

Vulnerability Profile of Mali

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March 2005

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ISBN 91 975237 5 5

Printed in the United Kingdom, 2005

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Introduction

Mali is the 19th most vulnerable of the 141 countries ranked¹ by the Global Leaders for Tomorrow Environment Task Force (2002). This means the country is vulnerable to stresses which, if not addressed, could be disastrous at both the household and national level. Vulnerability is a reflection of human capacity to cope with risks or shocks (see Box 1). Those who are least vulnerable cope the best and enjoy security, while the opposite applies to those households, communities and broader populations who are most vulnerable and who stand to lose the most from the effects of environmental change (UNEP, 2002). In participatory poverty assessments, the poor regularly identify vulnerability as a crucial dimension of poverty (Kanbur & Squire, 1999). In this study, part of Sida's country strategy planning process in Mali, I discuss the types of threats present in Mali, why people are sensitive to those threats and how they deal with them. I also look at how variations within society and geographical location shape vulnerability.

A more thorough understanding of vulnerability may help support to be targeted so as to increase people's resilience to stresses, thus decreasing the number of people who are, and who are at risk of becoming, poor. A vulnerability assessment is therefore an important element of development assistance and policy formulations for sustainable development. Many of the issues discussed here relate to the process of achieving the United Nations Development Programme's Millennium Goals.

Vulnerability in Mali: Background

This assessment looks at vulnerability across all scales from the individual to the national. The major trends dealt with here have been identified through discussions with various representatives in Mali and a review of the literature. In this vulnerability profile, I identify the factors and trends that potentially reduce livelihood sustainability in Mali. I assess how patterns of exposure, sensitivity, and resilience to environmental variability change in relation to the various conditions that exist in the country.

Basic national statistics are presented in Table 1. However, average national statistics for Mali often hide the most serious deprivation in the different regions; there are, for example, stark regional disparities in terms of economic performance, human development, social welfare provision and the prevalence of poverty. The three northern regions of Tombouctou, Gao and Kidal lack even the most basic of infrastructure and have the lowest incomes per person in the country (Appendix 1 provides a map of administrative regions). Meanwhile, the south hosts most of the country's major urban settlements.

¹ This index includes indicators on basic human sustenance and environmental health.

BOX 1 DEFINITIONS OF VULNERABILITY TERMS**Vulnerability**

Vulnerability is the degree to which a system or unit (such as a human group or a place) is likely to experience harm due to exposure to perturbations or stresses. It is comprised of three dimensions:

Exposure

The exposure of people, places and ecosystems to stresses, perturbations, and shocks.

Sensitivity

The degree to which people, places and ecosystems are affected by stress or perturbation, including their capacity to anticipate and cope with the stress.

Resilience

The ability of the exposed people, places and ecosystems to recover from the stress and to buffer themselves against and adapt to future stresses and perturbations.

(Source: Kasperson, J.X. and R.E. Kasperson. 2001. International Workshop on Vulnerability and Global Environmental Change. Stockholm Environment Institute, SEI Risk and Vulnerability Programme, Report, 2001:1. 36pp).

According to the Human Development Index, Mali is the 4th most disadvantaged country in the world (UNDP, 2002) and is heavily indebted. Maternal mortality is among the very highest in the world, at 930 deaths per 100,000 births (World Bank, 2002). Almost half of Mali's population has little or no access to education, clean water, health care, electricity, or adequate transport and communications. There are also some emerging and potentially severe environmental crises, in particular deforestation, degradation of land and depletion of fish stocks. Degradation of natural resources is leading to increased workloads, especially for women. These problems may be worsened by an apparent climatic trend of declining rainfall.

Table 1 General statistics for Mali

	Average	Source
Poverty (share of population below national poverty line)	67% (total); 30% (urban), 76% (rural)	CIA
GDP (US\$)	9.2 billion	CIA
GDP per capita (US\$)	840	CIA
Population (millions)	11.3 million	CIA
Population growth rate	2.97%	CIA
Total fertility rate	6.73 children/woman	CIA
Life expectancy at birth (years)	45.2 (total); 46.2 (women), 44.2 (men)	WHO
Proportion of population living in urban areas (1999)	29.2%	AFRISTAT

While Mali's ethnic composition is fairly homogenous compared to most sub-Saharan African countries, social hierarchy still plays a significant role. Social hierarchy is exclusively a question of aristocracy and nobility, and closely connected with family names and with rules of conduct for daily life. Hence, membership of an ethnic group, social class, or a specific clan determines social behaviour, possible marriage arrangements and even access to resources.

While this system is disintegrating in the major cities, the significance of the social categories has remained relatively unchanged in hundreds of villages. This is one of the reasons why so many young people abandon rural life to seek a new, if often miserable, life in the city free from social obligations (Leisinger & Schmitt, 1995).

LARGE-SCALE DISASTERS IN MALI

Recurring droughts, floods and epidemics are major threats in Mali (see Table 2). In the 30 events recorded between 1970 and 1998, about 6,866 people died and over 5 million were affected. Poverty is closely linked to disaster vulnerability; repeated exposure to stresses further reinforces poverty. The average annual frequency of large-scale disasters since 1970 is 1.07, the 12th highest frequency among the 48 Least Developed Countries (UNDP, 2001).

Table 2 Large-scale disasters in Mali 1970–1998

Type of event	No. of events	Persons killed	Persons affected
Epidemics	8	3,120	18,713
Droughts/famines/food shortages	13	3,615	5,202,000
Floods	4	131	49,195
Insect infestation	5	–	–

Source: UNDP, 2001

VULNERABILITY AND NATIONAL DEVELOPMENT

Cotton and gold are Mali's principal exports and the potential value of minerals, such as bauxite, manganese, copper, lithium and zinc, is very great. However, Mali's economy depends on the rural sector, which provides the bulk of employment, food (essentially cereals) and foreign exchange (cotton, livestock and fish) (Dioné, 2000). Mali produces more cotton than any other country in sub-Saharan Africa; therefore the economic health of the country is very much dependent on the price of cotton. Agriculture and livestock herding involve around 80 per cent of the population. There is a distinct north-south divide in agricultural production in Mali. The south produces enough rice, maize and millet to be able to export a portion, whereas the north suffers considerable food insecurity. Foreign aid makes up a considerable proportion of Mali's income.

International conflicts and disputes also have a bearing on Mali's vulnerability. Since September 2002 the Côte d'Ivoire crisis has caused major displacements of people. Malian families who had been established in the Côte d'Ivoire for several centuries have returned to Mali. According to the *Direction Nationale de la Protection Civile*, as of the end of January 2003 official records indicate 34,262 Malians and 511 foreign refugees arrived in the country, but other estimates suggest that the total is closer to 130,000. The whole country has been affected by this conflict, but especially the regions of Sikasso, Kayes, Koulikoro and Mopti delta (fishing communities), where refugee camps and the increased population pressure are likely to cause stress on an already fragile environment (FEWS NET, 2003). Nevertheless, the problems have not been as great as expected, possibly reflecting the well-functioning system for dealing with these issues. For example, representatives of the World Food Programme and

the Famine Early Warning System Network (FEWS)² in Mali consider that the early warning systems and the institutional set-up for food security (see Appendix 2) work well and provide good communication between the donor community and the government (Cina³ and Togola⁴, pers. comm. 2003).

The 2002 HIPC Initiative programme in Mali earmarked CFA.F 25.5 billion for vulnerable populations in accordance with the country's ten-year social programmes (for education, health and basic infrastructure) (African Development Bank/African Development Fund, 2002). However, no vulnerability assessments have been prepared for the Malian government. CILSS are very active in Mali with representatives in the Sahelian Parliamentarians Population/Development Network.

SENSITIVITY TO STRESSES

People's sensitivity to stress depends on their ability to recover from a shock or crisis. Major factors that determine sensitivity fall into the categories of health, migration, economic and political status. Sensitivity at finer scales—community, household or individual—depends on additional factors such as proximity and access to resources, individual characteristics and assets. Health is often highlighted in vulnerability assessments and it is a critical issue in Mali. In this section, I look at how health and health provision affect vulnerability.

Along with malaria, the AIDS epidemic (see below) is viewed as a priority health issue in Mali (OXFAM, 2002). Other prevalent diseases are hepatitis, tuberculosis and meningitis. However, in 1995, only 30 per cent of the population had access to health care (OXFAM, 2002). Lack of clean water and hygienic sanitation systems are the primary factors in the spread of infectious diseases. The transmission of these infectious and otherwise preventable diseases contributes to low life expectancy and high infant mortality. Key infrastructural problems include lack of available health services at village level and a lack of resources in the health system. The situation for women is particularly serious. Women have a one in seven chance of dying during childbirth or from an unsafe abortion. The fact that only 32 per cent of childbirths are attended by a trained medical assistant contributes to the extremely high rates of maternal mortality (OXFAM, 2002). In addition, female circumcision is still widely practised, sometimes even on infants (Borghese⁵, pers. comm. 2003).

The role of social and traditional institutions must be acknowledged when dealing with health issues. For example, a study of the *Fulbe* and *Bamanan* people showed that assumptions that proximity to health services would increase child survival rates were incorrect (Adams et al., 2002). Regardless of their distance from modern health services these groups overwhelmingly relied on traditional therapies because they perceive them to be more effective and accessible.

2 USAID has established a Famine Early Warning Systems Network (FEWS NET) in sub-Saharan Africa; an information system designed to identify problems in the food supply system which could potentially lead to famine, flood or other food-insecure conditions. The goal is to strengthen the abilities of African countries and regional organizations to manage risk of food insecurity through the provision of timely and analytical early warning and vulnerability information. It is a multi-disciplinary project which collects, analyses and distributes regional, national and sub-national information to decision-makers about potential or current famine or flood situations, allowing them to authorize timely measures to prevent food-insecure conditions in these nations. FEWS NET is present in Mali.

