Annex 1 Study Area 1 (Mali) Report

Programme Against African Trypanosomosis

Options For Tsetse Fly Eradication in the

Moist Savannah Zone of West Africa:

Technical and Economic Feasibility Study,

Phase 1 (Mali)

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Introduction

Mali is a landlocked country which covers 1,211,238 km^2 and contains around 10 million people.

Mali is cited among the less advanced countries with GDP of 156,264 CFA(220 US Dollars) per person. At least 75% of the population live in the rural areas and depend mainly on agriculture for their livelihood. The contribution of agriculture to GDP is about 50%. The population increase rate is 3.4% , while the GDP increase rate is about ----------. One of the major constraints to the integrated rural development in the portion of Malian territory (240,000 km^2 or 16%) infested with tsetse flies is the presence of trypanosomosis

Mali is infested with only three types of tsetse flies: a regressing *G.morsitans submorsitans* in the declining savannah and the persisting *G.palpalis gambiensis* and *G.tachinoides* alongside the river systems. *G.morsitans submorsitans*, being continuously pushed by the cultivation of new lands, tsetse control in Mali is likely to be restricted to a battle against reverine tsetse flies.

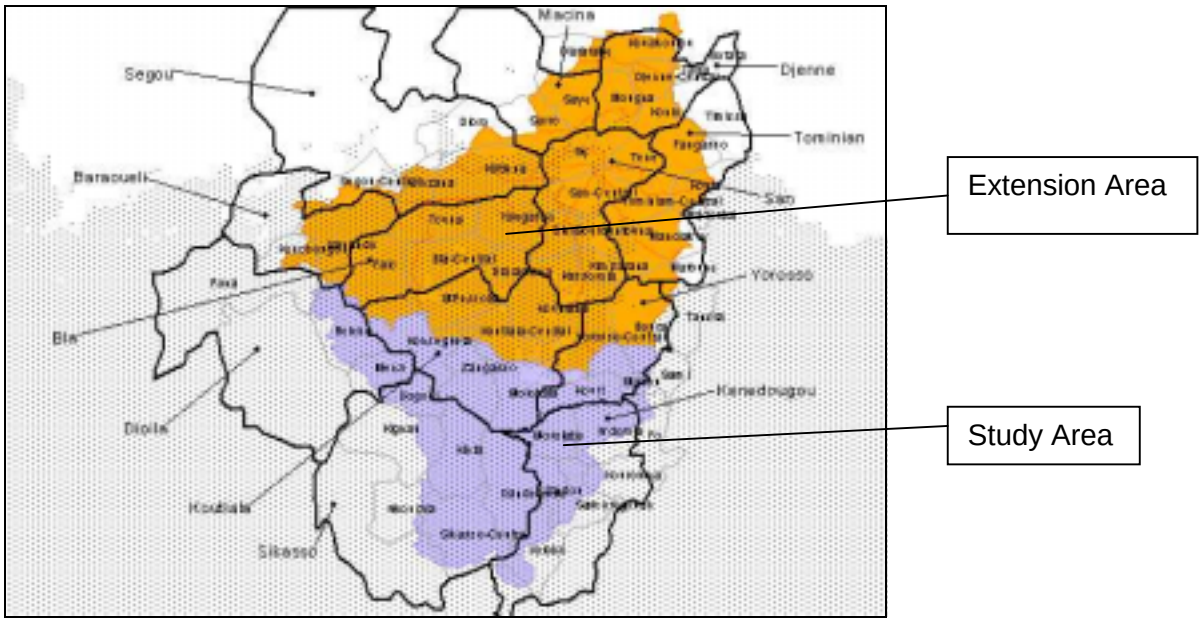
According to the criteria set up by PAAT, the cotton belt in the southern part of Mali which has a high potential for agricultural and livestock production, has been identified as a priority area for tsetse control. The development of this area is the responsibility of the "Compagnie Malienne pour le Développement des Textiles" known as CMDT. CMDT is a society owned by the Government of Mali (60%) and the "Compagnie Française pour le Développement des Textiles" known as CFDT (40%). Its primary mission was the promotion of the cotton business. Nowadays its activities have diversified and cover many other domains of socio-economic development such as food security, rural infrastructure (roads and bridges), public health, education, community organisation, etc.

The present work is a contribution to a study examining the costs and the benefits of tsetse eradication and ensuing agricultural development for a small project (17,000 sq km) at the Mali - Burkina Faso border.

Definition of the area

The area covers about just over 17,000 km^2 and represents the basin of the River Banifing which is a tributary of the River Bani. The area borders with Burkina Faso in the east. It is made of several territorial entities which are subject to both Government and CMDT nomenclatures. The government subdivisions are from the smallest to the biggest: arrondissement, cercle, region and those of CMDT are: secteur CMDT and region CMDT.

Figure 1 The Project Area



So the study area is made of 13 arrondissements scattered between different subdivisions as shown in table 1.

