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Biological Control of Locusts and Grasshoppers in the Dogon Area : a Participatory Rural Appraisal

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SUMMARY

Starting in 1989, the LUBILOSA project has developed a biological pesticide against locusts and grasshoppers, based on a specific and highly virulent fungus disease. The fungus spores are mixed in an oil formulation and sprayed with standard equipment. The biopesticide is much safer than currently used chemical pesticides, and showed high efficacy in field trials in the Dogon country of Mali from 1995 - 1996. A local NGO showed particular interest in using it for its locust campaigns. To assess how the biopesticide can be applied in a sustainable use strategy, a participatory rural appraisal was conducted in 4 villages, using tools such as individual and group interviews with men and women, village transect walks, and discussions with key informers.

The Dogon country covers the four eastern districts of the Mopti region in Mali. It has a typical Sahelian climate, and the land is mostly suitable for livestock and millet production. The area can no longer feed its population, estimated at less than one million people, and the resulting emigration helps to keep the population growth rate down to only 1.5 % a year, and population density at 16 inhab./per km². Horticulture is an important activity during the dry season, and onions are an important cash crop. From farmers estimates, an average millet yield of 500 kg/ha can be assumed with a value of \$50/ha.

The PRA results show that grasshoppers and locusts are major and recurrent pests in the Dogon area. The major crop, millet, suffers most, with yield reduction estimated between 60 and 100 % under a heavy attack. Farmers do no longer use indigenous control methods, but depend on the Plant Protection Service and projects. The PPS no longer has the operational funds, but a local NGO, supported by the Catholic church, has been organizing locust control for several years. Villagers have been asked a fixed contribution of \$35 per village to participate in the program. In the future, they will be asked to pay 25% of the costs.

Farmers generally displayed a positive attitude towards the biocontrol. Most people who attended the demonstrations recognized its comparatively slower action but acknowledged its longer persistence. Traditional methods, however, are no longer popular. There is a limited willingness to pay for a mycopesticide, which seems to be linked to availability of cash, strongly influenced by the onion production, the major cash crop. They declared a modest willingness to pay. Although not all villagers agreed, a figure of 5000 FCFA/ha came up in general.

In the villages visited, there was a clear interest in biological control. Millet, the crop most damaged by locusts, is a subsistence crop, and the region has a deficit. Therefore, it is doubtful that the yield gains of a locust treatment will translate into cash earnings to pay the treatment. Collaboration with the local NGO should be continued. They are well organized and have a solid extension organization with motivated workers. Through the Catholic church, they also have access to outside funding, and this donor has expressed an interest in biological control methods. LUBILOSA's future field work should concentrate on areas with relevance to extension and marketing, such as crop loss estimation, dose reduction and farmers' organization. Testing should be phased out in favor of distribution, financing and marketing.

1. INTRODUCTION

The Lubilosa program (Lutte Biologique contre les Locusts et Sautériaux) has developed a biological control method against locusts and grasshoppers, consisting of a fungus, *Metarhizium anisopliae* (*flavoviride*) var. *acridum*, a specific and highly virulent disease of locusts and grasshoppers. Spores of the fungus are currently produced at the IITA (International Institute of Tropical Agriculture) research station in Cotonou. These spores can easily be stored, and are used as a pesticide by mixing them with an oil formulation and applying them with standard spinning disc sprayers. For large-scale production, a licensing agreement has been signed with a specialized biopesticide producer in France.

