

CGIAR Systemwide Livestock Programme Progress Report

A. Project Information

1. Title of project

Identifying livestock-based risk management and coping options to reduce vulnerability to droughts in agro-pastoral and pastoral systems in East and West Africa

2. Project purpose

The purpose of this project is to identify intervention options (technical, policy, and institutional) that reduce the vulnerability of livestock keepers and/or communities dependent on livestock for their livelihoods to climatic shocks, particularly droughts, in pastoral and agro-pastoral systems in East and West Africa and the vulnerability of livestock to shocks. This purpose addresses the need to reduce vulnerability of both the pastoralists/agro-pastoralists and their livestock to droughts (securing livestock assets). Securing livestock assets is important in view of the roles they play in drought mitigation and coping strategies in pastoral and agro-pastoral systems.

3. Project Outputs

1. A synthesis of the best available knowledge on the changing nature of pastoralism and agro-pastoralism as a result of climate change, especially drought in East and West Africa, based on scientific and indigenous knowledge prepared.
2. Understanding of the changing nature in the vulnerability of pastoralists/agro-pastoralists to droughts in East and West Africa improved.
3. Livestock-based risk management and coping options to reduce vulnerability of pastoralists/agro-pastoralists to droughts in East and West Africa and potential policy options identified.

4. Project start and end date

01 April 2007 to March 31 2009

B. Investigators and collaborating Institutions

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C. Progress report

8. Period covered in this report

November 2007 – October 2008

9. Summary of progress in reporting period

During this reporting period which is essentially the last year of the project, most of the project activities were accomplished. While the first year of the project was spent on stakeholders' consultation, development of survey instruments and training of the enumerators, the second year of the project was spent in conducting and completing the surveys, data entry and analysis, and report writing. In Niger, household surveys on resource endowment and livelihood options, drought coping strategies, risk perception, and climate change perception were administered and completed. Data collected has been analyzed and a comprehensive report has been written. Community surveys on historical profile of the community, social group characterization, livestock mobility and vulnerability to food deficit were also conducted in the three study sites in Niger and were completed. The results from the surveys are included and discussed in the report for the household surveys. To gain better understanding of the vulnerability of the agro-pastoralists in Niger study sites to climatic shocks, especially drought, a community level workshop was organised at each study site using Participatory Vulnerability Analysis (PVA) framework developed by ActionAid International (2005). Though the focus of the PVA was on climatic shocks, non-climatic related disasters were mentioned in the course of the workshop in all the study sites and they were equally discussed. The community workshop was conducted in all the three study sites between July 20 and August 4, 2008. In Kenya, the household survey instruments were combined into one questionnaire due to logistics of administering different questionnaires and the survey was conducted in the two study sites and completed. A community survey on livestock mobility was also carried out in the study sites in Kenya. Data collected from the household and community surveys was analyzed and a comprehensive report was written. In addition to the surveys in the study sites in Kenya and Niger, a literature review of the vulnerability of the pastoralists and agro-pastoralists to climate change and variability was conducted. The review was carried out to establish the current knowledge and the information gaps on vulnerability to climate related shocks. During this reporting period, a synthesis on the impacts of climate change on pastoral and agro-pastoral systems in East and West Africa was prepared and spatial analysis of green fodder production (NDVI) over the past 15 years across the study sites in Kenya and Niger was conducted. A new project proposal with similar objectives to this project has been submitted and approved for funding by

GTZ/BMZ. The project is entitled “Supporting the vulnerable: Increasing the adaptive capacity of agro-pastoralists to climatic change in West and Southern Africa using a transdisciplinary approach”. Overall, the project has carried out all the activities planned for the second year.

10. Implemented work programme and results per output and activity

Activities for Output 1 (synthesis on changing nature of pastoralism and agro-pastoralism)

1.1 Consult stakeholders and plan for project implementation

This activity has already been accomplished in the first reporting period of the project. However, stakeholders’ consultation continued throughout this reporting period and it was the key to successful implementation of the project activities in the study sites.

1.2 Conduct desk study on impacts of climate change, especially droughts, on pastoral and agro-pastoral systems in East and West Africa based on scientific and indigenous knowledge

This activity mainly consists of two parts. First, there is the continental-level synthesis of past and current changes in climate on pastoral and agro-pastoral systems based on literature review. The second part is to zoom in to the study sites with the goal of establishing relationships between primary production (e.g. rangeland biomass) and weather parameters (rainfall, temperature) for the study sites. The scope of the desk study was to summarize what is currently known about the changing climate and how this may affect pastoralists and agro-pastoralists in the future. There is considerable uncertainty concerning even the broad impacts of climate change in the pastoral systems of both East and West Africa, particularly with regard to the direction of rainfall shifts in the West Africa and the degree to which climate variability is likely to increase in the future. In addition, climate is but one of the global drivers of change in these systems, and the way in which pastoral and agro-pastoral systems will evolve in the coming decades will require more complete understanding of the complex and dynamic interactions between climate, demographic change, economic development, and the environment. One of the biggest knowledge gaps relates to the systems-level impacts of changes in climate and climate variability on the vulnerability of livestock keepers. Recent global assessments of climate change, the environment, and agriculture have not had a great deal to say about these impacts. Main highlights of the synthesis are:

- Global mean surface temperature has increased with a linear trend of 0.74 °C over the last 100 years. Eleven of the past twelve years to 2006 rank among the 13 warmest twelve years on record.
- There has been some drying in the Sahel, the Mediterranean, southern Africa and parts of southern Asia. More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and subtropics.

