INDIGENOUS KNOWLEDGE AND ENVIRONMENTAL CONSERVATION IN EAST AFRICA

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INTRODUCTION

For thousands of years African societies have used knowledge of their local environments to sustain themselves and to maintain their cultural identity. Only recently has this knowledge been recognized by the western scientific community as a valuable source of environmental and social information. Today, large quantities of information exist which demonstrate the existence of effective indigenous strategies for ensuring sustainable use of resources. Such information suggests that indigenous knowledge and its application to enlightened environmental assessment and management should be taken seriously.

The phenomenon that indigenous societies have a rich understanding of their resources, and that they are skilled at experimenting and adapting to changes over time has led to the development of the notion of indigenous knowledge. This been variously labeled as 'traditional ecological/environmental knowledge', 'indigenous knowledge', 'customary law', 'local knowledge', 'indigenous skills', 'traditional knowledge' or' ethnoscience'. I have used indigenous knowledge broadly to encompass these expressions. Despite the lack of a universally accepted definition of the concept, there are certain characteristic features of indigenous knowledge commonly recognized: it is a body of knowledge built through generations living in close contact with nature, it includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use. Indigenous knowledge is integral to the social order in the sense that such things as rights of access of certain resources and rights over custodianship of certain knowledge are socially defined and regulated. The exercise of these rights has political, economic and social consequences in addition to those that are environmental/ecological. Although such knowledge may be local and culture specific, it often represents similar techno-ecological solutions in adjacent areas, and in certain cases functional equivalents in different environmental and socio-cultural settings. Since indigenous adaptations frequently involve long term adjustments to specific environments, they are important to environmental managers and conservationists in providing additional dimensions to scientific modes of human-environment interactions.

Many analysts and development practitioners view positively the effectiveness of indigenous strategies in solving development and environmental problems. There are however examples of unrestrained exploitation of resources based on the conviction that certain natural resources are unlimited or beyond human powers to manage. In certain cases such knowledge may have been destroyed by colonialism, or where they exist may be of limited utility for dealing with contemporary resource management problems because of rapid increases in population density and/or transformation of the production system.

This annotated bibliography presents citations which demonstrate the application of indigenous knowledge and strategies in ensuring the survival of traditional societies and in promoting environmental conservation in East Africa. I have considered indigenous knowledge and its application with respect to technical skills such as cultivation methods

and the construction of soil and water conservation structures. I have also extended beyond technical aspects to include non-technical insights, wisdom, ideas, perceptions and innovative capabilities which pertain to ecological, sociological, geographical and physical phenomena. Examples of indigenous knowledge are found in pastoral survival strategies, in soil and water conservation, farming systems, agroforestry, forest and wildlife conservation, meteorology, in land tenure arrangements, and in institutional mechanisms for regulating access and use of natural resources. These themes constitute the structure of my annotations. These citations describe the strategies, issues, challenges and opportunities to indigenous knowledge, which I briefly discussed in previous paragraphs.

My classification of the citations into the mentioned categories is not rigid; the categories are closely inter-linked and were constructed with the sole intention of capturing a broad variety of applications of indigenous knowledge to environmental management. Thus there is much overlapping between categories. For instance, although certain farming systems by maintaining the chemical and physical properties of soil enhance soil conservation, they were purposely classified under farming systems. Similarly, while agroforestry may fall squarely within farming systems, I treated it separately. Certain features of agroforestry systems such its mix of environmental benefits, its requirement of more intensive farming skills, as well as the mix of trees, crops and animals distinguish it from regular cropping systems. **I** have defined the farming systems category to include crop rotations, multiple cropping, inter-cropping, and shifting cultivation among other practices. Under the soil and water conservation category, I have mainly featured specific structures constructed to prevent soil loss, as well as irrigation and water harvesting/spreading techniques. I have taken East Africa to include Ethiopia, Kenya, Somalia, Sudan, Tanzania and Uganda; and limited my citations to the period beginning 1970 to date. A comprehensive search of the following databases yielded the citations:

Academic search FULLTEXT Elite
AGRICOLA
Anthropological Literature
British Library Catalogues
CARL Uncover and Reveal
CIKARD (Center for indigenous knowledge for agriculture and rural development, University of Iowa)
EconLit
IUCAT-Indiana University's Online Catalog
OCLCs WorldCat
Overseas Development Institute
Social Science Citation Index

Citations were extracted from journals, published books, unpublished reports and other grey material. Each citation begins with the authors last name and initials, followed by the year of publication and title, and the source of citation. Names of journals and book titles are

italicized. The bibliography is not exhaustive, since a large number of references could not be accessed for review.

PASTORAL STRATEGIES

Abdullahi, A.M. 1990. Pastoral production systems in Africa: A study of nomadic household economy and livestock marketing in central Somalia. Farming systems and resource economics in the tropics, Vol. 8. 267p.

This study investigates and describes the pastoral economics at household levels and marketing possibilities in different pastoral wealth groups in Central Somalia. The study communicates that different management strategies and marketing behaviors exist between different pastoral wealth groups or households. Within the framework of these objectives, the author determines the characteristics of pastoral systems by identifying the diversity of the pastoral resource bases. He describes the multi-purpose role and functions of different livestock species in the selected production systems, and identifies the determinants affecting the level, structure and seasonal pattern of incomes and expenditures among different wealth groups and households. The author finally evaluates the development of pastoral systems with regard to institutional, cultural and environmental attitudes which direct a tendency towards land use intensification.

Ayiemba, E.H.0.1981. Human ecology: A study of environmental perception and modes of survival among the Samburu in Kenya. IPAL technical report no. F-2. UNESCO-Man and the biosphere program. Human ecology consultancy reports on the Rendille Samburu and the role of women. Pp47-lll.

The author examines how the dynamic aspects of the environmental perception of the Samburu have influenced their personal life. In particular, the article looks at the relationship between the nomads and their perceptions of the environment and how this influences their organization of space utility. The author provides an outline of the Samburu social structure, the organization of administration and decision making among the Samburu, and consequently the structure of environmental decision making. The author considers Samburu migration as an adjustment procedure to environmental stress. He argues that their rejection of an agricultural economy in favor of a pastoral economy can be explained within the context of environmental and technological determinism. Sedentarization caused by farming or fishing involved greater opportunity costs and higher levels of ethnological development than nomads were prepared to meet. To them pastoralism offered a more flexible means of livelihood that demanded little effort and relatively low levels of technological inputs. The author observes that survival of the Samburu in different ecosystems with varying degrees of ecostress was enabled by a sound knowledge of environmental phenomena. Such knowledge was acquired through territorial mobility characterized by multiple migration returns, as well as through sound environmental education via the Samburu cultural system. The article concludes that environmental education is a means of fostering survival among the nomads, and helps to reduce environmental

risks caused by ignorance of the environments migrated into. And also that greater autonomy of individual family in environmental decision making banks heavily on the environmental knowledge of family heads.

Barrow, E.G.C. 1991. Building on local knowledge: The challenge of agroforestry for pastoral areas. *Agroforestry today,* oct-dec, 1991.pp4-7.

The author provides a brief description of the social and ecological strategies developed by three pastoral communities in East Africa: the Pokot and Turkana of Kenya and the Sukuma of Tanzania. The author cites characteristics of environmental management by these communities as being crucial for providing a sound basis for agroforestry. Such environmental management strategies include grazing management systems of the Pokot; the Pokots' detailed knowledge of local plant species and their uses; the Sukumas' strong social structures for enforcing grazing controls; and the ekwar (traditional agroforestry) system of the Turkana. The author outlines lessons for the development community, researchers and planners, all of who can learn from the way pastoral communities interact with their environment. He concludes that researchers and planners should attempt to identify valuable aspects of traditional natural resource management systems, and later assist local people in adapting these practices to changing socio-economic and environmental conditions.

Campbell, D.J. 1991. The impacts of development upon strategies for coping with drought among the Maasai of Kajiado District, Kenya. In: Stone, J.C. *(Ed.)Pastoral economies in Africa and long term responses to drought.* Proceedings of a colloquium at the University of Aberdeen. Aberdeen University Studies group. Ppll6-128.

The author examines the Maasai strategies for coping with drought and related food deficits in three time periods: precolonial, colonial and post-independence. The author observes that responses to drought among the Maasai are integral to the structure of society-environment interaction, and are therefore liable to change as the developmental context is altered. He argues that colonial and post-colonial development policies in Kenya failed to recognize this relationship and have altered the efficacy and variety of coping strategies, such that the Maasai are today more vulnerable to the effects of drought. To prevent the economic and social marginalization of the majority of the Maasai, the author recommends the adoption of development strategies which enhance the diversity and productivity of the Maasai economy.

De Gans, G. 1986. Taking indigenous knowledge seriously: The case of pastoral strategies among Turkana nomads of northwestern Kenya. ILEA newsletter, no. 5. Ppl4-16.

This article describes some aspects of traditional adaptive strategies among Turkana nomadic pastoralists of northwestern Kenya. Through their devices, these herders

have been able to cope with their harsh and unpredictable environment and to overcome the consequences of natural disasters. However, since the colonial intervention, the traditional system and way of life have been increasingly interfered. A process of fragmentary modernization threatens the viability of the pastoral strategies and makes the livestock owners more vulnerable to calamities like droughts. This article suggests that livestock development interventions must be based on indigenous knowledge systems and on the special skills of these pastoralists to survive in their surroundings. Finally, some experiences and lessons from the author's own work within the Turkana communities are described.