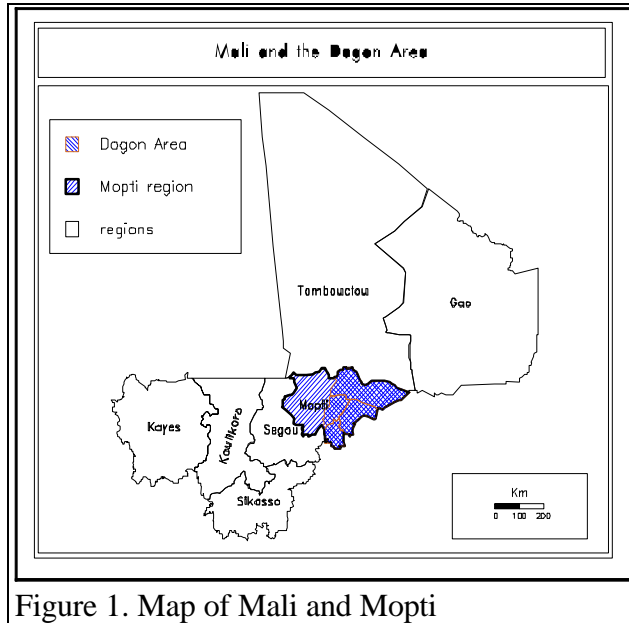


Figure 1. Map of Mali and Mopti

Field tests on different locust and grasshopper species in several countries revealed the efficacy of the product: a consistent high mortality is reached, although achieved speed of kill is less than with chemical pesticides. In Mali, tests were conducted in Mourdiah (Shah *et al.* 1998) and in the Dogon plateau (Douro-Kpindou *et al.* 1997). The Dogon area is of particular interest to Lubilosa, since the local NGO SECAMA (Secours Catholique du Mali) has identified locusts as a major problem and has been organizing campaigns in the villages through village brigades. The NGO was identified by a consultant as a promising collaborator (Stonehouse 1995). Initial contacts resulted in two years of field tests (Douro-Kpindou 1996) with good results. In a final stage of the program, research needs to focus on how to integrate application of the mycopenicide into the existing structures. This implies socioeconomic studies and participatory research with farmers.

Before the start of the new season, a Participatory Rural Appraisal (PRA) was conducted in order to get an overview of the socioeconomic conditions in the area, determine the data to be collected during field work, and to revise the campaign strategy where necessary. At the same time, this PRA is part of the preparatory work for a larger scale socioeconomic survey to be conducted after the harvest.

2. METHODOLOGY

The PRA was conducted from June 7 to June 11, 1997, by a team consisting of an agricultural economist, an agriculturalist, and the coordinator of the locust control program of the NGO. The team was assisted by the extension agents of the project, by village. Four villages were visited Koa, Golokanda, Yawa and Nombori, as well as a number of services and projects in Mopti, Sevare, Bandiagara and Pel (see details in Appendix 1). The villages were those where *Metarhizium* had been tested, selected together with the project, as a function of heavy locust problems.

In each village a village transect walk was organized to get acquainted with the village and its inhabitants, and the outline of a village map was drawn. In all villages a group interview was conducted with the farmers, animated by the local project extension agent. Topics included village organization, the agricultural calendar, importance of different crops, importance and prioritization of pests, locust control practices, and appreciation of the *Metarhizium* (see Guide d'entretien in Appendix 2). In two villages, women were also interviewed, more particularly on the role of women in agriculture, their prioritization of pests, and their role in locust control. In two villages, an individual farmer was interviewed. His house and fields were visited and some topics were discussed in more detail.

3. THE REGION - OVERVIEW

3.1. Mali

Mali is one of the poorest countries in the poorest continent, Africa. Its population was estimated at 8.65 million in 1993, growing at a rate of 2.2% (DNSI 1995) for a total area of 1,24 million km², or a density of 7 people/km². Its GNP (Gross National Product, an approximation of income) per capita is estimated at \$ 280, of which 44% from agriculture and 43% from services (World Bank 1994). The low level of development is also obvious in the health statistics. Life expectancy is only 48 years, only 25% of the children are vaccinated, and there are almost 20,000 people per doctor (World Bank 1994). Primary school enrollment stands at 24% (17% for girls) and adult literacy is 17% (11% for women) (World Bank 1994).

Mali stretches over a wide range of climates. Rainfall decreases from the South to the North and four major regions can be distinguished : desert (less than 200 mm of rainfall), Sahel (200 to 600 mm), semi-arid (600-800) and sub-humid (more than 800 mm). Agricultural production in the North is dominated by millet and sorghum with extensive cattle production, the subhumid zone is based on a cereal-cotton rotation (with maize becoming more important further south). Growth of cotton as a cash crop brought an intensification of agriculture with animal traction, use of fertilizers and pesticides, from which the North has not yet profited.

3.2. The Mopti Region

The Mopti region is located in the mid east of Mali, between the regions of Segou and Tombouctou (Figure 1). Its rainfall varies between 350 and 750 mm. It has an area of 79,017 km² for a population of 1.4 million in 1993 (DRPS 1993). In the previous century the region has known prosperous times, and was the center of several kingdoms, still visible in the rich architecture of the inner delta. Up until the 1970s the region was an exporter of rice, fish, and cattle. Since the droughts of the seventies, with another shock during the drought of the early 80s, the region suffers from substantial deficits in basic food production, especially cereals.

The administrative region of Mopti contains 8 districts ("cercles"), four of which form the agro-ecological zone of the Niger delta, also called the flooded area ("zone inondée": Djenné, Tenenkou, Youwarou and Mopti (DNSI 1996, DRPS 1993). The other four, Bandiagara, Bankass, Douentza and Koro form the dry area or "zone exondée", or grouped under the agro-ecological zone « plateau Dogon ». Note that part of this "plateau" zone is actually located south of the Bandiagar cliffs, also called "la plaine" or "Sénou".

3.3. The Dogon area

Several definitions of the Dogon area or Dogon plateau are being used. The name Dogon refers to an ethnic group, originating from Burkina Faso, but pushed eastward by other groups. Tradition has it

that they fled to the inhospitable area of the Bandiagara escarpment to escape prosecution and protect their culture and religion. They do indeed inhabit a difficult area, with little water and lots of sand.