Table 1 Government and CMDT area demarcations within the study area

Arrondissement (abreviation: ar.)	Government		CMDT	
	Cercle	Region	Secteur CMDT	Region CMDT
1.Zangasso	Koutiala	Sikasso	Koutiala	Koutiala
2.Konseguela	Koutiala	Sikasso	Koutiala	Koutiala
3.Molobala	Koutiala	Sikasso	Molobala	Koutiala
4.Kouri	Yorosso	Sikasso	Yorosso	Koutiala
5.Mahou	Yorosso	Sikasso	Yorosso	Koutiala
6.Yorosso	Yorosso	Sikasso	Yorosso	Koutiala
7.Sikasso	Sikasso	Sikasso	Sikasso	Sikasso
8.Denderesso	Sikasso	Sikasso	Sikasso	Sikasso
9.Klela	Sikasso	Sikasso	Klela	Sikasso
10.Kignan	Sikasso	Sikasso	Kignan	Sikasso
11.Dogoni	Sikasso	Sikasso	Kignan	Sikasso
12.Beleko	Dioila	Koulikoro	Beleko	Fana
13.Mena	Dioila	Koulikoro	Beleko	Fana

For data collection purposes, we have summarized this figure considering the fact that some data are from the government and others from CMDT and also the fact that some entities are entirely included in the study area and others only partially (fractions):

This gives us the following figure with only seven (7) territorial entities:

CMDT region of Koutiala

1. 1/2 sector of Koutiala(=arrondissement Zangasso + arrondissement Konseguela)
2. Total sector of Molobala(=ar. Molobala)
3. 1/2 sector of Yorosso(=ar. Kouri + ar. Mahou + ar. Yoroso central)

CMDT region of Sikasso

4. Total sector Sikasso(=ar. Sikasso central + ar. Denderesso)
5. Total sector Klela(=ar. Klela)
6. 1/3 sector Kignan(=ar. Kignan + ar. Dogoni)

CMDT region of Fana

7. Total sector Beleko(=ar. Beleko+ ar. Mena)

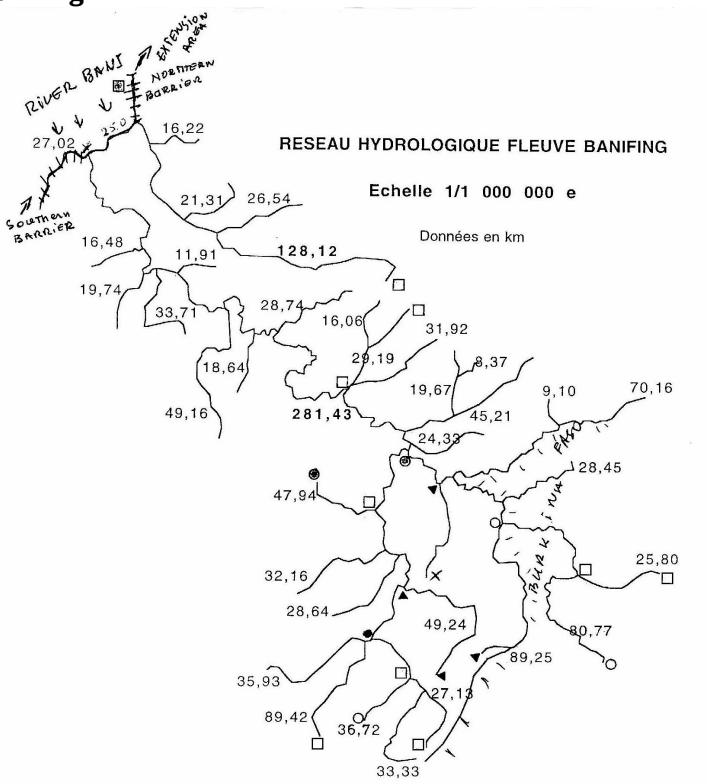
Relief:

The study area is a typical sudanian peneplain made of different types of soils(alluvio-sandy, lateritic and clayey) and sandstones. In the southern part of the area one can distinguish some escarpments of sandstones forming chains of hills disrupting the monotony of the landscape.

In its northern part (Koutiala), these sandstones called "grès koutiala" form a rocky chain going from N'Tosso (west) to Ourekela passing by Zangasso. Further north the peneplain goes down suddenly and disappears into the alluvions of the River Banifing (Monographie Cercle de Koutiala, 1997. Rapport Annuel de la Direction Régionale de la Statistique, 1986).

Hydrography:

Figure 2 The River Banifing



The main river, River Banifing**,** comprises two main arms, one coming from the east and serving as a natural border with Burkina Faso and the other coming from the south from inside Burkina Faso territory. The Banifing is reinforced inside the Malian territory by the River Lotio, which starts at the level of Sikasso. Several small rivers are draining rain waters from the chains of hills into the river bed of the Banifing. The length of the whole Banifing river system is about 2,000 km

Climate:

The study area is entirely inside the sub-humid zone between the isohyets 750 mm (in the north) and 1150 mm (in the south).

There are two main seasons: rainy (5-6 months) starting form May-June and dry (6-7months).starting from October-November.

The mean annual temperature is 27°C with maxima of 32 °C in April- May and minima of 24°C in December- January.

Hygrometry:

The mean relative humidity is under 50% from December - April and under 75% from June- October.

Vegetation:

The vegetation is represented by scarce forests, wooden and grass savannah and riparian vegetation. As one goes north or north-east, the vegetation becomes rare due to excessive exploitation of wood resources either for firewood or the extension of the cultivated lands. The dominant tree species are shea tree (*Vitellaria paradoxa*), Cailcédrat, *Tamarindus*, *Parkia biglobosa* (kapok).

