

INTEGRATED ASSESSMENT OF PASTORAL-WILDLIFE INTERACTIONS IN EAST AFRICA: IMPLICATIONS FOR PEOPLE, POLICY, CONSERVATION AND DEVELOPMENT IN EAST AFRICA

NARRATIVE SUMMARY

During 2001-2002, the POLEYC project (Policy Options for Livestock-based Livelihoods and Ecosystem Conservation) continued to develop and disseminate information requested by decision makers in East Africa for their use in balancing the needs of wildlife conservation with the needs of pastoral land users, while insuring the sustainability of semi-arid ecosystems in Kenya and Tanzania. Our approach is to combine Geographic Information System Technology with computer simulation models of the ecosystems (including the pastoral households which are part of them) to perform Integrated Assessments (IAs) of our study areas. These IAs predict the likely outcomes of possible future actions or events such as human population growth, animal disease control, changes in livestock stocking rates, etc. on wildlife, pastoral livestock, pastoral well-being, and ecosystem health. We have made progress on a variety of activities during the current year.

We completed the IA for the Ngorongoro ecosystem and disseminated the results of that analysis to all of our stakeholders, including the Ngorongoro Conservation Area Authority and the pastoralists living within the area. This analysis included the probable effects of continued human population growth and estimates of carrying capacity of the area for wildlife and livestock. Dissemination of results included written materials in Swahili and oral presentations in Maa. The oral presentations in the NCA were very well attended, reaching

over 1,000 pastoralists living in the area.

Progress was made in adapting our models to the Kajiado system and we collected much of the data needed to drive the models for that application. Scenarios to be examined were defined by stakeholders in the area, and many of them center around the effect of subdivision and privatization of land. A veterinary disease survey was completed for the area, and information on watering points and critical wildlife habitats was gathered. A meeting was held with group ranch representatives at which we presented our IA approach and the results from our analysis at NCA. This workshop increased local interest in our project and was very helpful in defining the scenarios to be investigated.

Initial work towards the IA at Tarangire/Manyara was completed. Contacts with important stakeholders in the area were established, and a compilation of existing data and information in the areas was obtained. The groundwork was laid which will permit the collection of all required data for the IA during the next two years.

Work was initiated in the Greater Meru ecosystem. We worked with our collaborators at the Kenya Wildlife Service to define goals for the analysis there. A vegetation map is being developed and important stakeholders identified. J. Kinyamario has initiated a literature review of information pertinent to our analysis there. Plans for the continuation of this work during the coming year were formalized.

Our modeling system was improved in a variety of ways during this period as well. The ecological model was changed to make its adaptation to new sites simpler and to allow it to be applied over larger spatial areas. The household economic model was modified to permit its application to areas in which pastoral households are more deeply involved in the market economy than is the case in Ngorongoro, where it was initially applied.

RESEARCH

Activity 1: Integrated Assessment of the Ngorongoro Conservation Area, Tanzania

Objectives identified for 2001-2002:

a. Improve, streamline, and otherwise refine the current version of the NCA integrated assessment package to fit the dimensions of the problem as defined by East African scientists, collaborators, and the NCAA staff.

The SAVANNA application to NCA was updated, using the newest version of the model, and incorporating significant improvements. For example, whereas in the previous model cattle were simply prevented from grazing in the short grass plains in the wet season because of malignant catarrhal fever, in the new model, cattle avoid migratory wildebeest. This process-based approach allows more flexibility. SAVANNA/PHEWS was adapted to disconnect households and cultivation, allowing cultivation to be separate from households. Modeled animal densities were refined using Management Zones defined by NCAA. The PHEWS model was modified to be appropriate for the new version of SAVANNA. This was important to do in order to realistically address the management

questions posed by the NCAA. This activity directly addresses the goal in the initial problem model to initiate a demand-driven integrated assessment (IA).

b. Develop Integrated Assessment scenarios of the effects of alternative policy decisions and management actions on human economic status, livestock production, wildlife populations, and ecosystem state.

Discussions were held with the NCAA to solidify the general questions to be addressed by POLEYC. These were followed by a series of meetings at CSU to define detailed integrated assessment scenarios. Victor Runyoro of the NCAA spent two weeks at CSU, contributing to IA scenario development and receiving training on SAVANNA and remote sensing techniques. The scenarios dealt with appropriate stocking rates in NCA, area under cultivation and its distribution, livestock disease control, and human population growth. Addressing the scenarios required integrating information, GIS analyses, and ecosystem and socioeconomic modeling. A combination of methods to estimate herbivore carrying capacity was used in NCA. Cultivation was mapped using remote sensing (Fig 1). The cultivation map was reformatted to be used in SAVANNA, and modified to change the distribution and area of cultivation for different scenarios. Ecological Modeling was conducted, and results presented in a form useful to decision makers. Analyses focusing specifically on the PHEWS model were conducted. Although we had not initially planned to have Victor Runyoro visit, his trip did allow us to focus on IA scenario development. His trip and subsequent IA analyses at CSU permitted him to present the results of the NCA analyses at a very important NCAA workshop. The analyses and development recommendations are found in Runyoro et al. (in press).

c. Present results of IA scenarios to: 1) the NCA Authority and its parent ministry; and 2) the Maasai community in NCA and a few NGOs supporting Maasai development.

Integrated assessment results were presented to members of the NCAA and other scientists in January of 2002. We agreed to a request by NCAA that they pass POLEYC results on to their parent ministry. This process is ongoing. We presented assessment results to the NCA Pastoral Council, with presentation content and selected visuals translated into KiSwahili. We presented results to pastoralists in Endulen, with presentation content in Maa. Members of the Danish-supported project *Ereto* attended each of these meetings. These results were discussed in community meetings in six sites within NCA during mid-September. Over 1,000 local Maasai pastoralists attended these meetings. Results from NCA were presented to a wider audience in East Africa, as a demonstration of the integrated assessment process and potential results.

A scientific report of POLEYC results has been provided to members of the NCAA, *Ereto*, and the Pastoral Council. A condensed version of POLEYC results using lay language was translated, used in community meetings, and provided to the Pastoral Council and pastoral community leaders. The report is available on the POLEYC/IMAS website at: <http://www.nrel.colostate.edu/projects/imas/>



Figure 1 - Cultivation in Ngorongoro Conservation Area, Tanzania, shown in black, for February 2000. Within the conservation area, 3,967 ha or 9,803 ac were mapped as cultivation. For context, a 5 km buffer around Ngorongoro Conservation Area is also shown.

webpubs.html. Papers have been prepared to disseminate results to the scientific community and multiple research briefs are in preparation (see Publications section below for listing).