Dietz, T. 1987. Pastoralists in dire straits: Survival strategies and external interventions in a semi-arid region at the Kenya/Uganda border, Western Pokot, 1900-1986. Netherlands Geographical Studies, 49. 324p.

The author investigates the strategies the Western Pokot developed to survive recurrent environmental crises; the impacts of external intervention on the crises and survival strategies of the Pokot; and the conditions under which pastoralism can be a viable livelihood in West Pokot. The author identifies three "layers" of survival strategies: physical survival; survival of animal wealth; and the survival of pastoralism. The study indicates that external actors can only partially influence 'development' because they lack the sensitivity and flexibility required to cope with these harsh and insecure environments, and that development planners should accept that local, dispersed survival strategies are often more important than planned strategies from above.

Dietz, T. 1991. Crisis survival strategies: A summary of concepts and an example from the semi-pastoral Pokot in Kenya/Uganda. In: Stone, J.C. *(Ed.)Pastoral economies in Africa and long term responses to drought.* Proceedings of a colloquium at the University of Aberdeen. Aberdeen University Studies group. Pp86-108.

The author categorizes crises survival strategies of the Pokot into three types: biological, capital and recovery strategies. The author observes that due to continuous threats of drought, livestock disease, and man-made problems, herders in West Pokot have developed a whole range of survival strategies. These crisis strategies are an extension of structural coping mechanisms with a seasonality background. The author provides a comprehensive description of the following strategies adopted by the West Pokot: herd accumulation, animal diversity, herd mobility, herd dispersal, herd management, the pastoral diet, environmental management, raids, acquisition of additional pasture and the exchange of livestock products for grains. The author also gives some attention to non-livestock strategies adopted during the most severe crisis of 1984-1986. Environmental strategies include: which grass to save for later grazing, where and when to establish dry season wells, as well as traditional grazing systems determined by elders. Such systems

include particular hills reserved for calf grazing, others for pregnant cows, hills for lactating cows, and the use of fire to enhance grazing.

Dyson-Hudson, N. And R. Dyson-Hudson. 1987. The structure of East African herds and the future of East African herders. *Development and Change,* vol. 13, pp213-238.

The authors investigate the structure and productivity of pastoralist herds, in order to understand pastoral survival strategies, their environmental perceptions, their technological capacity, management skills, and the needs and intentions of the human populations which manages the herds. The authors view the design of East African herds as an adaptive response at the level of individual behavior, matched at the level of aggregate collective behavior by the design of East African pastoral societies. These responses can be seen as a set of organizational attempts to optimize subsistence in an environment of low predictability and low primary productivity. There are sufficient organizing devices to facilitate collective action when it is politically necessary, but they are not so rigid as to inhibit individuals from independent action when that is ecologically necessary.

Fratkin, E. 1998. Ariaal Pastoralists of Kenya: Surviving drought and development in Africa's arid lands. Cultural Survival Studies in Ethnicity and Change. AHyn and Bacon. 139p.

This book focuses on the social life, cultural ecology and current situation of Ariaal pastoralists of northern Kenya. It shows how these people have survived vicissitudes of drought and political conflict as they wrest a living off their animals in the arid deserts and mountains of northern Kenya. The book also introduces readers to the political and economic problems faced by East African pastoralists today, looking at how the problems of population growth, economic commercialization, and loss of herding lands to ranches, farms and game parks is affecting the ability of livestock-keeping peoples to feed themselves. The author challenges the dominant development paradigm for arid lands that stresses commercial ranching, irrigated agriculture, and the settling of former nomads in towns. The author highlights the weaknesses and maladaptation of current development models, and suggests some alternatives focused on appropriate development that does not disrupt or end pastoral production in Africa's arid lands.

Fratkin, E. 1991. Surviving drought and development: Ariaal Pastoralists of northern Kenya. Westview Press. 152p.

The author investigates how the Ariaal maintain their livestock in this arid region of northern Kenya, and how they cope with the influences of development projects and Christian missionary activities. The author examines issues relating to the Ariaal as well as to pastoral development in general, for example issues on Pastoralists' self-sufficiency, the effects of range constriction on self-sufficiency, what constitutes

appropriate development in pastoral regions and the objectives of donor efforts. The author argues that modernization and development do not necessarily lead to the collapse of indigenous institutions and loss of culture, particularly when development efforts start from the needs of the people they are attempting to serve. The author describes the Ariaal strategy of livestock production and contends that these are the result of long-term adaptations to arid lands. He observes that development agencies, ironically, have consciously sought to alter these traditional subsistence systems to suit the needs of the market.

Herr, R. 1992. Pastoralism in Africa: Paths to the future. A review of Mennonite experience with African pastoralism communities. Mennonite Central Committee, P.O. Box 14894, Nairobi, Kenya. 68p.

This report presents a summary of the Mennonite workers' involvement and relationships with African Pastoralists for the past two decades. In Kenya, Mennonite efforts to relate to Pastoralists focus on camel herd improvement, community development initiatives and on research on traditional trees. Other relationships have focused on creating a "dialogue with Islam" and relating to controversial and issues. The ideas and writings presented in the report provide a reflection of Mennonite workers who have worked with Pastoralists. The aim of this effort is to reflect on the insights and emotion that have come from a posture of presence among, and learning from pastoral peoples and communities.

Herren, U.J. 1991. "Droughts have different tails": The impact of and response to crises in Mukogodo division, Laikipia District, Kenya. In: Stone, J.C. *(Ed.)Pastoral economies in Africa and long term responses to drought.* Proceedings of a colloquium at the University of Aberdeen. Aberdeen University Studies group .

This essay discusses the response to crises by Maasai speaking Pastoralists in Mukogodo division, North-central Kenya. It reviews the crises which have affected Mukogodo pastoralism since the turn of the century and situates them in a wider socio-economic and political context. It then shows how the consecutive crises of 1981, and 1984 have led to a process of stratification, which locks the poor half of the population into an inviable and residual "labor response pastoralism" with declining chances of recovery.

Homewood, K.M. and W.A. Rodgers, 1991. Maasailand ecology: Pastoralism development and wildlife conservation in Ngorongoro, Tanzania. Cambridge Studies in Applied Ecology and Resource management. Cambridge University Press, U.K. 266p.

The book focuses on the ecology and management of Ngorongoro Conservation Area (NCA) in northern Tanzania. The book describes the study of the ecology of N C A Maasai pastoralism and sets it in the wider context of the ecology of N C A and of

Maasailand in general. It explores the conservation values of N C A and those ecological issues that have given rise to conservationist concerns. It documents the nature and extent pastoralists and their impacts on the environment and wildlife. It looks at past management inputs affecting the Maasai and plots the course of pastoralists development in the N C A . The book seeks to establish which factors threaten the continued existence of conservation and of pastoralism in N C A , and conversely those factors that are either compatible with, or positively reinforce the aims of both. The book leads up to a synthesis of the various facets of N C A ecology- range, wildlife, livestock and human- and an integrated view of land prospects in N C A . The authors marshal evidence from historical, political, anthropological, development and archaeological as well as biological studies to explore the ecology of N C A and the future of joint pastoralists/conservation land use here and elsewhere. The book is a mixture of applied biology and the management issues of policies, politics and economics.

Lane, C . , and I. Scoones. 1993. Barabaig natural resource management. In: Young, M.D. and O.T. Solbrig (eds.) ***The world's savannahs: Economic driving forces, ecological constraints and policy options for sustainable land use.*** **Man and the biosphere series, vol. 12. UNESCO-Paris. Pp93-120.**

The authors examine pastoralist ecological management strategies using a case study from the Barabaig of Hanang district, Tanzania. By providing details of the Barabaig land use system, the authors argue that the way the Barabaig manage rangeland resources is a rational and sustainable form of land use. Evidence is given to show that their common land tenure arrangements are both sophisticated and effective for both production and conservation of land resources, but that one inappropriate and costly development project has undermined this system. The case study illustrates the rationale for traditional Barabaig natural resource management. Such management is based on a close understanding of the interactions between components of the landscape and the requirements of a range of resources to sustain production. The study demonstrates how an inappropriate assessment of the economic value of the pastoral production system, and the resources that it depends upon, has led to external intervention that undermines the sustainability of the existing system.

Manger, L. 1994. Managing pastoral adaptations in the Red Sea hills of Sudan: Challenges and dilemmas. Issues paper no. 52. Dryland Networks Program. International Institute for Environment and Development. 27p.

The author presents a descriptive discussion focusing on broad themes of relevance to pastoral planning within the context of Red Sea area pastoralism. The paper deals with four key issues: resource degradation, local groups and resource management, spatial flexibility and access to various resources, and the problem of development administration in the Red Sea Hills area. The author describes the indigenous

systems, their social organization and structure, and how they operate to secure control of access to productive resources. The notions of honor and shame within the social structure may serve as constraints to organizing viable groups for resource management.

Mburugu, E.K. 1981. Factors related to stock ownership and population movements; and perception of land pressure and other environmental changes among the Rendille in Marsabit district. IPAL technical report no. F-2. UNESCO-Man and the biosphere program. Human ecology consultancy reports on the Rendille Samburu and the role of women. Ppl-45.

