication, traditional medicine and pharmacy.
- Housing and working hygiene

All these fundamental actions on man education should be strictly organized and programmed in the framework of local health services which well partly ensure them, with the collaboration of school teachers, animators and specialists (external participants) and benefactors of the community.

A provisional budget is 8.25 millions F CFA is provided to that effect under compensatory measures.

16.3 Improvement on Water Supply System

This action is situated with regard to the objective of improving the hydro-sanitary environment of the population of the project area. Similarly, there is hope to improve the wells which will be compensated and equally installed in the resettlement areas (see 15.6 and 15.17 supra) ; 6 well will be restored and 1 well will be constructed, according to the norms of identical equipment. The total cost is estimated at 14.5 millions F CFA (2 million F CFA per rehabilitation, and 2.5 million per new well).

16.4 Agricultural Development Program

If we can anticipate that a revival of the cocoa crop and the restoration of affected fields by the project can be ensured within the framework of the new program for SODECAO financed by the World Bank, the guidance of the restoration of food production and its extension in the face of local demand related to the project, should by contrast be subject of a specific local program to be considered as a compensatory measure under MINAGRI. Production of cocoa seedlings in the nursery should equally be locally provided to be secured and in the light of compensations and restoration of cocoa trees that will be affected by the future Take In all, this component of local agricultural extension sill comprise of :

- Production of cocoa seedlings in nursery for the restoration of the affected ones.
- Production of fruits seedlings for the restoration of affected orchard or even a certain development
- A guide program and extension of the food crop production

(i) The creation of a collective nursery for the production of cocoa seedlings and fruit trees

The nursery should be installed and managed by an agent of the MINAGRI (who could be a young farmer of the area who would have undergone a training course). The needs for cocoa seedlings (1,700 seedlings per ha to be planted) would be respectively from 91,800, 20,400 or 8,500 seedlings following the variants V3, V2 or V1. Needs in fruit seedlings related to the damages caused by the project are previously defined above. In any case, the production envisaged in this domain could be over estimated to the demand of the farmers who, on this occasion, will have proposal of different improved seedlings (citrus, mangoes, guavas, pawpaw, banana, palm oil tree...) which they could develop alongside their resettlement. The theoretical measurement and corresponding costs of the nursery to be installed, during 1 to 2 years of functioning following the demand are presented below (see details in annex III).

Table 24

	Total nos. of seedlings to produce annually	Improved fruit seedlings	Improved palm oil trees seedling	Total area for nursery m2	Total cost for 1 year of running the nursery in million
Variant 3 (maximum)	100,000	7,200	1,000	1,000	1.3
Variant 2 (median)	26,000	4,600	1,000	260	0.8
Variant 1 (main)	14,000	4,500	1,000	140	0.8

N.B Salary for nursery worker included : 50,000 F CFA/month,
Installation price for the nursery + material : 80,000 F CFA.
Plastic sachets : 6 F CFA/unit.

The actual cost price for the seedling (10% allowance) for all the categories per variant would be;

V3: 14 F CFA; V2: 34 F CFA; V1 : 59 F CFA. We notice that the cost price per seedling increases rapidly at the level of variants 2 and 3. The nursery should therefore be measured at 100,000 seedlings/year no matter the variant and could also satisfy the other needs of the districts in terms of seedlings. The cost for cocoa seedlings should be borne by the affected farmers (owing to the comfortable norm of compensation, this would represent at least compensation of 22,400 F CFA per hectare, as compared to the official norm previously applied, par. 15,5,2). Fruit seedlings and palm tree should, by contrast, be subvention at 100% considering the low compensation rate for fruits, on the one hand, and the interest in the development of varieties of improve fruits and the palm oil, on the other hand.

(ii) Guidance and extension program for food production (annex III)

Beyond the strict re-establishment of food production of the affected lands by the project, though compensations (partly in kind) for the occupation of cultivated lands, extension of the food production first passes through the mobilization and valorization of the available labor to that effect. This does not require to change the present complex production systems: since they adapt conveniently to the local ecological and socio-economic conditions (this is need only for optimization). Even if the means for research of new theoretical systems were available, they would neither be realistic, nor compatible. To achieve this goal, we need:

- A guidance system and specific animation program for the productive women;
- Sensitization, training and animation of the male youths,

- Improving the small tool and cropping materials,

- Optimization of variety and association of crops with regard to new market demand, and the organization of commerce. Logistic and organizational means to be set up will be:

  # Make available popularize-animator (male 1 / female 1) equipped with means of transport and didactic material.

  # A life-saving programming system (specific) for the purchase of material and tool.

  # Creation of a foodstuff market at the Nyabessan Center

  # The formation by social links, of solidarity groups of food producers, (female / male) who could even reach the level of managing a vehicle in commune bought on credit at a preferential guaranteed rate. This will serve for the gathering and transporting of produce for sale, as well as the transporting of produce for sale, as well as the transportation of cropping material along the road axis and inside the proposed resettlement site, north of Nhemeyong.

    This component must be precise in the studies of APD (Detailed Design) and discussed with the persons concerned. At this stage, it is just identified according to the above principles and cost estimates below. There were normally two guidance posts of MINAGRI at Nyabessan for cocoa cropping. With the assumption that one post would be retained for the revival of cocoa crop, the other would be for the guidance of the women's food crops (a female technician to be sent), and another post could be opened as complementary to train and guide the male youth group on food agriculture. Although it will be under MINAGRI, this exceptional additional post could be finance within the first 5 years by the project, as well as the motorcycles and the running cost budget of the two guide-animators for food cropping. This component is independent from the variants of the project considered. It is globally estimated at this stage at:

- investment (2 motorcycles): 1.2 millions F CFA; annual budget (the salary of 1 guide + running cost): 3.0 million F CFA.

16.5 Organization of Fishing Development

We have seen in the previous chapters (X, par. 10.3; XII, par. 12.3) that, after normalization of the hydro-biological situation of the lake, the positive impact of the project on the fishing potential would be appreciable. It is a well known fact that the fishing activities will develop the immigration of "specialist" social groups. Experience acquired in other context of artificial reservoirs in Africa in general, and in Cameroon in particular (Mappe project notably) shows that it is vital to set up conservatory measures of control and stock management if there is need to continue with the resource and fishermen's revenue. Such measures are briefly defined below (see details annex III). Beyond such necessary measures, every public investment action concerning construction, equipment and economic organization can only be justified if it generates additional income for the fishermen's