ILRI

OUA-IBAR

European Commission

Farming in Tsetse Controlled Area
FITCA

Environmental Monitoring and Management Component
EMMC
Project N° 7 ACP RPR 578

Agro-pastoral and agro-ecological baseline survey Methodology

Short term consultancy

10 – 30 March 2002

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PAYS OU REGIONS CONCERNES : Kenya, Ouganda, Ethiopie

MOTS CLES : Tsetse control, trypanosomosis, environmental monitoring, Kenya, Uganda, Ethiopia

RESUME :

Mission pour la définition d'une méthode de prise d'information et de suivi concernant l'environnement dans les régions où est appliquée la lutte contre les tsé-tsé et les trypanosomoses animales et humaines.

Le rapport précise les problèmes environnementaux dominants spécifiques à chaque pays, il précise un certain nombre d'indicateurs de suivi, esquisse les méthodes de collecte des données et les conditions de réalisation à respecter pour leur mise en œuvre.

NOTE

Due to the difficult access of some sites and the amount of time spent in transport, it has been impossible to meet rigorously the Terms of Reference for the Short Term Consultancy **"Agro-ecological and agro-pastoral baseline survey in The FITCA Regional area"**.

For such a mission it would be very useful, long time before the consultancy, to provide basic information such as maps, reports, articles to prepare the consultancy and especially the field work.

This study represents a preliminary step to elaborate a more detailed operational methodology to implement the environmental monitoring programme in the selected sites in each country.

TABLE OF CONTENT

TERMS OF REFERENCE FOR SHORT TERM CONSULTANCY

Agro-ecological and agro-pastoral baseline survey in the FITCA Regional area

1. Background of the programme
   The European Union finances the FITCA program with regional and national indicative funds under the EDF VII, agreement #5682/reg. It will cover a period of four years and the total amount of the Financing agreement is 20 millions of Euro for the region. The Regional Tsetse co-ordination Unit based at OAU/IBAR offices supervises the FITCA Regional program.
   Part of this program, the Environmental Monitoring and Management Component (EMMC) funded by the EU (1,42 M Euro) is contracted to ILRI for the first 2 years period (TAC signed on March 28th 2001). ILRI is subcontracting two Institutes that are members of the SEMG (Scientific and Environment Monitoring Group). The Administrative Order # 1 describes the utilization of the reimbursable elements as reported in budget lines C&D. Due to the project design this part of the budget is mainly devoted to the coordination, management of the STC and field implementation of the EMMC.

2. Objective of the Consultancy
   The TOR of the EMMC emphasizes the necessity to adapt or develop appropriate methodologies for environmental monitoring and management. This STC will conduct an exhaustive survey in the FITCA area in order to draw a clear and easily interpretable picture of the main agro-ecosystem at the community level. As livestock will become the key activity after control of tsetse, the agro-pastoral and rangeland stocking rate shall be ranked in order to avoid over grazing and losses of biodiversity.
   Rangelands, fallows and forests will be described according to the usual tools of phyto-sociology in order to provide a baseline data at the first year of the project.

3. Methodology
   This STC will take place after the RS Imagery experts have provided their report. The expert will confirm the data provided by RSI through extensive ground observations. He/she will conduct this rapid survey with local community. He/she will take a special care on the traditional knowledge of the different ecological areas. He/she will evaluate the accuracy of this community knowledge. The Regional and national coordinators will provide the expert with some pilot areas where the expert will conduct a more itemized field survey. ILRI will provide facilities for species typing and sample treatment.

4. Expected results
   The expert will submit a comprehensive description of the different agro-pastoral systems within the FITCA area. He/she will provide the proper characteristics and description of the different biotopes encountered. He/she will provide the project with the major species of each of the different agro-pastoral unit. He/she will provide a pertinent monitoring design based on these different biological keys. The traditional indicators, as far as there will be accurate and pertinent will be integrated in the monitoring model.
   Links with RSI will be enhanced.

5. Profile of the expert
   He/she should be familiar with the different agro-pastoral and rangeland survey. He/she needs a good knowledge of the east African flora as well as an experience of community-base approaches. He/she should have a similar experience in the field of rangeland evaluation and vegetation cover analysis under developing country environment.

6. *Operational procedures*
   The STC will start with a briefing and preparation of the fieldwork with ILRI, PLE team, in Nairobi at the FITCA-EMMC HQ (3-4 days) The coordination unit will take care about the logistic aspect of this mission 15 field days should be devoted to Western Kenya and Uganda. 7 days with the Ethiopian team and 8 days in Tanzania (if the project is ongoing) will complete the fieldwork. 15 days in Nairobi will permit to develop a rather definitive report.

7. Reporting format and schedule

At the end of the STC, the expert will produce a brief note on his main observation on the existing situation.

He has to emphasize the different agro-pastoral system crossed along the survey and to give a precise situation of the possible environmental damages observed within the FITCA area.
The final report should be submitted for approbation at least 1 month after the end of the field phase of the mission.
The number and destination of these documents will be provided according the terms of the FITCA-EMMC Service Contract. Twelve copies of the reports shall be submitted as follows:

Regional EMMC Co-ordination	8*
Regional Authorising Officer	1
Delegation of the European commission	3
Total	**12**

* The co-ordination will provide one copy to each of the national programme

CALENDAR OF MISSION

Flight Europe to Africa : 10 – 11 March
10 March – Flight Montpellier Paris Amsterdam Nairobi.

Kenya : 11-17 March
11 March – Arrival Nairobi. Participation to debriefing of the preceding mission (De la Rocque, Kleitz, Djama) in ILRI with Dr Polizar, Dr Bourzat, Mrs Reed, Mr Maitima.
12 March – Nairobi, preparatory meeting in Nairobi (Dr Bourzat) before living to Western Kenya (by road), accompanied by Mr Maitima. Night in Kisumu.
13 March – Arrival Busia. Meeting with Dr Bauer, FITCA-Kenya. Meeting with the District Veterinary Officer. Visit of several farms in the township of Busia (with Mrs Wanjika). Meeting with Dr Oloo and Dr Bauer.
14 March – Visit of farms and tsetse infested places in Butalangi near lake Victoria (Busia district) with Mr Alushula.
15 March – Visit of the District Officer in Amukura (Teso district). Participation to the first crush pen launching by the Akopor community with the Teso District Commissioner. Visit to the Angurai region (Teso District) with Mr Munyoki. Coming back to Nairobi by road.
16 March – Nairobi. Report writing.
17 March – Flight Nairobi to Addis Ababa, arrival to ILRI.

Ethiopia : 17-23 March
18 March – OUA, opening ceremony of the 6th conference of OAU Ministers responsible for animal resources. Meeting with the FITCA national co-ordinator Dr Stanley Flint. Preparation of mission in Didessa valley. Meeting with a group of consultants for FITCA.
19 March – Travel by road to Debele through Bako and Nekemte.
20 March – Debele, meeting in the headquarters of NTTICC. Travel to Jimma, interviews in the Kabale and Goma districts (wereda).
21 March – Jimma, visit (with Dr Stanley Flint) onto the Dedessa valley through Limu Kossa until the village of Marotchima (limit of the tsetse controlled area). Several meetings with Agriculture Officers.
22 March – Jimma, meeting with the Head of Agriculture department, with the Forestry and Environment Department. Flight to Addis Ababa. Arrival to ILRI.
23 March – Addis Ababa, flight to Nairobi

Kenya : 23- 25 March
24 March – Nairobi, report writing
25 March – Nairobi ILRI, discussion with GIS Team (Meshack Nyabenge, Gérard De Wispelaere) and data base consultant (Gilles Fournié). Travel by road to Uganda with the EMMC Co-ordinator (Daniel Bourzat) and the EMMC ecologist (Joseph Maitima). Night in Tororo.

Uganda : 25 – 28 March
26 March – Tororo, visit of sites near the border (Kalait and Tororo regions).
27 March – Visit of sites in Soroti district.
28 March – Visit of sites in Kamuli district. Travel to Entebbe. Discussion with the National co-ordinator (Ambrose Gidudu). Flight to Nairobi.

Kenya : 28 – 29 March
29 March – Nairobi, discussion with the FITCA ecologist (Joseph Maitima), report writing. Flight to Montpellier through Amsterdam and Paris.

Flight to Europe : 29-30 March
30 March – Arrival to Montpellier.