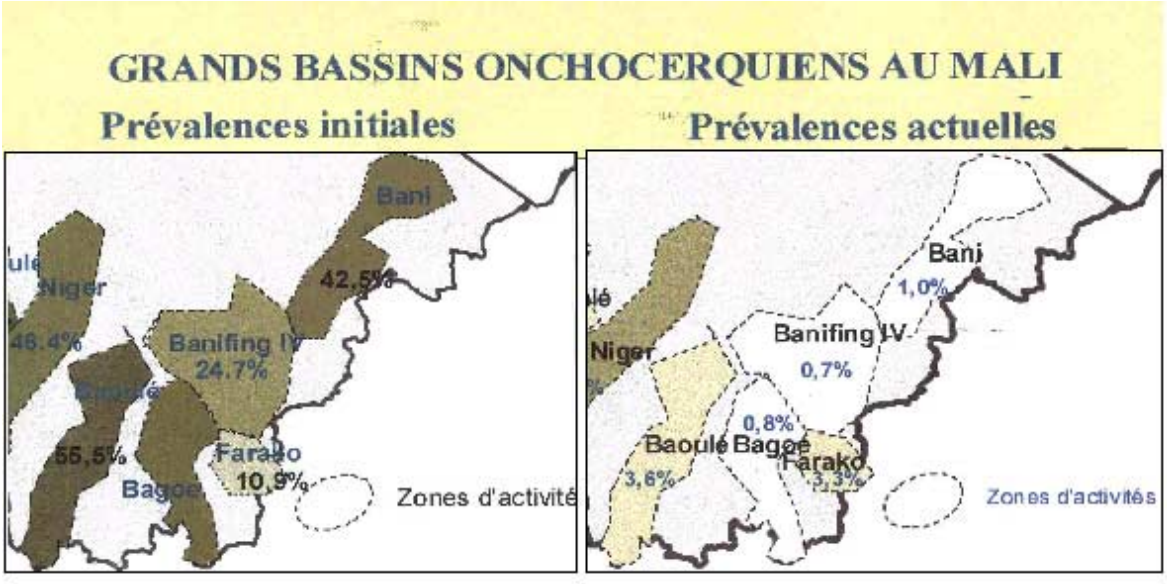
Human Factors:

The human population study area is around 769.225 people with a density of 48 hts/km2 et and rate of population increase of 3.0% per year. The study area is predominantly populated by the Minianka and the Bobo in the north and the center and by the Senoufo in the south. The Bambara and the Peuhl are present in all the parts of the study area. Except for the Fulani, the activity of all those tribes is agriculture; as for the Peuhl, pastoralism is the main activity. The cotton business has attracted many people into the area. They settle either as agropastoralists or as rented manpower. Many pastoralists also came in the area to look for better pastures and water. Some come there only temporarily while others settle for ever. Migrations out of the area do occur but young people to migrate seasonally to Cote d'Ivoire to look for small jobs. This has progressively changed attitudes and even the social structure of the area.

History of Onchocercosis and Human African Trypanosomosis (HAT)

The last cases of this disease were reported in the 1970's and are related to the southern part of the study area. Presently no new cases are being reported, despite the presence of the vector. It is generally admitted that the Onchocerciasis programme succeeded in cutting down the epidemiological chain by clearing the parasite but leaving the vector.

Figure 3 Onchocerciasis Control Campaign in SW Mali



As far as HAT is concerned, no cases have ever been officially reported and the disease seems to be completely unknown in this area. If this is not enough to rule out the presence of HAT, it may indicate at least, its extremely low incidence.

Importance of Agriculture and livestock:

The rural population get their subsistence and other resources mainly from agriculture and livestock production:

Agriculture: the main crops are: **cotton**, peanut , soya, bennissed (commercial), **corn, millet, sorghum, rice**, hungry rice (subsistence) and others like lemons, oranges, mangoes, yams, cassava, onions, peppers etc..

The cattle in the study area comprises two systems:

- **sedentary herds** belonging to the local populations with the vocation for draught oxen production. They also serve as "living banks" for the peasants who invest their incomes from selling agricultural products in cattle. These savings are mobilized and sold in case of bad harvests to enable the peasant to buy cereals from elsewhere or whenever more cash is needed.

- **transhumant herds** belonging to Sahelian cattle rearers who moved into the sub-humid areas as result of the drought in the 1970's and 1980's and have stayed ever since. There are also some seasonal transhumants.

Besides the cattle there are many other species of domestic animals: sheep, goats, poultry, donkeys and a very few horses and pigs (see table 12)

Food security

Food security is assured by the local production of subsistence products (cereals and others). For example in 2000-2001, the cereal production in all the CMDT areas was 1,132,000 tons which represents 366 kg/person, while the FAO norm is 250 kg/person. In case of cereal deficits, the sale of cotton and other commercial products combined with cattle offtakes give the peasants enough purchasing power to procure cereals from more "lucky" areas.

Crop Production

The **total land** surface of theMalian part of the study area according to our calculations (addition of all territorial units inside the study area) is **17,361 sq. km**. The non arable lands are represented by river beds, hills and mainly eroded lateritic lands.

The **arable** land covers **8,011 sq. km** (46% of the total area). The cultivated area is **3,318 sq. km** (41% of the arable area). The difference between arable and cultivated land gives a **reserve** of **4,693 sq. km**. This reserve divided by the cultivated land gives us the so-called 'agro-demographic potential' of the land which is 1.4 in our study area. This means that for each cultivated 1 sq. km there is a reserve of 1.4 sq. km. It is important to note that the norm recommended by CMDT is a reserve of 2 sq. km for each cultivated 1 sq. km. The progression of cultivated surface is about 6% yearly. There are efforts being conducted through anti-erosion measures to convert some non-arable to arable lands.