3 Interview with Mr. Gilbert Cina, World Food Programme, Mali.

4 Interview with Mr. Mamadou Togola, FEWS NET, Mali.

5 Interview with Dr. G. Borghese, UNICEF, Mali.

In addition, anecdotal evidence suggests that *Fulbe* women are reluctant to go to clinics because they are unfamiliar with town life and the culture of modern health care. The scope of emotional, cognitive and practical networks appears to have a powerful effect on child survival rates among the *Fulbe*. In the context of scarce economic and health resources, the non-monetary assistance these networks offer may represent the only reliable support. However social networks may also exert a negative impact, for example when dangerous traditional health advice is dispensed, and/or preventive action is discouraged.

Epidemics

The frequency of epidemics that cause large-scale disasters in Mali (Table 3) indicates their significance in a vulnerability profile. The numbers of people affected or killed are substantial and the loss of household labour, one of the most important assets poor people have, is a major blow to household security.

Table 3 Disasters caused by epidemics in Mali

Year	Killed	Total affected	Disease and comments
1969	500	4,000	Meningitis; Bamako Area
1969	13	23	Yellow fever; Kati-Faladie Area
1979	30	80	Meningitis; Koro region
1981	412	4,153	Meningitis
1984	1,022	4,502	Diarrhoeal/Enteric Cholera; Gao, Segou, Tombouctou, Mopti regions
1987	137	153	Yellow fever; Bamako and rural areas
1987	57	–	Diarrhoeal/Enteric Cholera; Western Mali
1988	47	159	Meningitis; Bamako
1997	1,098	9,666	Meningitis

Source: Centre for Research on the Epidemiology of Disasters (CRED)

(In order for a disaster to be entered into this database at least one of the following criteria has to be fulfilled: 10 or more people reported killed, 100 people reported affected, a call for international assistance, declaration of a state of emergency.)

HIV/AIDS

At the end of 1997, 1.7 per cent of Mali's total population had HIV/AIDS; in urban areas this figure rose to 4 per cent. The western part of Mali appears to be more heavily affected than other regions (UNAIDS, 2000). While these figures are very low when compared to other countries, concern is growing as the prevalence rates are increasing (Borghese, pers. comm. 2003). Given the large-scale circular migration from Mali to other countries where infection rates are higher, preventive actions should not wait for more people to become affected. The recent large-scale famine in southern Africa has, in a most daunting way, shown how AIDS/HIV exacerbates vulnerability and food security issues in subsistence farming systems where agricultural productivity depends on human labour (Stevens, 2002).

For a poorer person infected with HIV/AIDS, malnutrition and disease form a vicious circle. Biological and social factors make women more vulnerable to HIV/AIDS than men, especially in adolescence and youth (FAO, 2001). The disease commonly strikes the most productive members of society, with critical effects on agricultural as well as on all other aspects of economic and social development. Both rich and poor may succumb, but the poor are more vulnerable to its effects. HIV/AIDS prolongs and deepens poverty over time, stripping households of their assets and depleting human and social capital. These characteristics mean

that the disease simultaneously undermines both the production of food, and economic access to it, with severe implications for food security. When many households in a community are affected by HIV/AIDS, traditional safety mechanisms for the care of orphans, the elderly, the infirm, and the very poor can be overwhelmed and may collapse altogether (FAO, 2001).

VULNERABLE GROUPS

According to CILSS-Arghymet (2001) about 80,000 people in Mali are very vulnerable and this figure is on the increase (Table 4). However, this figure is rather lower than the other CILSS countries⁶. Table 4 estimates the vulnerability status of major rural livelihood groups defined by CILSS.

Table 4 Composition of rural farming systems in relation to vulnerability dynamics in Mali

Current status	Non-vulnerable	Vulnerable	Non-vulnerable	Vulnerable	Non-vulnerable pastoralists	Vulnerable pastoralists
<i>Stress Trends</i>	<i>Stable</i>	<i>Attenuated</i>	<i>Aggravated</i>	<i>Aggravated</i>		
Subsistence farmers	273,000	421,000	90,000	5,000	–	–
Subsistence pastoralists	915,000	629,000	532,000	–	–	–
Mixed ¹ farmers	767,000	486,000	257,000	–	–	–
Mixed ¹ pastoral	–	–	131,000	–	–	–
Cash crop farmers	1,159,000	555,000	91,000	–	–	–
Rice farmers /pastoralists	120,000	60,000	94,000	79,000	–	–
Pastoralists	–	–	–	–	251,000	365,000
Total	3,235,000	2,151,000	1,195,000	83,000	251,000	365,000

¹ Mixed refers to a household which produces food both for home consumption and for the commercial market.
Source: CILSS-Arghymet (2001)

The regions vulnerable to structural issues are shown in Appendix 3. The regions in western Mali are normally self-sufficient in food and the economy is not solely based on agricultural production. However, local production in the region of Kayes does not meet the population's cereal requirements. Migration is also very prominent in this region and thus there is a greater proportion of women living there. The lack of infrastructure discourages local investment and development.

The transition zones between Mali and Mauritania, Burkina Faso and Niger, mark the boundaries for the northern nomadic pastoralists and the southern sedentary cultivators. Here climatic constraints limit large-scale agricultural and livestock production. The Mopti region has a deficiency in cereals, but a growing agricultural sector (e.g., rice production) and the Niger delta region has excellent conditions for livestock production. Fishing is another important sector there. However, the regions outside the delta are vulnerable to agro-environmental stresses due to less favourable conditions with little rainfall as well as deforestation and land

⁶ Burkina Faso, Côte d'Ivoire, Cape Verde, Guinea Bissau, Gambia, Mauritania, Niger and Senegal.

degradation. The region of Gao receives very little rainfall and production mainly involves pastoralism (transhumance) and subsistence agriculture; the climatic constraints do not allow for much agricultural diversification. There are conflicts in this region between cultivators and pastoralists, as well as a risk of irreversible environmental degradation through resource exploitation.

Outside these vulnerable areas there are still many other vulnerable people (Table 5). While identifying some groups as vulnerable is a great generalization, it can ensure that development assistance reaches key target groups. For example, women are often mentioned as more vulnerable than men. However, during times of food shortage women's knowledge of wild foods and medicines is a particularly valuable asset. Nevertheless, the vulnerable groups identified in Table 5 should be considered in all types of vulnerability reduction work and during times of stress.

Table 5 Major vulnerable groups and individuals in Mali

	Major vulnerable groups	Vulnerable individuals within all groups
Rural Areas	Low-income households <i>Subsistence or small-scale farmers</i> <i>Landless peasants</i> <i>Fishers</i> <i>Nomadic pastoralists</i> <i>Sedentary herders, small-scale livestock</i> Non-diversified farmers <i>Indebted households</i> <i>Cotton growing households</i> Migrant workers Victims of conflicts <i>Refugees</i> <i>Internally displaced people</i> <i>Individuals marginalized through community and household disputes</i>	Women and children with extra workloads Women of childbearing age, especially pregnant and nursing mothers Children under five years old, especially infants Orphans Elderly Disabled and ill Widows and widowers Divorcees Female-headed households left behind by migrant male labourers Landless returnees Relatives who cannot receive remittances from migrants
Urban Areas	Marginal populations in urban areas <i>Peri-urban small-scale agricultural producers</i> <i>People living alone on small fixed incomes or without support</i> <i>Sex workers</i> <i>Unemployed</i> <i>Beggars</i> Migrant workers Recently arrived migrants Victims of conflicts <i>Refugees</i> <i>Internally displaced people</i> <i>Individuals marginalized due to community and household disputes</i>	Women and children with extra workloads Women of childbearing age, especially pregnant and nursing mothers Children under five years old, especially infants Orphans Elderly Disabled and ill Widows and widowers Divorcees Homeless people Street children Women and girls who are excluded from their families Relatives who cannot receive remittances from migrants

Major Environmental Stresses in Mali

Livelihoods in Mali are closely tied to environmental conditions through agriculture, pastoralism and fishing. Stresses are multiple; thus to successfully reduce vulnerability we must take an integrated approach. Furthermore, the environmental risks that people face vary from year to year and place to place. Some stresses correlate closely with natural variability and some are driven more directly by human activity. Climatic conditions create hazards that can cause harm of different magnitudes from local problems to large-scale disasters. Other environmental hazards, such as land degradation, are not caused directly by climatic variability, but may be worsened and initiated by it. Furthermore, higher population densities, such as those in urban areas, increase pressure on the environment and, if not managed, may lead to severe problems including soil, water and air pollution.

CLIMATIC STRESSES

Climate variability is important in a vulnerability context because of the many associated risk factors. In addition, it has often been observed that the African continent is particularly vulnerable to the impacts of climate change because of widespread poverty, recurrent droughts, inequitable land distribution and over-dependence on rainfed agriculture (c.f. Desanker and Magadza, 2001). In Mali, 80 per cent of the population is engaged in agriculture and pastoral activities. However, only one-quarter of the country receives sufficient rainfall to support extensive agriculture and just 2 per cent of the land is suitable for intensive cultivation (Leisinger and Schmitt, 1995). Thus, a large part of the population is vulnerable to climatic stresses. The rainfall trend for Sahel and West Africa over the last few decades is a gradual decline (see Appendix 4). When future rainfall patterns are modelled for the Sahel, the pattern is unclear. However, the effects of any future climate change and changes in climate variability, such as droughts and flooding, will increase the impact of population and land use pressure, erosion and siltation, etc. on the hydrological cycle.