RESOURCE PERSONS MET DURING THE MISSION

Kenya - Nairobi

Dr Daniel Bourzat – CIRAD, OUA/IBAR, FITCA-EMMC Co-ordinator
Dr Heinz Polizar – FITCA Regional Co-ordinator
Joseph Maitima – ILRI, Ecologist EMMC (j.maitima@cgiar.org)
Meshack Nyabenge – ILRI, GIS specialist
Dr Robin Reid – ILRI, Head of the People, Livestock and Environment programme (PLE)
Dr Stephane de la Rocque – CIRAD-Montpellier, entomologist
Dr Marcel Djama – CIRAD-Montpellier, sociologist
Gilles Kleitz – CIRAD-Montpellier, agronomist
Gérard De Wispelaere – CIRAD-Montpellier, teledetection specialist
Gilles Fournié – CIRAD-Montpellier, databases specialist

Western Kenya

Dr Burkhart Bauer – FITCA-Kenya project co-ordinator
Simon Karanja – FITCA-Kenya, tsetse ecologist and epidemiologist
Esther Wanjika – FITCA-Kenya assistant field officer
Dr Morekefu – District veterinary officer Busia (Busia District)
Dr Francis Oloo – FITCA-Kenya official liaison officer
Hannington Alashula – FITCA-Kenya
Eli Munyoki – FITCA-Kenya Medical laboratory technologist
Tom Anjere – District Officer, Amukura (Teso District)

Ethiopia

Dr. Miressa, FITCA National projet Co-ordinator
Dr. Stanley Flint, FITCA-Ethiopia Technical adviser (stanley_flint@freemail.et)
Aberre Worku, NTTICC Senior tsetse Officer, Bedele
Melese Qabate, Crop protection department in the, Kabale
Damtew Beressa, Forestry service, Agriculture office, Kabale
Tilaahun Ayele, Planning and programme department, Agriculture office, Kabale
Lamecha Etara, District of Goma, Head of Agriculture, Agaro
Fitera Abdidan, District of Goma, Agriculture Office
Mespia Abebe, District of Didessa, representative of the Head of Agriculture, Limu Kossa
Farmers of Marotchissa village, district of Didessa, and the Head of the Peasant Association
Mohammed Seid, Head of the Jimma Forestry Office
Dr. Botuma, veterinarian, wildlife expert in the Forestry Office
Adem Ali, Head of Agriculture department, Jimma
Beray Abebe, Deputy head of Agriculture department
Dr. David Bourn, consultant, director of Environmental Research Group Oxford Limited (ERGO)
Bruce King, consultant, land use planning

Uganda

Dr. Simon Gould, FITCA-Uganda Technical adviser (simongould@infocom.co.ug)
Dr. George Epieru, Head of the Soroti agriculture and animal production research institute
Ambrose Gidudu, FITCA National project co-ordinator (npc.fitca@utlonline.co.ug)

I. INTRODUCTION

1.1 Recall of the general frame

Farming in Tsetse Controlled Area and Environmental Monitoring and Management of Change
This paragraph was extracted from the terms of reference for the Environmental Monitoring and Management Component (EMMC) of the FITCA Project (Anonymous, 2000). The form was slightly edited for the purpose of this report.

"The European Union finances the FITCA programme with regional and national indicative funds under the EDF VII, agreement n°5682 / reg. It will cover a period of 4 years and the total amount of the Financing agreement is 20,000,000 euros for the region. The Regional Tsetse Co-ordination Unit based at OAU / IBAR offices supervises the FITCA Regional programme.

Most tsetse control / eradication projects of the past have failed in the long run because they proved not sustainable. After the initial control operations, funded or assisted by foreign donors, tsetse regularly reinvaded the cleared areas. Local communities were either not motivated to maintain control because they considered it a public good and not their concern, or, they were too poor to make any input into a continuation of tsetse control. Therefore the FITCA philosophy wants to ***engage the communities in tsetse control*** *in order to enable livestock keeping and to increase the agricultural productivity to enable the communities to continue control after the end of the project.*
As the agricultural policy (livestock and crops) in Kenya, Uganda, Ethiopia and Tanzania seeks to increase the productivity of agriculture in a sustainable manner, the FITCA project is perfectly in line with the national policies of these countries. One important constraint on livestock productivity in each country is trypanosomosis, transmitted by tsetse flies. Each FITCA country seeks to increase livestock productivity by controlling the disease, either directly or by controlling the vector. Tsetse control has the potential to remove a significant constraint to sustainable rural development and enhance agricultural production.

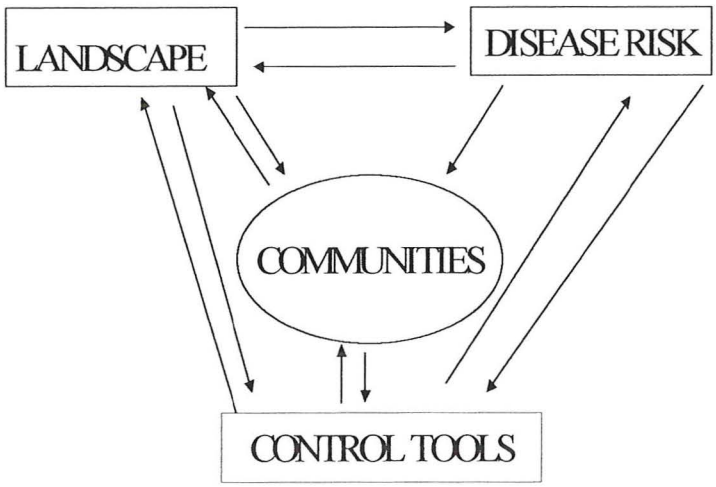
The sustainability of benefits achieved under the program is dependent on assuring that environmental attributes are not adversely affected, either directly by the control activities undertaken, or indirectly as a result of changes in the production systems arising through removal of the disease constraint. It is in the same intention that in the financing agreement it was foreseen that FITCA would assist in strengthening local capacity to monitor environmental changes. Funded by the EU, the environmental monitoring and impact assessment component is part of the regional FITCA program

"The environmental impacts of controlling tsetse-transmitted trypanosomosis can be separated into ***direct*** (e.g. effects of insecticides on wildlife) *and* ***indirect*** *components. During the last years, ILRI has developed monitoring tools related to the indirect impacts of livestock activities on environment. These research are currently conducted within the PLE programme (People, Livestock and Environment). The indirect impacts [...] are now of greatest concern. [They] are the effects of controlling trypanosomosis through the* ***expansion of livestock*** *and* ***human populations***, *and* ***land-use***. *Trypanosomosis is preventing the utilisation of livestock in vast* (fertile and humid) *areas of Africa and is the cause of overuse of areas outside the fly belts. Control of trypanosomosis increases the efficiency of oxen so those farmers can plough more land in areas with low compared with high disease prevalence. In many cases, control of animal trypanosomosis acts as magnet for human migration. People move to new lands after they are freed of the tsetse fly.*

If this disease is controlled, there are almost certainly environmental consequences resulting from the expansion of cultivation and livestock numbers, [such as] ***habitat loss and species extinction***, *a net release of* CO_2 *to the atmosphere and* ***loss of vegetative cover that protects soil structure and fertility***. *Farmers often burn vegetation in the process of clearing land, which further releases harmful greenhouse gases. Land cover changes can also affect regional-scale hydrology and climatology.*
These general environmental concerns apply to the specific project areas in the different countries as follows:

LANDSCAPE ENTRY POINT

CONCEPTUAL FRAMEWORK TRYS CONTROL
IMPACT ON ENVIRONMENT



Our understanding is that one of the main purpose of the EMMC project is to increase the level of information and awareness of environmental change and increase the capacity to respond proactively to these changes among stakeholders in FITCA participating countries.

1.2 Fight against trypanosomosis

Trypanosomosis is widespread in the whole of sub-saharan Africa, and affects livestock, wildlife, and humans. The incidence of trypanosomosis in Africa is associated with the presence of tsetse (Glossina spp.) which in tern is dependent on the availability of suitable habitats. For more than a decade much effort has been employed to control trypanosomosis. While infected animals have been treated with tyrypanocidal drugs, methods used to control the disease have been largely dominated by activities to reduce tsetse populations. Various methods have been used in different areas depending on tsetse species and resources available.

1.2.1 Glossine control programmes

Each of the FITCA countries has tsetse control programmes undertaken in different by different agencies. In Kenya the approach is to mobilize communities, empower them with tsetse control strategies and assist them to control tsetse to levels that people can restock their herds and regain confidence to settle on their farms. In Uganda FITCA tsetse control programme is mainly undertaken by governments through their district administrative networks. They are also placing efforts on empowering local communities cope with sleeping sickness cases and to understand and diagnose the disease. In Ethiopia, government is doing the control in areas tha have no very little human occupation with a view to settle farmers in the tsetse controlled areas.

1.2.2 Present step in the history of glossine control

Efforts in tsetse control have always been frustrated by reinvation of tsetse soon after the control programmes are completed. This has been due to several factors including inability by the communities to sustain control programmes themselves. It is thought that local communities were either not motivated enough to

maintain tsetse control because they considered it a public good and not their concern, or, they were too poor to make any input into a continuation of tsetse control.

1.2.3 Present activities of national programmes

FITCA approach is to control tsetse and empower local communities to maintain low tsetse populations by sustainable land use practices. It is the assumption of the project that sustainable land use practices will maintain low tsetse populations due to reduction of habitats suitable to tsetse habitation. Low tsetse populations will obviously result into low diseases incidences.

1.2.4 Objectives of the Programme.

FITCA

One of the main objective is to control trypanosomosis in the project areas to levels manageable by people the disease. The other larger FITCA objective is to sustain farming in tsetse control areas

EMMC within FITCA

Increased sustainability of natural resources and agricultural systems, through environmental monitoring and management, in participating FITCA countries These includes: Reducing decrease of soil fertility by 10 % ; Reduce deforestation by promoting balanced tree felling and replanta-tion and increase number of animals in environmentally sustainable manners

Increase the level of information and awareness of environmental change and increase the capacity to respond proactively to these changes among stakeholders in FITCA participating countries.

2. ANALYSIS OF ENVIRONMENTAL ISSUES IN EACH SITE

2.1 Identification of major specific environmental components

2.1.1 FITCA Project area in Kenya (Busia District)

Human population density in Western Kenya is high. Agriculture is the main activity in this region (as well as fishing along the Victoria Lake) farmers producing cereals, cassava and pulses for consumption and local market, milk and meat, sugar, tobacco, coffee and pepper as cash crop. Many farmers rear livestock.

This region is still seriously affected by animal trypanosomosis and now rarely by sleeping sickness. FITCA-Kenya project started in July 2001. It promotes the participation of farmers to tsetse control activities through adoption and self-use of two major techniques:

- in dairy production, the use of impregnated permanent nets around the barns where dairy cows remain. Two hundred farmers have been identified and receive convenient material, insecticide and extension service. The objective is 2500 farmers.
- In livestock rearing associated with farming (draught animals, meat production), cattle are impregnated with insecticide by spaying in a crush pan. These animals are alive targets, able to poison the flies. The spray is practised every 3 or 4 weeks (only against glossines) or 1 or 2 weeks (against glossines and ticks). The crush pan is built at communal level and a crush management committee is in charge of the spraying, the pomp, the purchase of insecticide and the payment of costs by farmers[1].