Table 2: Land cultivation 1999-2000 (data from CMDT report 2000)

Sectors	Area . sq. km Total (1)	Cultivable sq. km (2)	Cultivated sq. km (3)	PAT (4)	People (5)	Human density / sq km (6)	Cultivated sq. km/100 people (7)
1/2 koutiala:	2,097	1,034.62	533.37	0.93	67,515		0.79
Molobala	1,665	1,052.56	522.69	1.01	66,163		0.79
1/2 Yorosso	2,552	1,458.80	559.39	1.60	70,809		0.78
Total Koutiala R.	**6,314**	**3,545.98**	**1,615.45**	**1.20**	**204,487**	**32**	**0.79**
Sikasso	6,245	2,149.00	801.32	1.68	148,393		0.53
Klela	1,370	564.00	322.85	0.75	59,786		0.54
1/3 Kignan	1,537	613.00	142.68	3.3	26,422		0.54
Total Sikasso R.	**9,152**	**3,326.00**	**1,266.85**	**1.62**	**234,601**	**25.6**	**0.54**
Beleko	1,895	1,139.00	436;16	1.61	70348		0.62
Total Fana R	**1,895**	**1,139.00**	**436.16**	**1.61**	**70,348**	**37**	**0.62**
Ville (C) Sikasso					**90,000**		
Total general	**17,361**	**8,010.98**	**3,318.46**	**1.41**	**599,436**	**34.5**	**0.55**
		46.14%(1)	41.4%(2)				

PAT(4)= (2)-(3):3 = ratio of uncultivated over arable land

Table. 3: Yields and Production 1999-2000 campaign: main crops

Sectors	Corn			Millet-sorghum			Rice			Cotton		
	Cultiv. sq.km.	Yield Ton/ Sq.km	Prod. Ton	Cultiv. sq.km	Yield Ton/ sq.km	Prod.	Cultiv. Sq.km	Yield Ton/ Sq.km	Prod.	Cultiv. sq.km	Yield Ton/ sq.km	Prod. Ton
1/2 koutiala:	48.42	-	-	244.12	-	-	7.10	-	-	107.74	-	-
Molobala	45.11	-	-	210.74	-	-	1.11	-	-	105.58	-	-
1/2 Yorosso	24.33	-	-	124.89	-	-	.54	-	-	113.00	-	-
Tot Koutiala R.	**117.86**	**188.7**	**22,240**	**579.75**	**108.0**	**62,613**	**8.75**	**157.8**	**1,381**	**326.32**	**131.0**	**42,748**
Sikasso	174.39	-	-	122.45	-	-	41.34	-	-	185.91	-	-
Klela	98.08	-	-	147.45	-	-	34.16	-	-	74.90	-	-
1/3 Kignan	33.67	-	-	49.27	-	-	8.87	-	-	33.10	-	-
Tot. Sikasso R.	**306.14**	**236.6**	**72,433**	**319.19**	**103.5**	**22,686**	**85.37**	**181.8**	**15,520**	**293.91**	**139.8**	**41,089**
Beleko	94.82	-	-	150.92	-	-	24.80	-	-	124.30		-
Tot. Fana R	**94.82**	**186.6**	**17,693**	**150.92**	**103.2**	**15,575**	**24.80**	**153.2**	**3,799**	**124.30**	**130.2**	**16,184**
Total general	**518.82**	**204.0**	**112,366**	**1049.86**	**104.9**	**100,874**	**118.92**	**164.3**	**20,700**	**744.53**	**133.7**	**100,021**

Source: CMDT year 2000 Report

Table 4 Yields for the main crops over 10 years (kg/ha):

Years	Millet	Sorghum	Rice	Corn
1987/88	875	956	1248	1383
1988/89	1030	756	898	1310
1989/90	893	851	1672	1386
1990/91	1143	1024	963	1566
1991/92	1086	974	1569	1715
1992/93	618	714	1439	1026
1993/94	542	618	1591	1153
1994/95	770	679	1344	1350
1995/96	781	806	1367	1574
1996/97	988	1271	1460	1897
Average	**793**	**768**	**1232**	**1305**

Source: Recueil des Statistiques du Secteur Rural Malien, March 1998

Table 5 Prices to the Producer for 100kg in CFA(1999-2000)

Product	Millet	Sorghum	Corn	Rice(brut)	Cotton	Peanut
Price	8,000	7,400	6,900	8,900	17,000	24,900

The main cereals occupy 51 % of the cultivated land and the main cash crop (cotton) occupies 22.4% of cultivated land. It is generally accepted that the respective shares of subsistence and cash crops is 70% and 30%.

Table 6 Cotton yields from 1992 - 2000 in the sectors included in the study area (data from CMDT):

Sector/year	1992	1993	1994	1995	1996	1997	1998	1999	2000	Average
Koutiala	1331	1256	1137	1280	1285	1289	1295	1301	1310	1276
Sikasso	1357	1260	1067	1367	1372	1376	1384	1391	1398	1330.22
Fana	1302	1142	1098	1280	1283	1287	1290	1294	1302	1253.11

Animal work and agricultural machinery:

Draught oxen: The total estimate of working oxen in the study area is 102,394 which represents 51,197 pairs. One pair of oxen is enough to cultivate 5 hectares. This means that for cultivating 1 sq km 20 pairs of oxen are needed. The total culivated land in 2000 was 3,318 sq km, which requires about 66,637 pairs. The apparent deficit of oxen according to that calculation may be compensated by tractors and donkeys.