Precipitation varies both in amount, timing and location from year to year in Mali, but four major eco-climatic zones are distinguishable, the Sahara, Sahelian, Sudanian and Sudanian-Guinean, with an average annual precipitation ranging between 100 and 1,700 mm (Appendix 5). The one rainy season is entirely limited to the summer and lasts up to six months in the south and only two months in the north (CILSS-Arghymet, 2001, and Appendix 5). In the Sahelian zone, low precipitation and high evaporation rates are fundamental limiting factors for primary production. In addition to low precipitation, high temperatures characterize the Sahelian region with absolute maximums reaching more than 45°C. For example, in Gao the average precipitation is 261 mm and high temperatures contribute to a potential evapotranspiration as high as 2,255 mm. There are no months with a positive balance between rainfall and potential evapotranspiration (Raynaut et al., 1997). Under these extreme conditions, additional climatic stress or overgrazing can compromise the regrowth of pastures and leave the ground bare by limiting seed formation. In addition to high temperatures, winds may amplify the desiccating effect. In Mali, the often dust-laden Harmattan wind flows northeast to east (blowing from the Sahara desert to the Atlantic coast) between December and March. It also carries fires over wide areas, causing great damage to the savanna zone's plant life where only a few species are fire resistant (Leisinger & Schmitt, 1995). Thus, by eliminating ground cover bushfires represent a considerable secondary erosion factor in the Sudanese zone (Raynaut et al., 1997).

Irrespective of whether climate change will cause more frequent or more intense extreme events, it is apparent that many are sensitive to climatic hazards, especially the poor. For

national and international agencies, the cost of climatic hazards—impacts, recovery, and rehabilitation— may result in a shift in expenditure from reducing vulnerability to simply coping with immediate threats (Desanker & Magadza, 2001). The data in Appendix 6 show that droughts have contributed to severe large-scale disasters in Mali. Long droughts have occurred without substantial recovery periods. For example, the 1980–84 drought was the third in 10 years; in 1984, Gao received only 60 mm of rain (Hulme, 1996). However, when the rains returned, the vegetation of the Gourma region slowly recovered from this severe drought to almost its former condition.

Drought cannot be consistently defined based on a prescribed period or level of rainfall deficiency. Nonetheless, there are few rural communities in Africa that can face a drought of more than two years of very dry conditions without radical readjustment (Warren, 1996). Desiccation is then a dry period that is extended to the point where it destroys natural or cultural communities such that it will take many years to recover. In natural ecosystems, desiccation eliminates seed parents entirely, so that plant communities take many years to re-establish after the good rains return. It is the trees in many of the ‘tigerbush’ communities of Mali that were destroyed during the latest period of desiccation and it will take many years before they will regrow and reach maturity (Warren, 1996). However, drought, desiccation and dry-land degradation never come singly but amplify each other. A village that has already lost its soil fertility succumbs more quickly to a drought than one whose soils are intact. A pastoral group whose herds have been dramatically reduced by desiccation will collapse in a drought that might be barely noticed by a group untouched by the desiccation.

Table 6 outlines the direct and indirect impacts of droughts, thereby providing guidance in identifying strategies for reducing vulnerability. Although the consequences are most easily observed in agriculture, drought impacts are felt across all sectors, although the magnitude of impacts and differences in recovery varies within populations.

Table 6 Direct and indirect consequences of drought

Impacts	Impacts of drought				
	Agriculture Food security	Water Sanitation	Health	Infrastructure Shelter	Economic
Direct	Loss of agricultural output	Deterioration of water quality	Health status (e.g. malnutrition)	Wells	Funds diversion to relief
	Loss of livestock	Deterioration of sanitary conditions		Water distribution	Business loan defaults
	Food prices	River hydrology (decreased flow)	Irrigation	Local spending	
	Reduction of demand for labour				
	Food shortage				
Indirect	Household assets liquidated	Fetching water	Morbidity		Government revenue, ForEx
	Migration	Water disputes	Mortality	Loss of shelter	Inflation
	School Attendance				
	Land degradation and declining productivity				Diminished spending

Based on: Sharma et al. 2000

WATER STRESSES

Water is an essential part of any ecosystem and reductions in water quantity and quality have serious negative impacts. Environmental damage is leading to an increased frequency of natural disasters, such as floods, increasing where deforestation and soil erosion are reducing natural water attenuation (Appendix 6). It is the poor who are most affected by floods, pollution, scarce water supplies, and associated loss of valuable natural food sources (WWAP, 2003). In addition, people who live on marginal lands are at greater risk from floods or droughts.

Long-term precipitation records from the Sahara give a clear indication of declining precipitation in that region (UNEP, 1997; Appendix 4). These declines in precipitation result in reduced hydrological discharges in major river basins in the subhumid zones. Droughts lower the level of the rivers and the construction of dams changes the flow of these rivers. The Niger inner delta loses 40–50 per cent of its water annually to evapotranspiration and irrigation, with serious environmental consequences (République du Mali, 2000). People are also affected directly as permanent surface water contributes about 10 to 15 per cent of the water used for drinking and for food consumption in Mali (République du Mali, 2000). While groundwater is often of good quality, access is sometimes difficult and it is not used for irrigation. Often, the water is not enough for human needs, let alone watering livestock or irrigating fields. In the north there is a chronic water shortage and people have to rely on polluted water sources. In many cases, access to safe water is increasingly inequitable, and the poorest are likely to be the most adversely affected by changes (Hoff, 2001).

Irrigation has to be carefully supervised to avoid environmental problems such as salinization or soil alkalinization and to avoid damaging fauna and flora habitats. If we are to reduce vulnerability and achieve sustainable development based on intensified agriculture we must put in place good irrigation planning, as well as education to supplement traditional knowledge (CILSS, 2002). In the Senegal River basin dam construction has proved a mixed blessing; dams provide year-round water for agriculture, but also bring problems for health and aquatic ecosystems. Modifications to the hydrology of Mali's major rivers are also of concern. For example, in 2002 insufficient water caused problems for rice irrigation (République du Mali, 2002). The Sénégal River's hydrology has been modified by the Manatali dams upstream and Diama dams downstream. And the hydrology of Niger River has been modified by the Sélingué dam (CILSS, 2002).

While natural boundaries are not static in Mali, there are some major geographical divisions that help explain the main livelihood constraints imposed by water scarcity (Leisinger & Schmitt 1995):

- *The desert zone:* Fossil groundwater is the only permanently available water resource in this zone, whose main inhabitants are the Tuareg nomads who use camels and keep sheep and goats. However, the scarcity of natural vegetation in the desert and on its fringes sets narrow limits for nomadic pastoralism and makes intensive grazing impossible.
- *The Sahel zone:* The potential water supply is very limited here. Surface water and subterranean water resources, both of which are renewable and can be used over the long term, exclusively depend on existing watercourses. Most groundwater is fossil. In the southern part of this zone agriculture and pastoralism are often mixed. In the northern part animal husbandry is the only source of livelihood but there are serious fodder shortages from time to time. However, agriculture is continuing to expand into the north where dry years usually have disastrous consequences, as for example in the early 1970s and 1980s.

- *The river basins:* The Niger River supplies every type of water need, including irrigating croplands, especially in Mali's dry savanna and Sahel zones. Floodplain agriculture and pastoralism predominate in the delta, the primary rice-growing area, although vegetables and wheat are also cultivated. Hence pollution and changed hydrology could cause significant stress to both permanent and seasonal populations.
- *The savanna zones in southern Mali:* There is no significant restriction on water availability in the humid savanna zone and most agriculture in this region does not require irrigation. While agriculture dominates in the southern savanna zones, in the north agriculture and animal husbandry are equally important, and even complementary to each other. People in this region are therefore seldom thought of as vulnerable to water stress.

Lack of drinking water is usually much less of a problem for herders during years of drought than shortage of fodder. However, access to water is problematic in some areas, such as in the Bougouni area of southwest Mali, which accommodates limited use by herds of extensive pasture areas. Control over a water source, such as a well or bore-hole, is the main mechanism for controlling access to grazing. In both pasture and farming areas, rights to water remain a very important element in maintaining access to grazing. However, with the increasing scarcity of grazing land, concentration of livestock within the farming zones has meant that conflict management and regulation have become important (IIED, 1998).

ENVIRONMENTAL DEGRADATION AND VULNERABILITY

Agricultural livelihoods in Mali depend mainly on the use of natural resources; the degradation of these resources thus poses a risk for farmers and pastoralists. Unsustainable management practices and policies lead to environmental degradation, increasing people's vulnerability by reducing productivity.

In Mali, land is generally the common property of a group (family, village, or ethnic group) and is assigned for individual use according to fixed rules. The advantage of this is that landlessness is not so severe; however, the disadvantages are considerable, including a lack of collateral for credit or overuse of commonly owned land. For most farmers, there are neither the incentives nor the financial means to invest in soil conservation. The resulting erosion causes soil degradation and rapid destabilization (Leisinger & Schmitt, 1995).

One of the main causes of environmental transformation is the intensification and expansion of the cultivated area under cotton. The role of agricultural development in environmental degradation is mainly through deforestation and soil depletion. While domestic fuelwood use does not seem to cause any local deforestation, bush and woodlands continue to be converted to agricultural land. Wood and charcoal provide over 90 per cent of the country's energy needs and the growing urban demand for fuelwood then greatly contributes to the problem. The total change in forest area between 1990 and 1995 was -0.96 per cent, which can be compared to -0.71 per cent for sub-Saharan Africa (WRI, 2001). Mali has never had extensive forest cover, but at present the equivalent of 100,000 ha of forest is cleared every year for agricultural purposes to cover the demands estimated at 7,000 millions tons of wood (CILSS, 2002). Deforestation leads to the loss of topsoil and nutrients, mostly through wind and water erosion. The subsequent decline in soil fertility reduces agricultural production and degrades pastures. Soil erosion also causes siltation in waterways as well as salinization and acidification of soils. The net effect is an unstable ecosystem that cannot continue to provide a sustainable livelihood system for either humans or animals.

Trees and shrubs also provide ecosystem services, such as carbon sequestration, storage and transpiration of water for precipitation, maintenance of soil fertility and as habitats for a diverse array of plant and animal species. Moreover, they provide timber, traditional medicines, staple foods and drought emergency food. Any changes to these ecosystems will increase the vulnerability of the large part of the Burkina population that depends on forest species for subsistence needs. Women and poor households are particularly vulnerable to the loss of forest products such as fruit, medicinal plants, fuelwood, grazing and fodder, since they generally lack access to other resources and capital.