From our visit in the three sample zones chosen for the environmental monitoring, we noted:

- The northern zone in Teso District is hilly and densely populated. The Angurai region is under urgent control because of the high density of tsetse. In this region, animal diseases (mainly trypanosomosis) seriously reduced the livestock number. The use of traps and targets reduced the tsetse density. A part of arable lands is only fallow.
- In the surrounding region of Busia, dairy farms are numerous: cows are permanently in stable and fed with green fodder (napier grass) hay and commercial feed. Blood samples are regularly taken to control the degree of infection by trypanosome.

[1] We have had the opportunity to participate at the community crush launching of Amukura in Teso district, with the District Commissioner, the District Officer and the District Veterinary Officer.

- In regions close to Lake Victoria, small areas covered with spontaneous bushy vegetation (on hills, on bad soils, on flooded plains, along the rivers, between fields) constitute reservoirs for tsetse fly, but also for wildlife. The rural landscape is very cultivated, similar to bocage, with many hedgerows. Forests and savannahs disappeared almost completely. Out of fields, one can found some communal pastoral areas, often heavily grazed.

In a published study, ICRAF mentioned the risk of erosion in this western region. Conservation tillage method with plant cover has been proposed to protect the ground effectively.

Questions about environment have been observed or mentioned:

Rural areas

- About the direct effects of insecticide:
  - Positive impacts: the decrease of the fly number in stables and of the number of mosquitoes in farms. The type of insecticide, not systemic, prevents a contamination of milk by the chemical substance (it differs of the treatment with Trypamidium which can pass into the milk).
  - Negative if they are confirmed: selection of flies insecticide resistant (no resistance in tsetse fly, very sensitive). Effect on non-target bioagents, not always identified. For example, it is supposed that dungs do not degrade as fast as before (negative effect on dung beetle?).

- Indirect supposed impacts raise some questions:

  - Plantation of perennial grasses for green forage production: the most common is the napier grass (*Pennisetum purpureum*), used in zero grazing feeding system (cut and carry). The fields planted can be regularly cropped for several years. What is the consequence on soil fertility?

A perennial grass cover is known for its capability to accumulate organic matter in soil and participate to carbon sequestration. Organic matter in soil strongly contributes to fertility. Nevertheless, trials in Ivory Coast have shown a compact soil structure after several years under perennial forage grass (*Panicum maximum*).

  - Zero grazing system excludes the animals from the cropping areas. What is the effect on nutrient recycling to maintain the chemical fertility of soil? How is practised the use of animal manure?

  - Rural development will undoubtedly lead agricultural systems toward intensification and increase of livestock. What consequences on sustainability for soil and production systems (technical aspects) can we expect of this intensification?

Social conditions

The main objectives of farmers are clearly a higher production for cash, higher income and improvement of conditions of life and well being. We can underline that a 60% of the population in this region lives under the threshold of poverty (1 US$ daily). The mean size of farms is between 3 and 4 acres (1.2 to 1.6 ha). Soils are generally phosphorus deficient, limiting their fertility. Conservation of areas with native vegetation does not appear a necessity to farmers. They are convinced that land clearing helps the tsetse control.

Many farmers are members of various rural organisations and then participate to meetings. It could be easy to communicate useful technical information by this way, the farmers broadcasting this information around them. Trypanosomosis is one of the most important animal disease, but the farmers fight also against tick born diseases (babesiosis, anaplasmosis) and internal parasites. Dairy cows often suffer mammitis.

◆ Vegetation

In Busia District, most of the sites visited are under important agricultural pressure. The natural vegetation of the District which mostly lies within the Lake Victoria basin has been cleared for tsetse control, land cultivation, timber extraction and fuelwood collection over the past 30-40 years. The landscape is represented by a succession of small cultivated plots, which are delimited by hedges comprising indigenous trees

and shrubs as well as exotic species (*Cascabela thevetia, Juniperus procera, Grevillea robusta, Melia azedarach, Eucalyptus* spp., *Euphorbia tirucalli, Leucaena leucocephala*) which are often invasive such as *Lantana camara* and *Tithonia diversifolia* (Photo 1).
Cultivation and settlement have doubled between 1961 and 1997. The woody vegetation cover in the form of woodland, forest (including riverine forest) and shrubland was only 11% in 1997 (Bourn *et al.* 2001) and it is estimated that only 580 ha of forest reserve has been gazetted within the District. Grassland cover, which increased between 1961 and 1985, especially with an extension of fallow land, declined substantially since 1985 with more intensive land use.
Large to medium size trees such as *Milicia excelsa, Trichilia emetica, Apahia senegalensis, Albizia* sp. and tall *Ficus* remain in the surroundings of villages and are always kept for shade. Patches of dense thickets occur in the flood plains along the river courses and the grazing areas in which *Acacia brevispica, Cappacis tomentosa, Harrissonia abyssinica, Senna didymobotrya, Balanites aegyptiaca, Carissa edulis, Rhus* sp., *Euphorbia candelabrum, Grewia similis* are common species, often mixed with exotic species such as *Cascabela thevetia* and *Lantana camara.*
Rocky hills in the south of the District, more difficult to clear and crop, are sometimes covered with a dense bushy vegetation comprising *Acacia brevispica, Maytenus senegalensis, Markhamia lutea, Maerua sp. Dovyalis sp., Chaetacme aristata.* In Buladang'i, the woody cover of the hills is made of *Acacia brevispica, Croton* sp., *Phyllanthus* sp. *Ochna ovata, Harrisonia abyssinica, Dichrostachys cinerea, Carissa edulis, Haplocoelum foliolosum, Vita sp., Capparis tomentosa, Lannea fulva, Combretum sp.* (Photo 2). With a more or less important encroachment with *Lantana camara.* These hills, partly covered with patches of grassland dominated by *Loudetia kagerensis* and *Andropogon schirensis,* are used for grazing by cattle, sheep and goats.
In the Angurai area, agricultural pressure seems to be slightly less intense and it is still possible to find characteristic woody species on the rocky hills (*Terminalia spp., Combretum spp., Piliostigma thonningii, Hymenocardia acida, Vitex doniana, Ficus spp., Gardenia sp., Securidaca longepedunculata*) which are not completly under cultivation.

◆ Wildlife

Bush clearing, intensive land use, increasing livestock populations (indigenous zebu and grade livestock) led to a serious decline of the wildlife populations in the FITCA area. Most of the land is under cultivation (45%) or grassland (45%, including fallow) and most of large mammals disappeared, except the hippopotamus in the major rivers, as well as the bushbuck in the more bushy areas on the rocky hills.
The remaining natural vegetation, the numerous hedges around villages and the large areas of crops led to maintain interesting populations of birds which adapted themselves to a new environment. A survey of the rodent populations would certainly lead to the same result. The Nile crocodile and the monitor lizard are still commonly found along the major river courses of the area.
An environmental monitoring programme must take into account the main potentialities and constraints which characterise and/or affect the environment in the area. They can be listed as following:

POTENTIALITIES

- FITCA Kenya in place
- Adaptation of farmers to new conditions of production (intensification)
- Willingness of local communities to collaborate
- Afforestation (woody plots)
- Cultivated plots delimited with hedges

CONSTRAINTS

- Human sleeping sickness and animal trypanosomosis
- Population density and poverty
- Livestock populations (cattle density)
- Intensive land use
- Marketing systems
- Bush clearing
- Encroachment with exotic species
- Cropping and grazing on sensitive areas (slopes)
- Reduced wildlife populations

2.1.2 FITCA Project area in Ethiopia (Didessa Valley)

Few studies of environmental change and trypanosomosis control have been undertaken in Ethiopia. History and land use change have been mainly studied in the Angar and Ghibe Valleys and partly in the Didessa Valley in the southern western region of Ethiopia.

The Didessa Valley, which stands at 1300-1500 m above sea level, is 4-15 kms wide and delimited with steep escarpments rising to plateaux at 2000 m on either side. According to aerial photographs, prior to 1973-74, the upper part valley has been settled and farmed (Slingenbergh, 1922b; Bedane, 1998). These farmers left the valley around the year 1938 after unspecified epidemics (Ford *et al.*, 1976). Tsetse flies appear to have extent their range over the last 50-60 years. From 1986 to 1996, with support of the FAO, tsetse control has been carried out through using odour-bait and impregnated targets, in four sites in the upper Didessa Valley, leading to clear 1200-1500 km^2 of tsetse infested areas (NTTIC, 1996).
Tsetse fly can be found in five provinces of Ethiopia: Gambella, Benishangui, Orimia, Southern and Amhara. The NTTICC (National Tsetse and Trypanosomosis Investigation and Control Centre) is based in Bedele (Southern Province) and its intervention area covers the Didessa and Wama Valleys and the Ghibe Valley. NTTICC has collected data on the tsetse densities as well as socio-economic data (population, livestock, and land use). The NTTICC headquarter harbours the FITCA project.
Some other major animal diseases are mentioned by farmers: black leg, bovine tuberculosis, and anthrax.

Due to a lack of time only one site has been visited during the mission, in the Didessa River Valley in the Oromiya Region of southwestern Ethiopia. This area is dominated by wooded grasslands and harbours patches of forest as well as riverine forests: it was identified as a potential settlement area, especially for the farmers who left the valley after tsetse infestation in the fifty's. The FITCA Project should start soon tsetse control through community based tsetse control operations.