The author examines the nature of demands the social structure of the Rendille of Marsabit district (northen Kenya) imposes on the environment. The article outlines the effect of specific social arrangements which relate human and livestock populations to the "efficient" use of existing resources such as water and vegetation. The author observes that important social relations are created through the use of stock in the form of either loans or gifts of animals. Such relations become important in sharing labor and providing mutual support during disputes. Livestock ownership is influenced by preference for each type of stock, the availability of the resources for stock care, and the ability to secure assistance in stock care. Constant mobility of the nomads and the common use of scarce resources, particularly vegetation, result in communal land ownership. Selective allocation of land for use by different types of livestock numbers have increased. The Rendille do not perceive this as exerting land pressure, they also do not perceive migrations as a traditional method of conserving biotic resources.

McCabe, J.T., R.Dyson-Hudson, P.W. Lesly, P.H. Fry, J. Wienpahl. 1985. Movement and migration as pastroal responses to limited and unpredictable resources . In: Whitehead, E. et. al. (eds) Arid lands today and tomorrow. Proceedings of an international research and development conference. Tucson, Arizona, October 20-25, 1985. pp701-702.

The paper describes and analyzes the movement patterns of the Ngisonyoka section of Kenya's Turkana Pastoralists. the authors found that most movements occurred in response to environmental conditions such as forage availability and water quality. Social and political factors, though closely connected, do not constitute a major objective. Movement varies both seasonally and among individual herd-owners, since each herd-owner bases his movement decisions on the size and species composition of his herd, his labor force, and his own perceptions of the environment. The authors conclude that the migratory pattern of the Ngisonyoka has developed in such a way as to allow frequent movements, great flexibility and the ability to adjust group size to resources that are both scarce and unpredictable in both time and space.

McCabe, J.T. 1983. Land use management among the pastoral Turkana. *Rural Africana,* nos. 15&16, ppl09-126.

The author examines the pastoral production system of the Turkana and how it relates to the exploitation of natural resources and the general pattern of land use. The pattern of land use among the pastoral Ngisonyoka (a sub-section of the Turkana) involves frequent movements and exploitation of at least five habitat types based on climate, vegetation and soil. Each land owner acts as an independent decision maker adjusting his movement cycle and land management techniques in response to environmental change, social conditions, fluctuations in herd productivity, and annual and seasonal variations in numbers of both animals and humans. There is a marked variation in movement patterns and herd management techniques both within the same herding complex as well as among herd owners. For the Turkana, success and survival have depended on the ability to respond quickly to changing conditions. As a result, a system of land use has evolved in which fluidity, in terms of social organization and independent actions, is a key factor. Development schemes in such areas often attempt to impose rigidity on these indigenous systems. Pastoralists have historically ignored the regulations set down by development planners and pursued management strategies that have ensured their survival in harsh and unpredictable environments.

O'Brien, W.C. 1991. Participation and indigenous knowledge in development of African pastoralists. Msc. Thesis, Virginia Polytechnic Institute and State University. 166p.

This thesis provides a critical review of the literature on pastoral development and addresses the following questions: Do participatory approaches utilizing indigenous knowledge offer a sounder alternative to "top-down"initiatives in pastoral development? While "modernization"strategies in pastoral development have often accelerated social, economic and ecological breakdown, participatory approaches have seldom been attempted. The aerial scope of this thesis is mainly restricted to the arid rangelands of Kenya, and also in Niger where selected projects are discussed. Examples are also drawn from other regions where pastoralism is practiced and are presented to illustrate pastoral systems and to support the arguments presented in this research. The author defines the terms development, participation and indigenous knowledge as they relate to African pastoralism. He presents the indigenous socio-economic survival strategies of East African pastoralists, placing them within the context of a changing world. The author provides an analysis of several pastoral development projects undertaken by major foreign donors in contract with national governments, and attributes their lack of success to an ideology among planners and/or government officials which is "fundamentally hostile to pastoralism". The author, using the example of two NGO sponsored

projects, presents and evaluates a participatory approach to pastoral development based on indigenous knowledge. These provide evidence that participatory approaches can serve as a viable strategy in major, donor-sponsored projects. The author stresses the potential of participation and indigenous knowledge in improving the pastoral condition.

Oba, G and W.J. Lusigi. 1987. An overview of drought strategies and land use in African pastoral systems. Pastoral Development Network Paper 23a. Agricultural Administration Unit. Overseas development Institute. 33p.

The authors review pastoral nomadic strategies for mitigating drought effects, including the ecological and social significance of these strategies. The authors examine conditions contributing to the gradual breakdown of nomadism, including some current drought policies in the pastoral areas. The review highlights the general problems faced by pastoral peoples. The authors suggest that the development of pastoral lands must take a form suitable to the sociological, political and ecological system to which these areas are best adapted. They also suggests that an advantage might be gained by building onto the traditional forms of land use.

Oba, G. 1994. The role of indigenous range management knowledge for desertification control in Northern Kenya. Research report No. 4 form EPOS (Environmental Policy and Society) Uppsala and Linkoping universities. 40p.

This report presents a case study illustrating indigenous range management systems of the Rendille and Maa-speaking Ariaal Pastoralists of Northern Kenya. It provides a comprehensive description and analysis of the socio-ecological basis of the Pastoralists' indigenous range management, and how this may be employed to control desertification. The author discusses the historical evidence of desertification in this region of Kenya, and provides an account of Pastoralists' indigenous range management knowledge employed to adjusts to changing events.

Smith, A.B. 1992. Pastoralism in Africa: Origins and development ecology. Hurst and Company, U.K. 288p.

This book is an attempt to correct misconceptions about diminishing importance of pastoralism in various parts of Africa, by showing that the ecological adaptation of pastoralism has considerable time-depth in Africa. The book looks at the ethnological details of present and past pastoral survival and adaptation on the assumption that the environmental constraints of the present would equally have placed restrictions on pre-historical pastoral groups. It draws together ideas concerning how and when pastoralism began in Africa. In order to make sense of the past, a close look at the present pastoralism ecology is necessary. The author selectively chooses aspects of various herding societies in Africa to illustrate the cultural variability, complexity as well as the relationship with the wider ecology,

both social and physical. Aim is to broaden our understanding of the specific pressures on the herding way of life, and allows us to create models of the dynamics of changes affecting pastoralists. From these models we can produce hypotheses and a potential methodology for the study of pre-historic pastoralism in Africa, and, looking to the future, a statement on the prognosis for the survival of pastoralism can be made.

Western, D. 1982. The environment and ecology of pastoralists in arid savannas. *Development and Change,* vol. 13, ppl83-211.

The paper examines the dynamic interactions of pastoralists and their environments, focusing on the East African pastoral Masai group. The author delineates and discusses three inter-related components namely: the abiotic, biotic and the population, in order to highlight the significance of the environment to a pastoral society, and to highlight the efficiencies and limitations of pastoralist strategies in exploiting natural resources. The extreme demands of the environment on pastoralists have led to exploitation techniques that have been successful through time and have resulted in comparatively high human density on marginal lands. Recent changes result from their adopting technologies that initially increase their efficiency of exploitation, but which will eventually result in imbalances that exacerbate their potential for land degradation. The author emphasizes that a broader view of pastoralism in extreme environments is required, one in which the ecological, economic and social aspects are examined under a variety of situations, and in which the short and long term problems are evaluated. The author concludes that technology has contributed much to the problems facing pastoralists in the savannahs, not because it is inherently disruptive, but because it has been poorly applied and not balanced against prevailing social and ecological situations.

SOIL AND WATER CONSERVATION

Acres, B.D. 1984. Local farmers' experience of soils combined with reconnaissance soil survey for land use planning-an example from Tanzania. *Soil survey and land evaluation,* vol.4 no.3.pp77-86.

By relating information gathered from local farmers to that gained from a reconnaissance soil survey in the Tabora region of Tanzania, the author illustrates the African farmer's knowledge of the soils he uses and a means of recognizing and distinguishing them. Farmers recognized eight groups of soils, the distribution of these soils, and the crop suitability and constraints to agricultural production/land use imposed by each type of soil. Traditionally, farmers had access to land on each of the different soils to enable them to cultivate a range of crops and spread the risk of crop failure. The author shows that the results of a systematic soil survey can be related to

the soil nomenclature used by local farmers and their assessment of suitability for cultivation. A common soils nomenclature can promote understanding and communication between farmers, extension workers, planners and even administrators.

Adams, W.M. 1997. Capture and *desengagement:* Indigenous irrigation and development in sub-Saharan Africa. In: Adams, W.M and L.J. Slikkerveer (eds) *Indigenous knowledge and change in African agriculture.* Studies in technology and social change No. 26. Center for Indigenous Knowledge for Agriculture and Rural development. Iowa State University, Ames, Iowa. Ppl33-164.

The author describes the nature of indigenous irrigation in Africa, looking in particular at the hill furrow irrigation of Kenya and Tanzania. It describes attempts to 'capture' the irrigation by incorporating it into the market economy and changing its technical basis, and explores the implications of such changes in the ways in which the formal sector itself is organized due to first the impacts of structural adjustment and 'desengagement'. The author investigates how the process of 'development' affects indigenous irrigation, and how we should understand, study and create knowledge about indigenous irrigation.

Alemayehu, M. 1996. Traditional ditches in northern Shewa, the Ethiopian highlands. In: Reij et al. (Eds.) *Sustaining the soil: Indigenous soil and water conservation in Africa.* Earthscan publications. ppl63-169.