When Mali joined the structural adjustment programme in 1982, subsidies for inorganic fertilizers were dramatically reduced and their use fell instantly. Farmers were then more or less encouraged to clear new land to compensate for the lack of intensification (Benjaminsen, 2001). In the Office du Niger irrigation project, soil fertility problems were found to reduce the overall high productivity in the area. As soils become more degraded they become compacted, less permeable, and porous. Some soils have reached critical degradation levels (Kater et al., 2000). However, rehabilitation work and restructured management has improved overall crop performance.

This strategy of extensification and lower intensity production (that is, limited fertiliser use) may be a less costly approach for low-income farmers in an environment characterised by insufficient and unequally spaced rainfall, variable cereal prices and uncertain markets. It could, therefore, be called an adaptation strategy. However, the large expansion in the cotton-growing area, the decreased use of fallow periods between cropping cycles and the absence of sufficient organic and inorganic fertilization suggest that environmental degradation and soil fertility problems may not be able to sustain these levels of cotton and cereal production in Mali over the long term (Tefft, 2000). Whether this type of transformation is perceived as degradation or not, it is clear that biodiversity will be lost and as some natural resources are being conserved, others, such as wildlife, gallery forest, and probably certain plant species and genetic resources of value to agriculture are being lost from the area (Benjaminsen, 2001).

Loss of biodiversity

To maintain resilience within ecosystems it is important to conserve biodiversity and a rich gene bank. However, it is difficult in variable environments to reconcile people's short-term survival strategies with long-term resource conservation. Wildlife populations in Mali have decreased substantially over the last two decades (IUCN, 2002). There are 14 mammal, six bird, one reptile, and five tree species considered to be threatened in the country (WRI, 2001). The number of threatened mammal species has increased from 13 in 1996 to 14 in 2000, which is 9 per cent and 10 per cent respectively of the total amount of species in Mali (IUCN, 2002). Threatened and vulnerable mammals and birds in Mali are stressed because of habitat loss through agricultural expansion and overgrazing, hunting, extraction of wood, changes in native species dynamics and natural disasters such as drought. The Inner Niger Delta downstream of Bamako is one of the most important wetland areas in Africa, with diverse populations of animals, fish, birds and plants. It provides an essential staging post for migratory birds as well as one of the last sites for the West African manatee (which is classified as vulnerable by the World Conservation Union—IUCN, 2002).

Biodiversity loss renders many people vulnerable as individual species and more general ecosystem services are of enormous developmental value. However, biodiversity should not be equated in a limited way to natural resources or wildlife. It refers to all living things, wildlife, and domesticated organisms across all levels of biological organization—genetic, species

and ecosystem—not just those found useful at a specific time or place. Biodiversity plays an important role in people's ability to cope during dry spells because it offers choices and provides alternatives to fall back on when other resources become unavailable. Such flexibility in times of stress would be impossible without access to biodiversity. Dryland species are adapted to an environment known for its variation in climate, both in terms of temperature and water availability. Also, the humid areas within arid environments are important habitats for species with particular needs, such as migratory birds.

Pollution

More direct threats to the environment and human health are pollution from inadequate sanitation, poor waste management and the inappropriate use of chemical fertilizers and pesticides for agriculture or domestic use.

In urban areas there is a severe lack of public sanitation facilities. Only 1.5 per cent of the population is served by the sewage system, and the number of households connected to the public water supply varies between 12 per cent and 48 per cent (26 per cent in Bamako) (Diara, 1997). Water pollution affects both surface water and groundwater. Many of the traditional water sources in Mali are open wells that often contain polluted surface water mixed with sewage. The degradation of water quality is shown by biological/chemical pollution and physical pollution. The discharge of untreated sewage into rivers and estuaries contributes most to this type of pollution. Sanitary waste reduces water quality, and together with changes of flow in the rivers, contributes to a decline in fish populations. Moreover, the discharge of industrial wastes with a high toxic material content (from tanneries and gold mines) is also dangerous for surface and groundwater. Treatment of industrial wastes is insufficient or non-existent, and every day in Bamako alone, chemical pollutants, heavy metals and organic pollutants infiltrate into aquifers or directly into the river Niger. Domestic waste is another source of pollution; uncontrolled garbage amounts to 600 m³ a day in Bamako, and in smaller towns less than 30 per cent of the garbage is collected regularly (Diara, 1997). Air pollution is caused by industrial activities, by heating systems (smoke) and motor vehicle traffic.

In rural areas, pollution of soil and food by fertilizers and pesticides, pollution from solid and liquid wastes, and air pollution caused by smoke threaten the environment and human well-being. Excessive fertilizer use contributes to the eutrophication of surface water, the accumulation of nitrates in groundwater, the acidification of soils, and the emissions of nitric oxide, one of the greenhouse gases. In addition, Mali is a large consumer of pesticides, some of which enter the country illegally from its neighbours (Diara, 1997). The risks posed by pesticides are substantial. Empty containers are generally reused as drinking water containers or to store food. People handling them often have little or no protection, resulting in poisoning and environmental contamination.

INVESTING IN RESILIENCE AND ENVIRONMENTAL SUSTAINABILITY

People have adapted to patterns of climate variability through land-use systems that minimize risk, with agricultural calendars that are closely tuned to typical conditions and choices of crops and animal husbandry that best reflect prevailing conditions. However, rapid changes in this variability may severely disrupt production systems and livelihoods. The IPCC (McCarthy et al., 2001) suggests that the following broad adaptations are needed to cope with likely changes in precipitation and discharge regimes:

- refinement of early warning systems to enable timely remedial measures;
- water-use strategies—especially demand management—in industry, settlements and agriculture;
- intensified monitoring to improve data reliability;
- intensive research into energy use and alternate renewable energy at household and industrial levels;
- intensive research into design of infrastructure facilities, such as roads and telecommunications, to withstand extreme events;
- intensive research into flood control management technology;
- innovation in building designs (e.g. to minimize urban flooding);
- research into adaptive agricultural strategies.

All of the above points are relevant to environmental change and vulnerability in the Malian situation.

Degradation of natural resources and increasing water stress will further increase the vulnerability of many rural communities to climate change. Adaptation needs to increase the resilience of natural systems and their productivity in order to support the livelihoods of the poor. Although there are many examples of successful adaptations, their role in avoiding large-scale environmental degradation is still unclear. However local adaptations may both enhance livelihoods and protect natural resources.

Soil fertility has been suggested as the main factor limiting agricultural production. This is perhaps more important than the low and variable rainfall in the Sahel region (Wyatt, 2000). Farmers are aware of this problem and practice many different management techniques, such as agro-forestry, which can play an important role in soil fertility management and soil conservation and erosion control. Farmers use trees as hedges to demarcate fields and to protect them from livestock. Planting trees for firewood is still rare, but is a growing trend (IIED, 1998). Many have also argued that soil fertility is reduced significantly in the cotton-growing areas, but it has also been shown that it is necessary to differentiate between types of farmer and farming zones. As a result of falling prices and high input costs, there is now considerable interest in diversifying away from cotton. For example, the *bas fonds* (lower lying valley bottom lands) in the region around Sikasso have become important centres for production of dry season vegetables, which are sold in Bamako and Côte d'Ivoire. Rice production in the *bas fonds*, which is still controlled largely by women, has also grown in importance since devaluation, while maize has become a major cash crop for some farmers on land rotated with cotton.

In addition, the potential to purchase chemical fertilizers opens a broader range of options for cotton and rice. A study of Lagassagou in the north of Mali, between the Niger River and the Burkina Faso border, showed that the influence on decisions regarding soil fertility management and soil conservation seems to be as much a factor of the institutional arrangements and infrastructure as of poverty itself. Farmers here use local organic material, including manure from their livestock, to maintain fertility. Despite the immediate loss in production that comes from taking land out of production, fallowing continues to be practised. However, soil amendments are not used to a great extent mainly because of their high cost. Farmers may not maintain their soils at the highest possible level of fertility, but there are not large differences between the practices of resource-poor households and the resource-rich. Institutional arrangements therefore seem more important than the status of the household itself.

This has also been shown for agro-pastoral systems. Dalton and Masters (1997) argue that even though rapid intensification has disrupted traditional agro-pastoral systems, they can still be sustainable and increasingly productive given supportive government policies. Hence, further intensification can occur without depleting resources irreversibly. However, government intervention is most important, for example in providing research and extension to support market integration, and possibly also by imposing pasture taxes (so that the social costs of grazing common lands are included).

In the Senegal River Valley, desertification processes have been intensified by irrigated rice production. For example, thousands of hectares of former rice production areas have already been abandoned because of salinization. It has been recommended that vegetable gardens with associated agroforestry should be promoted in the area and NGOs have run agro-ecological projects in the region. However, it is interesting to note a key sociological feature of these dedicated agroforestry systems: the participants generally came from the ranks of the urban unemployed. The project participants were typically one or two generations removed from traditional village life but willing to migrate back to the country to secure gainful employment (Venema et al., 1997).

Institutional and local environmental management arrangements should also be revised in sectors with good production, such as the dynamic Office du Niger area, where the economic developments of the last decade have encouraged farmers to invest in their crops and fields. Since the scheme's management was restructured farmers have been able to count on a reliable water supply and improved security of tenure, and have increased their income by diversifying into vegetable production. However, the big issue is the current expansion of the irrigation scheme. The expansion has gained a lot of support because it will secure a livelihood for many people. However, expansion will also cut into neighbouring grazing lands and affect natural resource management in the Office du Niger, and if livestock numbers continue to rise, pressure on the remaining grazing lands will also increase. An environmental study concluded that expansion must include measures to reduce environmental impacts within and outside the irrigated area. This would involve improving water management, introducing wood and fodder production in the irrigated area, and consolidating services such as education, healthcare and credit programmes (Kater et al., 2000). Diversification should also focus on tree planting and wood production, but livestock producers' rights need to be assured. Different places and groups of people at several scales may respond differently to resource management schemes. For example, in cities, adherence to local institutions often prevents any sectoral reallocation of water from irrigation to domestic use. Treating water as a public good often leads to calls for such reallocations on the grounds of sound economic use. Such reallocation must be carefully evaluated, as often it entails the disappearance of local institutions whose resilience has ensured the security of their communities and simultaneously disrupting the livelihoods of these community members. What may appear to be a sound economic option on a greater scale can prove to be a disaster on a smaller scale (Mathieu & Trottier, 2001).