Settlement programme in the province would support the migrants during the first year. Actually, many settlers arrive spontaneously in newly occupied areas, helped by relatives, and are not controlled by the programme. Obviously, the future extension of tsetse control to wild areas will open new lands to settlement.

◆ Vegetation

Although the area was under human pressure several decades ago, the natural vegetation re-colonised almost the entire valley as if no disturbance occurred. In this part of the Valley (Marotissa village), wooded grasslands form the dominant vegetation type with *Entada, Terminalia, Combretum* tree species associated with numerous other shrubs or trees belonging to *Bridelia, Cussonia, Ficus, Gardenia, Grewia, Lannea, Maytenus, Piliostigma, Protea, Stereospermum, Ximenia* genera (Photo 3). Patches of forest and small riparian forests are still existing, probably with a high biodiversity potential.

Theoretically, the forests are under law protection against any clearing and cutting down of trees. Cutting a tree in the communal land is not allowed by the traditional rules without the chief allowance. Actually, some farmers settle in forests or go and cut down some trees for their own use. Large areas of forest are planted with coffee trees under the shade of tall trees. The Arabica coffee is native of this region and the indigenous forests contain a valuable diversity of wild coffee plants.

Cultivated areas
The medium altitude lands are likely to be largely cultivated, more than the low altitude lands (Photo 3). The main environmental risk mentioned by agricultural services in cropped areas is erosion. In most areas, the vegetal cover protects the ground efficiently. We have sometimes observed gully erosion starting on slopes along the tracks of cattle between the pasture and the watering point.

◆ Wildlife

The Didessa catchment lies immediately to the west of the Ghibe catchment in the Oromiya region. Assessment of the abundance and diversity of plants, large mammals, birds and butterflies has been done by ILRI in the Ghibe Valley. Results showed a high biodiversity potential of the area and various responses of taxonomic groups to land use after tsetse control (Reid *et al.* 1997, Wilson *et al*, 1997).
Information obtained with local farmers showed the area still harbours viable populations of large mammals (Buffalo, waterbuck, bushbuck, warthog, lion, and leopard). The results of in this part of the Upper Didessa Valley should be similar to those of the Ghibe Valley, according to the good condition of the vegetation.
As it occurred in the Angar Valley, Ghibe Valley and parts of the Upper Didessa Valley, settlement of farmers during and after tsetse control operations, will lead to a more or less important conversion of the natural vegetation to farmland, including the opening of forests.
The Ministry of Forestry and Environment has recently been created, spilt off from the Ministry of Agriculture, and is in phase of reorganisation. One of the divisions is called: environmental protection. Wildlife is under its control. There is no protected area registered in the region.

With regards to the global area where the FITCA Project will be implemented, potentialities and constraints of the region are:

POTENTIALITIES

- High agricultural potential
- Large cover of natural vegetation
- High potential of biodiversity
- Large mammal populations present
- Few settlements
- Environmental data available for the Ghibe Valley (similar to the Didessa Valley)
- Livestock part of the farming systems
- Peasant associations well organised
- Ministry of Environment and Forest recently separated from the Ministry of Agriculture

CONSTRAINTS

- Animal trypanosomosis at low to medium altitude
- Population density and growth
- Weakness of environmental policies (Land use, Forestry, Biodiversity conservation, etc.)
- FITCA not yet implemented
- Soil erosion (locally)
- Artificial fires
- Poaching
- Illegal logging
- Coffee plantations under forests
- No protected areas in the FITCA Project area

2.1.3 FITCA Project area in Uganda

FITCA-Uganda is starting. The project concerns 11 Ugandan districts and focuses on the human sleeping sickness (presently limited to about 200 annually diagnosed cases). In every district, it employs a district entomologist and a tsetse fly assistant. Animal trypanosomosis (*nagana*) is also a problem, but not so much taken into consideration. The project supports the farmer communities to undertake actions against tsetse fly and organises training, taking the example of the activities in FITCA-Kenya: distribution of material and insecticide for traps, crush pan building, pour-on spraying... It provides veterinary services (theoretically one in each county) with some equipment. The project wants to take in particular consideration the peasant knowledge and initiative, their culture, their vision on environment and landscape. Cattle are part of the mixed farming system, based on crops (draught, meat production), special breeds produce milk. The pastoral system is not used in this region.

The study sites for environmental monitoring have been chosen on the following criteria: numerous cases of sleeping sickness, large areas covered with natural vegetation or bushes, diversified ecosystems. The mission visited Kalait in Tororo district with dense crop occupation, (and close to the Angurai region in Kenya), Serere in Soroti district, with important livestock production, Namasagali and Namwenbma in the Kamuli district, with natural savannah in phase of clearing for cultivation.

The activities against sleeping sickness and for tsetse control are supposed to have no noticeable consequences on the population dynamic, quite high in Uganda, and the human distribution in the project area. Better control of *nagana* will probably increase the number of animals but no important change is expected in the production systems. Benefits of project should be over all an improvement of life conditions. There is no known national politic in land use planning (or not applied). The main landscape change is associated to land clearing to open new cropping areas.

Animals are moved for market purpose. A question raise about epidemiology of trypanosomosis: does movements of cattle facilitate the dissemination of the parasites and the sleeping sickness throughout the region?

◆ Vegetation

In Kulait, as well as in the closest site in Kenya, most of the land is under cultivation. The landscape is a mosaic of cropping plots and fallow (Photo 4). Some trees and shrubs such as *Albizia sp., Bridelia sp., Combretum sp. Markhamia lutea, Milicia excelsa, Piliostigma thonningii, Syzygium sp.* still remain in the fallow or around the huts of the farmers. They are often associated with exotic species such *as Cascabela thevetia, Euphorbia tirucalli, Melia azedarach, Tithonia diversifolia* and *Agave sp.* in the hedges which delimit the plots.

Fallow are manly covered with grasses: amongst the dominant species *are Andropogon sp., Brachiaria brizantha, Chloris virgata, Cymbopogon sp., Eleusine indica, Digitaria sp., Eragrostis tenuifolia, Hyparrhenia sp., Imperata cylindrica, Melinis repens, Panicum maximum* and *Sporobolus pyramidalis.*
The Malaba River, on the border with Uganda and Kenya is a small watercourse. The riparian vegetation has been highly degraded with cultivation close to the riverbanks.
As in the Kenyan site, the biodiversity is low in Kulait and studies linked with an environmental monitoring should focus on rodents, birds and butterflies.

In Serere area the natural vegetation is composed with wooded grasslands, grasslands and large swamps. Except some parts which are heavily used for cultivation, the area is not overpopulated as in the Totoro District. When the agricultural pressure is low, the vegetation is a mosaic of grassland and patches of woody thickets of various sizes (Photo 5).
The main woody species are represented by *Acacia polyacantha, Albizia zygia, Allophylus sp., Carissa edulis, Flueggea virosa, Grewia sp., Harrisonia abyssinica, Maytenus sp., Mimusops sp., Phyllanthus sp., Piliostigma thonningii, Vitex doniana* and numerous vine species such as *Paullinia pinnata.*
Phoenix reclinata, which is an indicator of hydromorphic soil, is also frequent. The herbaceous cover varies with hydromorphy and *Setaria sphacelata* and *Echinochloa* cf. *pyramidalis* (grasses) can be locally dominant. Other species include *Andropogon sp., Hyparrhenia sp., Imperata cylindrica, Panicum maximum, Sorghum arundinaceum, Sporobolus pyramidalis* and numerous sedges.

The visit in the Namasagali site was short, due to a lack of time. The area is under agricultural pressure and most of the natural vegetation has been removed.

◆ Wildlife

Although some parts of the FITCA Project area still harbour patches of natural vegetation, the human (agriculture, logging, poaching) and grazing pressure degrade the natural habitats viable for wildlife. Except for monkeys (Green monkey -*Cercopithecus aethiops*- for example), rodents, birds and insects, the global area is not anymore suitable for large mammals.
About the environmental issues, the potentialities and constraints of the study area can be summarised as follow:

POTENTIALITIES

- High agricultural potential
- Natural and secondary vegetation viable for biodiversity conservation (corridors)
- Large areas of wetlands viable for biodiversity or cropping
- Hedges in villages
- FITCA project just implemented: collection of basic data

CONSTRAINTS

- Human sleeping sickness and Animal trypanosomosis
- Human population density and growth
- Intensive land use
- Weakness of veterinary services and environmental policies (Land use, Forestry, Biodiversity conservation, et
- Poaching
- Illegal logging (fuelwood)
- No protected areas in the FITCA Project area
- Lack of basic data and data base

3. METHODOLOGICAL FRAMEWORK OF THE ENVIRONMENTAL MONITORING

3.1 Choice of indirect relevant indicators

It is clearly understood that the present component does not concern the study of the direct environmental impacts resulting of either the tsetse fly control or the chemical measures preventing or treating against trypanosomosis, but only their indirect consequences on ecosystems in the long term. The aim is to make sure that the ecosystems, submitted to change following the progress of the project, remain viable and that the production systems in development are sustainable.

In the field of environment, monitoring of natural or cultivated ecosystem must be supported by quantified, clear and easily accessible indicators. Among many possible indicators of change, we have to select only those linked with the human and animal trypanosomosis and the tsetse control.

Consequences of ecosystem changes are made out at different scales:

- at the village or district level, i.e. with a geographical approach, one can observe the land use and land cover evolution, as well as the ground cover and the state of surface. It is obvious that the environmental consequences must be interpreted in a long-term perspective. Remote sensing is the most useful tool for this approach.
- At the field level, attention must be given on the key environmental components or resources as soil, water (particularly in water bodies), vegetal and animal diversity. Tools of measurement are used on the field; measurements must be reproducible and comparable.
- In relation with rural production systems and rural population, the useful criteria are obtained by surveys and statistic data collection.