We have gone beyond the tasks expressed in the problem model, not only to present results in several languages but also to obtain feedback from all constituencies. This activity has been very important to the acceptance and use of the IA by stakeholders.

Activity 2: Integrated Assessment of the Amboseli Group Ranches, Kajiado District, Kenya

Objectives identified for 2001-2002:

a. Improve and adapt the POLEYC integrated assessment package to fit the question of subdivision for the Amboseli Group Ranches: 1) Refine PHEWS to better represent household economic activities in the Amboseli region, and 2) Refine SAVANNA to represent ecological constraints and subdivision issues in Kajiado.

Philip Thornton made an extended trip to CSU from ILRI in May 2002 in order to begin adapting the PHEWS model to reflect the more diversified economic situation characterizing pastoral production strategies in the Amboseli group ranches. A second trip to NREL to

finalize this adaptation of the model was made in October, following the GL-CRSP 2002 Program Conference. Randall Boone has made substantial progress in parameterizing the SAVANNA model to address the subdivision questions that will form the foundation for the Amboseli Integrated Assessment. Initial progress on an approach to look at subdivision impacts on pastoralists and their livestock was demonstrated at the EEP review meetings in June 2002. The refinement of PHEWS based on data from Kajiado is close to completion and should be finished early in 2003. The SAVANNA adaptation to Kajiado is complete and some results can be found in BurnSilver et al (in press).

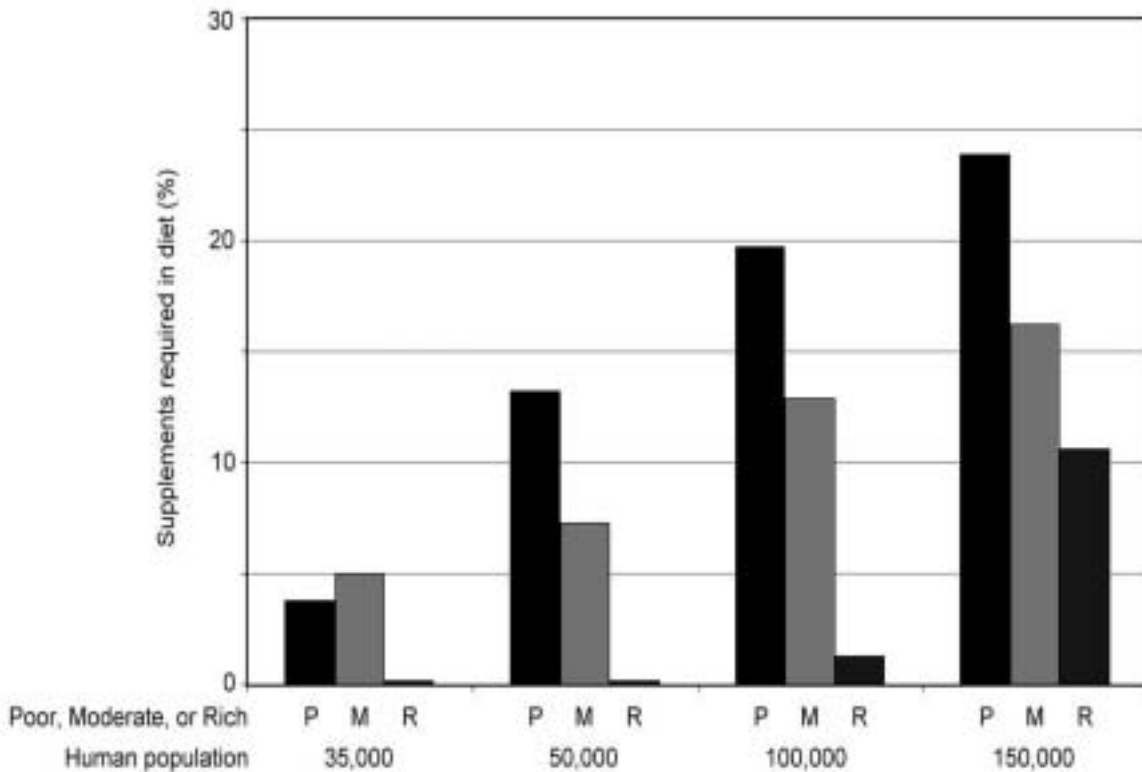


Figure 2 - Supplemental foods, such as relief aid, required by Maasai under different human populations and correspondingly increasing cultivation. Results are shown for poor, moderate, and rich households.



Figure 3 - Participants in one of six community meetings held in Ngorongoro Conservation Area in mid-September, 2002. Up to 350 Maasai attended each of these dissemination meetings.

b. Develop Integrated Assessment scenarios that illustrate alternative management decisions regarding subdivision and land use on human economic status, livestock production, wildlife populations, conflicts between people and wildlife, and ecosystem state.

The list of critical issues from the January workshop in Loitokitok (*see additional activities below*) became the foundation for development of IA scenarios for the Amboseli project area. Focus groups with Amboseli group ranch members in February 2002 also highlighted the range of subdivision options actually under consideration by group ranch members and leaders. Between March and June of 2002, these critical issues were recast as scenarios that illustrated potential tradeoffs on a range of issues for pastoralists, livestock, and wildlife. These scenarios were then translated into KiSwahili, and English and KiSwahili versions were disseminated for comment to group ranch representatives and important stakeholders in Kajiado and Nairobi. The comment period was open through the fall of 2002, and adjustments to the IA scenarios are being made currently on the basis of comments from POLEYC collaborators. A final version of these IA scenarios will be ready in early

2003. The scenarios relate to subdivision, carrying capacity of the system for livestock and wildlife, wildlife-livestock interactions, and human economic activities. The PHEWS-SAVANNA IA system is currently being adapted for Kajiado. The analyses will be complete early in 2003.

c. Collect ecological and economic field survey information needed to develop and improve integrated assessment scenarios and analyses.