Donkeys: The study area has an estimate of 25,896 donkeys. Those animals are used either for driving carts (rural transport) or for cultivation where the structure of the soil does not require oxen force.

Table 7 The number of agricultural machinery is summarized as follows:

Tractors	Ploughs	Multicultors	Drivenhoes	Harrows	Seeders	Carts	Spray pumps
91	35,499	27,033	1,660	600	17,532	21,340	29,578

INPUTS:

Artificial Fertilizers:
In the study area three types products are used:
- Complex fertilizer which contains azote, phosphorous and potassium, or its substitute called DAP (Diammonium phosphate)
  Urea
- PNT: this a local and natural product called "Phosphate Naturel de Tilemsi"

The recommended dose is 150 kg/ha of each product. Those products are sold in bags of 50 kg each.

Organic fertilizers:
They are mainly cow manure. 5 tons of manure represent 50 kg of complex artificial fertilizer.
Only 14% of all the cultivated land receive organic fertilizers and about 70% of it goes to the cotton.

Insecticides:
They are used on 100% of cotton fields and seem to be reserved to cotton.

Herbicides:
They are used on both cotton and cereals.

Plant diseases
Two main diseases are reported endemic: la phylodie et le déssechement. Some other parasitic diseases are also prevalent.

Table 8 The percentage of cultivated land receiving fertilizers and other inputs:

Culture/product	Complex Or DAP	Urea	PNT	Organic Fertilizer	Herbicides
Cotton	99.90	99.88	1.86	34.00	40.0
Corn	88.00	88.00	0.70	32.00	25.0
Millet/sorghum	13.33	18.66	0.06	4.10	3.0
Rice	32.00	34.33	0.20	3.30	3.4

The insecticides are used only for cotton. The volume used was 450 liters per sq.km of cotton occupied land which is 744.53 sq km making a total volume of 335,038 liters. The price of 1liter of insecticide is 3,190CFA.

Table 9 The prices of inputs are as follows in CFA (720CFA=1.00$ US)

Input (unit)	Price
Complex fertilizer(cotton, bag of 50kg)	9,550
Complex fertilizer(cereals,bag of 50kg)	9,250
DAP (bag of 50kg)	12,250
UREA (bag of 50kg)	7,950
PNT (bag of 50kg)	1,750
Herbicides(l), cotton, corn, rice	4,600, 3,370 6,500
Fungicides(thyrame-lindane),sachet (cotton)	290
Insecticides(l)	3,190

Table 10 Price and depreciation of agricultural machinery

	Price	Life span	Maintenance	Depreciation Rate	Depreciation/ hectare
Ploughs	25,000	12	5,832	8,587	1,484
Multicultor	36,778	15	8,011	10,776	2,195
Seeder	52,500	13	8,200	13,263	737
Cart	161,875	22	17,081	24,616	3,039
Pump insecticide	27,500	4	2,538	11,074	2,393
Pump herbicide	35,760	9	740	5,896	182
Oxen	211,250	9	6,200	32,165	8,438
Donkey	52,500	9	0	6,458	897
Total					19,365

Table 11 Manpower costs for different crops

	Cotton	Corn	Sorghum	Millet	Peanut
Man/day	128	109	110	109	204
Cost /day	514	514	514	514	514
Total cost	65,792	56,026	56,540	56,026	104,856

Table 12 An example of calculation of the cost of one hectare of cotton and cost of 1kg of cotton

Nomenclature	Value
Depreciation	19,365 CFA
Manpower(rental)	14,778 CFA
Input	54,322 CFA
Total	88,465 CFA
Production	1,337 kg
Cost of 1kg of cotton(1)	**66.1 CFA**
Manpower familial	46,967 CFA
Cost of 1kg of cotton(2)	**101.3 CFA**

Livestock Data:

The study area was populated with Ndama and Méré cattle (all humpless and trypanotolerant) until early 1960s. But in early independence years the promotion of cotton culture and the use of animal traction have encouraged the introduction of Zebu oxen into all the CMDT (cotton) areas. Rich peasants also started investing in Zebu herds as a means of producing oxen but also as a means of savings, i.e. "living banks". As a result, the local breeds of cattle were progressively absorbed by Zebu. These days more than 80% of the cattle are Zebu Peuhl (trypanosusceptible) and the rest are crosses with trypanotolerant breeds. Sheep and goats are mainly of local breeds (Djallonke sheep and dwarf goat). Poultry is also very important in the economy of this area. Its essentially made of indigenous stock but in the peri-urban areas of Sikasso and Koutiala there are some industrial farms dealing with exported breeds.