The proposed indicators and their justification are presented in the following pages.

3.2 Main indirect indicators for an environmental monitoring

3.2.1 Human population

Unusual changes of population could find explanation as a result of the tsetse control. They will be in the same time the cause of changes in land use and production systems.
Population data and population density are important indicators of human pressure on environment. Data on population number have to be interpreted taking into account the several other possible causes of variation as settlement programmes and incentives, migrations, etc. The data are collected by national census and completed by FITCA through socio-economic surveys.

3.2.2 Climate

- Rainfall an temperature

The most common climatic data (mean monthly temperature and rainfall) are needed to analyse some of the following indicators as the river flood, the crop yield, the botanical composition of herbaceous layer. These data can be obtained in the national meteorological services.

3.2.3 Land use/land cover

The consequences of tsetse fly invasion were mostly desertion of land by farmers, decrease of population density, lack of workers, lack of draught animals. Since the beginning of the XXth century, the epidemic of sleeping sickness occurring in this part of Eastern Africa and the following actions undertaken (including large scale land clearing and massive use of remnant insecticides) have thoroughly modified the human population distribution and the land use.

The current programmes of tsetse control remain in the line of these first actions, using new technologies much more benign for environment, but already facing technical difficulties limiting their effect. Nevertheless one expects a prompt positive impact on control of the farmers involvement in the tsetse fighting techniques (FITCA objective). Due to population pressure for land resulting of the natural population growth, changes in land use will continue to progress.

The first indicators of change concern the land use and principally:

- the ratio "cultivated area / total area"
- the ratio " area covered with natural vegetation / total area ; indigenous vegetation includes forest, savannah, riverine forest and old fallow.

These indicators must be establish using remote sensing techniques (see the "remote sensing" component of this consultation). Precision of measurement is limited by the perception capacity of the tools used. Analysis has to include diachronic comparisons on the same areas. These indicators are not useful *per se* to evaluate the environmental consequences but have to be combined with other complementary indicators (for instance, analysis of landscape and principles of landscape ecology as mentioned in the "remote sensing" component).

Other indicators concern the land use:

- the ratio "perennial crop areas / annual crop area
- the mean size of the ploughed fields

- the length, the structure, the botanical composition of hedgerow
- the size, the structure, the botanical composition of areas covered with natural woody vegetation included in the cultivated areas.
- The area, the structure and the botanical composition of fallow in relation with their age.

The three last indicators are directly related with the possible presence of glossines, the vegetation offering possible habitat for some species. Evolution of areas with bushy or woody vegetation can be interpreted with the density of flies. Production system changes can directly modify hedgerow and fallow density and distribution.

The methods to establish these indicators combine remote sensing techniques with high resolution product analysis (for ex. aerial photographs) and field measurements. At this very detailed scale, the monitoring is applied only on sampled areas, and observations are repeated at the same spots after a sufficient time interval. For the botanical composition, the survey will be practised on a permanent observation line.

3.2.4 Water and soil

Water and land resources are directly concerned by agricultural activity and livestock rearing. They constitute basic elements of the production system and their viability.
Consequences are not limited to the cultivated areas but have also indirect effects on the neighbouring ecosystems. The monitoring of these resources has a significant importance in environmental point of view. The proposed indicators are explained below:

◆ Date, frequency and level of river flood: the rainfall collected in a basin flow out differently according to the state of the soil surface, the vegetal cover, disposition of fields, hedgerow, anti-erosive mechanisms, etc. All change encouraging runoff will increase the risk and occurrence of flood as well as the amount of water infiltrating in soil and reconstituting the deep-water reserves is reduced. The project cannot install the specific tools and organise the data collection; it only can be aware of the existing monitoring systems and the national institutions or research centre in charge of it. A significant increase of floods can express a worrying reduction of water absorption by soils and/or an increase of sediments in the riverbed reducing the river flow.

◆ Erosion and transport of sediments in river: runoff carries some soil material to the river. The sediment is deposited away, in the bed of river or in the lakes fed by these rivers. Victoria Lake, for instance, is shallow and the silting up is a common preoccupation of the bordering countries. The project can not undertake measurements of the solid particles carried by flooding rivers but can use the existing data collected by specialised institutions. A significant increase of sediments in water must be analysed in comparison with the land use and land cover changes. If necessary, the project could propose the farmers to apply anti-erosive practices.

◆ Erosion and bare soil: land clearing or bad agricultural techniques can initiate superficial degradation of soil and later extension of eroded areas. Rehabilitation of degraded land is difficult and expensive. The best indicators to express erosion are the numbers of eroded places and the total area eroded in a specific zone. Eroded areas can be monitored by remote sensing. This technique informs on the zones to be monitored at field level and the dynamic is perceived by diachronic analysis. Anti-erosive techniques and tree plantations can by applied to reduce erosion.

◆ Soil fertility: evolution of agricultural practices and production systems modify the soil fertility status. This fertility is an important factor of sustainability of land resource.
Agricultural production systems are directly concerned by the consequences of tsetse control: labour, animal draught, cropping extensification, length of fallow, use of fallow, rotational system including forage crops, fertilisation with animal manure, etc. Unfortunately the follow up of soil fertility is very difficult (soil sampling and analysis).
The use of indirect evaluation is more relevant: measurement of crop yield (expressed by area unit and compared on the same place over a sufficient period), yield of annual crop at district level according to the statistics (if sufficiently accurate), report of the farmers, vegetation indicators (plant or weed species)...

◆ Water or soil pollution: use and storage of pesticides as the insecticides for tsetse control can produce localised pollution if unsafe. Direct impacts are not part of this project, but one must consider the long-term pollution hazard, particularly in water for domestic use. Water analysis could be ordered in case of doubt.

Note: during the mission, some farmers expressed their basic need of safe water for human consumption in the villages. They often have only access to the river, with unsafe water. Water availability is an important factor of

well being and hygiene improvement. Programmes against tsetse fly are positively perceived by population but cannot mask this other needs of water access and availability.

3.2.5 Biodiversity

The biodiversity is deeply modified by rural activities and land cover/land use changes after tsetse control. These actions represent a potential risk for sensitive areas. Environmental changes caused by clearings, ploughing, introduction of animal and plant species, hunting, fires lead to an increase in some species home range as well as the decrease or extinction of others. Associated predator populations are also affected.

◆ Vegetal diversity (woody and herbaceous plants)

Studies on vegetation and flora should focus on the indigenous savannah and forest areas (including riparian forests) (Ethiopia, Didessa Valley), on patches on natural vegetation which remain within the cultivated areas (thickets), on the rocky hills and on the riparian forests (Kenya, Uganda).
The floristic composition of the hedges and the role of network they play for wildlife (movements, refuges), especially for birds, rodents and insects, should be studied in this landscape under a high human pressure.
In the Lambwe Valley in Kenya, Maitima, Stones & Tumba (1998) showed that the avian density is higher in the human settlements than in the adjacent Ruma National Park. The cause is that human activities tend to increase food resources for the birds by increasing the diversity of plant shrub species.

Vegetation surveys will include the collection of the following data:

- ⇨ Species diversity
- ⇨ Species richness
- ⇨ Density
- ⇨ Vegetation structure (diameter (basal area), height, cover at species level)
- ⇨ Biomass
- ⇨ Spatial patterns of plant communities
- ⇨ Condition (vigour, mortality, number of damaged trees, etc.)
- ⇨ Regeneration
- ⇨ Status of species

A preliminary survey as a « T0 » must be done as soon as possible, especially in Ethiopia where large areas of natural vegetation still exist. The data could be obtained using similar survey methods used by ILRI (transects and plots) in the upper reaches of the Ghibe Valley in southwestern Ethiopia (Reid *et al.* 1997). They will permit a comparison of the vegetative characters in different land cover/land use types as well as between different production systems (cultivation techniques, farm sizes). Such a comparison could be also done between wooded grasslands, grasslands (including fallow) and riparian forests.

In Ethiopia, a particular attention should focus on the natural forests which present a high biodiversity potential. Firstly, illegal logging and collect of fuel wood is a common practice and large patches of forests are currently heavily degraded and fragmented. Secondly, farmers remove most of undergrowth vegetation to establish plantations of coffee under the shade of the large *Acacia* trees (Photo 5). They use fertilisers and herbicides to increase the production and no studies have been done to assess the impact of such agricultural practices on soils, natural vegetation and wildlife (important populations of *Colobus guereza* and *Cercopithecus mitis* live in these forests).

The tsetse control, using different methods (insecticide impregnated targets, pour-on insecticide on cattle, odour baited traps) will lead to a decline of the tsetse flies populations.
Thickets are refuges for flies but harbour vegetal and animal diversity. One can expect that it will not be necessary to maintain bush clearing if the tsetse control is efficient.

Uses of plants

Although natural resources uses are generally part of the socio-economic studies, the monitoring programme must also focus on the uses of natural resources as food for human and animals, traditional medicine, religious purposes, timber, fuelwood, fibres, dyes, thatch (Photo 6), etc.
A good knowledge of plant species is required for such a survey which must be conducted in close collaboration with the local farmers (traditional knowledge).
Collected data will show the way people use their natural resources, highlighting the difficulties that people meet to get the resources, due to the conversion of natural habitats to cultivation. They also will describe the traditional culture influence in such a populated area.

◆ Animal diversity

As for plants, basic data must be collected to establish a medium to long term monitoring programme. It is impossible to think about an exhaustive survey of all the animal groups and only three groups could be selected: medium-large mammals, small mammals, birds, insects (butterflies). The data will concern:

- ⇨ Status of species
- ⇨ Species diversity
- ⇨ Species richness
- ⇨ Density, index of abundance
- ⇨ Mass
- ⇨ Distribution (area occupied)
- ⇨ Migrations, movements

❖ Mammals

Monitoring of mammal populations is often difficult to implement and most of the time a costly exercise. In such an area as the FITCA Project, where the land is mostly under cultivation (except in Ethiopia), simple methods to assess selected wildlife populations must be used.