Shauna BurnSilver finished collecting socio-economic field data for her PhD study in the Amboseli group ranches in March 2002. Economic and land use data from this study are being used by Joana Roque de Pinho (PhD student NREL/CSU and 2002 J. Ellis Mentorship Program Awardee) as a baseline to focus her study on determining Maasai 'attitudes' toward wildlife, the strength of these attitudes, and the reasons they are held. Joana Roque de Pinho will gather additional data on economic costs/benefits associated with wildlife and ecotourism activities, and non-economic valuations of wildlife by Maasai of different age and gender groups. She plans to complete her field studies in February of 2003. Early results suggest that different areas of Kajiado are experiencing different types of

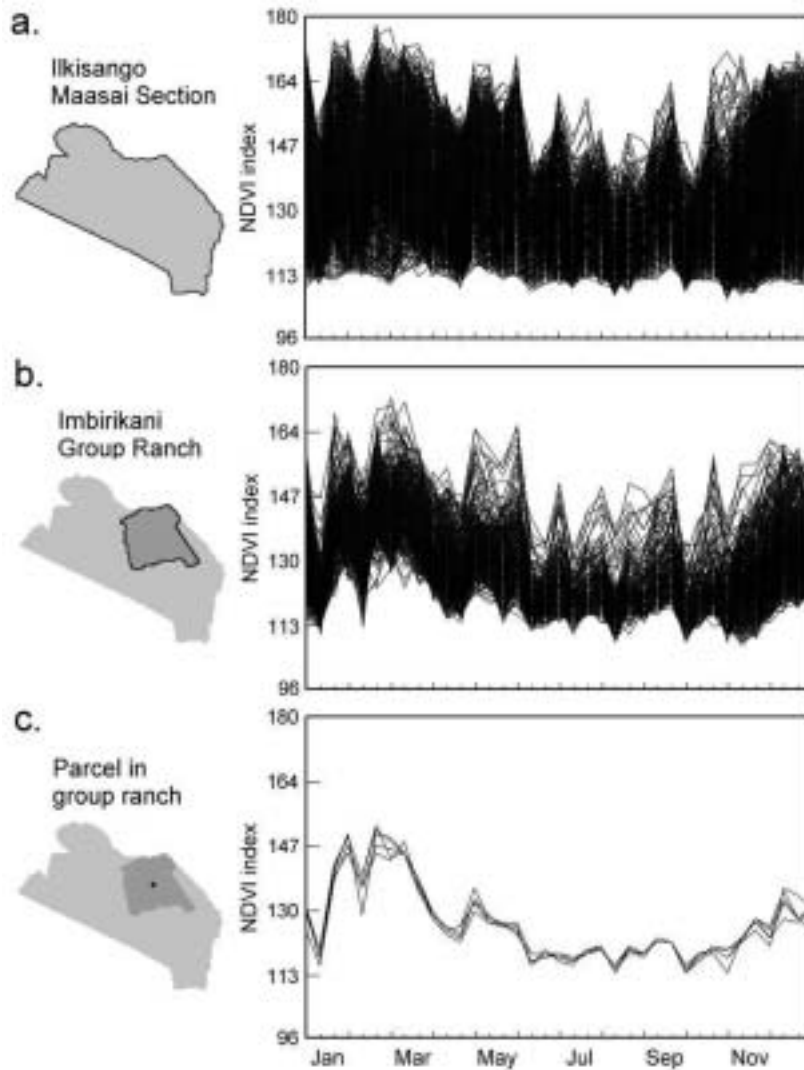


Figure 4 - Diversity of vegetation responses based on satellite images, for each 1 km² within southern Kajiado District, and reflecting the diversity of options available to livestock herders that use the parcels exclusively. In Ilkisingo Section (a), a wide diversity of landscape patches are available to herders; in Imbirikani Group Ranch (b), fewer options are available, with landscape patches greening up or senescing at similar times; and in a small parcel within the group ranch (c), vegetation responses are essentially overlapping and few options available to the landowner.

human-wildlife conflicts. In Imbirikani, elephants in particular are causing extensive crop damage, which residents are finding unacceptable. Lions are also being poisoned, a practice not culturally sanctioned but one that is becoming prevalent in this densely populated area. In Imbirikani Group Ranch, where benefits derived from wildlife-based tourism are substantial, the knowledge that these benefits are linked to wildlife is widespread. Wildlife is nevertheless regarded as a nuisance.

Jeff Worden (PhD student NREL/CSU) has continued his fieldwork in the Amboseli

group ranches, focused on documenting current and historical land use patterns of pastoralists and their effects on vegetation patterns at multiple scales. Some conclusions include: 1) sedentarization is increasing across all sites, 2) there is increased dispersion in the spatial pattern of settlement with subdivision, and 3) there is a reduction in the scale of resource use with increasing sedentarization, as well as fragmentation and a concomitant reduction in the size of grazing reserves. Jeff Worden will finish his work in early 2003.