Food Insecurity and Environmental Changes

According to Dioné (2000) there are at least five fundamental causes of food insecurity in the Sahel. The overarching cause is poverty, accompanied by the lack of appropriate agricultural technology for rainfed crops; the inability of government credit programmes to offset the composite effect of the tax burden; severe imperfections in labour, farm input supply, financial

and foodgrain markets; and rapid urbanization which contributes to a shift in consumption patterns away from domestic production structures (e.g., rice and wheat consumption have increased greatly). The principal causes of Mali's food problems are low resource endowment and low standards of living, exacerbated by inter-annual climatic fluctuations, the long-term effects of successive dry years, pests and diseases⁷ and macroeconomic stagnation (Davies, 1996).

As seen in Figure 1, the national trend of food security seems good. The great success in the Malian food sector in the 1990s has been the rapid increase in rice production, which more than doubled between 1987–88 and 1996–97 (Dioné, 2000). With an average production of about 2.5 million tons per year, Mali is one of the largest cereal producers in the Sahel. In a normal year, the production of local cereals, millet, sorghum and rice covers national needs.

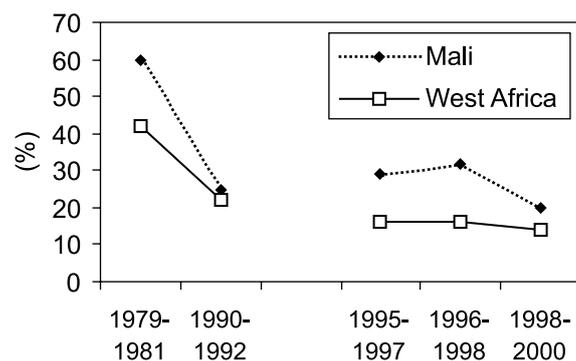


Figure 1 Trend of food security deficiencies in Mali and West Africa as proportion of undernourished people in total population. The gap between 1992–1995 is due to lack of data.

Source: FAO (1999), FAO (2000), FAO (2001), FAO (2002)

In contrast to secure systems, vulnerable ones do not bounce back to their pre-stress state, but become increasingly weakened over time (Davies, 1996). Farmers' strategies to reduce food insecurity vary across regions but generally involve maximum extensification of cultivated areas to minimize climatic risks, plus seasonal and international migration. All of these strategies again have implications and consequences for the exploitation of natural resources (CILSS, 2002). However, there seems to be a shift now from rural to urban food insecurity as a consequence of increased urbanization (Togola, pers. comm. 2003).

A study of Zone Lacustre in northern Mali has identified the following socio-economic indicators of a household's food vulnerability (Christiaensen and Boisvert, 2000):

1. *Households with lots of children are more vulnerable to food insecurity.* Children place great food demands on the household, further reducing a household's flexibility to deal with income shocks. The fact that food vulnerability is lower in households that can temporarily place their children with relatives during times of food shortages supports this hypothesis.

7 There have been four large-scale disasters recorded due to pest outbreaks in Mali (CRED). In the Mopti region, farmers estimated that locust damage reduces yields by 60 to 100%. The yield for millet, which is the most important crop and mostly intended for home consumption, varies between 100 kg/ha in a bad year (yields can even be zero after a locust attack) to 1,000 kg/ha (De Groote et al., 1997). Pests also attack other food and cash crops, such as cotton, with great losses in yield. Pests in Mali also affect livestock, but veterinary cover is patchy and privatized. Animals therefore remain vulnerable to disease outbreaks, resulting in serious losses of pastoral herds and oxen for ploughing.

2. *Female-headed households are less vulnerable to widespread shocks.* Christiaensen and Boisvert attribute this to the existence of basic community solidarity. However, many others argue that female-headed households are generally more vulnerable as women have less access to resources and capital.
3. *Formal education does not reduce a household's vulnerability.* It has been suggested that there are few opportunities for formally educated people to put their knowledge to work in rural areas. Alternatively, school curricula may not be sufficiently adapted to rural circumstances.
4. Average food consumption during the hunger season increases with the size of the last household harvest but as *the income share derived from agriculture increases, so the vulnerability-reducing effect of good harvests decreases.*

In a study by Conte & Morrow (2002) of northern Mali, only 25 per cent of 714 households studied produced enough cereal for the entire household; for 45 per cent of households, cereal production met less than half of their needs. When taking into account other sources of income they identified almost 40 per cent of households as food insecure, while 25 per cent could cope successfully with a regular food gap and 35 per cent of the households enjoyed relatively good food availability and/or accessibility. Nonetheless, high levels of malnutrition persist. Their study further showed that *chronically food insecure communities* are those farming on marginal lands and with few productive assets. Furthermore, these communities are situated in environmentally 'difficult' areas and are repeatedly exposed to natural hazards. Even though these households very often do not even own the basic tools to weed or harvest, agriculture contributes about 40 per cent of their income and handicrafts another 25 per cent. They are vulnerable year round, and even in exceptionally good years their food security status does not substantially improve. *Communities vulnerable to periodic food insecurity* are not solid enough to be able to cope easily with the large cereal production shortfalls, nor with prolonged stress. They usually rely on under-performing agriculture as well as several other sources of income, such as livestock or fishing, along with trade, migration and sometimes horticulture.

Vulnerable communities from a food security perspective are those who cannot meet their basic food needs from their own production, and whose income-generating activities do not provide reliable economic access to adequate food. Households in these communities are particularly vulnerable during the lean period, the length of which can vary from one year to the next according to agro-meteorological conditions and cereal yields. Groups in this category include marginal and small-scale farmers without adequate, basic productive tools or inputs; marginal, semi-sedentary pastoralists; female-headed households with young children, relying on handicrafts; expectant and nursing mothers; children under three; and primary schoolchildren.

There are high proportions of chronically food insecure and vulnerable households in the regions of Tombouctou and Mopti. Many communities in Gao region are also chronically food insecure. The overall situation in northern Kayes and northern Koulikoro is better, but pockets of chronic food insecurity are present there, particularly in communities located near the Mauritania border. Insufficient rainfall in 2002–03 (and the two preceding years) contributed to higher than average cereal prices in 2002–03. The situation therefore became most difficult in the regions of Kayes, Koulikoro, Mopti and Gao (SAP, 2003).

Although this discussion has focused on rural people, food security is present and increasing in urban areas, where targeting the most vulnerable is harder (Maiga⁸, pers. comm. 2003). Adequate nutrition is achieved when individuals have access to enough food of good quality, health services, sanitation, clean water and housing. Table 7 below show how regions with little access to drinking water and sanitation also have high malnutrition rates. In addition, good childcare and appropriate feeding practices are often linked to human and social capital development. Food aid targeting should thus be addressed through comprehensive programmes including education, hygiene, and access to sanitation and clean water to increase resilience to food insecurity.

Table 7 Proportion of households with access to drinking water and sanitation and proportion of malnutrition rates in children per region in Mali

Region	Proportion of households with access to drinking water (%)	Proportion of households with access to adequate sanitation (%)	Moderate malnutrition in children under 5 years old (%)	Severe malnutrition in children under 5 years old (%)
Kayes	65.8	9.1	19.0	11.0
Koulikoro	58.7	8.0	15.4	7.7
Sikasso	84.4	1.4	19.8	7.8
Ségou	43.0	0.8	15.6	13.3
Mopti	40.0	1.0	17.9	11.8
Tombouctou	98.8	10.8	18.6	13.6
Gao	–	–	–	–
Bamako	88	17.7	14.6	5.9
Urban areas	86.6	11.7	15.4	7.5
Rural areas	55.3	3.4	18.6	10.7
Mali	66.4	6.3	17.4	9.5

Source: OXFAM (2002)

COPING WITH FOOD INSECURITY

Not all livelihood systems have adapted to changes in natural resource availability and increasing vulnerability in the same way, nor are they all equally vulnerable. For example, in peri-urban areas the proximity to the city is of great importance. Diversification is great as agricultural and fishing activities can more easily be combined with other sources of income (Groupe Recherche/Actions pour le Développement, 2001a and 2001b). However, there are several groups who do not have access to land and who therefore merit additional attention in a vulnerability context. Given the difficulties of maintaining the many assets required for a successful farming enterprise, attention should focus on ways to support a range of diversification strategies both within and outside the farming sector. Easier access to credit to help develop a range of diversification opportunities has been suggested as a valuable way forward for poorer households (IIED et al., 1999).

In the majority of the communities in northern Mali, households vulnerable to food insecurity live side by side with successful households. This is particularly the case among purely farming communities, where households with access to sources of cash income, for example from

⁸ Mr. I. Maiga GRAD - Groupe de Recherche – Actions pour le Développement, Bamako, Mali.

commerce or remittances from abroad, are much more food secure than households which lack professional skills, have high levels of illiteracy and overall limited job opportunities. Such limitations leave these households with very few options. Households that are successfully coping with their food gap and are able to meet their minimum food needs have two, and sometimes three, different sources of income. For example, pastoralists try to meet their food needs through seasonal migration, trading and wage labour (Conte & Morrow, 2002). Small-scale farmers with good access to food have a second important source of income, generally from wage-labour or trade, and surplus farmers also make a living from livestock, horticulture, or remittances. However, malnutrition among children is still common even in households where food availability and economic access is good.