According to the classification of agro-ecological zone by the DNSI, the Dogon plateau covers the four eastern districts of the Mopti administrative region (Figure 2), an area of 48,000 km².

Geographically, « plateau » would suggest the area on top of the cliffs. According to this definition, maintained by the Direction Nationale de l'Agriculture in their regional development plan for the area (DNA 1993) the Dogon plateau corresponds more or less with the Bandiagara district. This district is more densely populated, 190,000 people for 7,700 km², or 24.8 people per km².

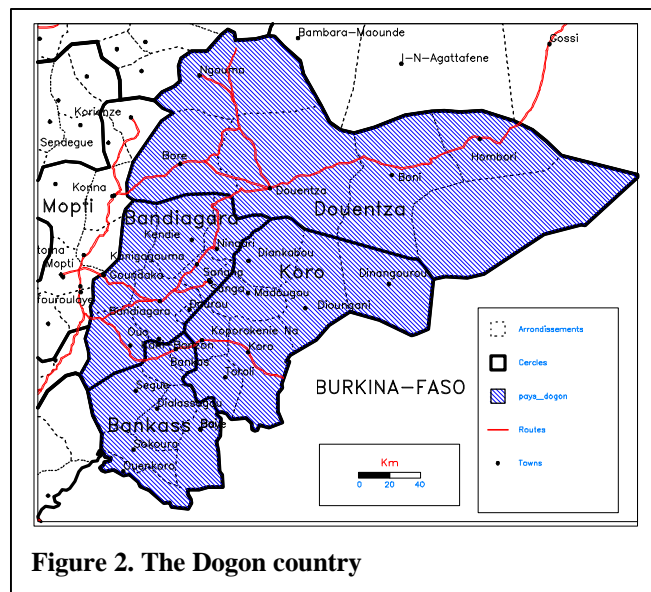


Figure 2. The Dogon country

4. ENVIRONMENT OF THE DOGON AREA

4.1. Physical

The Mopti region has two distinct areas: the flooded zone, corresponding roughly to the four western districts, and the dry zone. The dry zone is dominated by the Bandiagara escarpment, a 150 km long series of sandstone cliffs, which divides the area in the northern Dogon plateau, and the lower area, called the Seno. The Dogon plateau and the Seno form together the Dogon area.

The villages were selected based on frequency of grasshopper outbreaks and on geographic distribution: one village was chosen at the western end of the cliff (Koa), one on the plateau (Golokanda), one on top of the cliff (Yawa) and one underneath (Nombori) (see Appendix 1 for details).

4.2. Climate

This region falls under the typical Sahelian climate (Figure 3): a hot dry season transforms into a unimodal rainy season of 4 to 6 months, followed by a cooler dry season.

Average rainfall over the recorded period is 534 mm in Mopti (Niger valley), 584 mm in Bankass (South of the cliffs) and 604 mm in Bandiagara, on top of the cliffs (Source: Sivakumar et al. 1984).

These averages were calculated of available time series, some extending to 61 years, up to 1981. Since then, rainfall has been lower (Figure 4).

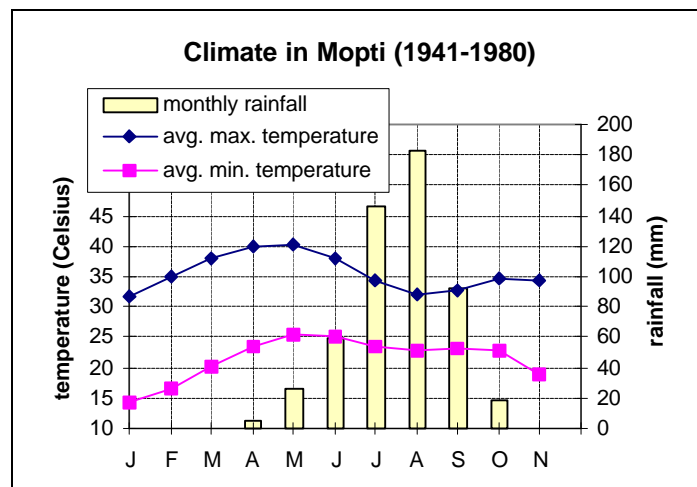


Figure 3.

The average rainfall in Bandiagara for example, 550 mm over the last 70 years, has decreased to 450 over the last 25 years (Agrar- und Hydrotechnik GMBH, 1993).