Livestock production systems:

-Semi-sedentary system: practised by the local people in the villages; the main goal of this system is the production of working oxen and meat

-Transhumant system: practised by the Peuhl whose main goal is the production of meat and milk

and more recently,

- Semi-intensive systems in the peri-urban areas of Koutiala and Sikasso: the main goal is milk but also eggs(poultry)

Tab.13. Livestock 2000

Sectors	Cattle (1)	Sheep Goats	Donkeys	Horses	Pigs	Poultry	Draught Oxen
1/2 Koutiala:	50957	49146	7459	34	479	117760	17252
Molobala	43642	25622	4023	45	823	91579	15947
1/2 Yorosso	27700	26224	2055	219	5213	88000	9420
Total Koutiala R.	**122299**	**100992**	**13537**	**298**	**6515**	**297339**	**42619**
Sikasso	50713	37600	3993	6	169	237116	18816
Klela	41173	21327	3802	6	395	106550	14878
1/3 Kignan	22492	24037	1776	7	70	55157	6952
Total Sikasso R.	**114378**	**82964**	**9571**	**19**	**634**	**398823**	**40646**
Beleko	57313	43041	2788	37	782	102513	19129
Total Fana R	**57313**	**43041**	**2788**	**37**	**782**	**102513**	**19129**
Total General	**293990**	**226997**	**25896**	**354**	**7931**	**798675**	**102394 34.83% (1)**

Source: Fiche Technique No. 23.2 , octobre 2000, CMDT.

Table 14 Herd Productivity Parameters

Parameters	Région of Sikasso agropastoral/cash culture system
Herd size	39 +/-21.7
Male	50% <1 year:: 6% 1-4 years:12% >4years:32%
Female	*(50%) <1 year:: 7% 1-4 years:17% >4years:26%
Ratio females/ male	8,46*
Age first calving(years)	4.8
Calving rate(%)	51
Calving Interval (months)	21
Total offtake(%)	3.9
Sales(%)	2.5
Herd growth(%)	2.9
Annual numeric yield(%)	6.8
Age for selling males(years)	5
Age)for selling females(years)	8
Mortality rate 0-1 year General	 16% 5.6%
Milk production % milked cows/ total herd mean production/cow(liter) length of the lactation period(j)	 15% 0.64 164

Source: Bosma et al.1996, Yaya Konaté 1997

Prices of livestock and livestock products:
Data from OMBEVI, 1995 for the town of Sikasso
Bovine meat:
with bones: 900CFA/kg
without bones: 1,100CFA/kg
Sheep and goat meat: 900CFA/kg
Milk: 200CFA/l