According to the evidence presented above, public activities that enhance the diversity of local income sources and introduce relief work schemes offer some hope. Transport and fishing and agricultural equipment gives households access to off-farm employment during the 'the hungry season', when households are unable to secure a steady supply of food throughout the year. Irrigated agriculture is also considered to be a promising route to reducing food vulnerability. However, care is needed when introducing irrigation schemes and the complex agricultural production systems they support to societies characterized by low input agriculture and weak transport and communication infrastructure. In this context, attention must be given to institutional issues so as to support supply and marketing. Otherwise, these efforts are bound to fail, despite their substantial potential for reducing vulnerability (Christiaensen & Boisvert, 2000). However, interventions that facilitate access to irrigated agriculture and off-farm employment have the potential to substantially reduce the number of food vulnerable households and the average food vulnerability of the population (Christiaensen & Boisvert, 2000).

Migration: Impacts on Both Vulnerability and Security

Whilst migrations within West Africa are a traditional process, today they are increasingly driven by unequal economic development and industrialization in the region. Some development poles (e.g. Côte d'Ivoire) have emerged and strengthened, while other regions (e.g. the Sahel hinterlands) have been plagued by stagnation, if not regression. In the Sahel there are four principal types of migration present today: to urban centres, to more favourable agricultural zones, to cotton-growing areas and overseas (CILSS-Arghymet, 2001). However, the agricultural sector generally attracts the most migrants, followed by forest exploitation, cattle raising, fishing and hunting, and trading activities. Migrants leaving Mali for Côte d'Ivoire are mainly from Nioro, Kayes, Ségou, Mopti and Sikasso regions (UNAIDS, 2000). Remittances from migrants are very important for the communities left behind. However, conflicts such as the 2002/03 conflict in the Côte d'Ivoire, create difficulties and hardships for the migrants, which can hinder the delivery of remittances.

In comparison with labour migration in the early 1900s, migration work today is more desirable and respectable (Grosz-Ngaté, 2000). However, the person (often a woman) left behind has extra responsibility for the children and for farming; the significance of lost labour may be substantial if the loss takes place during the labour intensive months of the year. In most cases, migrants tend to settle where there is already an established link or relationship with people from their own areas or regions, which helps to reduce their potential isolation and vulnerability away from home. But migrants are less secure and statistically prone to be

infected with sexually transmitted diseases such as HIV/AIDS, which they may then spread to their spouse and wider community. In Mali, short-term migration also involves a great mobility of male and female traders, associated with the weekly markets held in a rotational basis in various localities in the Sikasso region. Regular brief but frequent migration is also reported among sex workers operating in mining or agro-industrial sites, such as the gold mines of Fourou and cotton industries of the Sikasso region in Mali. Such migration bears high HIV risk factors. Furthermore, migrant women often have intimate relationships with policemen or customs officers at the borders, or with drivers, so as to avoid problems and to save as much of their profit as possible (UNAIDS, 2000).

The main motives for rural-urban migration in Mali are shown in Figure 2. Few leave to study. The main impetus for men is work, and marriage for women (Traoré, 2001). Children who arrive in urban areas are particularly vulnerable and girls who are ‘employed’ as housemaids are often treated very badly and abused sexually (Borghese, pers comm⁹). Furthermore, children who are prematurely separated from their parents are statistically much less likely to have their most basic needs, such as love, protection and education, met (Kielland & Sanogo, 2002).

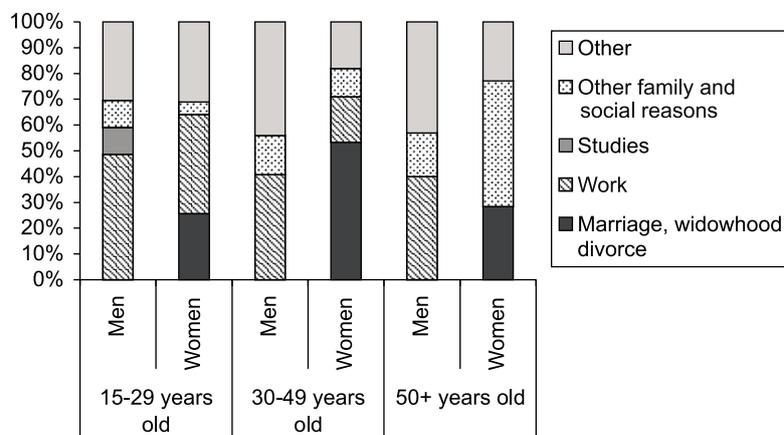


Figure 2 Principal motives for rural-urban migration in Mali

Source: Traoré (2001)

MIGRATION AS A COPING STRATEGY

Even though migration may increase vulnerability, it is also a key survival strategy in coping with climatic variability, political and ethnical conflicts, and food insecurity in the Sahel and West African region (CILSS-Arghymet, 2001). As already mentioned, migration to coastal West African countries has been very important in Mali; an estimated two million migrants left Mali between 1960 and 1990 to go to these countries. Many more have been involved in temporary migration. It is important to note that the term migration also includes circulation, which involves periodic changes in residence following some kind of cycle. The influence of mobility upon people and places is substantial, and yet the concept of mobility remains elusive. It challenges demographic notions about residential permanence and the separation of urban and rural, and it demonstrates the real difficulty of capturing a moving population. Embracing both ecology and economics it structures how people work, how they see their land and country, and also how they deal with risk. The massive out-migrations, decimations

9 Interview with Dr. G. Borghese, UNICEF, Mali.

of herds, and widespread human suffering still resulted in a relatively low loss of life from the multiyear droughts. This resilience, which is bred into the backbone of the cultures of the Sahel, has permitted the continued settlement of a region inhospitable to many activities (Rain, 1999). However, Christiaensen and Boisvert (2000) argue that there is little to be gained from policies that facilitate temporary out-migration (i.e. encourage migration away from high risk areas to low risk environments).

Resilience in Social Support Networks

Household income diversification is an important route to security. Insurance during times of stress is provided through social support networks such as food and non-food gifts among family and community members and the temporary placement of children with family (Adams et al., 2002). Social networks can also benefit health by reducing and/or insulating individuals from stress, and helping people cope through access to needed support.

Social institutions, particularly those based on family relations, are thus an essential foundation providing security, status, access to resources, and a means for mobilising capital for investment. The average size of farm households is 22 people; some of the largest contain 50 or more people. Such extended families can provide the security, labour, and capital needed for investment in agricultural and off-farm activities (IIED, 1998). That women's social ties or networks are instrumental in resource mobilization is well established in the economic and anthropological literature (Adams et al., 2002). A study of social relations and security in Zaradougou village (in Sikasso) showed how the complex household often provides a successful structure for managing very diverse agricultural enterprises and ensuring secure livelihoods for its members. However, for others, the tensions created by conflicting interests and personalities are impossible to maintain within the household, leading to fragmentation and increased vulnerability. In Dalonguebougou village (in Segou) complex households have remarkable resilience, managing the complicated livelihood portfolios of large numbers of people and largely succeeding in assuring their food security, even in drought years. However, even here households may break up when it is no longer possible to manage the competing demands of different subgroups within the larger domestic unit. In both these villages households of the same ethnic group are linked by age-group associations, in a relationship of mutual aid which will last throughout their lives (IIED et al., 1999).

Conclusions

The most pervasive threats to livelihood security in Mali are climate related. Climatic variability has led to several large-scale disasters (i.e., droughts and floods), which have killed many people and affected many more. The low level and high variability of rainfall causes major difficulties for people and livestock and leads to considerable variations in crop yields, grazing availability and water supply.

- The current situation, and the greater threats posed by climate change, means that people's adaptation efforts must be supported if vulnerability is to be reduced in this region.

Tackling land and water degradation

Land degradation (partially caused by deforestation) and water degradation are major problems throughout the country, reducing the resilience of natural and human systems alike. Rural populations are most vulnerable to loss of soil fertility, accelerated soil erosion and salinization. Urban populations in Mali are exposed to pollution (of water, air and soil) in various ways that render them vulnerable. Lack of safe drinking water and sanitation is causing vulnerability in both rural and urban areas.

- Sustainable environmental use and management strategies are needed to increase the social, human health, and environmental underpinnings of resilience and broader coping capacities at community level;
- Improving access to safe water and adequate sanitation will relieve additional stresses and exposures to large segments of the poorer and more vulnerable populations.

Preventing food insecurity

Food insecurity is a major outcome of vulnerability in Mali. Serious environmental degradation affects farmers, as well as livestock holders, reducing their capacity to access food. Moreover, opportunities for income-generating activities are very limited, and often short- or long-term migration is the only survival strategy available. Urban food insecurity is also an increasing problem.

- As food insecurity is a central problem with broad implications for the overall vulnerability situation in Mali, tackling it should be a priority in poverty and vulnerability reduction efforts.
- The regions of Mopti, Tombouktou, Gao, and part of Kayes and Koilikoro should be given high priority. They have been identified as most vulnerable to food insecurity because their difficult climatic conditions, erratic rainfall, and limited natural resource endowment results in a structural deficit in cereal production.
- Vulnerability reduction efforts should balance narrowly focused technical approaches with broader efforts in support of development. Strategies to reduce food insecurity can be integrated through education, natural resources, health and economic development, as well as agricultural sectors.

Targeting the most vulnerable

Factors influencing household vulnerability in Mali are primarily related to poverty, education, health, migration and gender inequality issues. Therefore, vulnerability levels differ within seemingly homogenous populations. Overall, women and children are the more vulnerable as their access to and control over resources and capital are generally more limited than men's, and their sensitivity is more pronounced. However, the vulnerability of women differs greatly depending on the threat and their specific situation. Children living in urban areas or without parental or family support are particularly vulnerable. As in the case of food insecurity, both narrow targeted technical solutions and broader development efforts can be combined to reduce the vulnerability of these groups.

- Targeting vulnerability reduction to meet the specific needs of the most vulnerable (as identified in Table 5) can concentrate efforts on reducing the most severe impacts of poverty and environmental stresses.

Supporting people's own coping strategies

Promoting diversification of income and resources is one of the more successful risk/vulnerability management strategies.