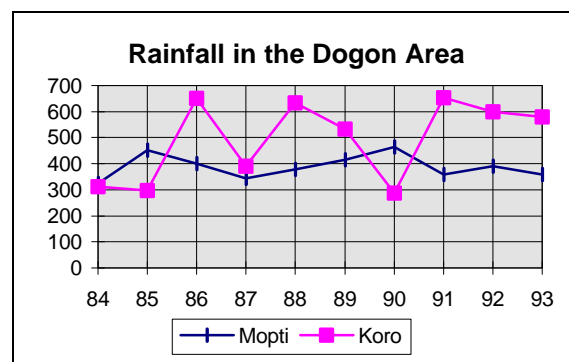


Figure 4

4.3. Population

At the last census, population in the Dogon area was estimated at 774,000 people, with a growth rate of 1.53%. Extrapolated this would mean a population of 822,000 people in 1997. The low growth rate is largely due to emigration. The overall population density is low, 15,6 people per km², but this is strongly influenced by the low density (less than 7 people per km²) in the most northern district, Douenzan. The other districts have a population density between 21 and 28 people per km².

Table 1. Population in the Dogon area

<i>district</i>	<i>area (km²)</i>	<i>population 1997</i>	<i>population density (n/ km²)</i>	<i>cattle (n/(1993))</i>	<i>cattle density (n/ km²)</i>
Bandiagara	7601.2	212,359	26.3	40,287	5.3
Bankass	6072.9	179,985	27.9	382,798	63.0
Douentzan	25109.2	180,988	6.8	148,551	5.9
Koro	10970.6	248,879	21.3	64,516	5.9
total	49753.9	822,211	15.6	636,152	12.8

4.4. Social organization

The Dogon live in villages dispersed over the area. In Bandiagara, a village has on average 450 inhabitants in 38 households, or around 12 people per household. A household can be defined as a group of related people who live together and work on common household fields. This usually includes the brothers and sons of the household head, together with their wives and children. Polygamy is common. Men can marry women from the same village or from other villages (although "courting in another village takes a lot of energy and courage"), with some restriction on family relations. Previously, adult men would not start a sperate household before their father had died, but this custom seems to be becoming less common. Within the household several nuclear families can exist, defined as a man with his wives and children. The nuclear family group fills certain functions, and can, for example, take their meals separate from the rest of the household for several months a year.

The economy of the Dogon country is based on agriculture. The traditional cereal crop of millet is no longer able to feed its population, and horticulture in the counter season is becoming more and more important, especially onions. Surplus and cash crops are traded on the markets, held every five days in the largest villages and subdistrict ("arrondissement") center. The general use of donkey carts have made the area more accessible to distant markets.

5. AGRICULTURE

5.1. Organization

The households of the Dogon live in compounds grouped closely into villages. They are quite different in size; the visited villages vary from 20 to 101 households. The villagers estimate that each household has between 2 and 15 ha of land in cultivation (see Table 2 for more details). The office for agricultural statistics estimates that Dogon households have on average 2.5 ha of agricultural land in production (DRPS-Mopti. 1993).

Table 2. Characteristics of visited villages and their households

	<i>Koa</i>	<i>Golokand</i>	<i>Yawa</i>	<i>Nombori</i>
		<i>a</i>		
number of households (hh)	20	37	45	101
area cultivated (ha/hh)	10	5-15	12	2-15
workers (n/hh)				4-10
fallow (ha/hh)	5 (5 yrs)		12	> cultivated
horticulture (ha/hh)		0.866		
number of hh with animal tractions	all	?	25 hh	75%

The land tenure system is traditional. Land belongs to the family who first arrived, but this ownership is not absolute. Land cannot be sold and has to be shared with new arrivals as long as there is land available. During the rainy season, all household members work together in the household fields, directed by the head of the household. Apart from these fields, individuals can have their own small plots. Usually they are allowed 1 or 2 days a week to work on these private plots.

The agricultural calendar closely follows the rains. Fields are cleaned at the end of the dry season; then when the first rains fall, small pockets are turned over where the seed is planted. When the seedlings emerge, the surrounding soil is further broken up by hoe, a combined tilling and weeding operation. This activity is repeated for several times every couple of weeks.

5.2. Crops

The most important field crop by far is millet, which covers between 50 and 80% of cultivated land. Other crops of importance are sorghum, fonio, cowpea, peanuts and bambara nuts (voandzou). Millet is mostly intended for home consumption, while the groundnuts are largely sold. Sorghum and bambara nuts can be used for both purposes (see Table 3 for an overview, the official statistics are presented in Appendix). In horticulture, onion is by far the most important crop, mostly grown in the dry season for the market.