Oxen: 50,000-80,000CFA

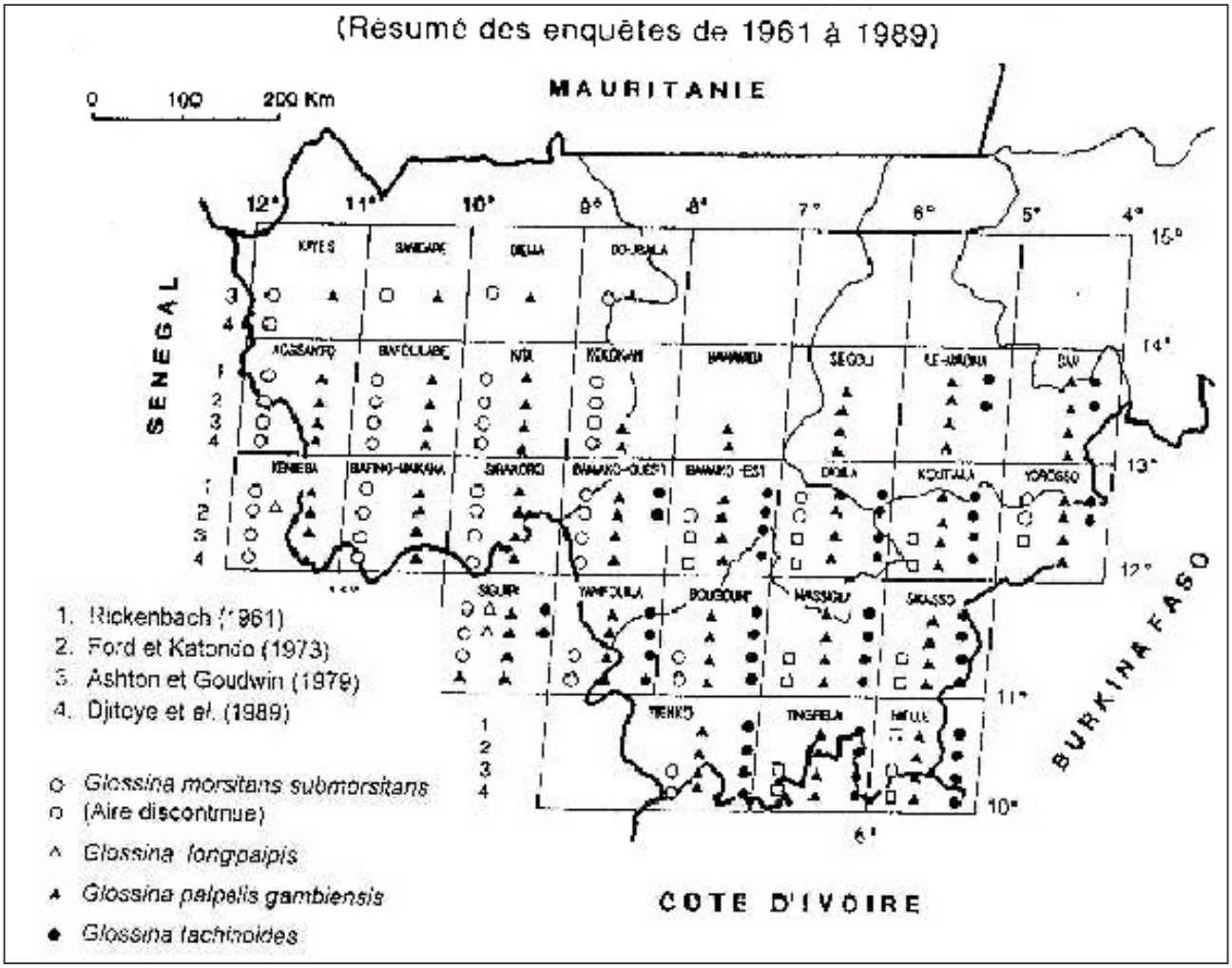
Heifers: 50,000-80,000CFA

Tsetse/Trypanosomosis Situation

Tsetse species and densities

There are two reference documents on tsetse distribution in Mali which are Ford and Katondo maps(1979) and Djitteye *et al* maps, an update of the first ones by CVL (1989). In those last maps apparent densities (DAP=number of flies/trap/day are indicated).

Figure 4 Tsetse Distribution in SW Mali



There are only two species of tsetse and both are riverine: *G.palpalis gambiensis*(mean DAP:3) and *G.tachinoides* (mean DAP:5), according to Djitteye *et al*.,1989.

As for *G. morsitans submorsitans* which used to be present in the area, it is now virtually absent as its density in the area according to the 1989 maps (see fig. 4) was very low (DAP:0.07). With the progressive occupation of the land and the destruction of the savannah, this species has regressed and should not be considered in this project.

Trypanosome Species and Prevalences:

The reference document here is a note compiling survey data from 1977 -1987 and prepared in 1990 by Diall et al. According to those surveys in this area there are two major species which are: *T.congolense* and *T.vivax*. The prevalences ranged from 0 to 15%. *T.brucei* is present but rarely detected and has less impact on cattle than the first two species.

Animal Hosts:

The study area was populated with Ndama and Méré cattle (all humpless and trypanotolerant) until early 1960s. But in early independence years the promotion of cotton culture and the use of animal traction have encouraged the introduction of Zebu oxen into all the CMDT (cotton) areas. Rich peasants also started investing in Zebu herds as a means of producing oxen but also as a mean of saving "live banks". This way, the local breeds of cattle were progressively absorbed by Zebu. These days more than 80% of the cattle are Zebu Peuhl (trypanosusceptible) and the rest are crosses with trypanotolerant breeds. Sheep and goats are mainly of local breeds (Diallonke sheep and dwarf goat).

The pathologic and economic importance of the disease
There is a strong people's belief that trypanosomosis was introduced in the area with the Zebu cattle and is related to the use of animals in cultivation. This is to say that the disease became noticeable mainly when the genotype of cattle shifted towards the Zebu breed. In the early 1980's outbreaks of trypanosomosis left many villages without working oxen. This was perceived as a big disaster in the region. In the two villages selected for parasitological investigations 65% of the cattle were found to be infected with trypanosomosis. The diagnosis was confirmed by the chemoprophylactic programme which was implemented in these villages and which stopped the problem temporarily.

Tsetse Eradication Project Outline

The Project Strategy:

From a theoretical point of view trypanosomosis control is based on parasite control (drugs), tsetse control and exploiting trypanotolerance, or any combination of those methods. In the study area the reintroduction of Ndama cattle would not be acceptable to the people. A large scale programme based on chemotherapy is expensive and may be dangerous in terms of the chemoresistance risk as its not easy to achieve a rational use of those drugs in the absence of precise diagnosis in field situations.

So the best technically feasible and probably the most cost-effective approach would be tsetse control.

The control of tsetse in this area should be resumed for the control of riverine flies exclusively.

Therefore we are dealing only with linear fly habitat which corresponds to the network of the **River Banifing**. The length of this network inside Malian territory is 1,428 km rounded to 1,500 km. The control of the tsetse in this area should aim to eradicate the tsetse populations by SIT after a population suppression phase using targets and insecticide-treated animals. The phases of this control programme would be as follows:

Survey and Planning Phase: Baseline assessments through parasitological and entomological surveys. This will help generate up-to-date baseline data on tsetse distribution and densities and on trypanosomosis prevalence (Cost - $100.000).

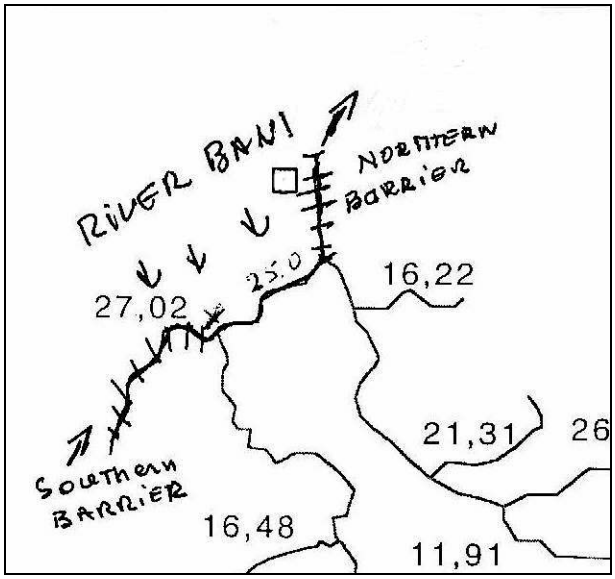
Phase 1(years 1 and 2): Population suppression using targets and insecticide treated animals.