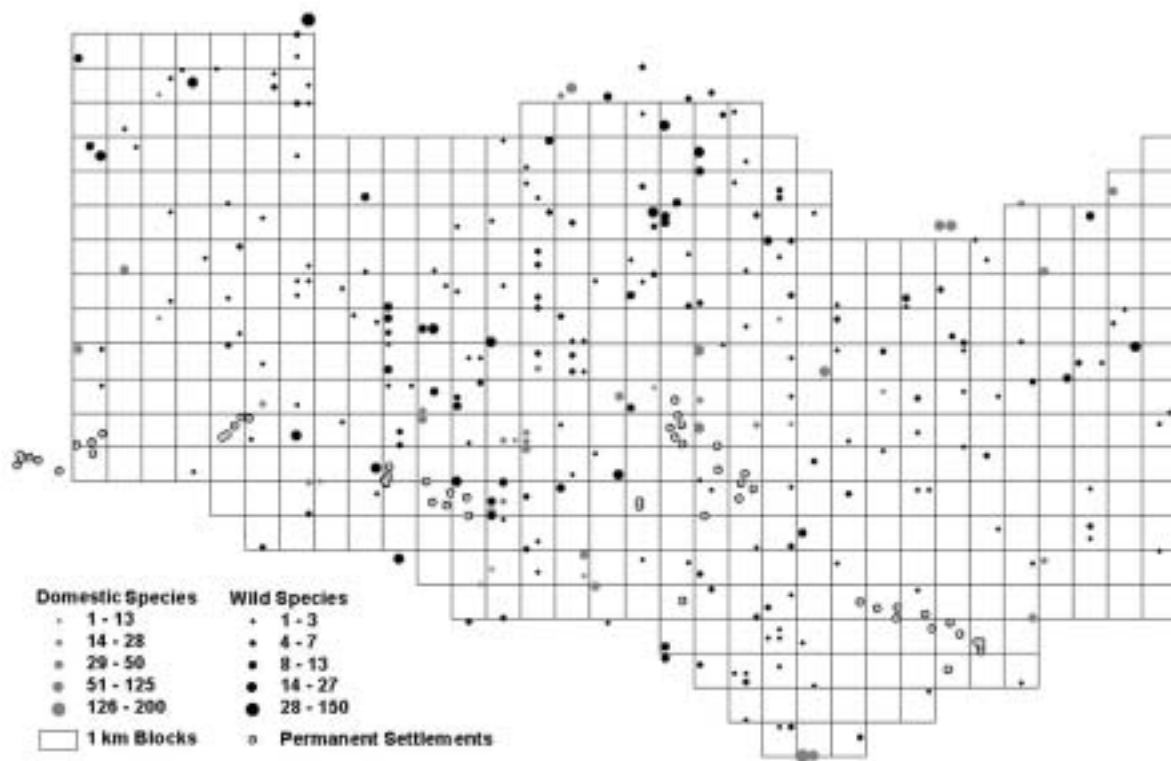


Figure 5 - Distributions of wild and domestic herbivore species in the Meshanni Ridge area north of Amboseli National Park, Kajiado District, Kenya, during the dry season of 2000 (J. Worden, thesis data). Herbivore and settlement distributions are from aerial surveys.

The data from these projects are essential to either: 1) IA adaptation and scenario runs, or 2) interpreting stakeholder concerns and their perceptions of the IA results.

Additional Activities carried out in Kajiado 2001-2002:

a. Presented results of NCA Integrated Assessment to Kajiado Group Ranches and KWS as an example of how IAs can be used in policy and planning.

Results of the IA for the NCA were presented to a combined group of 25 Group Ranch and stakeholder representatives (KWS, the Amboseli Tsavo Group Ranch Conservation Association, the African

Conservation Centre, and SARDEP) at a workshop in Loitokitok, Kajiado in January 2002. Workshop participants used this example of NCA IA scenarios to generate an initial list of 'critical issues' that they considered important in Amboseli. These related to subdivision, carrying capacity of the system for livestock and wildlife, wildlife-livestock interactions, and human economic activities. This activity relates directly to Activity 2b and has been very helpful in scenario development.

b. Initiate disease assessment fieldwork to identify important wildlife-livestock disease relationships.

In collaboration with the District Veterinary Office of Kajiado, a team of two veterinarians began field studies in early August 2002 in 6 study areas across four Amboseli group ranches. The duration of the study was one month, and the goals were to identify significant livestock-wildlife diseases in the Amboseli area, identify disease hot-spots on the landscape and highlight important pastoral coping strategies. Results of the study will be integrated into the IA for the Amboseli area, and will be publicized in a wildlife-livestock disease research brief. This was conducted because disease is an important component of wildlife-livestock interactions. Our work on this issue is a result of workshops and subsequent referrals to us as being something important we could and should address.

c. Collect and synthesize additional data layers on water point distribution and critical wildlife habitats/connectivity.

Working with M. Nyabenge (GIS specialist at ILRI), 2 Maasai field assistants were in the field (September 2002) collecting GPS data on existing water points in order to fill in gaps identified in the GIS data layer for SAVANNA. Jeff Worden was also working with D. Western during this period to use wildlife count data and aerial photos of the Amboseli group ranch area to identify the spatial extent of critical wildlife corridors and habitats. These data will be an important element in the Amboseli Integrated Assessment based on scenarios developed with the collaborators.

Activity 3: Integrated Assessment of the Tarangire/Manyara Ecosystem, Tanzania

Objectives identified for 2001-2002:

a. Establish working relationships with agencies and NGOs active in the TME.

This task was successfully completed, but due to the large number of active organizations in this region, new relationships continue to arise. A POLEYC team demonstrated the IA approach and capabilities based on results from the NCA Integrated Assessment to TME collaborators in January 2002. Agencies and NGOs include Tanzania National Parks, Tanzania Wildlife Research Institute, OIKOS (Italian), Inuuyat e Maa (Maasai pastoralists), African Wildlife Fund, Manyara Ranch, Conservation Information Centre, and local community leaders.

b. Develop literature-based and spatial databases for the Tarangire/Manyara ecosystem.

Considerable progress was made in this area, both as preparation for model application, and for planning field research conducted by Stacy Lynn. A literature review is underway for the TME to identify and organize previous research and grey literature sources that relate to integrated assessment issues identified for the TME. An existing literature review for the project area performed by Clive Jones (Director of Manyara Ranch) in 2001-02 was made available to us by Mr. Jones. This has proven to be an invaluable resource for us and it has been augmented by Stacy Lynn during her work in the area. A Landsat satellite TM scene was purchased (by ILRI) as the basis for development of a vegetation data layer, and GIS layers on animal movements for domestic and wild species, Maasai settlement locations, and water points are being assembled based on collaboration with the organization OIKOS.

c. Conduct field reconnaissance of the ecological conditions of the TME.

The area was visited during the January field campaign organized by Allan Kijazi, Jim Ellis, and Shauna BurnSilver, with participation by Boone, Coughenour, DeMartini, Roque de Pinho, Thornton, and African collaborators. Stacy Lynn was in the field for 3 months (May – July 2002) conducting more in-depth reconnaissance to plan the main portion of her fieldwork, to be conducted in 2003. Her work in gathering GIS data layers has been supported by GIS personnel at ILRI (Nyabenge, Serneels). Terry McCabe worked with Stacy for several weeks during this period as well, identifying land allocation mechanisms that are affecting both the rate and direction of Maasai land use change.

d. Initiate field research on conflicts and constraints to conservation and development in the TME.

Initial progress has been made on this objective, initiated by Stacy Lynn's 2002 fieldwork. She and Terry McCabe conducted several focus groups with TME Maasai to define appropriate questions and boundaries for the overall TME study. In addition to meeting local people, meetings were held with several important land managers from Tarangire National Park, TANAPA, TAWIRI, AWF, Manyara Ranch, Simanjiro District, and others. She also cleared the research plan with COSTECH and obtained all necessary research permits for this project. She returned from the field in mid-August 2002. The next phase of work will focus on collection of data to be used in the IA through interviews with local people, as well as with a wide variety of stakeholders, NGOs, and agencies. A final research proposal

has been prepared, incorporating findings from the 2002 trip.