Table 3. Agriculture

	<i>Koa</i>	<i>Golokanda</i>	<i>Yawa</i>	<i>Nombori</i>	
rank of crops in importance (% of land)					
- millet	1 (50%)	1 (75%)	1(>80%)	1 (75%)	
- sorghum	2 (25%)	2 (in clay soils)	x	x	
- cowpea	3 (10%)	x	x	2	
- peanuts	4 (10%)	x	3		
- rice	5 (5%)	x (very little)			
- bambara nuts		x			
- fonio		3	2	3	
sales of field crops	1/3, sorghum	esp. only (40%)	peanuts	none	peanuts, bambara nuts
sales of horticultural crops	onions, most of others			onions, most of rest	all
yield of millet (kg/ha)	1000	480	200 - 600	100-500	
price of millet (FCFA/kg)	70	37.5 (harvest) 90 (now)		80- 100	
yield of onions		40,000			
price of onions		100-125			

Farmers yield estimations vary between 100 kg/ha in a bad year (even 0 after a locust attack) to 1000 kg/ha (Table 3). The national statistics office estimates the millet yield for the Dogon area at 447 kg/ha for the period of 1993 to 1995 (DNSI, 1996c). The prices farmers pay for millet on the local market vary between 40 and 100 FCFA/kg, while the average millet price in Bamako from 1990 to 1995 is 92 FCFA/kg (DNSI 1996d). Assuming 70 FCFA/kg as an average price in the rural areas, the value of the production of one ha of millet can be estimated at to 31,000 FCFA, or about \$50. Of course these values are very variable, and the estimated crop value should probably be seen as a low estimate. Prices are increasing slowly since the devaluation of 1993, and yields can be substantially higher. The Famine Early Warning System for example estimates the average yield of millet between 1985 and 1992 at 620 kg/ha (Appendix 7).

5.3. Animals

Livestock in this Sahelian climate is, of course, very important. Households have on average 15 goats, 8 sheep, and 7 cattle. The distribution is uneven: the northern district of Douentza has relatively more goats, while cattle are concentrated in the southwestern district of Bankass (Table 4).

Table 4. Average number of animals per household (DRSP 1993)

<i>district</i>	<i>number of animals per total number cattle</i>				<i>density (n/ km²)</i>	<i>(n/)</i>
	<i>cattle</i>	<i>ovins</i>	<i>caprins</i>	<i>asins</i>		
Bandiagara	1.81	4.71	9.75	0.51	40,287	5.3
Bankass	20.34	15.05	20.68	1.35	382,798	63.0
Douentzan	7.85	6.79	21.62	0.81	148,551	5.9
Koro	2.48	7.27	12.02	0.75	64,516	5.9
total	7.40	8.21	15.44	0.83	636,152	12.8

5.4. Pests

The first pest mentioned in all villages was locusts and grasshoppers, except for one village where blister beetles had become more important over the last 6 years (see Table 5 for an overview). Of course, these villages were not selected at random, but because of their locust problems. Other major pests are beetles, stem borers, and head borers. Farmers estimate that locust damage reduces yields by 60 to 100 %. Locusts generally attack all farms, although not all fields; fields closer to fallow reportedly have more locust and grasshopper problems. Damage can vary between years and between villages.

Table 5. Ranking of pests on field crops in 4 villages, by importance

	<i>Koa</i>	<i>Golokanda</i>	<i>Yawa</i>	<i>Nombori</i>
locusts and grasshoppers	1(cereals, not legumes)	1(millet)	1	1 (before, 88-90)
blister beetles	2		3	3
lepidoptera	3 (on groundnuts)	3 (but 1 on onion)	2 (ear borers, miners)	1 (90-96)
coleoptera		2 (millet)		
striga		4		
rats			x	
monkeys	4			
remaining yield after locust invasion	0-40%	1/24	1/3	almost none
number of locusts invasions over last 10 years (88-97)		5 (4 yrs average + 95: very serious)	9 (‘96, <86 good, rest bad)	3 (usually before 88, and 88-90)

In the past, villagers tried to control locusts by beating them with sticks or by digging trenches to bury them in. Lately, however, the locusts seem to have changed their

behavior: “they are a lot smarter now”. Generally, farmers feel that there is little that can be done except for treating with chemical pesticides. Such treatments are organized by a Malian NGO, the *Projet d'Agriculture Durable*, supported by the Catholic church. All four villages participate in the program, and have a village brigade. In the past, villages had to contribute 20,000 FCFA each, and provide men for the brigades. The members of the brigade, usually 8 to 10 young men, receive training in locust control from the NGO, which also provided chemicals and equipment. All villages visited have a village brigade (Table 6) and have 9 to 15 sprayers or dusters. From 1997 on, the villages have been asked to pay 25% of the cost of the chemicals.