In Kenya and Uganda, the low proportion of natural vegetation excludes a survey of large mammals. Medium size mammals (bushbuck, duikers) could still be present at low density in some vegetation types (riparian forest, woody thickets for example).

In the Didessa Valley in Ethiopia, large mammal populations (buffalo, waterbuck, warthog, bushpig for example) still occur in the wooded grasslands, grasslands and forests. According to the landscape (hilly region, low network of roads) and the cost of wildlife surveys, aerial surveys cannot be applied in such an area. For large mammals, line transect sampling will be the most efficient way to make direct observations of individuals and record signs (browse, dungs and tracks). Ground transects, following secondary roads or trails of predetermined direction, will be used in such an area.

In both areas, small mammal populations (rodents and insectivores) can be determined by using traps placed on transects (trap lines).

These surveys will provide qualitative (species identification) as well as quantitative data (abundance, index) which should be sufficient to monitor the trend within the populations. These data could be completed by interviews with local populations.

❖ ***Birds***

Birds have often been used as indicators of environmental change (Morrison, 1986; Pomeroy, 1991) and are good indicators of local ecological conditions. They are relatively easy to identify (visually or through audible sounds), except for immatures, and numerous identification guides are available. A problem of using birds as indicators is that birds tend to be « cosmopolitan » in distribution, meaning that they can move easily from site to site (Gardiner, 1997).

Many methods exist to monitor land birds (Distance sampling, Timed Species-count), but point counts are the most efficient way to make counts and collect data in forest and grassland habitats (Elzinga, 2001). Data will provide the number and abundance of species in the different types of vegetation and the abundance of species can also be compared between land uses.

❖ Butterflies

Butterflies are colourful, readily identified, and diurnal. They are sensitive indicators of changing environmental conditions (Kremen, 1994). Due to the enthusiasm of amateur butterfly collectors, this group is one of the best known within the invertebrates. and various identification guides are also available.

As for bird methods, transects in contrasted land use types could be set out to assess the relative abundance of butterflies.

One watcher and one recorder can be used to record data. Species difficult to identify must be caught. Butterfly trapnets can also be hung in the transects to collect species which are difficult to see or to catch by net.

Such a study will be especially interesting in the Didessa Valley in Ethiopia. Previous studies conducted in the Ghibe Valley permitted to add new species (*Anthene, Tuxentius, Acraea* and *Bicyclus* genera) to the Ethiopian checklist (Gardiner, 1998).

✒ *Animal uses*

As for plants, wild animal uses must be ***addressed.*** Bushmeat is obtained through illegal hunting and little information is known about the consumption by local people. Rodents and insects often play an important role in the diet of children, as a source of proteins, as well as in the traditional culture.

The honey production is increasing in the FITCA Project area and local farmers would like to improve their technology for a better production (Photo 7). This can be done in providing better equipment but also through the promotion and conservation of plant species used by the bees.
Animal uses in the traditional medicine or for religious purposes is not well known in the FITCA Project area. Socio-economic surveys should provide information in this issue.

Problem animal control

Human/animal conflicts are more and more frequent in the overpopulated areas when the land cover changes from indigenous vegetation and habitats to cropping areas. These conflicts should not be a problem in most of the FITCA area in Kenya and Uganda where large mammals are extinct. They could occur in heavy cultivated areas, especially with monkeys when patches of natural vegetation remain or with birds which feed on grains.
In the Didessa Valley in Ethiopia, the conversion of relatively pristine areas of savannah and forest into crops will certainly lead to conflicts between farmers and large mammals (especially buffaloes) and monkeys, the first years after people settlement.

It would be interesting to assess how the land conversion, after tsetse control, affects the use by farmers of natural resources, plants and animals species, in terms of quality, quantity, time spent and distance used to get the products.
Such changes in the daily life of human population will affect their traditional culture with the risk of a huge loss in traditional knowledge.

3.2.6 Production systems

Cultivated areas are submitted to their own ecological mechanisms and constitute particular ecosystems. These ecosystems, dominant in the study areas and mostly increasing, are very important in the global ecological balance.

Environmental impacts due to rural production systems are multiplied by the number of farms concerned. As the tsetse control project and the FITCA will probably stimulate the increase of the farms number and production system changes, an environmental monitoring cannot avoid focusing on the evolution of these areas and these systems. The results will be used to propose adapted technical interventions and incentives to alleviate unfair practices and support or create environmentally sound techniques. A selection of possible indicators follows:

- Draught animal number: this indicator is expressed in mean number of draught animals hold in farm, or by area unit. Ploughing with oxen is generally a cause of extending the cropped areas and often a certain extensification of agricultural techniques. Indirectly, an increase of animal number indicates an improvement of animal health conditions. If the ploughing is correctly practised, the direct consequences on soil properties are equivalent with a manual digging. Mechanical weeding can be more efficient than the manual one.
- Number of tractors and areas cultivated with motorization. The use of tractor has two explanations: 1) the difficulty of rearing cattle due to bad sanitary conditions, 2) availability of capital, invested in agriculture but often from other activity, then oriented to a more speculative agriculture. Ploughing with a tractor is more aggressive to soil than the preceding techniques. Environmental risks are globally higher in this case.
- The ratio "cash crop areas / food crop areas". Environmental impact of cash crops is closely related to the cropping techniques used (chemical fertilisers, pesticides, herbicides, and type of rotation). Evolution of this indicator has to be interpreted with caution and after a good knowledge of the actual conditions in the field. It is also linked with an improvement of cultural techniques and farmer income.
- Tree planted areas: the private production of trees for construction, services and domestic energy (fuel wood) reduces the need of farmers to cut native trees, particularly in forest, and then contributes to reduce the pressure on natural vegetation.
- The mean cereal yield, according to the type of ploughing. This indicator has a complex significance: an increase means a higher intensification, or an improvement of agricultural techniques, (but indirectly could be seen as an enforcement of the sustainability); a decrease means an extensification (may be linked with a lack of labour or of animal draught), or a degradation of soil fertility. The production of this indicator will result of special measurements on sample areas. It can be compared with the local statistics.
- The number of cattle in a specified area. Such data represent a global information on production systems. Obviously the cattle number is related with the control of animal trypanosomosis. The actual objectives of livestock rearing must be analysed (capitalisation of benefits, animal energy supply, milk

production for family consumption, for cash, animal production for market, for social purpose, for prestige...). They represent a good indicator of production systems and income changes.

◆ The areas of forage crops and pastures: if possible, evaluation will separate communal pastures and private areas for grazing or foraging. At present, this analysis is done with the land use / land cover study. Data on pasture areas must be interpreted in comparison with the livestock number. An extension would be diversely interpreted: either a reduction of cropped areas and then a conversion to pasture (difficulty to cultivate, lack of labour, more or less conversion to livestock), or an increase of pasture needs (more livestock).

◆ The carcass weight in the main categories of animals. These data would be collected on the slaughtering places. This indicator informs on the evolution of feeding conditions and animal health conditions, as well as on the farmer's need for cash (change of commercialised animal age).

◆ The milk production is an other production indicator.

The data will be collected on limited sample areas, previously selected in function of relevance with the subject and activity of the project. The same data will be taken at regular time interval.

3.2.7 Socio-economy

The national components of the regional project FITCA employ a specialist in socio-economy, in charge of collecting existing relevant data and organising specific surveys for complementary information.
The first surveys have been recently achieved to identify the population and the households concerned by the project. These data inform over all, as far as we are informed, on the population structure by administrative unit, on the livestock population, on the livestock infrastructure.

A specific consultation for FITCA / EMMC deals with the socio-economic monitoring in relation with environment and we send the reader to this proposal.

3.3 Data recovering

3.3.1 Bibliography and upper-level planning documents review

A bibliography review seems to be necessary to compile information about environment, plant and animal species and/or populations in the FITCA Project area. A review of upper-level planning documents should also be done to be sure that the objectives of the Project fit with those of the planning documents (conservation actions for example).
Ecological models (which describe important ecological components and their relationships), references sites which can serve as comparison (the Ghibe Valley in Ethiopia for example), studies on similar species, historical conditions and pictures can be useful information to set objective-based monitoring.

3.3.2 Collection of basic data linked with indirect indicators

The implementation of an environmental monitoring programme, looking at the consequences of tsetse control on the environment (Fig. 1), needs a good understanding of the area in terms of land use system, soil and biodiversity. Two different ways or methodologies must be addressed and combined for an environmental monitoring in the FITCA Project area.

1- The land use/land cover, in populated areas, can be monitored through a cartographic analysis using remote sensing (satellite images and aerial photographs).

The study will assess the proportion between the different land uses (natural vegetation, fallow, crops, water bodies, etc.). At the same time, ground surveys will permit a definition of the production systems and a follow up of indicators such as soil fertility, soil productivity, and soil erosion for example.

In parallel, socio-economic studies and surveys at local level (small-scale farms) should indicate the trends in the crop production, crop productivity, and incomes for the farmers, etc.