Terry McCabe's work in Tarangire concentrated on land use, land use change, and wildlife – pastoral conflicts in the region. His results indicate that the system of land use is undergoing a rapid change involving a transformation to large-scale, mechanized agriculture in the savannas east of Tarangire. This change is a clear threat to use of the areas as wildlife corridors or migratory routes. This land use change is being driven by a number of factors, not the least of which is the new view the area Maasai have of themselves – as an agro-pastoral people, practicing a livelihood strategy based on both livestock and cultivated agriculture. Their involvement in the Tanzanite business provides many of them with money to buy tractors and other agricultural inputs that can change the spatial scale of cultivation drastically. This appears to be a critical time for land use systems in this region. In general, younger men lean toward complete privatization and subdivision, whereas older men would like to see much of the area remain open to all as common grazing land. The way in which these competing views play out will have important impacts on the future of pastoralism and wildlife conservation in the area. Formal data collection for the IA will be conducted from January through August 2003.

e. Collect field ecological and economic survey information needed to develop and improve Integrated Assessment scenarios and analyses.

This activity is largely postponed for the main portion of Stacy Lynn's field research, beginning in January of 2003. Terry McCabe also will collect data in two TME locations for use in parameterizing the PHEWS model.

f. Initiate efforts to adapt PHEWS and SAVANNA models to the TME.

This is addressed in the section on model development.

Activity 4: Integrated Assessment of the Greater Meru Ecosystem, Kenya

Objectives identified for 2001-2002:

a. Work with KWS to define specific goals for Integrated Assessment associated with their restoration efforts in the Greater Meru Ecosystem (GME).

In consultation with employees of KWS in Nairobi and with the Chief Warden of the park (Mark Jenkins), a list of preliminary problems and/or issues that the IA could address was developed following a trip our group made in January 2002. As an introduction to the POLEYC approach and capabilities, a team demonstrated Integrated Assessment results from the NCA to KWS scientists at KWS Headquarters in Nairobi. Subsequent issues identified for the GME include: competing land uses (pastoralism, joint wildlife/livestock enterprises, ecotourism), increased human settlement in the GME, unauthorized incursion into the Park proper by Borana and Somali pastoral populations to the north, wildlife translocation issues, effects of elephant populations on vegetation, the effects of fencing on corridors/connectivity between different reserves, wildlife and livestock disease, and loss of water resources in the park due to outside uses. In addition, the IA must be developed in such a way as to be useful to KWS in the development of their 1-year, 5-year and 20-year master management plans for the GME.

b. Conduct field reconnaissance of ecological conditions in the GME.

Development of a vegetation map is currently underway. Graduate student John Otuoma of the University of Nairobi, using a cover map developed by AFRICOVER, is doing this work under the direction of Dr. Jenesio Kinyamario. During the year, various members of the POLEYC team have been to the GME to familiarize themselves with ecological and socio-economic issues there. These include: J. Ellis, M. Coughenour, S. BurnSilver, R. Boone, J. DeMartini, J. Roque de Pinho, D. Swift, J. Mworira, P. Thornton, M. Mulama, W. Mutero, and J. Otuoma.

c. Conduct a preliminary analysis of community attitudes and socio-economic conditions among local Borana herders and Meru agro-pastoralists.

This work on assessing community attitudes is ongoing. It is being conducted by Kenyan consultants reporting to KWS and working with SOFRECO, a French development group. D.Swift, W.Mutero, and J. Otuoma met with this team in Meru National Park in July to discuss potential sharing of this data and of socio-economic data already collected by SOFRECO.

d. Initiate literature-based and spatial databases for the GME.

Jenesio Kinyamario has undertaken a review of all available open and grey literature publications that deal with socio-economic and ecological conditions in the GME. The review entailed two trips to the GME to visit government offices and NGOs in the area, which allowed the POLEYC team to both identify data sources and make additional

contacts with local NGOs and stakeholders currently working in the GME.

e. Conduct training and promote GIS database development for the GME at KWS headquarters in Nairobi and at the GME Research Center in Meru National Park.

Training and the promotion of GIS development for the Greater Meru Ecosystem (GME) at Kenya Wildlife Service (KWS) and Meru National Park were proposed. A visit to the park confirmed that facilities are not yet advanced enough to be used for the training of groups, and GIS training at KWS focused on GME is premature - spatial layers for the area are too scarce. Instead, we focused on database development. For example, John Otuoma, a student working with Jenesio Kinyamario, is creating a vegetation map for the region. Preliminary analyses of community attitudes were also proposed. However, we have postponed these analyses pending the outcome of a literature review. We are now aware of recent and ongoing socio-economic work in GME supported by other nations, and do not wish to duplicate efforts. After the literature review compiles existing information, we will re-evaluate our socio-economic objectives.

Activity 5: Model Development and Adaptation

Objectives identified for 2001-2002:

a. Refine and streamline SAVANNA for easier adaptation to new CRSP sites.

Version 5a of the model was developed during this time period. This version includes improvements that will make the model easier to adapt to new sites, as well as a variety of

more general improvements. All the details of the model improvements cannot and need not be described here. As examples, however: a) the weather routines were generalized to accommodate large spatial domains, b) the initialization process for vegetation submodel was streamlined, c) the graphical user interface (SAVANNA Modeling System or SMS) was refined and updated, d) more straightforward data inputs for the soil decomposition and nutrient cycling submodel were developed, e) GIS inputs from the newest version of IDRISI (IDRISI-32) were enabled, and f) we began work on developing plant and animal parameter files that will be generally applicable across a wide range of systems in East Africa. This task should be completed early in 2003.

b. Modify PHEWS to better accommodate a variety of economic conditions relevant at different sites.

The adaptation of the PHEWS model to Ngorongoro Conservation Area entailed modeling households weakly tied to local and regional markets. In other POLEYC sites, especially in Kajiado, decisions made by pastoralists and agro-pastoralists are more tightly tied to market conditions. In PHEWS for NCA, livestock were purchased and sold at fixed prices. In Kajiado, prices are associated with market conditions. There is a large diversity of land use types across Kajiado Maasailand as well, with households raising livestock only, livestock and rain-fed crops, livestock and irrigated crops, employment in local businesses, etc, and these responses vary among group ranches. PHEWS has therefore been modified from the original 3 household categories (poor, medium, and rich) to include 9 household categories identifiable in the Kajiado area.

c. Begin model adaptation to new sites.