- Most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.
- Current climate models indicate that continued greenhouse gas emissions at or above current rates will cause further warming and induce many changes in the global climate system during the 21st century, and these are very likely to be larger than those observed during the 20th century. For the next two decades, a warming of about 0.2°C per decade is projected for a range of different emission scenarios.
- Impacts of climate change can vary greatly due to the development pathway assumed, such as estimates of regional population, changes in income levels, and degree of technological development. These (and other factors) are strong determinants of vulnerability to climate change.
- The likely impacts of climate change on agriculture are regionally highly distinct. In general terms, global food production may increase with increases in local average temperatures over the range 1 to 3 °C, but above. In the tropics and subtropics in general, crop yields may fall by 10 to 20% to 2050 because of warming and drying, but there are places where yield losses may be much more severe, even catastrophic; this, it may decrease (IPCC, 2007).
- Vulnerability to climate change should be seen as a state that is governed not just by climate change itself but by multiple processes and stressors. This approach involves dealing with biophysical vulnerability, or the sensitivity of the natural environment to an exposure to a hazard; and social vulnerability, or the sensitivity of the human environment to the exposure.
- Even for a low greenhouse gas emission scenario, the Global Circulation Model (GCM) used in this analysis indicates that pastoral systems (LGA) in both West and East Africa are likely to undergo a considerable shortening of the growing season and the total area affected by droughts is likely to increase.
- There may be considerable spatial heterogeneity of response of length of growing period to projected climate change. Some areas may see some expansion in growing seasons, particularly in the highland areas, while other areas may see contractions. There are in fact considerable differences between the different GCMs in terms of projected changes in temperatures, rainfall and length of growing periods in regions of Africa.
- There is not much consensus between the GCMs concerning future rainfall in West Africa, while there is more consensus for East Africa. However, these results should be taken at best as merely indicative.
- One of the most evident and important effects of climate change on livestock production is mediated through changes in feed resources.
- Livestock are particularly important for increasing the resilience of vulnerable poor people, subject to climatic, market and disease shocks through diversifying risk and increasing assets.

1.3 Conduct spatial analysis of green fodder production (NDVI) over the past 15 years across the study sites in Kenya and Niger

The basic questions being addressed by this activity are: 1. Has the amount and variability in greenness changed over the last 15 years? 2. How have pastoral communities (or households) responded to greenness in vegetation (NDVI) over the last 15 years? Do they respond to greenness in the same way now as 15 years ago? For the NDVI analysis for Niger, 2 data sets were identified to be suitable and complementary for the study: GIMMS (The Global Inventory Modeling and Mapping Studies) and Spot Vegetation. GIMMS data set was obtained from the Global Land Cover Facility (GLCF) web site. It consists of a time series of normalized difference vegetation index (NDVI) over a 22 year period. Complete coverage is available on bi-weekly basis through maximum compositing of daily NOAA AVHRR NDVI data acquired at 4 km spatial resolution. For this study the time series from first 15 days of January 1983 to last 15 days of December 2003 have been selected. To provide as homogenous series as possible GIMMS NDVI has been corrected for: residual sensor degradation and sensor inter-calibration differences; distortions caused by persistent cloud cover globally; solar zenith angle and viewing angle effects due to satellite drift; volcanic aerosols; missing data in the Northern Hemisphere during winter using interpolation due to high solar zenith angles; low signal to noise ratios due to sub-pixel cloud contamination and water vapor.

In addition to GIMMS data, Spot Vegetation data has also been selected for the period 2000-2007. The Vegetation program consists of an earth observation sensor onboard of the Spot satellite with a daily coverage of the entire earth at a spatial resolution of 1 km. The program aims at providing 'ready to use' high quality remote sensing imagery available at end-users in near real-time. To process the data in similar manner, Python scripts were developed and the time series images were clipped to given regions of interest (in this study, Niger, West Africa). Yearly local statistics (mean, min, max, std) over the regions of interest were computed at the pixel level and statistical images were generated. In addition the decadal local statistics over the periods of interest were computed at the pixel level and the deviation from mean for each period was computed (that is, NDVI for a given decade of a given year minus the NDVI average value for that decade over the range of years). Semi-variograms of anomalies for 1200 random points spread over the agro-pastoral zone of Niger were then computed. The GIMMS NDVI time series for the three sites in Niger from 1985 to 2000 ranged from 0.09 – 0.48 for Fakara; 0.03 – 0.34 for Gabi; and 0.04 – 0.21 for Zermou. NDVI peaked in 1991, 1995, 2000 for Fakara, Gabi and Zermou, respectively.

For Kenya sites (Amboseli and Samburu), vegetation dynamics in the study sites was examined using NDVI as gathered from Advanced Very High Radiometric Resolution (AVHRR) satellite. In addition, the fluctuations and progression of vegetation production during the period 1982-2006 was analyzed. The NDVI datasets were downloaded from the African Data Dissemination Service (<http://earlywarnings.usgs.gov/adds/>). NDVI provides a measure of the amount and vigor of the vegetation and the magnitude relates to the photosynthetic activity in the observed vegetation. NDVI is derived from data collected by National Oceanic and Atmospheric Administration (NOAA) satellites, and processed by Global Inventory Monitoring and Modeling Studies (GIMMS) at the National Aeronautical and Space Administration (NASA). The data has been corrected for aerosols, satellite drift and sensor degradation.

The monthly rainfall and NDVI were calculated for the entire time series using the z-transform $((x_i - u) / \text{std})$ with x_i being the value for a given month in year i , u the mean value for that month across all years and std the standard deviation. Inter-annual and seasonal variations were also analyzed as well as the departure of the standardized rainfall and NDVI components from their respective means. Percentiles of monthly, seasonal, and annual rainfall and NDVI totals were computed to reveal the severity and expected recurrence of extreme events. Rainfall totals and NDVI falling within the percentiles 0-10, 11-25, 26-40, 41-75, 76-90, 91-95 and 96-100% were classified, respectively as extreme, severe or moderate, drought years, normal, wet, very wet or extremely wet years. Major highlights of the study are:

- During the first two decades (1960-80) 4 drought events were observed and in the last two decades (1980-2002) 7 drought events of significant magnitude were recorded.
- A cross-correlation between rainfall and NDVI shows a 2-month lag ($r = 0.45$, $P < 0.05$, $n = 256$ months). This implies that NDVI is a good indicator of the impact of inter-annual climate variability on vegetation conditions. The pattern was cyclic and stronger on 24 months scale.
- Comparison between NDVI profile for Amboseli and Samburu indicated high monthly variability of NDVI in Amboseli (Mean = 0.34, Std = 0.12) as compared to Samburu (Mean = 0.41, Std = 0.08). The NDVI for the 2 study sites were almost similar in general patterns especially the wet ($r = 0.5923$, $n = 200$, $P < 0.0001$) season as compared to the dry season ($r = 0.2891$, $n = 100$, $P = 0.0035$).
- Extreme decline in the annual vegetation production in Amboseli occurred in 1984, 1994, and 1996 and severe loss of production was observed in 1991, 1992 and 1997. Moderate losses in vegetation production were registered in 1986, 1999 and 2000. However, extreme increase in vegetation production was observed in 1998 and wet years of 1983, 1990 and 2003 gave rise to good production of vegetation.
- Extreme decline in the annual vegetation production in Samburu occurred in 1984, 1993, and 2000 and severe loss of production was observed in 1992, 1994 and 2006. Moderate losses in vegetation production were registered from 1986-1988 and 1991. However, extreme increase in vegetation production was observed in 1998 and wet years of 1983, 1985, 1995, 2002 and 2003 gave rise to good production of vegetation.