2- The second approach will focus on the areas which still harbour primary and/or secondary habitats viable for biodiversity conservation. These areas include the network of hedges delimiting the plots in heavy cultivated areas and working as potential corridors with woody thickets, forests, riparian vegetation (when such a vegetation exists around the villages or in the area). In this case the monitoring will focus directly on the biodiversity and mainly on large and medium size mammals (especially in Ethiopia), small mammals (rodents and shrews), birds and insects (especially butterflies

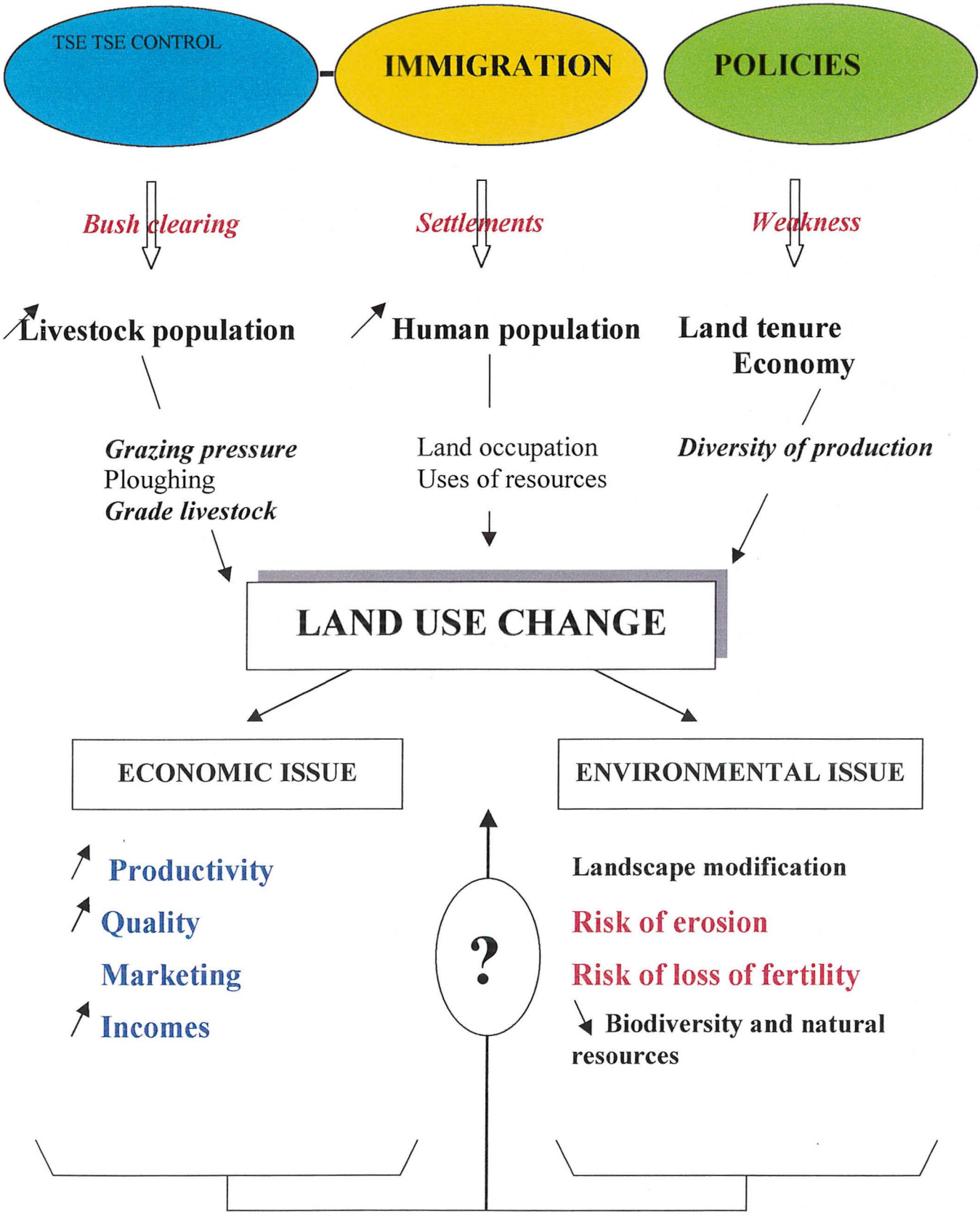


Fig. 1. Causes and possible consequences of land use change after tsetse control in the FITCA Project area.

which are sensitive indicators of ecological disturbance). Previous studies (Wilson *et al.*, 1997; Reid & Brent, 1998), conducted in southwestern Ethiopia, showed that tsetse control in small scale farms has no negative impact on bird species[2] diversity, but will alter composition.
Nevertheless an important extent of small holders farms could lead to a negative impact on bird species richness and large shift in species composition may occur. In southwestern Ethiopia again, Robin S. Reid *et al.* (1997) showed that few changes appear in the vegetation in the process of conversion of wooded grasslands into smallholder farms after tsetse control.

The first approach is more directly linked to ***land use and agronomy*** while the second will directly address the ***biodiversity conservation issue***. Oral history/recall studies, describing household level changes after tsetse control, would complete positively these two approaches.

In such a project, where human pressure is often important, an environmental monitoring programme to assess the impact of tsetse control on the environment should give a high priority to biodiversity conservation when habitats are still viable for wild plants and animals.
Methods and sampling to be used for the collection of baseline data, and then for the monitoring, will be defined after the choice of selected sites within the FITCA Project area in each country. A general land cover/land use map will be necessary to identify land cover/land use types and to select study plots to be sampled.

As shows the figure 2, the monitoring of environmental changes, including species and/or human population changes, must be place in the context of a management framework and will seek to improve and/or validate management efficiency. Environmental studies (baseline surveys) and monitoring must:

- ➔ be realised with regards to the objectives, the resources available and the duration of the Project
- ➔ determine the scale of interest for monitoring
- ➔ consider selected areas as priorities
- ➔ identify priority species and/or populations
- ➔ determine intensity of monitoring
- ➔ use simple survey methods
- ➔ rely on relevant indicators
- ➔ involve specialists and/or people already trained on survey methods, collection and conservation of specimens
- ➔ involve local communities in the collection of data.

Common failures in monitoring programmes include:

- institutional problems such as " Lack of institutional support to implement monitoring or failure to place monitoring within a management framework.
- technical problems such as the use of multiple observers or unreliable data which complicates interpretation of results.

The collection of basic data (including socio-economic data), monitoring and updating of data bases (linked with a GIS) will provide information on:

- average rainfall and temperature
- evolution of land use/land cover
- vegetative structure of the different vegetation types
- floristic composition of the different vegetation types
- changes in natural vegetation parameters
- status of animal and plants species
- estimation and trend of animal populations
- soil erosion
- water characteristics

Such information will help the definition of tools to:

- design management conservation strategies

[2] Over one-third (224) of the 861 species known to occur in Ethiopia and one-quarter (7) of all known Ethiopian endemic bird species were recorded in the Ghibe Valley.

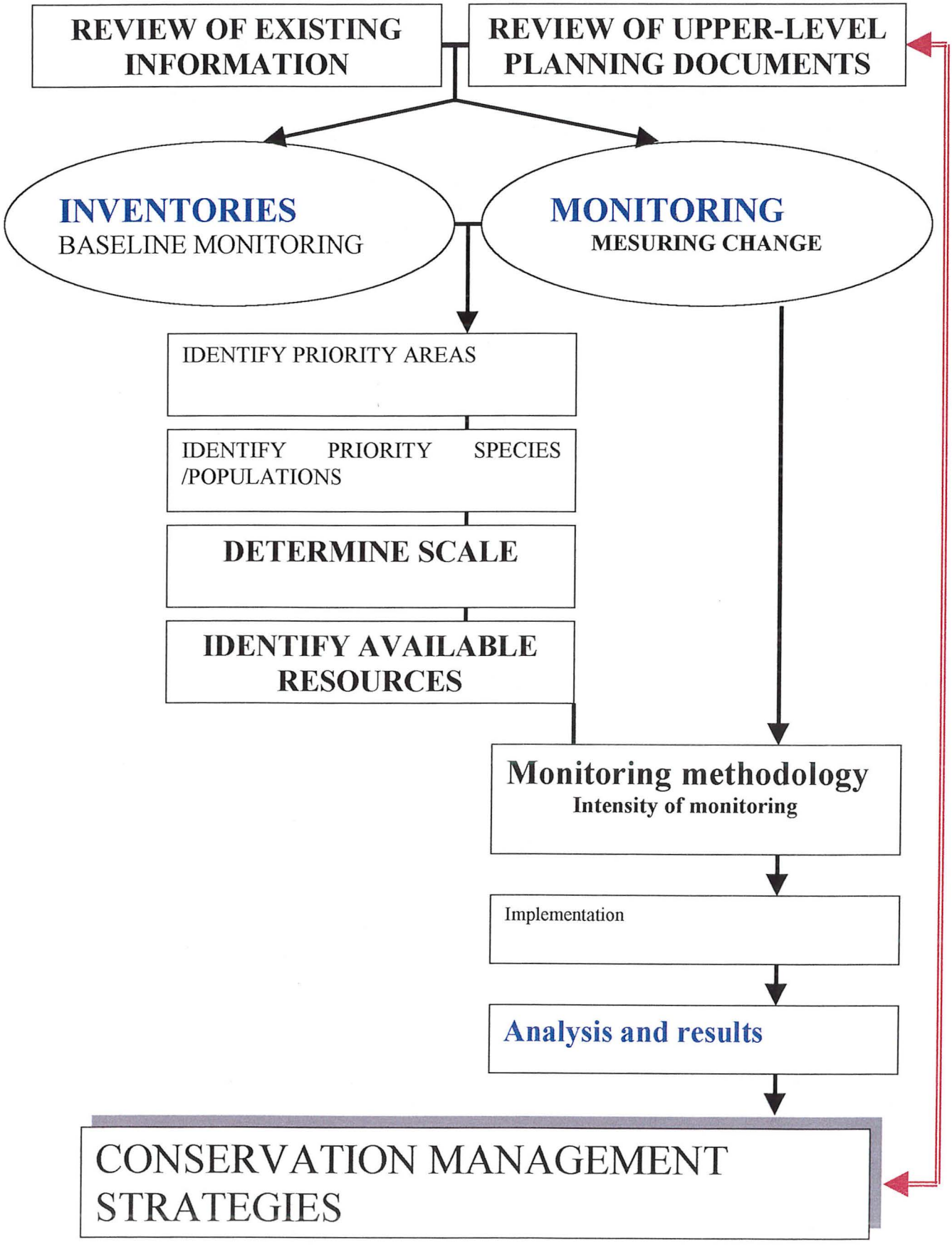


Fig. 2. Simple design of the environmental monitoring programme in the FITCA Project area.