The author examines the factors which influence farmers' use and assessment of traditional ditches. He finds that traditional ditch construction for soil and water conservation is widely practiced by farmers cultivating crops on the steep slopes of the Ethiopian highlands. Farmers perceived this practice to be an effective way of controlling soil erosion and water logging, and continue to build ditches regardless of whether other forms of soil and water conservation are introduced.

Asrat, K., K. Idris and M. Semegu. 1996.The 'flexibility' of indigenous soil and water conservation techniques: A case study of the Harerge highlands, Ethiopia.In: Reij et al. (Eds.) *Sustaining the soil: Indigenous soil and water conservation in Africa.* Earthscan publications. ppl56-162.

The authors describe traditional soil and water conservation techniques used by farmers in the Harerge highlands of Ethiopia, and explain how these techniques are uniquely adapted to the different crops, labor demand patterns and physical conditions found in the agro-ecological/altitudinal zones of the highlands. These soil and water conservation structures are constructed in response to local needs and circumstances. Introduced structures fail to do this. The authors thus argue that by failing to address the diversity of local needs and circumstances, project interventions can undermine the flexibility of traditional approaches to soil and water

conservation.

Barrow, E.G.C. 1989. The value of traditional knowledge in present-day soil conservation practice: The example of West Pokot and Turkana. In: Thomas, D.B. et. al. (eds) Soil and water conservation in Kenya: Proceedings of the 3rd National Workshop Kabete, Nairobi, 16-19 Sepetmber,1986. pp471-485.

The paper highlights traditional values that Pokot and Turkana people of Kenya have which could be of intrinsic value to soil and water conservation if used sensibly in the dry areas. It further attempts to identify methods of incorporating such traditional values in soil and water conservation practice for arid and semi-arid lands. The author cites the sustained management of woody species, grazing management, the cultural value and attachment placed on trees as of integral importance in sustained rangeland management, and by inference, soil and water conservation. The broader traditional range management policies help conserve the arid lands, while the attitudes to woody species (trees in particular), ensure that very few or no trees are actually cut. This acts as a conservation control along rivers and water courses where the majority of the good trees are found. The author observes that these well-developed traditional land management systems are in danger of breaking down, largely due to outside interference, without trying to adopt the system to new changes.

Barrow, E. 1988. Trees and pastoralists: The case of the Pokot and Turkana. Social Forestry Network. Overseas Development Institute. 24p.

The article highlights some of the traditional values that the Pokot and Turkana have which could be of intrinsic value to soil and water conservation, if used sensibly in dry areas. It further identifies methods of incorporating such traditional values into soil and water conservation practice for arid and semi-arid lands. The author outlines specific range management and land use strategies, as well as woody species utilization and management among the Pokot and Turkana. The author emphasizes the role of extension in relation to woodland management in these areas, and perceives it as a link between differing degrees of traditional knowledge in the use of trees and woodland management, and tree planting, which in many cases is an alien concept to the people. The author notes the importance of using traditional knowledge and traditional management systems as a base for pastoral development projects.

Critchley, W.R.J., C. Reij and T.T. Willcocks. 1994. Indigenous soil and water conservation: A review of the state of knowledge and prospects for building on traditions. *Land degradation and rehabilitation*, vol. 5, pp293-314.

This review explores two hypotheses: first, that much can be learned from previously ignored indigenous soils and water conservation practices; and secondly, that indigenous soil and water conservation can often act as a suitable starting point for the development of technologies and programs. The authors provide examples of

indigenous soils and water conservation techniques from various countries worldwide, with a specific emphasis on sub-Saharan countries. The authors indicate that indigenous soil and water conservation evolves and thrives under a suite of specific circumstances. These include where moisture limits the production of crops and fruits; where there is cultivation of hillsides; and where there is population pressure. The authors also examine circumstances under which indigenous soil and water conservation is abandoned. They find that exodus of labor from where terracing requires a high level of maintenance, and an associated breakdown of social organization for maintenance, is one important cause. Others include: decreasing rainfall; shift of technology from the hoe toward oxen or tractor ploughing and where projects have ignored the existing traditions and superimposed new structures over the old. Based on their review, the authors conclude that although there is a widespread tradition of soil and water conservation which has been consistently overlooked, the little that is known confirms there are useful lessons to be drawn from indigenous soil and water conservation. They also conclude that although there is only limited evidence of projects which have used indigenous soil and water conservation as a starting point and performed positively as a result, there are indicators that this approach holds promise. Building on traditions may constitute a best-bet strategy against the backdrop of frequent failure in resource conservation programs.

Critchley, W. 1989. Building on a tradition of rainwater harvesting. *Appropriate technology* vol.16, no. 2, pplO-12.

The author briefly describes some traditional rain water harvesting techniques in sub-Saharan Africa. These include the *caag* system of Somalia, the *terus* of Sudan and the stone bunds in Burkina Faso. The author states that these systems enable pastoralists to make the most of irregular rainfall, and argues that these methods can sustain a delicate balance between cropping and pastoralism which is both environmentally and socially appropriate. The author cites eight guiding principles for projects and development planners about to embark on rainwater harvesting systems. These include building on traditional technique, establishing needs and encouraging participation, and avoiding systems which the people cannot replicate or maintain themselves.

El Sammani, M.O. and S.M.A. Dabloub. 1996. Making the most of local knowledge: Water harvesting in the red sea hills of northern Sudan. In: Reij et al. (Eds.) *Sustaining the soil: Indigenous soil and water conservation in Africa.* Earthscan publications. Pp28-34.

This account looks at the continuing importance of indigenous techniques of water harvesting in the red sea hills of Sudan. Water harvesting and conservation methods have been practiced for centuries in this region, a region which would otherwise be

unable to support human habitation. The authors describe the local technologies for harvesting water, the labor requirements for implementing technology, and the social organization of these efforts. The author observes that indigenous methods of water conservation are crucial to farming in the arid environments of the red sea hills, and provide the most feasible way of irrigating crops using simple technology and locally available materials.

International Fund for Agricultural development (IFAD), 1992. Soil and water conservation in sub-Saharan Africa: Towards sustainable production by the rural poor. IF AD, 1992.109p.

This paper attempts to treat soil and water conservation in the whole of sub-Saharan Africa. The scope of the paper is limited to soil and water conservation on the rainfed agricultural land of small scale farmers. In its discussion of responses to land degradation, the paper describes indigenous systems of cultivation as well as indigenous responses to land degradation, in particular indigenous soil and water conservation techniques, for a cross section of countries throughout sub-Saharan Africa. The paper broadly analyzes the causes for the breakdown of traditional systems and highlights the potential of indigenous conservation systems. It outlines reasons for the failure of many soil and water conservation projects, and suggests that indigenous conservation techniques be used as a starting point for new program, within a more participatory framework.

Kruger, H., B. Fantaw, Y.G. Michael and K. Kajela. 1996. Creating an inventory of indigenous soil and water conservation measures in Ethiopia. In: Reij et al. (Eds.) ***Sustaining the soil: Indigenous soil and water conservation in Africa.*** **Earthscan publications. ppl70-180.**

The inventory of indigenous soil measures described in this chapter provides detailed information about the diverse and ingenious ways in which framers have evolved to try and manage their land. The inventory demonstrates not only the strengths of these practices and the options for improvement, but also where major weaknesses exist. \the research suggests that there is wider scope for integrating aspects of indigenous soil and water conservation approaches and vice versa to improve their acceptance and appropriateness.

Lema, A.J. 1996. Cultivating the valleys: Vinyungu farming in Tanzania. In: Reij et al. (Eds.) ***Sustaining the soil: Indigenous soil and water conservation in Africa.*** **Earthscan publications.Pp 139-144.**

This chapter focuses on an indigenous soil and water conservation technique in south western Tanzania known as Vinyungu valley bottom cultivation. The author contrasts it with upland dry and wet season cultivation, but also notes the low attention this technique receives in agricultural production.

Mascarenhas, O. and P.G. Veit. 1994. Indigenous knowledge in resource management: Irrigation in Msanzi, Tanzania. From the ground up case study series, No. 6. World Resources Institute and Africa Center for Technology Studies. 58p.

This account examines an indigenous irrigation and water-drainage system in Msanzi village in South West Tanzania. This system has increased agricultural production, through both expansion and intensification, and improved the well-being of the local citizenry. The study analyses the critical factors that led to effective water management practices in Msanzi and to identify those policy and program options that could encourage other rural communities to make similar developmental advances.

Mbegu, A.C. 1996. Making the most of compost: A look at the *Wafipa* mounds in Tanzania. In: Reij et al. (Eds.) *Sustaining the soil: Indigenous soil and water conservation in Africa.* Earthscan publications. Ppl34-138.

This article outlines farmer's perception of the *'wafipa'* mound cultivation system of the Ufipa plateau of south west Tanzania. It also determines the extent of *Wafipa* mound cultivation. This technique evolved from a practical understanding of the poor fertility on soils of the Ufipa plateau, and involves the use of compost mounds, which not only improve soil fertility, but also (due to their arrangement in rows on slopes) provide an important barrier to water run-off.

Mohammed, Y.A. 1996. Drought and the need to change. In: Reij et al. (Eds.) *Sustaining the soil: Indigenous soil and water conservation in Africa.* Earthscan publications. Pp35-43.

The author describes the indigenous technique of harvesting water run-off in Central Darfur, El Fasher Province in Sudan. He compares the indigenous *trus (tera* singular)system with modern, introduced water spreading techniques, and cites advantages of *trus* as its lower cost and less sophistication. The author cites that *trus* technology has survived because it is rooted in the local culture, and more importantly, because it enables farmers to grow millet in sandy soils and sorghum in clay soils. The complementarity of clay and sandy soils maximizes the potential of this ecological setting and provides more secure food production in the region.