Use of targets alongside all the river network (on both sides) in dry seasons as follows:

- end of rainy season (end of October): first deployment of targets at intervals of 100m (50m for the barriers)
- end of January: re-impregnation and redeployment of targets in the same condition as the initial one
- end of May: withdrawal of targets on the rivers for storage until the end of the rains in October (and so on); but the barrier targets should be left in place where possible.

The linear distance to be treated will be rounded up to 2,000 km to take into account the Burkina side of river. With 100m intervals we need 10 targets per km. As both sides are to be dealt with we will need in total 2,000 x 10 x 2= 40,000 targets. The total size of the area being 20,000 km^2 this will make it equivalent to 2 targets/km^2.

Figure 5 Location of Barriers against Re-invasion



The barrier against re-invasion will be 100 km length on the river Bani with a southern portion and a northern portion as shown in figure 1. As each and every river will be treated from its source there is no need of barriers on those ends.

- Use of insecticide-treated cattle: this is done only in year one in the rainy season before the SIT. It helps kill both tsetse and ticks, therefore cattle owners may be willing to contribute both financially and physically. The minimum cattle density required for this technique to be effective is 15 cattle/km^2. This almost corresponds to the cattle density in the studied area. The insecticide to use is Deltamethrine Pour-on, Spot-on or Butox Pour-on. Two treatments should be done at 6 weeks intervals.

Phase 2 (years 2 and 3): Use of SIT during the rainy seasons in years 2 and 3.
Sterile males of both species (*G.palpalis gambiensis and G.tachinoides*) will be produced at CIRDES in Bobo Dioulasso. We can consider the release dose of 75 flies/km^2/week for each species over a period of 16 weeks.

The distance between Bobo-Dioulasso and Sikasso the main town of the area is about 200 km (2-3 hours drive). Sikasso will have a real airport by the end of 2001, thus allowing closer aerial support for the project.

Monitoring: During phases 1 and 2 (years 1, 2 and 3) tsetse and parasite monitoring will also be conducted in some selected villages or points to assess the efficacy of the control operations.

Project Budget Outline

The Costs

1. Project Planning: Costs of initial surveys and project planning: **100,000$**

2. Suppression:
   - Costs of purchase and deployment of targets :
     40,000 targets x 15$ = **600,000 $**
   - Costs of servicing those targets (6 times +replacement of 20% of them)
     60% of (1) = **360,000$**
   - Costs of 2 insecticide treatments of cattle (15cattle/km^2):
     15cattle/km^2 x 2 x 20,000 km^2 = 600,000 treated cattle
     600,000 x 0.75$/ animal = **450,000 $**

3. Eradication
   - Costs of SIT(years 2 and 3): 2,000 sq km x 800$/sq km = **1,600,000 $**

4. Protection
   - Costs of barrier establishment and maintenance(100 km over 20 years)

     400 targets @ 20% of (1)+(2) = **128,000 $**

5. Overheads: 25% of above total = 779,500**$**

6. Contingency: 25% of above total = 779,500**$**

Summary:

Costs of pre-project surveys and project planning:	100,000$	
Costs of suppression:	1,410,000$	
Costs of eradication	1,600,000$	
Costs of protecting against re-invasion	128,000$	3,238,000
Overheads (25% of project costs)	809,500$	
Contingency: (25% of project costs)	809,500$	
Total:	**4,857,000$**	
Equivalent to	$ 240/km^2	

The Impact of Tsetse and Trypanosomosis Eradication

In this study area, the human population pressure is mainly high in the north where the degradation of natural resources is therefore the most advanced. The pressure on land is driving the livestock production towards intensification. In both agriculture and livestock, the efforts to increase the productivity should be combined with natural resources conservation measures in order to limit erosion. The erosion problem is not fully perceived by the peasants and so the anti-erosive methods need to be less demanding in terms of labour, money, and investments in order to be adopted.

The tsetse eradication project as outlined will likely increase the productivity of small milk farms around the cities and reduce the mortality rate in both village and pastoral herds. These pastoral herds will be pushed towards the south where pressure on land is less important or towards marginal lands unsuitable for agriculture.

This study area is not meant to support huge number of herds so what is needed here is better individual productivity and higher herd offtake

The Benefits:*(as summarized in DFID doc)*

The benefits from tsetse eradication in this area comprise normally:

Direct benefits:

1. improvement in milk and meat production from the present cattle herd

2. increase in production resulting from a combination of enlarged cattle herds and higher offtakes

3. improve in the productivity of other animals

Indirect benefits:

1. increase in productivity resulting from mixed farming and better application of draught power

2. savings on the costs of trypanocidal drugs

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Complement on the Burkina Faso Portion:

The Burkina portion is 3152 km² and comprises partially 4 departments already described in the Burkina study and with different rate of inclusion into study area no. 1 (Mali). In the main report these data from these areas has been incorporated extrapolating the Malian data proportionately. This is considered sufficiently accurate for this study as there is a high degree of similarity throughout the study area.

Data on agriculture, livestock, human population and the physical environment are provided in the Study Area 2.

The costs of the tsetse control in the Burkina Faso portion have been included in the calculations above. The benefits of the project have been calculated in the main report by extrapolating the Mali data.