- Diversification can be supported by providing credit, offering insurance and ensuring easier access to markets, in conjunction with good quality, relevant education and extension services that reach all, especially the most vulnerable groups.
- Flexibility is a key characteristic of many successful strategies to reduce poor people's vulnerability. Where there are multiple stresses and complex, dynamic household situations, access to an array of options is important in dealing with unexpected combinations of events.

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Appendix 1

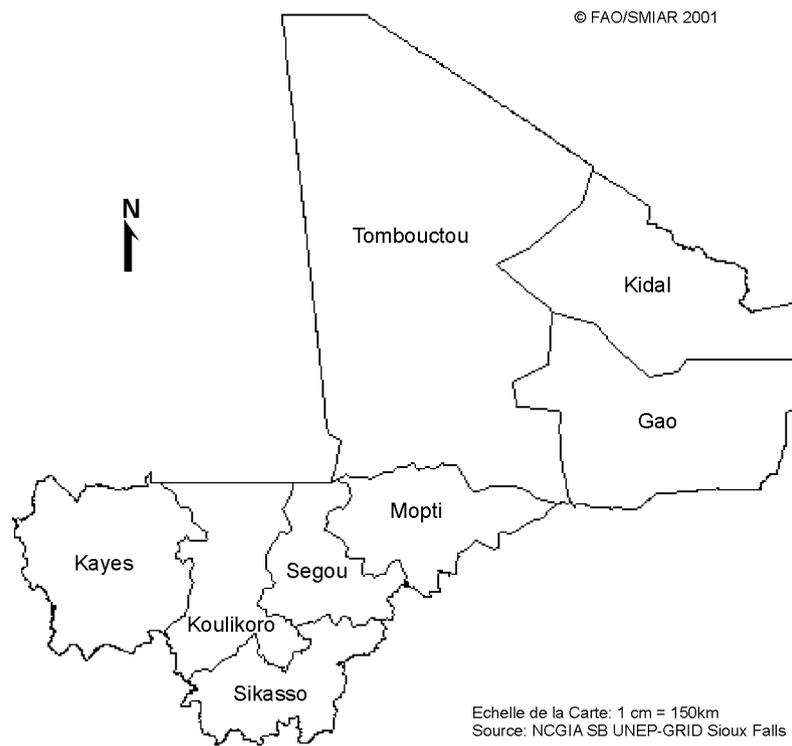


Figure A1 Administrative regions in Mali

Appendix 2

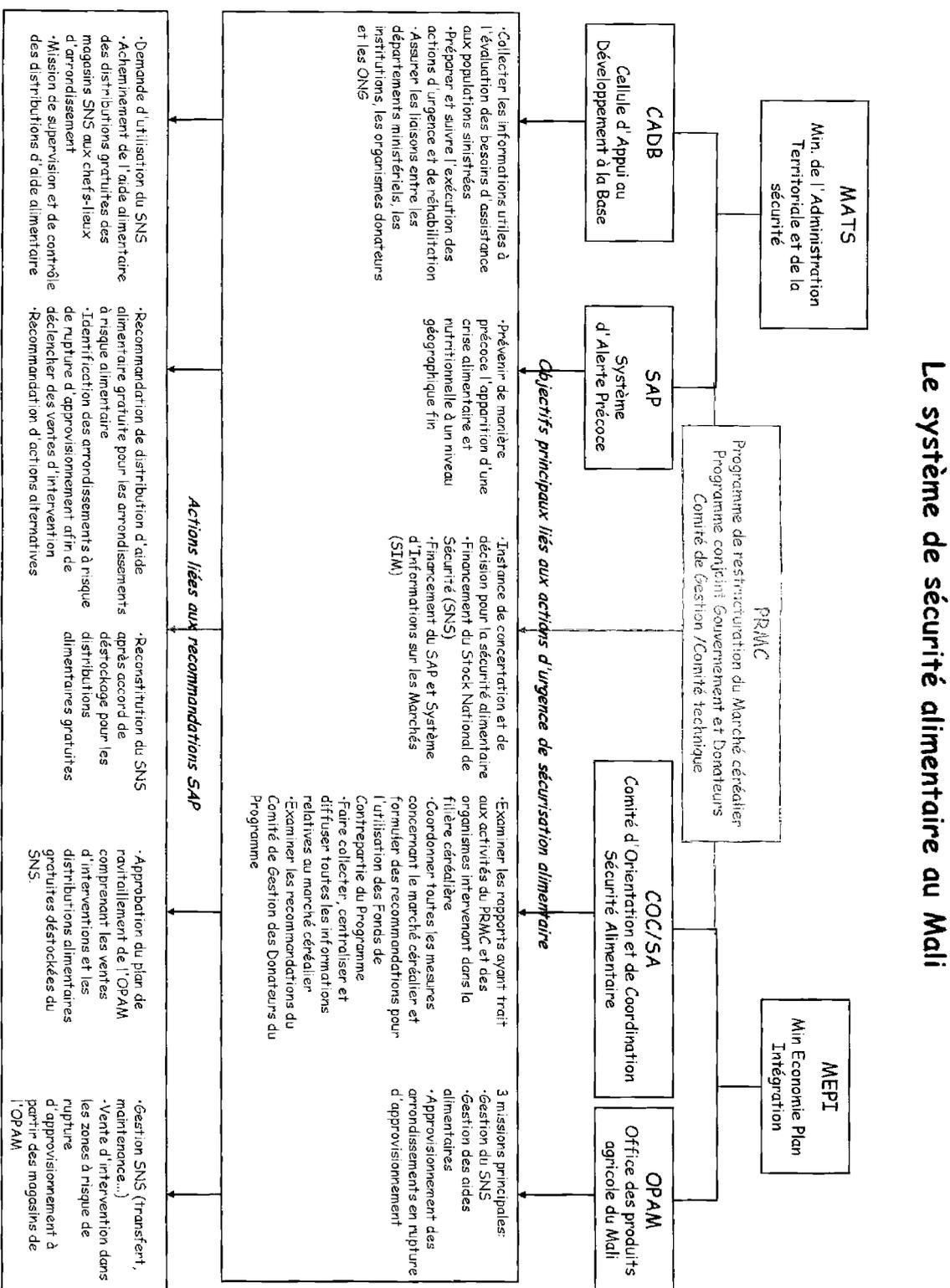


Figure A2 Le système de sécurité alimentaire du Mali

Appendix 3

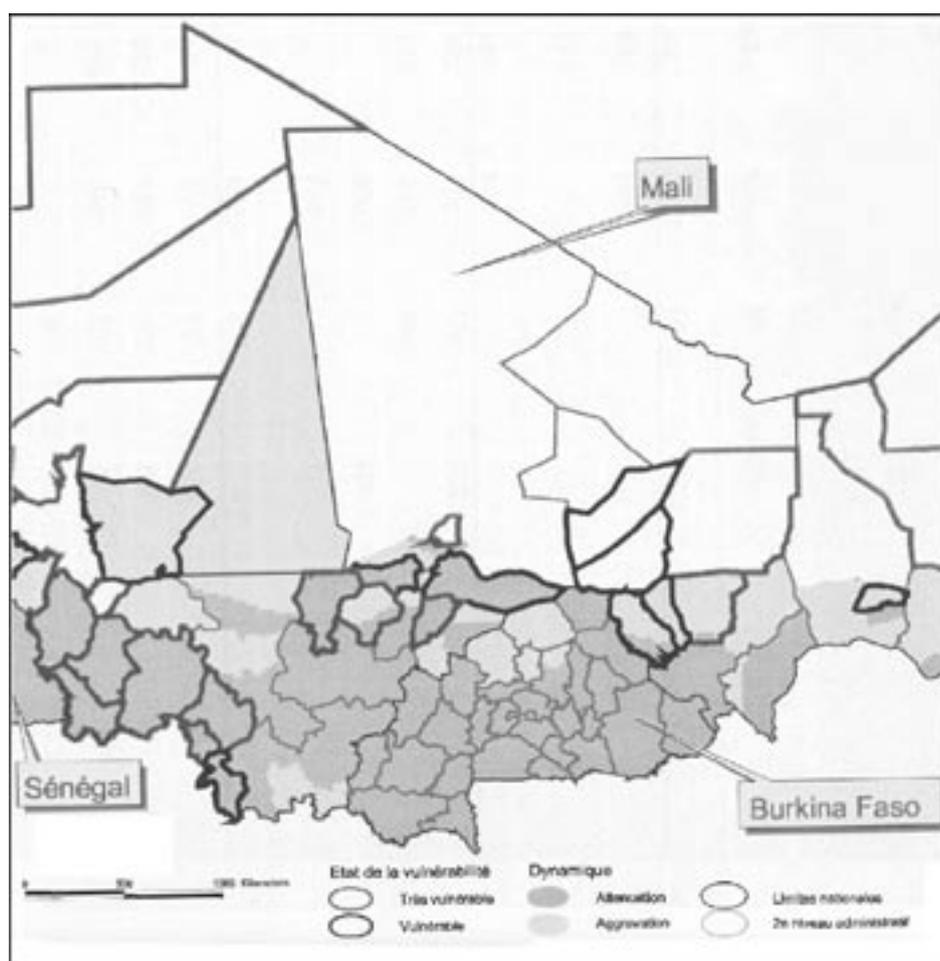


Figure A3 Extract from map of the CILSS countries showing status and trends of vulnerability in the rural areas

Source: CILSS – Arghymet (2001)