1.4 Conduct interviews in study sites on livestock management strategies in response to droughts and identify constraints to livestock mobility

Given the high spatiotemporal variability of rainfall and vegetative production, the mobility of livestock is an important risk management strategy for rural households in dryland Africa. A reduction in the mobility of livestock will, all else being equal (e.g. access to feed supplements), increase the vulnerability of households to localized forage shortages. Livestock mobility also has the environmental advantage of leading to a better adjustment of grazing pressure to the shifting mosaic of forage availability. Livestock

mobility can be thought of as the maximum distance a herd travels away from the home base across a year or season. In West Africa, one can roughly divide livestock management systems into the following: 1. those that manage their livestock within the village territory (usually within 5 km radius of home village); 2. those that go on a short travel movements sometime during the year (usually less than around 40 km from home village) to often to avoid cropped fields (rainy season) or to access markets such as manure contracting or milk (dry season); and 3. longer transhumance movements (greater than 40 km in distance) usually oriented in a north-south direction with movements during the rainy season generally to the north and during the dry season to the south. Livestock mobility is not without cost. Extra-local livestock movements require: information about pasture and security conditions at alternative destinations; social networks to reduce security risks in destination areas; increased herding labor investments; reduced access to milking animals by family members or markets; increased potential of exposure to livestock disease; and increased energy expenditure by animals.

In both Kenya and Niger study sites, community survey was conducted in all the study sites to gather basic information on the prevalence, requirements, and constraints of livestock mobility. The data collected was analyzed and results from the survey were included in a separate report for Kenya and Niger. Based on our group interviews, livestock mobility varies significantly across the study sites. In Niger, a large fraction of livestock moving longer distances away from the home base during the rainy season in the Fakara while a very high fraction of animals remain in the village territory (Zermou) or within 40 km (Gabi) in the other two sites. During the dry season, there is a greater prevalence of longer movements from Gabi while the other two sites show less mobility (except for the case of sheep for Fakara). In sum, livestock mobility declines as one moves from Fakara to Gabi and to Zermou study sites.

Despite the variation in livestock mobility across the three sites in Niger, no significant differences in informants' views of the advantages of livestock mobility were found in group interviews. Responses to the open-ended question of what are the advantages gained from sending livestock outside of the village territory during wet and dry years could be categorized into three common classes in all three study sites namely; 1. to escape the lack of pasture due to the prevalence of cropped fields; 2. to avoid crop damage; and 3. to access pastures of higher quality outside of the village territory. In Gabi, the avoidance of crop damage was ranked as significantly less important than the other two most important reasons. For the Fakara study site, access to higher quality pastures was viewed of much less importance during dry years compared to wet years. Interestingly, rankings at each study site were less strong and difference between study sites more evident for the stated disadvantages for sending livestock outside of the village territory. In the Fakara, extra-village livestock mobility was seen to be associated with a greater potential for farmer-herder conflicts during wet years while during dry years, mobility's chief disadvantages were greater energy expenditures by livestock and the risk of not finding pasture/water at distant destinations. In Zermou, while there were no consistently highly ranked disadvantage during wet years, increased farmer-herder conflict, less access to livestock products, and greater risk of not finding pasture/water were major disadvantages during dry years. Zermou informants cite the greater likelihood

of livestock being stolen by herders and greater energy expenditure by animals as the major disadvantages of extra-village livestock mobility, no matter the type of year.

A major resource required for effective livestock mobility is information about conditions at potential destinations. In group interviews conducted at each of the study sites, informants were asked whether certain pieces of information at potential destinations sites were absolutely necessary, very helpful or not very helpful in making the decision to move livestock there during the rainy and dry seasons. During the rainy season, the magnitude of rainfall and the quality of pasture are generally seen as pieces of information that are necessary for making a decision to move with the spatial extent of pastures and the presence of livestock disease seen as useful pieces of information. During the dry season, the spatial extent of pastures is seen as necessary with the presence/absence of livestock disease, thieves, and government officials seen as useful pieces of information.

In Kenya, the community survey was conducted through focus group discussion with between 8 – 10 carefully selected representatives of the community in four areas. The primary focus of this discussion was to elicit qualitative information on livestock mobility and vulnerability. Mobility among pastoralists is the key mechanism for dealing with risks in rangelands. For centuries pastoral groups have responded to uncertainty and risk by migrating in search of pasture and water which are heterogeneously distributed in time and space. Traditional early warning systems that predict variation of rainfall in terms of space and time is therefore a key determinant of such movement. Traditionally, the typical *maa* migration follows a circular route complete with water points and along corridors inhabited by friendly tribes. Since the herds usually return home after a seasonal migration, this is more of transhumant movement rather than nomadic pastoralism. The length and duration of movement are determined largely by the severity of drought; in discussions with community groups this period ranged from two months to one year. However, as communities surveyed observed, an increasing frequency and severity of covariate risk, spanning ever increasing expanses limits the effectiveness of mobility. Since the 1970s communities in Kajiado and Samburu observed that the intervals between successive droughts and extended dry periods have reduced from approximately 1 every 10 years (1960s and 1970s) to 1 drought every 6 to 8 years. Another evolving risk that has significant impact on mobility is conflict. While traditional livestock rustling parties practiced by the Maasai and Samburu communities, mainly as a show of bravery, were harmless and hardly resulted in destitution, current raiding has evolved into a dangerous livelihood threatening crime.

Activities for Output 2 (improved understanding of vulnerability of pastoralists/agro-pastoralists)

2.1 Analyze relevant existing information and identify information gaps

This review focuses on the main sources of risk faced by pastoralist and their vulnerability, and the traditional response mechanisms. Having laid out the common knowledge in risk management, we then explored new ideas and innovations that may

have greater efficacy in pro-poor risk management. In this review, we focus on the main covariate shocks that wreak havoc among pastoralists and agro-pastoralists in sub-Saharan Africa. These sources of risk can be placed into four different, though often interrelated categories: climate, disease, market exclusion and price volatility, and policy shocks.