Table 6. Pest control statistics

	<i>Koa</i>	<i>Golokanda</i>	<i>Yawa</i>	<i>Nombori</i>	
members of village brigade (n)	10		10	12	8
number of spinning disc sprayers	10		2	4	5
number of dusters	5	2 (backpack) + 5 (manual)		5	13

6. FARMERS' PERCEPTIONS

Farmers generally displayed a positive attitude towards the biological control of locusts and grasshoppers. Most villagers who attended the demonstrations easily recognized its comparatively slower action but acknowledged its longer persistence. They expressed a modest willingness to pay. Although not all villagers agreed, a figure of 5000 FCFA/ha came up in general. Some people declared they could not pay this, or it would depend on their cash flow, others would go up to 10,000 FCFA, even 20,000 FCFA. The willingness to pay clearly depends on income and cash availability, and availability of credit might play a major role here.

Farmers were also engaged in a discussion about application technology. The advantages and disadvantages of ULV (used with the spinning disc sprayers) and EC formulations (used with knapsack sprayers) were discussed. The villagers are very aware of the advantages and disadvantages of both systems. ULV sprayers use very low volumes of pesticides in an oil formulation, but they are more expensive and use batteries. EC sprayers use water formulation, they are a bit more expensive than ULV sprayers but do not require batteries. On the other hand, they use considerable amounts of water, which needs to be brought up to the fields. There was no consensus on which technology was superior.

Table 7. Farmers' perceptions about locust control

	Koa	Golokanda	Yawa	Nombori
willingness to pay (FCFA/ha)	5000, 10000 (even 20000 if needed)	5000 (if money av.) 10000 (some)	5000 (but not all) 10000 (some)	
how ULV vs. EC	sales of millet - prefer water over batteries - if water is less eff. : doubt	batteries are no problem 35000 FCFA: no problem	one prefers ULV (less tiring), others water	prefer transporting water over buying batteries
biopesticide	- good efficacy	slower than chemicals but it works	they noticed the difference with control	- biopesticide not as good as chemicals - did not see much difference with control

7. CONCLUSION

Grasshoppers and locusts are a major problem, at least for the villages visited. From interviews with key informers this can be extrapolated over a substantial part of the Dogon country. A more structured and quantitative overview is needed on a representative sample to give an overview of the whole area.

In the visited villages, there was a clear interest in biological control. Traditional methods, however, are no longer popular. There is a limited willingness to pay for a mycopesticide, which seems to be linked to availability of cash, strongly influenced by the onion production, the major cash crop. Millet, the crop most damaged by locusts, is a subsistence crop, and the region has a deficit. Therefore, it is doubtful that the yield gains of a locust treatment will translate into cash earnings to pay for the treatment.

The local NGO, Projet Diocèsane d'Agriculture Durable ,has a solid extension organization with motivated workers. Through the Catholic church, they also have access to outside funding such as Misereor in Germany. This donor has until now provided support for chemical pesticides, but has expressed an interest in biological control methods. Several other organizations are active in the region, a public relations effort should be undertaken, starting with a regional workshop. In the future, LUBILOSA's field work should concentrate on areas with relevance to extension and marketing, such as crop loss estimation, dose reduction and farmers' organization. Testing should be phased out in favor of distribution, financing and marketing.

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APPENDICES

Appendix 1. Organization of the Participatory Rural Appraisal

Team : Hugo De Groote (agricultural economist), Douro-Kpindou (ingénieur agronome), Thomas Togola (coordinateur lutte anti-acridienne projet APH)

date	place	discussion with	other activities	with
7-6-97	Pel	Jan Antonissen Germain Arassa	village tour	
9-6-97	Sevare	Abbe		
	Koa	11 men	village tour, visit fields	Michel
	Mopti	Djiguiba Hamadoun, Min. du Plan	library, copy documents	
10-6-97	Bandiagara	Action Promotion Humaine: - Armand Kassogué, directeur projet - Dinla Dougnon, coord. hydraulique Mission Catholique: Mons. Jean Zerbo, Evêque de Mopti		
	Gelokanda	16 men, 5 women	village tour, visit fields	Amaka Tite Togo, David Sagara, animateur agr. durable
	projet PVAPD	Kassoum Sidibe	copy documents	
	Yawa	12 men, 1 woman	village tour	
11-6-97	Nombori	22 men	village tour, visit fields	

Appendix 2. Contacts from second visit

Diabaté Teninko, Directeur, Directeur Nationale d'Appui au Monde Rural (RAMR, ancien PNVA: projet national de vulgarisation agricole) Sevare
 Diakite Dramane, chef SAA Goundaka
 Djiguiba Mamadou, agent PV et enqueteur projet, traducteur pour le Peul
 Gilbert, gérant chambres de passage, Centre Jean Bosco à Sevare (Diocèse de Mopti), tel/fax 420 024
 Hamadou Djiguita, Directeur Adjoint, Direction Régionale du Plan et de la Statistique (DRPS) Mopti, tel 430 327, 430 446
 Kodio Amadou, Dr., chef d'équipe, Equipe Systèmes de Production et Gestion des Ressources Naturelles (ESPGRN), Mopti, Institut d'Economie Rurale (IER)
 Marcel, gérant, Hotel le Village, BP 35 Bandiagara, tel 420 331
 Sangara David, animateur, projet APH (avant PHR), tel/(fax quand ca marche) 420 024
 Sangare Brema, chef secteur Développement Rural, chef de projet PNVA Bandiagara
 Sidibe Kassim, coordinateur PNVA/PVABD
 Togo Jean-Pierre, chef secteur P.V. B.P. 17, Tel. (223) 42 01 02, Fax (223) 42 01 11 Bandiagara
 Togo Thomas, coordinateur, Projet Diocésane d'Agriculture Durable (avant PV diocèse), BP 45 Mopti, Tel. (223) 43 05 45, Fax (223) 43 00 56