The new sites are Tarangire and Meru. The model adaptations have just begun. The first step in model application to a new site is simply to become familiar with the site and the key issues. This then enables a general design for model configuration, in terms of identifying the spatial domain, the relevant plant and animal functional groups, management scenarios, etc. This process is underway for both sites, based upon information obtained in workshops, field reconnaissance, and interviews. Considerable progress has been made on research into data inputs to the model for the Tarangire site. We have identified and procured key data sources from literature and unpublished reports. We have also made contacts with people and projects who have critical data needed to run the model. Progress in Meru has been slower, as there are fewer existing data sources. There has been far less research conducted there than in Tarangire; however, our Kenyan collaborators are making good inroads into procuring the data that are available. A PHEWS application for Meru/Tarangire is not yet initiated.

Activity 6: Regional Analyses

Objectives identified for 2001-2002:

a. Begin regional analyses of pastoral wildlife interactions using GIS and remote sensing data.

This work is the PhD dissertation of Joyce Acen, a graduate student from Uganda whom we have been training for the last 3 years. She has completed her coursework as of spring term 2002, and is engaged in her research full time. The objective is for her to finish her work

and her dissertation by the end of the 2002/2003 funding cycle. Joyce spent 3 months at ILRI in 2002 working with Russ Kruska, Meshak Nyabenge, and Suzanne Serneels to begin a synthesis of regional databases for her work. Ms. Acen's work will center on an analysis of spatial and temporal patterns of change in range condition (or evidence of range degradation), and how these relate to large herbivore densities. She will also investigate the effects of increasing crop agriculture on livestock density and productivity.

GENDER

This program has a fairly large number of women scientists. Most of the graduate students on the project are women (Acen, Roque de Pinho, Lynn, BurnSilver), as are several of the senior investigators (Galvin, Reid, Serneels). Gender issues, such as access to resources and decision-making roles, are addressed in our socioeconomic surveys. Contributions of women to the diversification strategies of Maasai households in Kajiado are considered in analyses. The same will be true for fieldwork in the TME and GME. The attitudes of Maasai women (young and old) towards wildlife as a unique group are considered explicitly in the work of Joana Roque de Pinho. Women's groups will be targeted for outreach efforts in Kajiado, as these groups have an active voice in managing land use and economic decisions in the Amboseli Group Ranches.

POLICY

The Integrated Assessment applications that we plan are directly policy-oriented. In these situations, contentious issues having to do with land use and conservation policy are

under review and policies are very likely to be changed. Our IA applications have an excellent opportunity to enlighten policy makers about the probable outcomes of their alternative policy choices. Some of these applications are also management-oriented (Meru). In these cases, policies may also be influenced by weighing the results of the IAs and the implications for development and conservation policy, nation-wide.

OUTREACH

Our outreach targets are many, and our approaches vary depending upon our audience. We disseminate our results to all decision makers who have an impact on resource management in the pastoral zones of Kenya and Tanzania. This includes individual pastoral herd owners and their families who make a multitude of decisions about marketing, stocking rates, animal disease control, coexistence with wildlife, and other issues. This has been accomplished by disseminating our results in non-technical language, in written reports in KiSwahili, and in oral presentations in Maa. We also interact with NGOs in the pastoral zones, and with pastoral groups such as the group ranch committees in Kajiado. These communications include those described above, as well as more technical English language reports, where appropriate. We provide results that are useful to the management staff of our institutional collaborators, such as NCAA and the Kenya Wildlife Service. We interact with decision makers in government ministries that are responsible for decision making in the pastoral zones. These communications take the form of face-to-face meetings and workshops designed to describe our IA approach and the

results we have obtained. We maintain open communication with the USAID Missions in both countries, briefing them on our work and providing them with our reports. We continue to develop "Research Briefs," suitable for most of the non-technical audiences mentioned above.

DEVELOPMENTAL IMPACT

Our Integrated Assessment approach was developed to address issues of conflict and complementarity between conservation and livestock development in arid and semi-arid portions of East Africa, where wildlife and pastoralists have traditionally shared the ecosystem. GL-CRSP support provided an opportunity to begin to apply models and other aspects of integrated assessment to problems related to livestock development. These technologies have, heretofore, been used only to a limited extent in this sort of development context. Our development-relevant goals are to assist pastoral people, policy-makers, and agencies in weighing alternative development and conservation strategies before implementing development or conservation policies and procedures that may be problematic. As a result of demonstrations and work carried out in the first phase of our GL-CRSP project, and due to our outreach and communication activities, we have been asked by conservation agencies (i.e., NCAA), wildlife, land, and conservation management agencies (i.e., KWS), and pastoral people (i.e., Amboseli-Tsavo Group Ranch Conservation Association) in East Africa to assist them in development planning using integrated assessment. As we continue with these applications, the results will benefit the host countries in terms of development and conservation planning, as well as policy analysis. This project has a large team, with a

net result of creating multiple linkages with numerous agencies and institutions in East Africa. IARC collaboration is through ILRI, our primary collaborator.

Environmental impact. The project improves the environment by suggesting management options that will maintain or improve grazing conditions and balance wildlife and livestock uses.

Agricultural sustainability. The IA approach that we use (incorporating the SAVANNA modeling system) emulates long-term ecosystem dynamics, enabling us to determine if specific management actions are likely to lead to sustainable resource exploitation strategies.

Contributions to U.S. agriculture. Lessons learned in studying the semi-arid systems of East Africa can and do shed light on management problems in semi-arid systems in the U.S. In particular, techniques for mitigating wildlife – livestock conflicts are applicable to situations in the U.S. where similar conflicts exist.

Contributions to host countries. We are assisting the resource management agencies of Kenya and Tanzania with planning for land management in areas where wildlife and livestock are in potential conflict. Our results should assist the host countries in the development of management plans that will improve wildlife conservation and pastoral well-being.

Linkages and networking. We have developed important working linkages with many governmental, parastatal, and non-governmental agencies in both countries.

Collaboration with international research centers (IARCs) and CRSPs. One of our most important collaborators in the project is ILRI. We work closely with Robin Reid, Phillip Thornton, and Mrigesh Kshatryia of that organization, among others, on many aspects of the project.

OTHER CONTRIBUTIONS

Support for free markets and economic growth. Our IA assessments demonstrate (and therefore support) the need for broader market involvement of pastoral peoples and for the growth of national economies of East African countries, in order to improve both human economic welfare and environmental sustainability.