Appendix 4

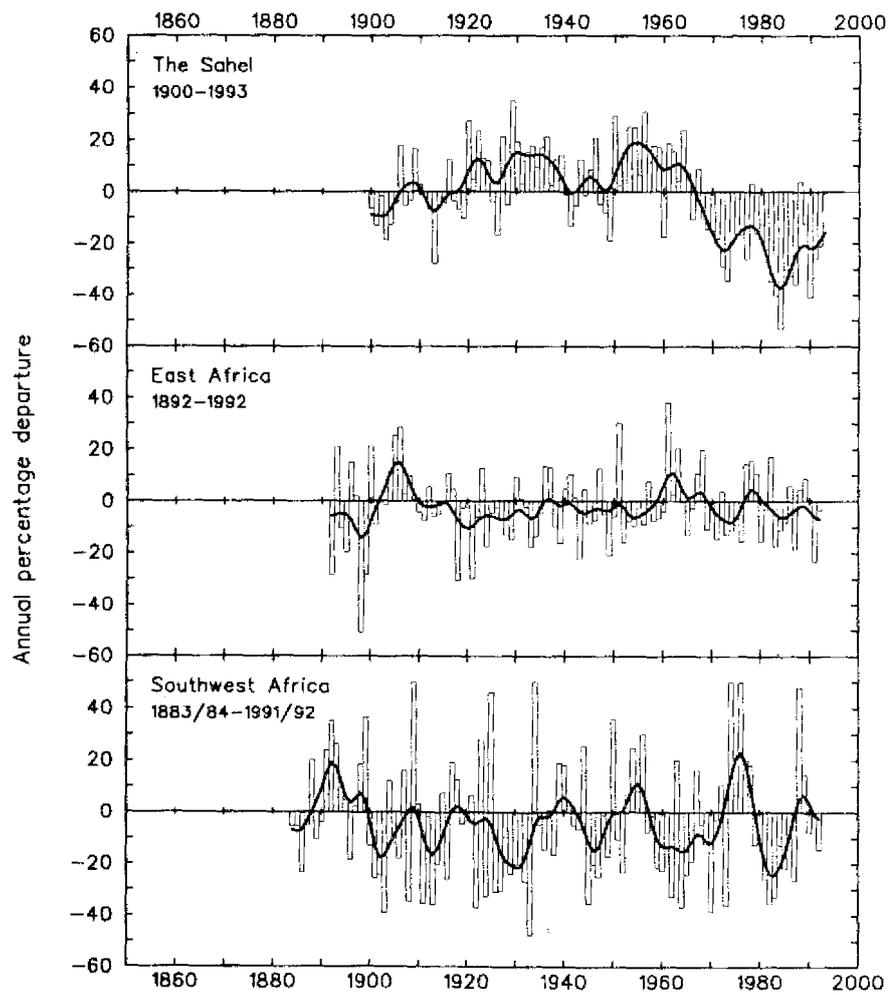


Figure A4 Annual rainfall anomaly indices expressed as percentage departures from 1951-80 average

Source: Hulme (1996)

Appendix 5

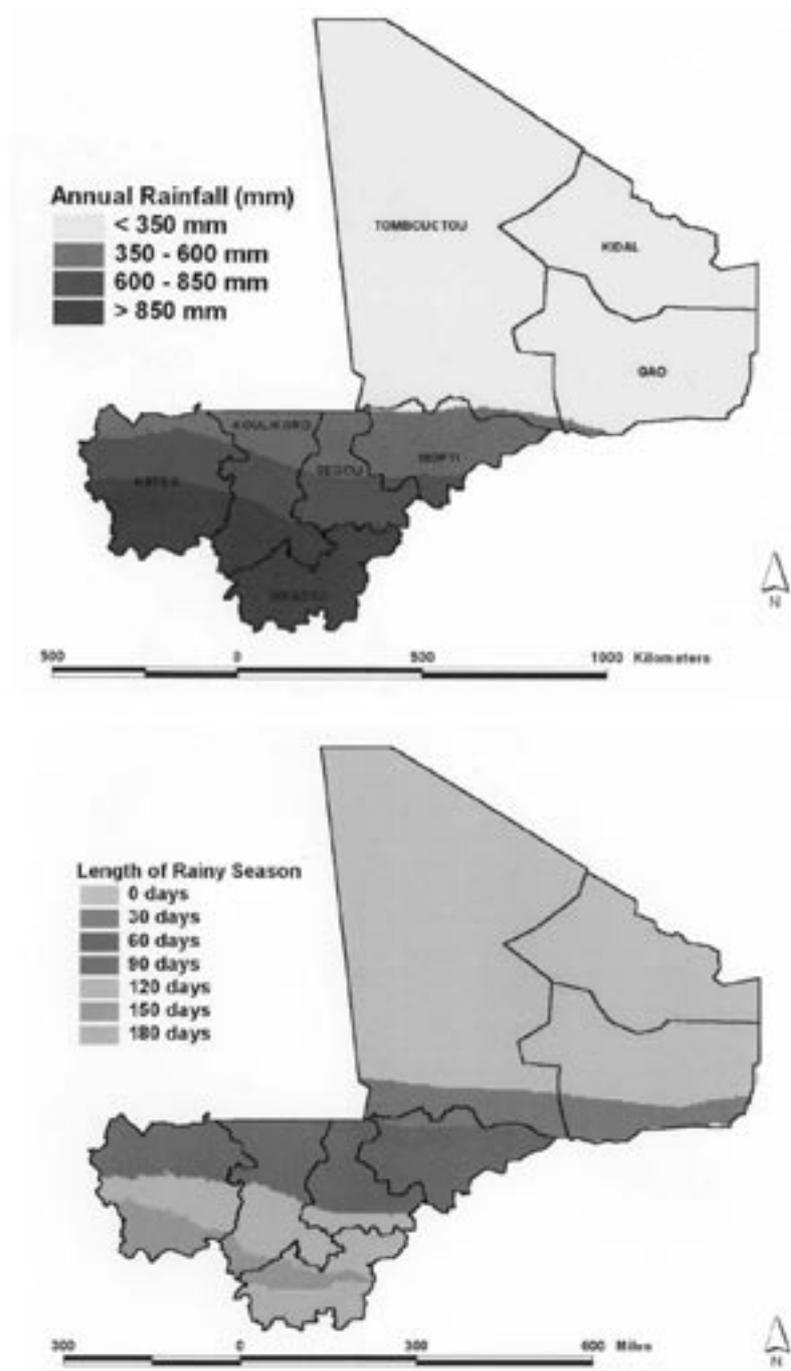


Figure A5 Rainfall in Mali

Source: USAID & Texas University <http://cnrit.tamu.edu/IMPACT>

Appendix 6

Table A1 Disasters caused by drought in Mali

Year	Total affected	Location and comments
1910	-	Sahel (1910-1914)
1911	-	Sahel (1910-1914)
1912	-	Sahel (1910-1914)
1913	-	Sahel (1910-1914)
1914	-	Sahel (1910-1914)
1940	-	Sahel (1940-1944)
1941	-	Sahel (1940-1944)
1942	-	Sahel (1940-1944)
1943	-	Sahel (1940-1944)
1944	-	Sahel (1940-1944)
1966	-	Drought (Sahel); Kayes, Bamako, Gao
1969	-	N, Kayes, Gao, Bamako. Continuation of Sahel Drought.
1969	-	Northern Mali
1971	633,333	Countrywide
1972	633,333	Sahel drought-nationwide; (1972-1975)
1973	633,333	Entire country; Sahel (1972-1975)
1974	-	Sahel-general; Sahel (1972-1975)
1975	-	Continuation of Sahel drought; Sahel (1972-1975)
1978	-	Niger River area
1980	-	Western region. Devastating drought, causing crop failures & food shortages
1982	1,500,000	Food shortage; Sahelian/Sudan zones, directly affected entire farming and herding populations. Sahel (1982-1985)
1983	-	Severe drought persisting in whole Mali, resulting in food & water shortages Sahel (1982-1985)
1985	-	Sahel (1982-1985)
1991	302,000	Critical food situation due to drought and insects

Source: Centre for Research on the Epidemiology of Disasters (CRED)

(In order for a disaster to be entered into this database at least one of the following criteria has to be fulfilled: 10 or more people reported killed, 100 people reported affected, a call for international assistance, declaration of a state of emergency.)

Table A2 Disasters caused by floods in Mali

Year	Killed	Total affected	Location and comments
1988	17	10,000	Bamako, Segou, Koulikorou
1989	1	14,635	Asango; several areas of country, heavy rains destroyed mud homes
1998	3	1,784	Koulikoro, Kayes
1998	-	4,650	Koulikoro, Kayes; torrential rains
1999	2	2,200	Bamako, Koulikoro, Keleya and Koutiala; Heavy rains, hundreds families homeless, rail network cut
2000	15	-	Abeïbara; torrential rains
2001	2	3,500	Sikasso, Kidal, Mopti, Koulikoro, Bamako. Bamako's worst flood in 40 years, 2350 affected, 1817 houses destroyed, 970 ha farmland washed away and thousands displaced. Request for international assistance

Source: Centre for Research on the Epidemiology of Disasters (CRED)

(In order for a disaster to be entered into this database at least one of the following criteria has to be fulfilled: 10 or more people reported killed, 100 people reported affected, a call for international assistance, declaration of a state of emergency.)

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SEI is an independent, international research institute specializing in sustainable development and environment issues. It works at local, national, regional and global policy levels. The SEI research programmes aim to clarify the requirements, strategies and policies for a transition to sustainability. These goals are linked to the principles advocated in Agenda 21 and the Conventions such as Climate Change, Ozone Layer Protection and Biological Diversity. SEI along with its predecessor, the Beijer Institute, has been engaged in major environment and development issues for a quarter of a century.

Mission

SEI's mission is to support decision-making and induce change towards sustainable development around the world by providing integrative knowledge that bridges science and policy in the field of environment and development.

The SEI mission developed from the insights gained at the 1972 UN Conference on the Human Environment in Stockholm (after which the Institute derives its name), the work of the (Brundtland) World Commission for Environment and Development and the 1992 UN Conference on Environment and Development. The Institute was established in 1989 following an initiative by the Swedish Government to develop an international environment/development research organisation.



Risk and Vulnerability Programme

This programme conducts research on environmental and technological hazards and global environmental change. Expanding on ongoing and previous work on risk analysis, risk perception, and risk management, research now also focuses on the differential vulnerability of people, places, and ecosystems. The hallmark of this programme is integrated analyses that seek to bridge the best of the social and ecological sciences. A major priority is the development of policies and initiatives that hold promise for enhancing human security, adaptive capacities, social equity, and resilient societies.

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