Appendix 3. The villages visited

	<i>Koa</i>	<i>Golokanda</i>	<i>Yawa</i>	<i>Nombori</i>
cercle	Sevare	Bandiagara	Bandiagara	Bandiagara
arrondissement	Goundaka	Kani rel. vill de Goro	Dourou	Dourou
location	end of cliff	on the plateau	top of cliff	underneath cliff
longitude	14 29 509 N	14 19 509 N	14 17 985 N	14 19 789 N
latitude	4 01 139 W	3 44 467 W	3 25 140 W	3 24 271 W

Appendix 4. Guide d'Entretien

Visite du Village

- carte du terroir: croquis du village avec relief, hydrographie, point importants, localisation des champs, vergers, pâturages, ...
- localisation des champs, cultures, friches

Entretiens en groupe

- assemblée générale et présentation du groupe et organisation des paysans en groupes (les vieux, les jeunes, les femmes)
- Institutions actives dans le village (organisations paysannes...)
- Institutions dans le secteur d'agriculture (vulgarisation, P.V., crédit,...)
- Relations entre institutions

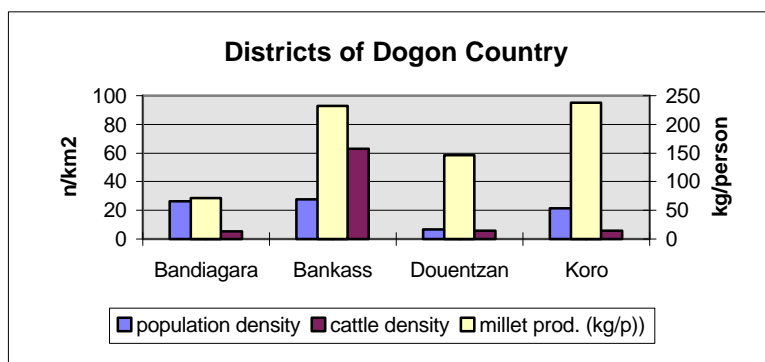
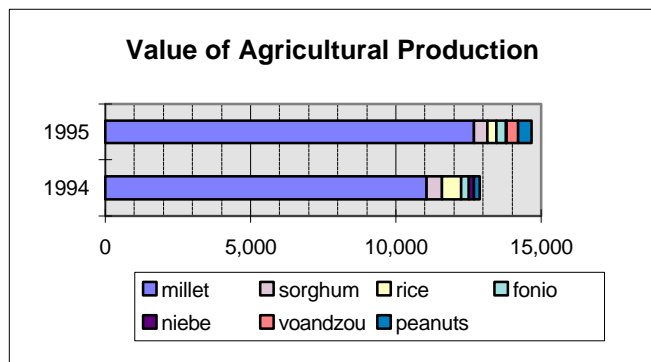
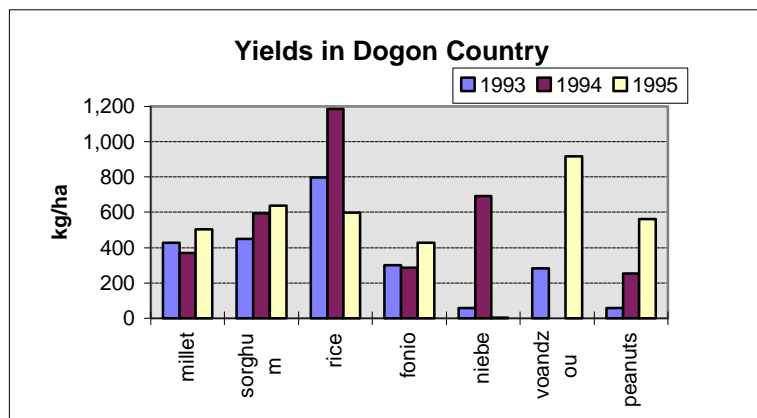
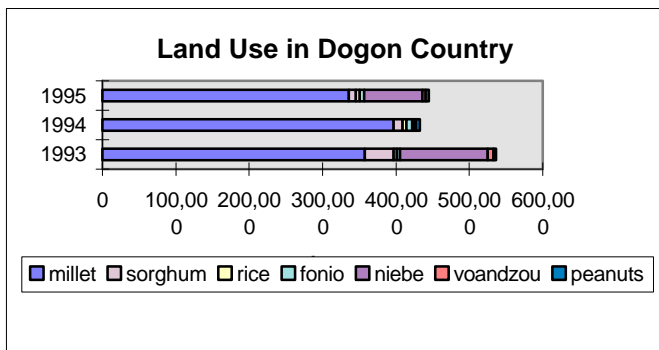
Questions communes pour les groupes