Concern for individuals. The GL-CRSP Integrated Assessments are focused on household level actions and impacts; therefore, the project promotes concern for individuals.

Support for democracy. Project activities involve stakeholder input and responses, promoting linkages within East African societies between stakeholders and policy-makers, a cornerstone function of democracy.

LEVERAGED FUNDS AND LINKED PROJECTS

The following projects contributed leveraged funds to GL-CRSP POLEYC during the period July 1-Sept 30, 2002:

USDI/USGS/BRD- PI: Mike Coughenour: “Spatial Ecosystem Modeling of Yellowstone Bison and the Environment.” Total Award \$113,034. Project Period: 6/97-5/02. Project uses SAVANNA Ecosystem Model to model interactions between bison populations and vegetation in Yellowstone N.P. Model

parameterization and testing in this case contribute to GL- CRSP modeling activities in East African Sites.

EPA/STAR- PI: Mike Coughenour: "Assessing the Consequences of Climate Change for a National Park and its Gateway: Interactions of multiple stressors." Total Award \$894,846. Project Period: 10/99-9/02. Project uses SAVANNA Ecosystem Model to model the affects of climate on vegetation and herbivore populations. Model parameterization and testing in this case contribute to GL-CRSP modeling activities in East African Sites.

University of Alaska/NSF- PI: Mike Coughenour: "Modeling Spatial Plant-Geese Interactions in the Yukon Delta." Total Award \$ 314,403. Project Period: 6/00-5/05. Project uses SAVANNA Ecosystem Model. Model parameterization and testing in this case contribute to GL-CRSP modeling activities in East African Sites.

NOAA Office of Economics and Human Dimensions of Climate Fluctuation- PI: Kathleen Galvin: "Responses to Climate Variability and Utility of Climate Forecast Information for the Livestock Sector in Arid and Semi-Arid Zones, South Africa." Total Award \$358,914. Project Period: 7/98-7/02. Phillip Thornton developed a model to identify the impact of climate variability on household economy. Both Thornton (ILRI) and Boone (NREL/CSU) linked the household model to the SAVANNA ecosystem model. Funds from the NOAA grant were leveraged to the GL-CRSP to help Thornton and Boone link the SAVANNA and PHEWS models for applications to the NCA and Kajiado GL-CRSP sites.

NSF Dissertation Improvement Grant- PhD student Jeff Worden: "Maasai Settlement, Landscape Mosaics, and the Spatial Patterning of Vegetation and Wildlife in East Africa."

Total Award, \$20,000. Project Period: 5/01-10/02. The PhD research of Jeff Worden is funded through a combination of GL-CRSP and NSF funds. Funds leveraged to the GL-CRSP through NSF have increased the scope of Jeff Worden's PhD research project.

People, Livestock, Environment Program Funds and ILRI Core Funds- Program Head: Robin Reid. Multiple Project Activities under the general project heading of "Land-Use and Settlement Patterns in Pastoral Ecosystems of Northern Tanzania and Southern Kenya." The following research activities were leveraged: salary for project supervision for R. Reid, travel funds and costs of community workshops in the Mara, the salary of a biometrician to assist both A. Muchiru and F. Atieno in data analyses, and overhead costs of GL-CRSP activities not covered by GL-CRSP funds. Amount Leveraged: \$3,500.

Government of Finland- PI: Robin Reid/ILRI Associate professional officer (Finnish). Funds supported activities under general project heading of "Land-Use and Settlement Patterns in Pastoral Ecosystems of Northern Tanzania and Southern Kenya." Leveraged funds supported the salary of an ILRI associate professional officer, contributing to a ground truthing exercise in Amboseli (Kajiado project area) and the Mara. Amount Leveraged: \$2,000.

Swedish International Development Agency (SIDA) grant to ILRI- PI: Robin Reid/ILRI Post Doc. Funds supported activities under general project heading of "Land-Use and Settlement Patterns in Pastoral Ecosystems of Northern Tanzania and Southern Kenya." Leveraged funds supported the salary of an ILRI Post Doc, contributing to ground-truthing land use types and community workshops held in Kajiado and the Mara. Amount Leveraged: \$2,000.

University of Nairobi- J. Njoka/F. Atieno. "Landscape Change Patterns, Land Use and Environmental Diversity in Kenyan Rangelands: The Case of Greater Amboseli Ecosystem 1988-1998." Leveraged funds from the University of Nairobi contributed to the salary of J. Njoka to support collaborative work on the research paper of F. Atieno (ILRI). Amount Leveraged: \$500.

Unknown Donor- D. Western/A. Muchiru. "The role of abandoned Maasai settlements on dynamics of savanna vegetation and soils, Amboseli, Kenya." Leveraged funds from an unknown donor contributed to the salary of D. Western to support work on the research paper of A. Muchiru (ILRI). Amount Leveraged: \$500.

SAIA- PI: R. Reid/R. Kruska. Funds supported activities under general project heading of "Land-Use and Settlement Patterns in Pastoral Ecosystems of Northern Tanzania and Southern Kenya." Leveraged funds provided a salary for R. Kruska (ILRI) to oversee the research activities of M. Waweru, F. Atieno, and Oderu. Amount Leveraged: \$2,500.

DFID- PI: Phillip Thornton. "Poverty and Livestock Mapping." Leveraged funds supported 1 month of salary for an ILRI research technician working on spatial poverty database for East African region. Amount Leveraged: \$1,500.

TRAINING

During the last funding year we supported six PhD students and one master's student. We hosted a number of non-degree training workshops in Kenya and Tanzania, as well as dissemination meetings, and training at CSU for two African scientists in SAVANNA and IA methodology.

Degree:

Joyce Acen (Uganda), PhD student; degree date: 2003; Ecology; Colorado State University.

Jeff Worden, PhD student; degree date: 2003; Ecology; Colorado State University.

Shauna BurnSilver, PhD student; degree date: 2003; Human Ecology; Colorado State University.

Stacy Lynn, PhD student; degree date: 2004; Ecology; Colorado State University.

Joana Roque de Pinho (Portugal), PhD student; degree date: 2004; Human Ecology; Colorado State University.

John Otuomo (Kenya), M.S. student; degree date: 2004; Botany; University of Nairobi.

Oltisatti Kamuaru (Kenya), PhD student; degree date: 2004; Range Ecology; University of Nairobi.

Non-degree:

Stacy Lynn – Wilderness Transponder First-Aid Training. Colorado State University Outdoor Program.