Mohammed, Y.A. 1994. Traditional water harvesting techniques and their contribution to food security: Case study of Wadaa village, Northern Darfur, Sudan. In: Ahmed, M.M. (ed.) ***Indigenous knowledge for sustainable development in the Sudan.*** **Institute of African and Asian Studies. University of Khartoum, Sudan. Sudan library series 20. University Press, Khartoum, Sudan. Ppl78-214.**

The paper highlights the contribution of indigenous knowledge and the relevance of traditional practices in the solution of environmental and food security problems in drought-stricken areas of the Sudan. The study assesses opportunities for development of indigenous water harvesting techniques.

Ostberg, W. 1995. Land is coming up: The Burunge of Central Tanzania and their environments. Stockholm studies in social anthropology. 258p.

This study examines how the Burunge of Tanzania relate to their land resource. Local forms of land husbandry is studied in a wide framework, including both social stratification and ethnic relations. The author presents examples of indigenous soil conservation techniques, and discusses the confrontation between local understanding of good husbandry as against soil conservation introduced by a development project. It further examines how the Burunge perceived the processes of soil formation and erosion, and presents a Burunge theory of soils. The author also considers forestry as an energizing component of Burunge subsistence.

Ravnborg, H.M. 1990. Peasant's production system and their knowledge of soil fertility and its maintenance: The case of Iringa disrict, Tanzania. Center for Development Research, Working paper 90.1. Denmark.

The study was conducted to identify peasants' concept of environmental sustainability in relation to their agricultural production. The author places emphasis on the utilization and maintenance (or improvement) of soil resources, particularly the chemical and physical properties of the soil. The author describes farmers' different techniques of soil preservation, and notes that the farmers have clear ideas on the notion of unsustainability, as opposed to sustainability. In areas of low soil fertility and pronounced land scarcity fallow rotation is difficult, and many farmers regard their present cultivation practices as unsustainable. Since means of improving soil fertility such as manure were hard to get hold of, these farmers saw no other solution than continuing their present practices. The author argues that having a notion of sustainability involves a judgement of longer term consequences of the present family practices. For farmers whose knowledge is primarily based on direct observations, such judgements are difficult to make unless changes can actually be observed.

Reij, C. 1991. Indigenous soil and water conservation in Africa. Gatekeeper Series no. 27. International Institute for Environment and Development. 35p.

The paper addresses the current knowledge of indigenous soil and water conservation in Africa in order to identify research needs and policy requirements in the field of African indigenous soil and water conservation. The author demonstrates that despite a growing awareness of the importance of indigenous knowledge in soil and water conservation, African soil and water conservation continues to be neglected. The author analyzes cases where indigenous techniques have been maintained or abandoned, as well as the effects of project interventions on the survival or abandonment of indigenous soil and water conservation techniques. A detailed annex presents examples of indigenous soil and water conservation techniques from Somalia, Sudan, Cameroon, Morocco and Tunisia.

Scoones, I., C. Reij and C. Toulmin. 1996. Sustaining the soil: Indigenous soil and water conservation in Africa. In: Reij et al. (Eds.) *Sustaining the soil: Indigenous soil and water conservation in Africa.* Earthscan publications. Ppl-27.

This overview chapter analyzes the failure of soil and water conservation measures in Africa from the early colonial era to the present, with the aim of determining the reason and investigating alternative approaches which build on local traditions in soil and water management. The authors identify the key characteristics of locally managed soil and water conservation systems, they examine the conditions necessary for the successful adoption and expansion and suggest ways in which development approaches can be organized to be more effective in promoting the process of local level soil and water conservation technology development. The authors suggest a dynamic interpretation of "indigenous", which results to a wide-ranging perspective on technology. They argue that the distinction between indigenous and introduced technology is in many cases artificial, since many so-called indigenous technologies have been introduced and virtually all introduced technologies have been indigenized through local adaptation. They further argue that externally derived technology is not necessarily inappropriate, but rather, the manner in which the technology is introduced will fundamentally determine its compatibility with indigenous soil and water conservation practices.

Soper, R. 1983. A survey of the irrigation systems of the Marakwet. In: Kipkorir, B. et al (eds) Kerio valley: Past, present and future. Proceedings of a seminar held in Nairobi at the Institute of African Studies, University of Nairobi, May 21-22, 1981.pp75-95.

The author describes the traditional irrigation furrows constructed by the Marakwets, its technology, and provides estimates of the water capacity and the area served. The author observes that the pattern, size and alignment of furrows are logically consistent with physical factors. However, under some exceptional circumstances,

the design of the furrow system may be determined by cultural factors, so that a clan may make its own furrow arrangement as a way of establishing its rights. The author describes the allocation of water and observes that the allocation system is intimately bound up with social organization and the history of the Marakwet communities.

Ssennyonga, J.W. 1983. The Marakwet irrigation system as a model of a systems-approach to water management. In: Kipkorir, B. et al (eds) Kerio valley: Past, present and future. Proceedings of a seminar held in Nairobi at the Institute of African Studies, University of Nairobi, May 21-22,1981.pp96-lll.

The paper presents the institutional background of the traditional furrow irrigation system of the ethnic Marakwet of Kenya. The author outlines its basic organizational and managerial factors. Furrows were constructed and owned by clans or lineages. This system is modified by the physical distance of a group's residential and agricultural lands, and the labor demands in relation to construction. These circumstances led to several clans/lineages sharing the construction and ownership of furrows. Access rights are allocated according to convenient water source regardless of ownership. The author discusses furrow maintenance systems, labor mobilization, conflict management, and change management. The author summarizes this system as a model run by local communities on non-bureaucratic principles, with a simple design and an economy of access rules. The system offers multiple benefits to the user in that there are vested and overlapping interests in several furrows, for example, domestic, livestock and irrigation needs are served by different water furrows. In addition there are benefits accruing from inter-clan arrangements e.g. access to land, special treat at feasts. A ll these overlapping interests generate a level of commitment hard to find in large scale and bureaucratically organized systems. The author emphasizes three replicable features of the Marakwet irrigation system as: its institutional integration within the social system; its non-bureaucratic management; and its maintenance by the community.

Temu, A.E.M., and S.Bisanda. 1996. Pit cultivation in the Matengo highlands of Tanzania.In: Reij et al. (Eds.) *Sustaining the soil: Indigenous soil and water conservation in Africa.* Earthscan publications. pp 145-150.

This chapter describes a pitting technique of cultivation known locally as *'nguro'* or *'ingolu'* which was developed by the Matengo ethnic group living in Msinga district in the southern highlands of Tanzania. The technique, developed by the Matengo to control soil erosion on steep highlands and to improve soil fertility, is probably over two hundred years old, and is still in use today. It serves as a good example of a successful indigenous technique which controls erosion on steep hillsides.

van Dijk, J.A. 1993. Opportunities for expanding water harvesting in sub-Saharan Africa: The case of the *Teras* of Kassala. Gatekeeper series n. 40. Sustainable

agriculture programme, International Institute for Environmental and Development. 19p.

The author describes the *Teras* technique, an indigenous water harvesting technique practised by peasant farmers in the Kassala border area of east Sudan. The *Teras* system has the dual objective of capturing small run-off volumes generated by light early rains, as well as to reduce flow velocities to less erosive magnitudes during heavy rains. Both are aimed at maximizing the lands agricultural productivity. The author shows that the structure and function of *Teras* vary with physical characteristics such as slope configuration. Although the technique is labor intensive, and provides relatively low grain yields, the *terus* are critically important strategies for spreading and managing risk. The author concludes that its small scale, private management and adaptive capacity make it a technology replicable in other areas of the Sudan and sub-Saharan Africa, and urges rural development programmes to tap the rich source of indigenous knowledge more than is presently the case.

Van Dijk, J.A. 1995. Taking the waters: soil and water conservation among the settling Beja nomads in Eastern Sudan. African studies center, Leiden. Research series 4/1995.

The study focuses on the effects of government soil and water conservation interventions and the importance of indigenous soil and water conservation in household livelihoods in four selected villages in the Border area of Sudan from the 1980s onwards. A historical evidence of early crop production is provided, covering the period which starts at the end of the 19th century, and reporting on emerging indigenous and introduced soil and water conservation techniques. The effects of government soil and water conservation in the Border area are assessed in terms of common project evaluation measures of effectiveness, efficiency, impact, and project sustainability. The importance of indigenous soil and water conservation in household livelihoods is assessed in terms of income, coverage of cultivated lands, the allocation of labor time, and the perception of land users.

FARMING SYSTEMS

Al-Batal, S.M.A. 1994. Agricultural systems, practices, and traditions in northern Sudan: A case study of the Nubian region. In: Ahmed, M.M. (ed) *Indigenous farming systems, knowledge and practices in the Sudan.* Institute f African and Asian Studies, university of Khartoum, Sudan. Sudan library series 21. pp41-93.

The paper provides a comprehensive description of farming systems, practices and traditions adapted by the Nubians of northern Sudan, focusing extensively on the soil

and water conservation techniques utilized by farmers. The author outlines relationships between traditional and modern agricultural technology, and identifies the main influence of modern agriculture on traditional systems as the increased use of chemical fertilizers and the introduction of water pumps. The author notes that modern technological innovations did not significantly change the traditional agriculture system.