- importance des cultures (autoconsommation et commercialisation)
- calendrier saisonnier
- organisation des travaux champêtres
- importances des pestes et ravageurs des cultures (classement hiérarchique)
- importance et historique des sauteriaux (10 dernières années)
- impact des sauteriaux sur la qualité et le rendement des cultures
- connaissance de la biologie des sauteriaux
- mesure de lutte contre les ravageurs en générale et les sauteriaux en particulier
- responsabilités (par groupe d'âge et genre) concernant la lutte contre les sauteriaux

Entretiens individuels, visite d'exploitation

- historique de l'exploitation
- structure, facteurs de production (main d'oeuvres, terre, bétail)
- visite des champs

Appendix 5. Agricultural statistics (DNSI 1996)



Appendix 6. Agricultural production in Dogon country 1985-92 (USAID/FEWS webpage)

district	agric. statistics	fonio	maize	millet	niebe	peanut	rice	sorghum
Bandiagara	production (MT)	1,256	1	35,686	111	610	144	3,782
	area (ha)	2,338	89	51,634	1,273	1,288	218	5,641
	yield (MT/ha)	0.537	0.011	0.691	0.087	0.474	0.661	0.670
Bankass	production (MT)	879	76	55,487	2,470	495	716	7,692
	area (ha)	1,547	235	71,435	21,970	634	589	14,544
	yield (MT/ha)	0.568	0.323	0.777	0.112	0.781	1.216	0.529
Douentza	production (MT)	0	0	14,372	0	0	174	508
	area (ha)	0	0	36,721	351	131	143	2,891
	yield (MT/ha)			0.391	0.000	0.000	1.217	0.176
Koro	production (MT)	63	93	37,212	1,732	631		747
	area (ha)	681	465	69,813	14,217	1,033	7	2,794
	yield (MT/ha)	0.093	0.200	0.533	0.122	0.611		0.267
Total	production (MT)	2,198	170	142,757	4,313	1,736	1,034	12,729
	production (% of total)	1%	0%	87%	3%	1%	1%	8%
	area (ha)	4,566	789	229,603	37,811	3,086	957	25,870
	area (% of total)	2%	0%	76%	12%	1%	0%	9%
	yield (MT/ha)	0.481	0.215	0.622	0.114	0.563	1.080	0.492

Appendix 7. Millet production in Dogon Country (Source: USAID/FEWS website)

district	agric. statistics	1985	1986	1987	1988	1989	1990	1991	1992	Avg
Bandiagara	production (MT)	15,279	11,680	12,546	113,925	32,842	34,855	40,243	24,116	35,686
	area (ha)	32,725	27,200	32,687	74,391	54,005	66,793	70,308	54,965	51,634
	yield (MT/ha)	0.467	0.429	0.384	1.531	0.608	0.522	0.572	0.439	0.691
Bankass	production (MT)	37,745	43,601	73,730	84,594	28,695	50,016	67,812	57,706	55,487
	area (ha)	41,621	42,299	42,730	100,082	48,556	83,302	118,476	94,412	71,435
	yield (MT/ha)	0.907	1.031	1.725	0.845	0.591	0.600	0.572	0.611	0.777
Douentza	production (MT)	14,180	8,746	9,958	21,587	18,453	15,794	18,722	7,533	14,372
	area (ha)	31,209	39,884	31,415	42,322	41,657	42,744	32,709	31,831	36,721
	yield (MT/ha)	0.454	0.219	0.317	0.510	0.443	0.370	0.572	0.237	0.391
Koro	production (MT)	19,538	24,207	24,124	41,440	21,949	48,233	46,447	71,758	37,212
	area (ha)	31,744	44,328	38,445	66,998	44,648	133,144	81,148	118,052	69,813
	yield (MT/ha)	0.615	0.546	0.627	0.619	0.492	0.362	0.572	0.608	0.533
Total	production (MT)	21,686	22,059	30,090	65,387	25,485	37,225	43,306	40,278	35,689
	area (ha)	34,325	38,428	36,319	70,948	47,217	81,496	75,660	74,815	57,401
	yield (MT/ha)	0.632	0.574	0.828	0.922	0.540	0.457	0.572	0.538	0.622