IA Demonstration Workshop – January 24, 2002. Location: Loitokitok, Kenya. Participants: Group Ranch and local NGO representatives. Presenters: Jim Ellis, Randall Boone, Shauna BurnSilver.

Focus Group on subdivision issues – February 10-15, 2002. Location: Kajiado, Kenya. Participants: Imbirikani North GR members, Eselengei GR members, Meshenani GR members. Presenter: Shauna BurnSilver.

IA Demonstration workshop at KWS Headquarters.

Mrigesh Kshatriya – trained on SAVANNA at NREL, CSU. Dates: July – August, 2002. Trainers: Randall Boone, Michael Coughenour.

NCA Dissemination of IA results to NCAA management – January 2002, Tanzania. Presenters: Jim Ellis, Randall Boone, Shauna BurnSilver.

NCA Dissemination of IA results to Executive Pastoral Council – January 2002, Tanzania. Presenters: Jim Ellis, Randall Boone, Shauna BurnSilver.

NCA Dissemination of IA results to Maasai community members – January 2002, Tanzania. Presenters: Jim Ellis, Randall Boone, Shauna BurnSilver.

IA Demonstration workshop – January 2002. Location: Tarangire, Tanzania. Presenters: Jim Ellis, Randall Boone, Shauna BurnSilver.

Victor Runyoro – trained in IA methodology at NREL, CSU. Dates: October 2001. Trainer: Randall Boone.

NCA Community Meetings – September 19-24, 2002, Tanzania. Presenters: S. BurnSilver, G. Leboy, M. Kshatriya, M. Nyabenge, A. Mwillawa.

COLLABORATING PERSONNEL

Principal U.S. Team Members:

Michael Coughenour, Senior Research Scientist, NREL

Kathleen Galvin, Senior Research Scientist, NREL

Randall Boone, Research Scientist, NREL
Shauna BurnSilver, Project Manager and PhD Candidate, NREL

James DeMartini, Professor, CSU

Terrance McCabe, Professor, CU

Jeff Worden, PhD Candidate, NREL

Stacy Lynn, PhD Candidate, NREL

Joana Roque de Pinho, PhD Candidate, NREL

ILRI Principal Team Members:

Robin Reid, Senior Systems Ecologist, ILRI

Philip Thornton, Research Scientist, ILRI, Nairobi; Edinburgh, Scotland

Meshak Nyabenge, GIS analyst

Joseph Ogutu, Ecologist and Modeller

Leah Muraya, Data Analyst

Mrigesh Kshatriya, Ecosystem Modeler

Suzanne Serneels, Geographer, Remote Sensing

Russ Kruska, GIS Lab Leader

Kamau Kimani, Project Manager and Geographer

Principal Host Country Team Members:

Kenya

Jenesio Kinyamario (Kenyan PI), Professor, Univ. Nairobi, Dept. of Botany

John Mworira, Research Associate, Univ. Nairobi

John Otuoma, MS student, Univ. Nairobi, Dept. of Botany

Jesse Njoka, Professor, Univ. Nairobi

Stephen Mbogoh, Professor, Univ. Nairobi

Mrigesh Kshatriya, Research Scientist, ILRI

Kamau Kimani, Research Associate, ILRI

Jackson Wandera, Land Use Planning Coordinator, SARDEP

Wilber Ottichilo, Director General, RCMRD

David Western, Director, ACC

Jan Grootenhuis, Veterinarian, Private Consultant

Paul Rwambo, Veterinarian, Private Consultant

Richard Bagine, Research Director, KWS

Wycliffe Mutero, GIS Leader, KWS

Michael Kipkeu, Senior Warden, Amboseli NP

Mark Jenkins, Senior Warden, Meru NP
P. Ole Kamuaro, Assistant to the Director,
Natural Environmental Secretariat, and PhD
Candidate, Univ. of Nairobi

Nick Georgiadis, Director, Mpala
Research Centre

James Likampa, Group Ranch
Representative, Imbirikani

David Salaash, Group Ranch
Representative, Eselengei

Leonard Partimo, Group Ranch
Representative, Olgululuri/Lolarashi

Ole Sitaya, Group Ranch Representative,
Osilalei

Joseph Miaron, Manager, Amboseli/Tsavo
Group Ranch Conservation Association

Tanzania

Allan Kijazi (Tanzanian PI), Acting
Conservator, NCAA, Ngorongoro

Victor Runyoro, Chief Ecologist, NCAA,
Ngorongoro

Emmanuel Chausi, Conservator, NCAA,
Ngorongoro

Emmanuel Gereta, Consultant to
TANAPA

Angello Mwilawa, Livestock Research
Scientist, LPRI, Mpwapwa

Francis Ole Ikayo, Director, Inuyat e-Maa
Peter Toima, Director, Maasai

Advancement Association, Arusha
Carol Sorensen, ERETO, Ngorongoro

Gaspar Leboy, ERETO, Ngorongoro
Cuthbert Nahonyo, Professor, University

of Dar es Salaam
Elifuraha Mtalo, Director, UCLAS

Patricia Moehlman, Private Consultant
Fatheem Banyikawa, Research Scientist,

SUNY and Serengeti Research Institute

Uganda

Joyce Acen, PhD Candidate, NREL

COLLABORATING INSTITUTIONS

Kenya:

International Livestock Research Institute,
Nairobi

University of Nairobi

Kenyatta University, Nairobi

Kenya Agricultural Research Institute,
Nairobi

Kenya Wildlife Service, Nairobi

Regional Centre for Mapping of Resources
for Development, Nairobi

National Environment Management
Authority, Nairobi

Mpala Research Centre, Nanyuki

Amboseli/Tsavo Group Ranches
Conservation Association, Loitokitok

Semi-Arid Regional Development
Program, Kajiado

African Conservation Centre, Nairobi

PACT CORE, Nairobi

SOFRECO, Clichy, France (working in
GME)

African Wildlife Foundation, Nairobi

Tanzania:

University of Dar es Salaam

Ngorongoro Conservation Area Authority,
Ngorongoro

Inuyat e-Maa, Arusha

African Wildlife Foundation, Arusha

Tanzanian National Parks, Arusha

Livestock Production Research Institute,
Mpwapwa

Ngorongoro Conservation Area Authority,
Ngorongoro

University College of Lands and
Architectural Studies, Univ. of Dar es Salaam

Executive Pastoral Council, Ngorongoro

OIKOS, Verese, Italy (working in TME)