Basehart, H.W. 1973. Cultivation intensity, settlement patterns, and homestead forms among the Matengo of Tanzania. *Ethnology,* vol. 7, no. l.pp59-73.

The author compares one indigenous, intensive cultivation system with a more extensive type of farming practiced by the Matengo in the highlands of southwestern Tanzania. The author describes the characteristic style of cultivation by the Matengo, referred to by agriculturalists as the 'pit system'. This has been found to be most effective in preventing erosion of the cultivated mountainsides. Use of pits with green manuring, crop rotation and fallowing insures the maintenance of fertility of the fields. The author suggests that population pressure and invasions by the Songea Ngoni may have fostered intensive cultivation among the Matengo as an adaptive

Belshaw, D. 1979. Taking indigenous knowledge seriously: The case of inter-cropping techniques in East Africa. IDS bulletin, vol. 10, no. 2. Institute for Development Studies, Brighton, England. Pp24-27.

The author focuses on changes in the attitudes of research workers to inter-cropping techniques in tropical Africa, and especially in three East African countries, over the last twenty years. Inter-cropping or associated cropping is an indigenous technique practiced in small scale farming systems in the tropics. The author presents a historical outline of applied scientific and economic research on inter-cropping systems in East Africa. Possible advantages of such systems include raising farm outputs, reducing variance in output levels, reducing labor inputs per unit of product, ensuring a timely supply of a varied range of fresh foods and avoiding cash outlays on inputs such as fertilizer. The author argues that by applying the standard agronomic criteria to evaluate the appropriateness of the inter-cropping technique, recent experimental researchers ignored the utility of inter-cropping in meeting other farm objectives. To overcome this problem, the author suggests the adoption of research approaches which consider the fundamental human needs of rural farmers and their dependents as the central concern of the research activity.

Brokensha, D., and B.W. Riley. 1991. The centrality of indigenous knowledge for the agricultural development of marginal areas of Africa. In: Leakey, R.E. and L.J. Slikkerveer (eds) *Origins and development of agriculture in east Africa: The ethnosystems approach to the study of early food production in Kenya.* Studies in Technical and Social Change, No. 19. Technology and Social Change Program. Iowa

State University, Ames, Iowa. Pp209-214.

The authors indicate that many previous studies have demonstrated that local farming systems in Africa are characterized by being dynamic, diversified, appropriate, with low capital and high labor demands. They note that these systems have been distorted by the colonial experience, introduction of cash and cash crops, markets, commercialization of natural resources, migrant labor and advent of strangers, state intervention and population growth. They use Mbeere in Kenya as evidence of these effects. They caution that "traditional ways" should not be romanticized, but what is required is a balance between indigenous and western knowledge, especially in development intervention. They recommend that indigenous knowledge is an essential starting point in looking at modern and past African farming systems, especially in marginal areas where such knowledge was necessary for survival. Development interventions will fail unless account is taken of indigenous knowledge.

El-Medani, K.A. 1994. Some aspects of indigenous farming knowledge in the Blue Nile area: The case of Abu Gumi village. In: Ahmed, M.M. (ed) ***Indigenous farming systems, knowledge and practices in the Sudan.*** **Institute of African and Asian Studies, university of Khartoum, Sudan. Sudan library series 21.pp95-135.**

The author discusses the indigenous agricultural activities of the traditional farmers in the Blue Nile region of the Sudan, and their management of different ecological and environmental conditions within the region. Emphasis is placed on farmers' indigenous knowledge and the way it is utilized to make important agricultural decisions regarding soil preservation. The author notes that the introduction of mechanized methods by modern projects has created environmental problems.

Gallaij, J. and A.H. Sidikou. 1978. Traditional strategies, modern decision-making and management of natural resources in the Sudan-Sahel. In: Management of natural resources in Africa: Traditional strategies and modern decision-making. MAB technical notes 9. UNESCO/UNEP.

The authors describe traditional agricultural strategies adopted by farmers in the Sudano-Sahelian region. They illustrate the spatio-temporal strategies of the Zarma of Niger; the irrigation techniques of the Dogons of Mali,; the rice cultivation strategies of farming peasants in the Niger river valleys; the rice cultivation strategies of the Oulof people of the lower Senegal valley. These case studies are used to hilight the essential characteristics of traditional strategies in the Sudano-Sahelian zone. The authors argue that the essential characteristics of traditional Sudano-Sahelian traditional strategies involves matching food security with village ideology. The authors highlight fundamental conflicts between modern and traditional strategies. A major constraint of modern strategies is that they base development

projects on exist administrative structures such as provinces, departments/counties, districts or villages. This often leads to the loss of regional characteristics upon which traditional strategies are founded.

Knight, G.C. 1974. Ecology and change: Rural modernization in an African community. Academic Press, New York. 300p.

The author explains the traditional agricultural system of the Nyiha of southwestern Tanzania, and outlines the process and results of agricultural change within this society. He provides a comprehensive account of traditional agricultural practices used by the Nyiha for exploiting their environment. He discusses the Nyiha's complement of tools and crops, as well as the land management systems, focusing on the way in which agricultural practice articulates crops and environment through the seasons and the years. The author also considers contemporary agricultural patterns, analyzing farming systems distribution throughout Unyiha as a basis for evaluating agrarian change in recent decades, such as intensified food production, cash crop growing and adoption of new technologies. Sources of change are both indigenous, such as migration and inter-cultural marriages, as well as external, such as through missionaries, through traders, and the government via agricultural extension officers. The author proposes four models of agrarian change among the Nyiha of Tanzania.

Mothoa, M.P. 1994. The design and development of sustainable agricultural systems for small farmers in the third world: A review. Masters thesis in agriculture, University of Pretoria, South Africa.377P.

This study is based on a literature review from which a strategy for small-scale farm development in a developing world scenario is proposed. The role of indigenous knowledge and the preservation of traditional social institutions and farming systems is stressed. The study argues that the crucial factor in the concept of sustainability is not just the elimination of expensive capital inputs, but diversification of the farm business to minimize production and marketing risks. It is argued that production approaches that have been adopted from developed countries were transferred without being necessarily suited to the circumstances of the small farmer and the consumer in a third world situation.

Naulikha, G.M.K. 1992. The relative importance of indigenous knowledge and modern strategies in the development of agricultures in Trans-Nzoia district, Rift Valley province, Kenya. Paper presented at the African Studies Association of the

U.K., university of Sterling, 8-10 September, 1992. 20p.

The author outlines the indigenous agricultural practices in Trans Nzoia district prior to colonialism, and examines how agricultural policies in the colonial and post-independence influenced indigenous agricultural practice. The colonial era was characterized by the subjugation of African agriculture to European settler farming, which was large scale and used modern equipment. Colonial strategies were maintained at independence. Despite these influences, the author notes that a small number of small-scale farmers in the district still utilize a mix of both traditional and modern farming methods. The author recommends that agricultural policies should promote such mixed strategies as a way of increasing agricultural productivity.

Naulikha, G.M. 1997. Indigenous knowledge and modern strategies in the development of agriculture in Trans-Nzoia district, Rift Valley Province, Kenya. In: Adams, W.M and L.J. Slikkerveer (eds.) ***Indigenous knowledge and change in African agriculture.*** **Studies in technology and social change N. 26. Center for Indigenous Knowledge for Agriculture and Rural development. Iowa State University, Ames, Iowa. Pp57-66.**

Thus paper presents a historical view of agricultural development in Trans-Nzoia district in Kenya. The author observes that changes in agricultural strategies during the colonial period, as well as after independence have contributed to the decline in indigenous knowledge by local farmers. This resulted in a breakdown in the food security systems of local communities and increased uncertainty and environmental risk. The author emphasizes the need for policy makers, rural development planners in Trans-Nzoia to incorporate indigenous agricultural knowledge in planning, implementation and appraisal of projects. This may help Kenya attain increased production and food self-sufficiency.

Rahman, A.I.A. 1994. Traditional farmers' coping strategy for combating environmental stress in Kosti area, west of the White Nile. In: Ahmed, M.M. (ed) ***Indigenous farming systems, knowledge and practices in the Sudan.*** **Institute African and Asian Studies, university of Khartoum, Sudan. Sudan library series 21.**

The author investigates the viability of traditional strategies for coping with drought, describes the strategies adopted and the objectives underlying the strategy.

Sharland, R.W. 1989. Indigenous knowledge and technical change in a subsistence society: Lessons from the Moru of Sudan. Agricultural Administration (Research and Extension) Network. Network paper no. 9. Agricultural Administration Unit. Overseas development Institute. 30p.

This study of the Moru people of southern Sudan highlights the complexity of the agricultural system and its interactions with the wild environment. Practical responses to problems conceptually removed from commercial thinking, and often

ingenious in their effectiveness, are identified by the author. Knowledge gaps present spheres in which indigenous knowledge can intertwine with more formal knowledge in developing solutions. The author presents a methodology for using indigenous knowledge, and offers specific recommendations on how this knowledge can be linked to formal knowledge. The authors observe that internal processes of change, indigenous experimentation and an analysis of peoples resistance to specific teaching from outside could lead to scenarios of how indigenous knowledge can be used especially when relating to the subsistence sector.