For a majority of livestock producers, climate shocks that result in water and fodder scarcity represent the most significant risk that they face (Mude et al., 2007, McPeak et al 2007 – Kenya and southern Ethiopia). The pastoral and agro-pastoral areas in SSA are particularly vulnerable to droughts. Droughts can be defined as periods of unusually low rainfall (Pratt et al., 1997). Droughts usually reduce water and forage availability in the rangelands, thus creating imbalance between the number of livestock and available fodder. Droughts have become part of the normal cycle of life in arid and semi-arid areas, where rainfall is low at the best of times and abnormally low every few years. In Africa, nine major droughts have occurred in the last four decades: 1965/66, 1972/74, 1981/84, 1986/87, 1991/92, 1994/95, 1999/2001 and lastly 2005/06, with 1981/84 being the worst drought ever for the Greater Horn of Africa (Rass, 2006). Pastoral and agro-pastoral livelihoods are sensitively attuned to conditions of low and variable rainfall. While drought is a major climatic risk factor affecting livestock-based livelihoods, the main source of vulnerability derives from the inability of pastoralism and related livelihoods to cope with drought. In North Eastern Kenya, Browne et al. (2007) report an increase in poverty since the drought of 1997-98, with livestock ownership declining across all wealth groups in pastoral areas. The immediate consequence of drought is to exacerbate the seasonal hunger that has been witnessed across many rural communities throughout SSA (Chambers, Pacey and Longhurst, 1981). Given that livestock and crop production in pastoral and agro-pastoral areas depend directly on rainfall, drought has a direct and immediate effect on rural livelihoods in these systems. A typical feature of drought in pastoralist communities is a decline in the “barter terms of trade” (livestock to grain prices), as the value of livestock falls while staple food prices rise (McPeak and Little, 2006).

Diseases serve as another major source of risk in pastoral and agro-pastoral systems, especially for poor livestock keepers who are less able to protect their herds from contracting various diseases. Animal diseases constitute a grave, sometimes ever-present source of risk to poor livestock keepers in a variety of ways and continue to be a major constrain livestock productivity, agricultural development and poverty alleviation in many regions of the developing world including SSA. Greater exposure to a wide array of risks related to animal disease and reduced capacity to control disease combine to make the disease risks a nightmare for many poor livestock keepers. Existing close to the survival threshold, poor livestock keepers tend to be more risk-averse, and so less likely to ‘take a chance’ on preventive disease technologies.

Access to markets has been identified as a precondition for livestock development and the economic growth of poor livestock keepers will depend on fair market access for their livestock produce (Pica-Ciamarra, 2005). Pastoralists and agro-pastoralists in sub-Saharan Africa are exposed to the risk of being excluded from domestic and international

markets as a result of high transaction costs resulting from inadequate livestock-marketing infrastructure coupled with the inability to comply with international food safety standards/requirements. In East Africa the exclusion from international markets particularly those of the Near East has been due to lack of compliance with health standards. Poor dairy hygiene for example in pastoral systems make contract scheme with processors particularly difficult. In West Africa, the major challenge is to substitute livestock products imports to the coastal markets with local and regional produce (Rass, 2006).

Because livestock herders are both producers and consumers of livestock products, volatility in prices, further exacerbated by climatic conditions, disease outbreaks and seasonal supply changes, is a major source of risk and vulnerability. Since livestock represent a store of wealth and a productive asset in addition to a source of income, producers respond less to increasing prices in the short term than they otherwise would if they did not also consume livestock products and directly depend on them for future income flows. This keeps prices higher than they would otherwise be in a strictly producer equilibrium. Similarly, when prices decrease, production is not reduced as much as it otherwise would, resulting in larger price declines.

Evolving socioeconomic conditions, the increasing integration of international trade, and changes in the organizational structure of the livestock sector due to the demand-driven livestock revolution are some of the main causes of policy shocks that affect poor households. For pastoralists and agro-pastoralists in Africa, the changes in land tenure systems and increasing sedentarization are presenting even greater challenges. In much of East Africa, many pastoral communities are faced with the challenges of shifts in land tenure policy from communal to individual landholdings coupled with high in-migration rates. The Maasai pastoralists in southern Kenya for example, are currently facing the risk of land subdivision and land fragmentation. Changes in land tenure also have implications on livestock mobility, which is one of the risk management strategies in pastoral systems. Livestock mobility is facilitated by the common-pool nature of most grazing resources, which significantly reduces the transactions costs associated with mobility. Other policy shocks include the ever increasingly stringent international food safety standards – meeting strict welfare, hygiene and disease control regulations set by livestock importers such as Europe and the Middle East and the difficulties associated with poor pastoralist and agro-pastoralists adhering to these set standards. Increasing intensification that favors larger producers – case of the US and other developing countries whereby industrial farms have a competitive advantage due to economies of scale. Increasing globalization also poses other dangers such as exploitation and dumping of sub-standard/fake veterinary drugs and feeds, largely for the illiterate pastoralists and agro-pastoralists.

To cope with fluctuation in forage and water availability resulting from climatic variability, pastoralists and agro-pastoralists have developed a variety of survival strategies largely based on endogenous social safety nets. Migration is one of the primary ways in which pastoralists and agro-pastoralists have historically adapted to spatial and temporal variation in rainfall and vegetation. Among the many risk management

strategies that have been identified, livestock migration is often seen as one of the most valuable, since it enables herders to improve mean output as well as decrease output fluctuations associated with variability in rainfall. In order to cope with risks, households in risky environments have also developed sophisticated (*ex-ante*) risk-management strategies, including self-insurance via savings and informal insurance mechanisms. Traditionally, livestock keepers in pastoral and agro-pastoral systems have often kept precautionary savings and self insure, by building up assets (bigger herds) in good years to allow 'acceptable' levels of depletion in bad years. There is a strong motivation among pastoralists to accumulate large herds as a risk-reduction strategy and it is widely assumed that pastoralists will build up herds to the highest levels in non-drought times. The aim of the opportunistic stocking strategy is to ensure that the pastoralists have enough reproductive females for re-establishing the herd after the crisis is over. Other informal insurance arrangements include intra-community mechanisms. These are mechanisms by which members of pastoral communities assist each other during drought times for example. These includes the custom of distributing meat around the community when animals are slaughtered, thus maximizing the welfare impact of slaughter and avoiding waste.