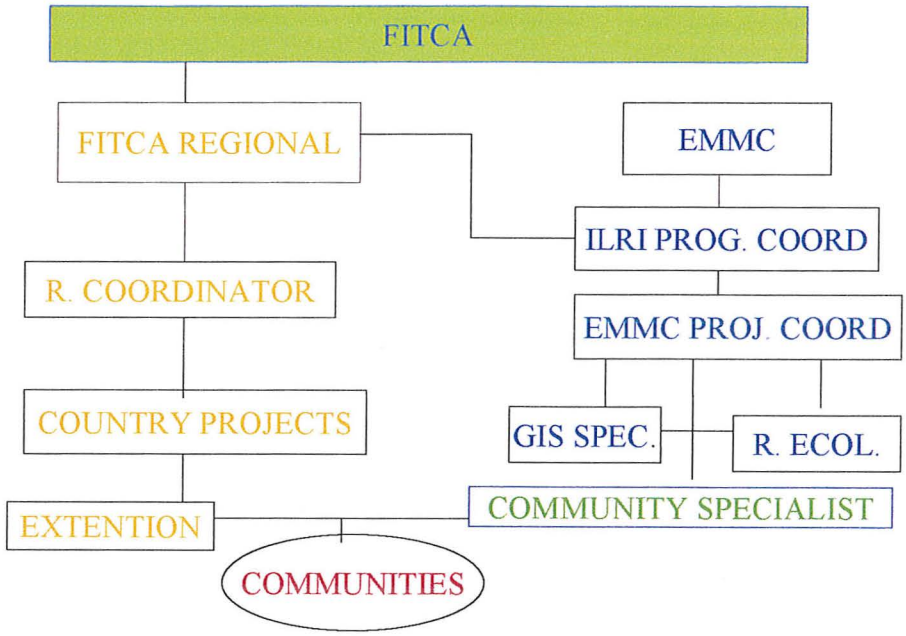
- improve the land use system
- propose more adequate production systems
- separate the effects of tsetse control from other factors that drive agricultural expansion (Six broad factors, linked to animal traction increase the likelihood of agricultural expansion after tsetse control – Agroecological conditions and the strength of the disease constraint – Land availability – Type of technology and its likelihood of adoption – Accessibility and functioning of markets – Farmer characteristics – Culture (Reid, Robin S, *pers. com.*).
- propose conservation activities (at species/population level, sensitive areas (forests and riparian forests, rocky hills, wetlands, creation of sanctuaries, etc.)
- establish fire management programmes
- develop communication and co-ordination with public and other groups.

3.4 Conditions of implementation

3.4.1 Environmental monitoring organisation

⇨ Identification of institutions and people in charge of the monitoring.

⇨ Monitoring will involve permanent government staff in all FITCA countries. EMMC project staff especially community specialists will work with government extension personnel (see diagram below).



⇨ Institutional support

→ Environmental monitoring will be supported by national institutions through the extension personnel.

→ Funding

Funds provided to EMMC are for development of monitoring tools. Funds for long term monitoring will be necessary

→ Duration of the monitoring

The project is for four years. Monitoring should continue after the project. Monitoring may continue in one of several alternatives. One of the alternatives is that the project may get extended for a phase two of another four years and in this case monitoring will continue as in phase 1. If the phase two is not funded then monitoring will be scaled down to activities that can be managed by extension officers.

3.4.2 Complementary tools

⇨ Training
Once the monitoring system is developed training on the extension people will be conducted on the extension personnel and appropriate sectors or individuals of the community.

⇨ Workshops
Workshops will be organized from time to time partly to get people's perceptions on the environmental changes taking place and secondly to train them on how to detect changes – monitor and action to be taken.

⇨ Access to the data and communication
Data to be generated in this project will be made available to all country FITCA teams and the national government extension staff in all relevant countries

4. CONCLUSION: CONDITIONS OF SUCCESS

The main goals of the management in the proposed area during and after tsetse control, on the environmental side, must be clearly defined and closely linked to the time frame to prove the efficiency of the monitoring exercise. For example, several questions can rise from management objectives such as:

- Which indicators has to be chosen? *Monitor a species directly (counts of measures of performance) or monitor some indicator of species success (habitat indicators).*
- Are current populations viable?
- Are management conditions available to maintain or increase the abundance of a species?
- Are management conditions available to prevent logging in the natural forests?

A management objective (actions) must correspond to a management response:

- to maintain (or increase) some bird species in cultivated areas will lead to maintain or increase live hedge area, or introduced plant species.
- to maintain woody thickets on rocky hills will lead to prevent them from grazing, fire and collection of fuelwood.

4.1 Characteristics of an environmental monitoring

An environmental monitoring is not an impact study. Such impact study consists of an evaluation of the possible consequences of an action on the environment before the implementation of this action. It is a part of the preliminary phase, leading to a contradictory debate between the environmental requirements and the project objectives before designing the plan. Specific protocols are available for elaborating impact study.

An environmental monitoring is composed of an assessment of the current ecological situation when an action is starting, or before starting, then of a follow-up to monitor the results or the effects on environment, based on criteria or indicators previously designed and regularly measured or assessed.

The environmental monitoring of a development project is a difficult task and has to respect some conditions to be actually useful and informative:

⇨ the aim of this monitoring should be clear, to allow decision making and reorientation. The monitoring would be addressed to identified institutions or persons.
⇨ It should be analysed in reference with a long-term vision of environment and not be impressed by court living events without long term significance.
⇨ Indicators should be practical and meaningful, related with the causes or the actions under monitoring, to report the project impacts. A small number of indicators, particularly relevant and accurate, should be preferred to many uncertain indicators.
⇨ The persons in charge of the monitoring should keep an independent position from the project leadership to feel free in his conclusions and proposals to environmental protection.
⇨ Environmental objectives should be largely shared with the concerned population and also supported by the authorities. Proposals for environmental considerations will be realistic and feasible only if they follow or if they are accompanied by a current evolution of institutional and juridical arrangements for environment at a regional or a national level.

If not, the monitoring will be vain.

4.2 Quality of indicators

On a theoretical point of view, an environmental indicator should comply with the following characteristics:

⇨ to be quantitative and largely applicable

⇨ to be sensitive and accurate, enough to allow early indication of change. For example, it will be chosen according to the minimum period of time needed to perceive the change.

⇨ to be able to characterise the state and the evolution (or dynamic, or condition of state change)

⇨ to take into account the ecological processes induced by the project.

We can add some complementary conditions of quality. An indicator should:

⇨ stay in the line of user's expectations (necessity of clear monitoring objectives as mentioned above, and of good knowledge of these expectations)

⇨ be negotiated with the stakeholders (responding to the share of environmental objectives mentioned above). It will take into account the traditional knowledge (grass root indicators)

⇨ be cheap to obtain (to be easily supported by the project or by involved organisation)

⇨ enter in a long-term process and live beyond the strict limit of the project (responding to the necessity of a long-term vision).

4.3 Involvement of national organisations

⇨ A short term monitoring, corresponding with the duration of project, can only produce information about the direct results of the project. It would be used for a final evaluation of the project, comparing actual with expected results. We could call it environmental project evaluation.

⇨ An environmental monitoring is based on repeated observations and measurement over a long period. The duration should be sufficient to let the mechanisms initiated or influenced by the project produce their effects on environment. Noticeable changes cannot be perceived before at least 5 years.

⇨ The monitoring, even if it was initiated by the project, should be progressively transferred to permanent structures. Diverse national organisations bring sufficient capabilities for such activity : services in the Ministries of Forest and Environment, services in the Ministries of Agriculture and Livestock, (may be in the Ministries of Health), organisation such the National Environmental Management Authority in Kenya and Uganda. Some laboratories in the Universities can provide scientific complementary research. A scientific and methodological support can by provided by international research institutions, private specialists and foreign universities.

⇨ If the funding for the monitoring could be initially covered by the project, the budget should be finally provided by the institution in charge of the monitoring for a long term viability.

⇨ The objectives and subjects of the monitoring should follow the principles of the national and regional policies on environment and conservation, as well as on land use planning. This activity should receive an efficient support from the authorities.

⇨ The monitoring can produce useful results only if the juridical frame and the progress of the environmental policies are strong and dynamic.

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Photo 1. Encroachment of fallow and roadside with *Tithonia diversifolia* in Busia District in Kenya.

Photo 2. Woody thickets on the rocky hills in southwe. stern Busia District in Kenya.

Photo 3. Wooded grasslands with *Entada, Terminalia, Combretum* tree species in the Didessa Valley

Photo 4. Land use in Kulait area, in south eastern Uganda, is a mosaic of cropping plots and fallow delimited by live hedges.

Photo 5. In Serere area in northern part of the FITCA Project area, natural vegetation forms a mosaic of grassland and patches of dense woody thickets.

Photo 6. Coffee plantation under *Acacia abyssinica* forest in Oromia Province

Photo 7. Use of natural resource (grasses) for thatching in the Oromyia Province

Photo 8. Honey production using traditional hives in the Oromyia Province in southwestern Ethiopia.