Slikkerveer, L.J. 1997. Indigenous agricultural knowledge systems in Kenya: Toward conservation of bio-cultural diversity in East Africa. In: Adams, W.M and L.J. Slikkerveer (eds.) ***Indigenous knowledge and change in African agriculture.*** **Studies in technology and social change N. 26. Center for Indigenous Knowledge for Agriculture and Rural development. Iowa State University, Ames, Iowa. Ppl9-38.**

This account presents the results of a joint Kenyan/Netherlands pilot study in palaeo-ethnobotany in Western Kenya, with the aim of assessing (pre)historical dimensions of traditional farming systems which have evolved over many generations in Eastern Africa. The implications of this study for further collaboration between Kenyan Resource Center for Indigenous Knowledge (KENRIK) and the Leiden Ethnosystems and Development Program (LEAD) are indicated. The objectives and progress of a related project (the joint Kenya-INDAKS) are assessed with a view to enhancing sustainable agricultural development and to conserve Kenya's bio-cultural diversity. The author describes the negative impacts of monocropping systems on plant and crop biodiversity in Kenya, and the potential role of indigenous agricultural knowledge in the sustainable management and conservation of biodiversity in Eastern Africa.

Westphal,. 1975. Agricultural systems in Ethiopia. Agricultural reports 826. College of Agriculture, Haille Sellassie I University, Ethiopia, and the Agricultural University, Wageningen, The Netherlands. Center for agricultural publishing and documentation, Wageningen. 278p.

This publication deals with different agricultural systems found in Ethiopia, and is based on field work conducted in Ethiopia between 1967-68, and supplemented by literature reviews. While previous authors have distinguished three types of agriculture, this author identifies four agricultural systems: the sed-farming complex, the ensete-planting complex, shifting cultivation and the pastoral complex. The author provides a comprehensive description of the crops grown in each system and its relation to soil, topography and climate, as well as planting methods and the soil and water conservation techniques employed by farmers. The specific ethnic/cultural linkages to each of these farming systems is provided.

Wiersum, K. 1986. The effect of intensification of shifting cultivation in Africa on stabilizing land use and forest conservation. ***Netherlands journal of agricultural science,*** **vol. 34, no. 4. Pp485-488.**

In order to assess the effect of the intensification of shifting cultivation on stabilization of land use and on conservation of forest and tree resources, the author investigates four case studies of changes in shifting cultivation systems in Tanzania, Ivory Coast, Madagascar, and Sierra Leone. The traditional land use system is described in each study with relation to natural and socio-economic environment and to cultivation and production characteristics. Changes in the land use system resulting either from indigenous strategies or outside interventions are also described. Both traditional and alternative cultivation systems are analyzed as to their ecological stability, management resilience, production sustainability and economic reliability. The effect on forest and tree resources was also taken into account. The author finds that traditional indigenous shifting cultivation systems generally provided a sustained production of agricultural products for local use. Ecological stability and production sustainability were preserved by various management practices which provided for resilience against variable and adverse weather conditions, biotic perturbations and soil degradation and erosion. They also limited labor peaks with related labor shortages. Trees played an important role in such systems, not only as fallow crops for regenerating physical and chemical properties of soil and suppressing weeds, pests and diseases, but also by the production of basic needs such as food, fuel and timber. Due to the extensive nature of these forms of shifting cultivation, forest resources were traditionally not much affected. This ecological stability and production sustainability has been broken down by prevailing forms of deteriorated and exploitative shifting cultivation. These new cropping practices are generally less stable ecologically, provide sustained yields under favorable conditions, but are limited by several socio-economic constraints such as the low return to labor, increased peak labor demands, lack of capital and the need for good marketing conditions. The author argues that the intensification of shifting cultivation will stabilize land use and decrease pressure on forest resources only if intensification is combined with measures to control possible negative effects on the socio-economic environment.

AGROFORESTRY

Barrow, E.G.C. 1988. Trees, people and the dry lands: The role of local knowledge. In: Agroforestry development in Kenya. Proceedings of the second Kenya national seminar on agroforestry held in Nairobi, Kenya, 7-16 Nov. 1988.

The importance of traditional knowledge to in development, its relevance to the change process and why it has not been fully utilized in the past is discussed. Pokot and Turkana transhumance are discussed in a broad land management perspective, and

then as they relate to individual tree species and their utilization and management. These are then briefly compared to the Sukuma (in Tanzania) agrosilvopastoral system. In all cases, the people of the area display a rich and detailed local knowledge base as it relates to the environment and ecology. This comprises a detailed ethnobotanical knowledge as it relates to species utilization and their management, which is then related to broad land-management systems that(especially in Pokot and Turkana) are environmentally sound, ecologically viable, and culturally acceptable. This is then related to traditional conservatism and constraints pertaining to such lands. Owing to the realization that the traditional base is not perfect, ways are discussed as to how the people and the knowledge base can be brought into the focus of development and change, particularly in the silvopastoral context. The conclusion challenges researchers and developers alike, to give a real and meaningful emphasis to the traditional database by relating their work and keeping the focus of such work on the people who live in these areas. The basis for change and improvement lies with making the people of the area the focus. They must be given the responsibility for their environment through the use of traditional knowledge as a foundation stone for sustainable development.

Cartledge, D.M. 1995. Taming the mountain: human ecology, indigenous knowledge and sustainable resource management in the Doko Gamo society of Ethiopia. PhD dissertation, University of Florida. 310p.

This dissertation examines the management of the unique ensete-based agrosilvopastoral systems found in this part of Ethiopia via a detailed case study of Doko Gamo society. The Doko people have developed a system of resource management centered around the endemic species *Ensete ventricosum.* This has proven to be a relatively sustainable anthropogenic system characterized by a number of interdependent locally-developed management practices. Underpinning this system are a comprehensive set of traditional rules and institutions that serve to replicate the system from one generation to the next. Sustained-yield management practices are common in Doko where a variety of social control processes act to limit seasonal exploitation of valued resources. Social norms and institutions promote a respect for the land and its resources, preservation of valued species, ecological awareness, the intergenerational transfer of knowledge, a sense of community, and respect for local political authority and leadership. There is evidence, however, suggesting that recent demographic and sociopolitical factors may unbalance this historically sustainable system.

Cook, C.C. and M. Grut. 1990. Agroforestry in sub-Saharan Africa: A farmer's perspective. World Bank technical paper no. 112. World bank, Washington, D.C. 94p.

The study reviews agroforestry practices in sub-Saharan Africa as seen from the

farmer's perspective. It specifically describes and analyzes seven case studies, which include both indigenous and innovative agroforestry systems in the highlands of East Africa and the semi-arid and humid lowland zones of West Africa, the authors identify a range of issues: technical, economic, social, institutional and research regarding agroforestry in Africa. For example, they suggest that improving the use of indigenous species is better than introducing exotic tree and shrub species. The authors make conclusions and recommendations regarding the direction which policy, economic and institutional and research interventions should take with regard to agroforestry development in Africa.

Ferandes, E.C.M., A. Oktingati, and J. Maghembe. 1984. The Chagga homegardens.: A multi-storeyed cropping system on Mount Kilimanjaro (northern Tanzania). ***Agrofrestry systems,*** **Vol. 2, pp73-86.**

The authors identify the major components of the Chagga homegardens, describe their interactions and major aspects, and present an evaluation of the system's ecological stability, productivity and sustainability. The homegardens are characterized by an internal integration of numerous multi-purpose trees and shrubs with food crops and animals simultaneously on the same land. The authors note that the Chagga are skilled farmers with an intimate knowledge of the crops and their ecological requirements. They have a good idea of functions/uses of the plant species on their farms. The large species diversity provides both subsistence and cash crops. It enables the farmer to keep his management options open and provides insurance against drought, pests and economic risks. Other advantages to this intimate multi-storeyed, multi-species interaction include: soil conservation, nutrient cycling and nutrient efficiency, and microclimate enhancement.

Hammer, T. 1982. Reforestation and community development in the Sudan. DERAP publication No. 150. The Michelsen Institute, Development research and Action Program. Bergen, Norway. 72p.

The study describes nomads and cultivators' adaptation to the semi-arid savanna of northern Sudan, and gives an account of policies and measures aimed at protecting the natural resources. The author describes the traditional/indigenous use of and the rights to land, and concludes that this use is well adapted to environmental conditions. The author describes a traditional agro-silvopastoral system in which subsistence crop growing is alternated with livestock production and *Acacia Senegal* growing on a forty year rotation. This system maintains soil fertility, reduces erosion, provides food, fuel and income for the farmers, the author argues that policy

support for development in the Sudan should emphasize the strengthening of traditional agriculture.

Leslie, A.D. 1991. Agroforestry practices in Somalia. *Forest ecology and management,* vol. 45, pp293-308.

The author describes traditional agroforestry methods in Somalia, as well as attempts to introduce new agroforesty practices. The physical, social and political constraints for agroforestry development and recommendations for future development are presented. Most agroforestry is found near the two main rivers, the Jubba and the Shabeelle. On rainfed land, scattered trees most frequently *Dobera glabra,* are retained. These provide limited dry season browse, fruits and poles, but are mainly used as shade for the farmer and his livestock. A bush fallow is often used to maintain soil fertility. On irrigated land, crops are commonly grown alongside young fruit trees until shade becomes too great. Other practices include growing crops in mature coconut plantations and with date palms. Large banana plantations are protected by shelter belts of *Casuarina equisetifolia.*

Oduol, P.A. and J.R.W. Aluma. 1990. The banana (*Musa* sp.)-Coffee Robusta: Traditional agroforestry system of Uganda. *Agroforestry systems,* vol. 11. Pp213-226.