Diversification is an income smoothing strategy, aimed at reducing the risk in the income process. Diversifying income sources, such as moving into other ventures such as crop farming and off-farm activities such as casual labor represents an important mechanism for income smoothing and risk mitigation. Diversification into non-agricultural income sources is a key poverty avoidance strategy for many poor smallholders across Africa. In sub-Saharan Africa, previous studies show the increasing importance of non-farm income in diversifying income sources and increasing total income with non-farm income constituting roughly 35 percent of rural household income.

In this review we have placed chronic poverty as a central element to the determination of vulnerability. Our conceptual framework sees vulnerability as a function of not just the profile of risks a system is exposed to but the internal capacity of that system to handle risks; its resilience and adaptive capacity. This implies the need to recognize that targeted development increases the human capital and risk management capacities of households, and the vulnerability to climate related shocks. The Index Based Livestock Insurance could be of particular interest to pastoralists and agro-pastoralists in Sub-Saharan Africa. Targeting safety nets is also critical to better risk management. Careful targeting of safety nets can reduce the need for expensive risk management through portfolio management or the need to sell off critical assets to meet serious income shortfalls in the event of shock, and thereby prevent descent into chronic poverty.

2.2 Conduct interviews and participatory vulnerability analysis in study sites (stakeholder analysis, situation analysis, analyzing causes, analyzing community action)

A community workshop was conducted in each study site in Niger from July 20 to August 4 2008 to gain better understanding of the vulnerability of the agro-pastoralists to climatic shocks, especially drought. For the workshop, we used Participatory

Vulnerability Analysis (PVA) framework tool developed by ActionAid International. The enumerators and facilitators for the community workshops were first trained in the use of PVA tool. At the heart of PVA is an attempt to break down the complexity of vulnerability into manageable components with communities in a participatory process to diagnose vulnerability and its causes and identify with the communities what can be done to reduce their exposure to hazards and shocks. Participatory vulnerability analysis is a systematic process that involves communities and other stakeholders in an in-depth examination of their vulnerability, and at the same time empowers or motivates them to take appropriate actions. PVA is a qualitative way of analysing vulnerability, which involves participation of vulnerable people themselves. The analytical framework for PVA entails four steps: i) Situation analysis of vulnerability. This includes identification of stakeholders and time line analysis of the disasters the community has faced; ii) Analysis of the causes of vulnerability – the underlying causes, severity and prioritising the list of causes; iii) Analysis of community action and capacity – establishing the existing strategies, resources and assets used to reduce vulnerability and external assistance received and their effectiveness; and (iv) drawing action from analysis – prioritising broad interventions including actions to be done by the communities and those by the external agencies. The community workshops on PVA in the three agro-pastoral communities in Niger provided us with useful feedbacks on their vulnerability to climatic shocks, especially drought, and other hazards (human and animal epidemics, flooding, conflict, wild bush fire). According to the respondents in all the three sites, the incidence of droughts has become more frequent in the last three decades. The common features of drought in all the sites included sudden cessation of rainfall, late onset of rainfall and insufficient rainfall, which led to poor crop yield or complete crop failure. The main impacts of droughts on livelihoods of the communities were sales of livestock to buy grains and forced migration of young people. Children and elderly people were the most vulnerable groups in case of droughts. Poor households without livestock were also mentioned as vulnerable to droughts and the associated crop failure as they had no means to buy grains to meet household food deficit. The major coping strategies of the community in response to droughts included harvesting of wild plants, sales of livestock to buy grains, migration to near by towns or neighboring country (Nigeria for those in Gabi and Zermou) and help from relations. These coping measures were generally seen as ineffective when faced with severe droughts. In all the three sites, government interventions in form of food aids were seen as very important in enhancing their ability to cope. However, some food aids by the government were not always regular and not well targeted. Assistance from NGOs to the communities in coping with droughts was quite minimal or none except for the drought of 2005 which attracted worldwide attention due to its severity.

To reduce vulnerability to future drought/famine, the workshop participants suggested the need to expand cultivated land, application of fertilizers to increase crop yield, adoption of improved and drought tolerant crop varieties and reclamation of degraded land. Off-season farming (vegetable production) was identified as an income generating activity that will reduce their vulnerability to climate related shocks. In all the sites, the participants tend to rely on external assistance as means to reduce vulnerability to future hazards. The external assistance required to be better prepared for future droughts/famine

included supply of agricultural inputs at subsidized rate, establishment of cereal bank and digging of wells for off-season farming. In Kenya, PVA tool was not used for the community analysis of vulnerability to climatic shocks. Instead, it was discussed through a focus group discussion composing of 8 – 10 adults. From the discussions, the communities surveyed opined that the frequency of drought has increased in the past decade and that repeated droughts have rendered them more vulnerable to future shocks.

2.3 Organize community workshops to share lessons

This activity was partly achieved during the community workshop on Participatory Vulnerability Analysis when some key findings from the surveys on risk perceptions, coping strategies and livestock mobility were presented. In general, the communities agreed with the key findings presented and laid much emphasis on projects to reduce their vulnerability to climate related shocks, especially income generating projects and those that address the problem of feed scarcity for the livestock.

Activities for Output 3 (livestock-based risk management and coping options)

3.1 Conduct surveys in study sites on livestock-based risk management and coping options in response to drought including impacts of policy

Survey instruments were developed on drought coping strategies, risk perception, and household vulnerability to food deficit. In Niger, these questionnaires were administered separately whereas in Kenya, the questionnaires were combined and fielded as one due to logistical problems. In addition, the questionnaire for Kenya was modified to fit the socio-cultural situation of the study sites. All the surveys were conducted at household level. In the study sites in Niger, the risks associated with animal husbandry were investigated by asking heads of sampled households to identify the major risks/constraints to gaining a livelihood through animal husbandry experienced over the past five years. The question was posed in an open-ended fashion and once the informant had finished outlining risks, they were asked whether they had experienced risks not mentioned (and listed on survey form). Once all risks experienced were listed, informants were asked to rank those experienced in order of importance (1 being the most important). For those risks experienced, informants were asked whether their household was more or less capable to manage these risks compared to other households in the community and why. Generally, the following risks/constraints were most often mentioned and ranked highly by informants across all three study areas: lack of pasture; lack of access to pasture/water due to cropped fields; and fluctuation of feed supplements. These major constraints were more highly mentioned and ranked in Gabi and Zermou where local shortages of pasture are highest. The survey also addressed the question on how climate change and variability has affected livestock husbandry over the past two decades. The respondents in the three sites in Niger mentioned increased labor emigration, increased dependence of households on remittances from labor migrants; increased ownership of livestock by non-specialists; increased need to supplement livestock feed; and reduced livestock mobility as some of the impacts of climate change on livestock husbandry. Generally, livestock are seen as an important part of the

investment strategy by rural households to deal with climatic risk. For most Sahelian households, livestock plays an important role in the circulation of economic surplus within the household economy. Economic surplus is converted into cash which is converted to livestock which is converted into cash which is converted into grain. Therefore, livestock rearing represents an important part of livelihood strategies to reduce household vulnerability to drought. Livestock rearing, if mobile, is seen by all as less vulnerable to rainfall deficit compared to crop agriculture. Moreover, livestock represents a major store of wealth for income generated not only through livestock husbandry but crop agriculture and labor migration as well.

There is a general sense among the surveyed populations that their food security has continued to decline in recent years. With the resources available to them, families in all three study sites develop livelihood strategies that combine three major productive activities: crop agriculture, livestock husbandry and labor migration in order to subsist. All of the 88 households surveyed farm with millet being the major crop and sorghum important in Zermou and Gabi. Virtually all of the households in the Fakara and in Gabi have at least one member owning livestock currently. On the other hand, 66% and 85% of the 33 surveyed households in Zermou have at least one member who currently owns livestock or has at some point over the past three years. Dry-season labor migration is common in all three study areas. Generally, the risks associated with crop agriculture by the informants across all three study areas were crop loss due to drought/pests (with exception of Zermou); inherently low productivity of fields; and labor shortage (with exception of Gabi). Generally, the risks/constraints associated with livestock husbandry by the informants across all three study areas were lack of pasture; lack of access to pasture/water due to cropped fields; and fluctuation of feed supplements. Actions taken by households in case of food deficit were increased labor migration and the selling of livestock. The selling of male animals was the most highly ranked measure in all three study areas. The selling of female animals was less highly ranked but still important (reflecting the standard practice of selling male prior to female livestock). Across all three study sites, investments into livestock (for fattening and rearing) and into petty commerce were the most often cited investments. The importance of livestock as a preferred investment matches the finding that livestock represent the major stores of wealth that are mobilized in response to harvest shortfalls. In sum, crop agriculture, livestock husbandry and labor migration have different strengths with respect to their contributions to the effective management of climate risk by rural households. Working together these pursuits increase the resilience of rural households – with respect to lowering the vulnerability to climate risk, the effect of these activities working together is greater than the sum of their individual contributions.

In order to evaluate the relative importance of different livelihood strategies pursued in Kenya study sites, each household was asked to rank a set of livelihoods (top 5) according to their importance in generating income over the past 10 years. The same was asked of household expectations of effective strategies 5 years into the future. The ranks have been normalized on a scale of 0 to 1, with one meaning highest rank while zero meaning not ranked. The results show that livestock keeping and the related trade in livestock remain the most significant livelihoods in the two study sites, only declining

slightly over the past 10 years as more pastoralists diversify into crop production, trade and employment; livelihoods which have become increasingly important over the past 10 years. While livestock husbandry is clearly the main activity, this analysis also points to the increasing significance of a number of activities; wage and salaried employment are important income earners that result from the growth of towns, sedentarization and education. Some differences across districts are noted – In Samburu, livestock husbandry continues to be regarded as an even greater income earner into the future while respondents in Kajiado see a declining role. Crop production on the other hand is a more important alternative in Kajiado.

Assessing exposure to and community perceptions of risk is key to understanding the reasons behind the set of livelihood choices, coping and mitigation strategies and ultimately vulnerability. From a set of potential risks, each household was asked to rank 5 of the most pressing risks based on the degree of impact on livelihoods. These would be the risks that are most dreaded either for their ferocity or frequency and their negative impacts on livelihoods. Natural disaster risks, especially those arising from climatic variability were viewed as most threatening. Forage scarcity is the key risk manifestation in this category; this is clearly because it affects the primary livelihood, pastoralism directly. Forage scarcity is a function of droughts (climatic variation) and compounded by poor pasture management often arising from unplanned grazing. Climate change and the increasingly greater constraints to livestock mobility in much of Kenya's arid and semi-arid areas have made forage scarcity the more important threat to pastoralist livelihoods. This is more so in Kajiado than Samburu where tenure systems have imposed undesirable changes to mobility patterns. Inadequate water availability and food insecurity are also directly traceable to droughts. But food insecurity, the more urgent concern in Samburu, can be described as a composite risk that results from a variety of factors, external and internal including the state of infrastructure and market access.

Disease risks; represented by human and animal health concerns in the area also ranked highly, human sickness second only to forage scarcity, while animal health concerns are fourth after food insecurity. Human diseases of concern include malaria and HIV/Aids, particularly in Samburu, fueled in part by an increasingly important tourist culture and breakdown in social structure. Socioeconomic risks, especially those related to fluctuations in the market, are also increasingly important for pastoralists.

Mitigation refers to actions (or strategies) pursued before the occurrence of a risk event that might reduce the impact of the expected shock. Lethargic responses to the likelihood and onset of key shocks have been observed in many societies to be the result of poverty and helplessness. The prominence of 'prayers and ceremonies' as a form of mitigation against impending disaster suggests that fatalism still plays a role in societal response to risk. This is particularly so in Samburu, which has a greater incidence of poverty. Predictably, mitigation strategies that protect the primary livelihood asset, livestock are generally ranked as more effective. Livestock herd accumulation, a traditionally popular self-insurance strategy is still widely practiced. Altering the mix of species allows pastoralists to take advantage of declining vegetation cover and improve mobility, and is often a longer term strategy to the point of being an adaptation; cattle are more

susceptible to drought while camels are more resistant and can endure dry spells for a longer period of time. Other strategies of note including diversifying to alternative activities, storing food, accumulation of savings are seen as less effective by many poor pastoral communities because they require human and economic resources. While traditionally pastoralists would move into hunting, gathering and farming in response to risks, they now have newer options such as casual labor, petty trade, charcoal burning and moving into towns. Nonetheless, the relatively low ranking of diversification, often hailed as an important risk management strategy, may reflect a strong preference for pastoral production.

Each household was asked to rank their coping strategies, during the occurrence of shocks, primarily drought. Coping strategies are actions that are pursued *ex post* as reactions to the occurrence of a risk event. Coping strategies are therefore employed to survive the impacts of a disaster. Rankings reveal that most households regard the sale of livestock as a more effective coping response. The sale of large (cattle) and small ruminants (sheep and goats) are almost equally effective ways to cope with shock. This provides much-needed income for food, water and medicine while reducing the herd sizes to manageable levels. External support (from friends and relatives or as food aid from agencies) is also seen as critical. Both help smooth consumption and with the sale of livestock, comprise the top four ranked coping strategies. Although food aid, provided in these districts through a WFP program is critical in saving lives during disasters, the households seem aware that ultimately food aid may perpetuate dependency and increase vulnerability. There is similarity in the ranking of coping mechanisms in Samburu and Kajiado; removing children from school is equally rejected in both districts (ranked last) as an effective coping option because of the presence of school feeding programs and the longer term adaptive effects of education. Also ranked low is the support from local institutions such as churches and living with relatives, often because these are also susceptible to the covariate risks such as droughts that affect entire communities. Reduction in consumption is ineffective, not just because consumption cannot be reduced beyond survival levels but because at this stage there is usually little or no food available for consumption.

To assess risk management, investment choices and development options in the study sites, we asked households to rank a set of risk management and development interventions according to their beneficial influence over the past 10 years. We also asked them to consider the expected effectiveness of the same efforts looking into the future 10 years. Human health has been the most important development intervention overall, followed by livestock health. This is not surprising as disease risk was a top concern among these households. Food aid is ranked third, closely followed by education and literacy. A startling result is that the top 3 interventions (human health, livestock health and food aid) are expected to be less effective in the future. Perhaps this points to a growing importance of climatic variability in the risk profile, a shock that is not amenable to these development and risk management strategies. Significantly, education and literacy is perceived to be a more effective intervention into the future, perhaps because of the clear potential to use education for livelihood diversification, remittance potential and increasing adaptive potential. Livestock marketing and wildlife management are the

two other activities that are seen to have greater effectiveness into the future than in the past. A surprising result is the lowly ranked land tenure management. For pastoralists, this ought to be an important issue with influence on mobility and access to rangelands. The low ranking may be attributable to a lack of understanding among the pastoral communities.

3.2 Organize end of project workshop for feedback, monitoring and evaluation of progress and impact

This activity will take place towards the end of the project in February or March 2009.

11. Summary of major achievements during the reporting period

Major achievements during the reporting period include the followings:

- Conduct and completion of household surveys on resource endowment and livelihood options, drought coping strategies, risk perception and vulnerability to food deficit in the study sites in Niger.
- Conduct and completion of community surveys on historical profile of the community, social group characterization and livestock mobility in the study sites in Niger.
- Conduct and completion of household survey on livelihood options, risk exposure and vulnerability, and coping strategies in study sites in Kenya.
- Conduct and completion of community survey on livestock mobility in study sites in Kenya.
- Completion of data entry for all the household and community surveys in Niger and Kenya.
- Completion of data analysis and reports on the household and community surveys.
- Conduct of community level workshop on Participatory Vulnerability Analysis (PVA) in the three study sites in Niger, using PVA framework developed by ActionAid International. For this workshop, enumerators and workshop facilitators were trained in the use of PVA framework.
- Completion of synthesis on the impacts of climate change on pastoral and agro-pastoral systems in East and West Africa.
- Completion of literature review on the vulnerability of the pastoralists and agro-pastoralists to climate change and variability.
- Conduct of spatial analysis of green fodder production (NDVI) over the past 15 years across the study sites in Niger and Kenya.
- Participation in a new proposal addressing risk/vulnerability to climate change and variability in agro-pastoral systems in West and Southern Africa submitted GTZ/BMZ. The proposal was approved for funding early this year.
- Participation in a new proposal on potential of new dual-purpose sorghums to enhance livelihoods and promote sustainable crop-livestock integration and

intensification in West Africa submitted to SLP for funding. The proposal is led by ICRISAT.

12. Outputs: a) products, b) people trained, c) technology transferred, d) reports and publications, e) presentations in conferences

b) People trained – 3 enumerators, 1 research technician and 2 INRAN socio-economists in Niger were trained in the use of Participatory Vulnerability Analysis framework in July 2008.

13. Implications of research outputs and achievements

Improving resilience in pastoral and agro-pastoral systems to climatic shocks and other stress is necessary to reducing the vulnerability, and consequently enhancing the livelihood of livestock dependent households. Pastoralists and agro-pastoralists in the study sites unanimously affirmed the reality of climate change and variability, and its impacts on their livelihood through the stakeholders' consultation and the surveys. This in a way confirms that the project is addressing an issue that has direct bearing on the livelihood of the people in the study areas. Though the project addresses vulnerability to climate change and variability, vulnerability to climate change should be seen as a state that is governed not just by climate change itself but by multiple processes and stressors. This approach involves dealing with biophysical vulnerability, or the sensitivity of the natural environment to an exposure to a hazard; and social vulnerability, or the sensitivity of the human environment to the exposure. From our findings from the surveys, livestock are particularly important for increasing the resilience of vulnerable poor people, subject to climatic, market and disease shocks through diversifying risk and increasing assets. Measures and interventions that secure livestock assets are necessary to reduce the vulnerability of pastoralists and agro-pastoralists to climatic shocks.

The results from the surveys and literature review support the following conclusions and recommendations by the project:

- Vulnerability to drought (at the household and community levels) is not solely shaped by economic wealth but by the reliance of household livelihoods on different economic activities as well as the particular productive practices pursued.
- Informants stressed that vulnerability to drought is strongly shaped by economic activities during good years as well as drought years. Informants view drought as inevitable and therefore pursue strategies that allow them to subsist across the drought cycle through the storage of wealth.
- Technological innovations that would reduce the vulnerability of crop-related household income to drought not only involve the adoption of drought resistant crops but also would involve: increased access to widely-dispersed fields; greater

access to markets for food crops (to facilitate moving in and out of market); and greater access to fertilizers to increase yields during good years.

- With respect to coping with drought, it is unlikely that increased access to climatic information will reduce the vulnerability of crop agriculture to low rainfall given limits to predicting rainfall at village scales. Given the inherently high spatial variability of rainfall at the local level, rural peoples will not likely react significantly to early warnings.
- Livestock rearing represents an important part of livelihood strategies to reduce household vulnerability to drought. Livestock rearing, if mobile, is seen by all as less vulnerable to rainfall deficit compared to crop agriculture. Moreover, livestock represents a major store of wealth for income generated not only through livestock husbandry but crop agriculture and labor migration as well.
- The vulnerability of livestock rearing is increased if livestock mobility declines. Livestock mobility is limited by knowledge/social contacts, security of herding contracts, agricultural encroachment, labor availability and information about distant pasture locations. All of these constraints need to be addressed to counter trends toward livestock sedentarization.
- Innovations that increase access of pasture information to herders need to utilize herder's social networks to disseminate information that is expressed in terms of their pastoral geographies (e.g. conditions of pastures surrounding their encampment points).
- While price fluctuations are not cited often by informants as a major factor behind their vulnerability to drought, innovations such as grain and feed supplement banks are likely to reduce household vulnerability by allowing local farmers to benefit rather than suffer from predictable movements of prices across a typical year.

From the project findings, a number of possible initiatives to improve drought coping could be explored through discussions with the study communities:

1. Look into how might local community grain banks be broadened toward a poverty bank model which would provide a mix of credit, loans in kind, and community stocking (purchased grain and fodder) and purchasing (fertilizer) activities to reduce local vulnerabilities to drought. Index Based Livestock Insurance could be of particular interest to pastoralists and agro-pastoralists in Sub-Saharan Africa and should be looked into as an innovation to reduce vulnerability of livestock based livelihoods to climate change and variability.
2. One advantage of growing food crops (rather than cotton or other cash crops) is that producers can move in and out of the market in response to household need and price conditions. One major limitation of millet/sorghum agriculture is the limited demand for the crop outside of the Sahelian zone. Therefore, during good

years, the market can become saturated. Improvements in the market for these food crops (improvements in access etc.) should therefore reduce vulnerability by allowing farmers to make greater profits during good years. In addition, the greater marketing of local cowpea production to markets in Nigeria would have an additional benefit of increasing local supply of cowpea hay, an important livestock feed supplement.

3. Difficult but important is a necessary discussion about how might the impediments to livestock mobility be lowered in the local community. A way forward in such a discussion is to: A). Introduce findings and then discuss the importance of livestock as an investment in the community for all social groups; B). Discuss the problems associated with livestock in village territory during the growing season; and C). Present findings and lead a discussion about why do not more livestock leave the territory during the growing season trying to get people to recognize this.

14. Problems and measures taken

Survey instruments have to be modified to fit the socio-cultural situations on the ground in each country. For Kenya, all the household level questionnaires were combined as one and are being fielded once unlike in Niger where the questionnaires were fielded separately at household level. The reason for fielding household level questionnaire once in study sites in Kenya is a very high cost of conducting survey when compared to Niger. Nevertheless, there are many similar questions in the household-level questionnaires fielded in both countries, which will allow for regional comparison of results.

Another problem related to the surveys in the two countries is the separate analysis of the data collected by the scientists involved (Matt Turner and Andrew Mude) because the survey instruments used were not the same for the two countries though some questions were similar. Separate reports were also produced for the study sites in each country. This problem did not allow for regional comparison (East versus West Africa) of the findings.

Another problem encountered is the departure of INRAN principal investigator, Tahirou Abdoulaye, who took up a new position with IITA in Kano, Nigeria in September 2007. The socio-economist chosen (Boureima Moussa) to replace Tahirou by INRAN could not carry out the literature review on pastoral/agro-pastoral vulnerability in Niger due to lack of necessary training and experience. However, he performed very well in the conduct of participatory vulnerability analysis in the study sites in Niger.

15. Linkages with other research

The project is linked to a number of project and proposals, which address similar issues relating to impacts of climate change and variability on the livelihood of livestock dependent households in East and West Africa. These projects are:

- World Bank project on Kenya Adaptation to Climate Change in the Arid Lands. Andrew Mude is heavily involved in this project, which has similar objectives to this SLP project. This project also addresses livelihood options (the risks and

- returns associated with them including their availability) and risk-management strategies (both mitigation and coping) due to apparently increasing vulnerability caused by climate change
- Adaptation to climate change in Africa proposal submitted to BMZ. This proposal also addresses vulnerability of agro-pastoral system to climate change and variability. The study sites for this proposal are in Mali and Mozambique. Andrew Mude is one of the principal investigators in this BMZ proposal. The proposal has been approved for funding early this year.
 - Dynamic Interactions among People, Livestock, and Savanna Ecosystems under Climate Change. The project will be working at a regional scale and will cover Kenya and Tanzania. The project will also conduct in depth studies at meso and site level. The meso-scale and site-level coincides with the SLP sites in Kenya so that we can use some of the information to scale up our work, but also the regional project will have the benefit of very indepth information at household level. The main objective of the project is to analyze how savanna vegetation respond to a changing climate and what are the combinatory effects of human land management and climatic change impacts on savanna vegetation, and how are livelihood systems of pastoralists and agro-pastoralists responding to climate change in the context of the evolving socioeconomic systems. Phil Thornton and Mohammed Said are involved in this project.
 - Strategic Analysis and Knowledge Support System (SAKSS) project of mapping option for action to address vulnerability based on three key indicators, natural risks, diseases risks (both livestock and human), and socio-economic risk in Common Market of Eastern and Southern Africa (COMESA) region. Andrew Mude is working on developing methodologies of mapping and analyzing the information at a broad scale level. Part of the objective of the project is to improve policy making and better targeted investments that are strengthening the resilience and adaptive capacity of vulnerable communities within the COMESA countries. The SLP study can fit in this as one of the case studies, within the broader scope of the project. Andrew Mude is involved in this project.
 - Sustainable management of globally significant endemic ruminant livestock of West Africa. This GEF project has an outcome on natural resource management and activities that address the impact of climate change on evolution of natural resources in four project countries (Gambia, Guinea, Mali and Senegal) and the aspect of vulnerability. Some of the survey instruments developed for our SLP project on reducing the vulnerability of pastoral and agro-pastoral systems will be useful for this GEF project. Augustine Ayantunde and Mohammed Said are involved in the natural resource management activities of the GEF project.

D. Summary of research plans for next reporting period per output and activity (not applicable for last Annual Progress Report)

Not applicable as this is the last annual progress report. What remains is the final project report which is due by March 31 2009. Also, the end of the project workshop will be held either in February or March 2009.