The banana-coffee robusta homegardens represent a traditional Ugandan agroforestry system, which comprises a purely mixed cropping system managed on a sustained production basis. The authors describe the components, management, productivity and socio-economic aspects of these home gardens. The basic primary production in these agroforestry system is based on bananas as the main food crop and *Coffee robusta* as the main cash crop. The system is devoted to the production of perennial crops, animals and crops in mixtures. Other food crops are grown on a subsistence basis, and surplus sold for cash. Trees are grown in the system for timber, fuelwood, fodder, medicinal and other uses. Animal production is characterized by intensive poultry keeping, piggery and some dairying. Fishing is a key income earner. There is no mechanization in this system. The cultivation pattern is characterized by small areas of annual crops within the homestead, surrounded by large areas of perennial crops. The authors cite the advantage of this system as: ensuring nutrient cycling, soil conservation and sustaining a high degree of genetic diversity among plants. The diversity of species ensures continuous supply of food, products and services.

Poschen, P. 1986. An evaluation of the *Acacia albida-based* agroforestry practices in the Hararghe highlands of Eastern Ethiopia. *Agroforestry Systems,* vol. 4, ppl29-143.

Growing *A. Albida* as a permanent tree crop on farmlands with cereals, vegetables and coffee underneath or in between is an indigenous agroforesty system in the Hararghe highlands of eastern Ethiopia. However, there is practically no systematic record or data on the merits and demerits of this practice. This article presents the

results of an investigation into the effects of the presence of *A. Albida* on farmlands on the yield of maize *(Zea mays* L.) and sorghum *(Sorghum bicolor* L. Moench). A significant increase in crop yields by an average 56% was found or the crops growing under the tree canopies compared to those away from the trees. The trees enhanced the fertility status of the soil and improved its physical condition in terms of crop growth. Additional benefits from the *A. Albida* trees include supply of fuelwood and fodder. Prospects for an extension of this promising agroforestry technique are discussed against the background of state policy and trends of agricultural development in the area. Despite the slow and variable growth of *A. Albida* and conflict with the spreading cultivation of Ch'at *(Catha edulis* Forsk.), the prospects of extension of this technique are good. The author recommends that its propagation should be incorporated into the programs of the extension agencies of the various government agencies concerned with and use.

Rocheleau, D.E. 1991. Gender, ecology and the science of survival: Stories and lessons form Kenya. *Agriculture and human values,* Vol 8, nos. 1& *2,* pp 156-165.

The paper notes the current resurgence of ethnoscience research and states a case for including gendered knowledge and skills, supported by a brief review of relevant cultural ecology and ecofeminist field studies. The author argues the case from the point of view of better, more complete science as well as from the ethical imperative to serve womens' interest as the 'daily managers of the living environment'. The Kenyan case study of womens' agroforestry work follows their response to the drought of 1985 and chronicles the unfolding discovery of womens' ecological, political and social science as gendered survival skills. The case is re-counted as a story, in keeping with an explicit choice to learn through participation and to report through story-telling. The experience of rural women and researchers during the drought provides several lessons for both groups about their respective knowledge systems, their agroforestry works, and the relationship of both local and national economy.

Sharland, R.W. 1991. Trees in the garden: Interaction between the wild and agricultural domains in practice among the Moru of southern Sudan. *Unasylva* vol. 42, no. 1. pp55-61.

The author provides an account of traditional agro-silvopastoral and tree conservation strategies of the Moru people of southern Sudan. Such strategies include treatment of trees when clearing land for cultivation, selection of fuelwod species, their understanding of the regeneration concept, tree species as indicators of soil condition, and tree species interactions with livestock. The different ways tree species are treated show a clear differentiation between species. The author suggests that these interactions, so familiar to the Moru people, points to the potential for more formal development of agrosilvicultural systems and agroforestry.

Teketay, D and A. Tegineh. 1991. Traditional tree-crop based agroforesty in coffee producing areas of Harerge, Eastern Ethiopia. *Agroforestry systems,* vol. 16, pp257-267.

The author's preliminary survey of seven coffee producing provinces in eastern Ethiopia revealed the existence of a traditional tree crop based agroforestry system practiced by farmers. In this system coffee (C. *Arabica)* was found to grow under the shade of several trees (16 species), usually intercropped with one or several (total of 15) important grain, fruit, vegetable, stimulant, oilseed and spice crops. Up to 69% of the trees are leguminous e.g. *Ficus* sp. or *Cordia africana.* The system is characterized by the integration of crops, livestock and sometimes agriculture. The authors note a lack of quantified research on the beneficial or detrimental effects of this agroforestry system and recommend further research.

FOREST/WOODLAND CONSERVATION

Castro, P. 1990. Sacred groves and social change in Kirinyaga, Kenya. In: Chaiken, M.S. and A.K. Fleuret (eds) *Social change and applied anthropology: Essays in honor of David W. Brokensha.* Westview press. pp277-289.

The study examines changes in the perception and use of sacred groves among the Ndia and Gichugu Kikuyu of Kirinyaga district, Kenya. It analyzes the linkages between religious conversion, wider process of cultural change, and modifications in a particular form of common property resource regime. The author notes that although sacred groves have hardly been studied as a locally important common property resource, there is increasing appreciation of their role as a valuable cultural and environmental resource. The author outlines the socio-cultural significance of the Kikuyu sacred groves, and the challenges colonialism imposed on the continued tradition. In particular, the author singles out the introduction of new belief systems, political hierarchy, and economic stratification as critical aspects of colonialism which eroded the socio-cultural significance of the sacred groves.

Ellis, J., D.L. Coppock, J.T. McCabe, K. Galvin and J. Wienpahl. 1984. Aspects of energy consumption in a pastoral ecosystem: Wood use by the south Turkana. In: Barnes, C, J. Ensminger and P. O'Keefe (eds.) *Wood, energy and households: Perspectives on rural Kenya.* Energy and Development in Africa series no. 6. The Beijer Institute and the Scandinavian Institute of African Studies. Ppl64-187.

The authors investigate patterns of wood use by the Ngisonyoka sub-section of the

south Turkana, a pastoral people uninfluenced by the outside world and who live a relatively traditional pastoral life-style. The authors outline the traditional Turkana strategies of coping with environmental variability, and describe Turkana social organization in the context of wood utilization. The authors find that the Turkana's conservative and selective use of tree species has been crucial to sustaining the woody environment, since they found no evidence of deforestation or other misuse of the environment.

Gerden, C.A. and S. Mtallo. 1990. Traditional forest reserves in Babati district, Tanzania: A study in human ecology. Working paper 128. Swedish University of Agricultural Sciences, International Rural Development Center, Uppsala. 52p.

The authors examine the role of traditional forest reserves (TFRs) in environmental conservation in six wards of Babati district, Tanzania. They define TFRs as a forested area, not less than 0.04 hectares, which are protected by residents of the adjacent area in accordance with customary laws. The authors identified and classified seven types of TFRs based on function. For example, for circumcision rites and dances, meeting places for elders, cemetery/burial grounds, natural spring sites, medicine mens TFR, rainmaking TFRs and TFR for traditional teaching of young women. Traditional views and practices regarding specific tree species are mentioned, including penalties for non-compliance. The authors observe that the effectiveness of TFRs is demonstrated by the fact that the TFRs have been virtually untouched for generations. They note that TFRs demonstrate the wise ecological beliefs and behaviors of the elders.

Kajembe, G.C. 1994. Indigenous management systems as a basis for community forestry in Tanzania: A case study of Dodoma urban and Lushoto districts. PhD thesis, Wageningen Agricultural University, Wageningen, The Netherlands. 193p.

This report presents an analysis of the nature of both indigenous and professionally sponsored community forestry management systems in two districts in Tanzania. The author describes various types of internally generated forest and tree management systems at two levels: household and supra-household. At the household level, the author discusses such practices as the way farmers arrange trees in their farms; the balance between indigenous and exotic tree species; regeneration and tending techniques. Household organization is identified as a major factor for the functioning of management systems at the household level because it organizes labor, decision-making processes, distribution of authority, property rights and obligations among members. Management systems at a supra-household level consist mainly of sets of organized use-rights. They are concerned mostly with regulating who has the right of access to particular forest/tree resources and excluding others. The author draws attention to the fundamental differences between indigenous and professional management systems. The author demonstrates the existence of a gap between

indigenous and professional forest/tree management systems and shows how project interventions generated confrontations as well as varying degrees of collaboration and participation. A model to bridge the gap between internally generated initiatives and externally sponsored interventions is suggested.

Mukhtal, M.E. and E.L, Warrag. 1994. Some aspects of traditional forest utilization in the Sudan. In: Ahmed, M.M. (ed.) ***Indigenous knowledge for sustainable development in the Sudan.*** **Institute of African and Asian Studies. University of Khartoum, Sudan. Sudan library series 20. University Press, Khartoum, Sudan. Ppl29-151.**

The authors outline traditional uses of forest resources, and the technologies evolved for the use of these resources. They describe the traditional methods and criteria used for tree species classification and identification, technology specific to wood preservation and the selection criteria of quality wood for firewood.

Niamir, M. 1990. Traditional woodlands management techniques of African Pastoralists. ***Unasylva,*** **vol.41, no. l.pp49-58.**

The article describes several types of traditional woodland management techniques among African pastoralists, including mobility and rotational grazing, the harvesting, regeneration and protection of trees and shrubs, forest reserves, sacred groves and traditional social controls. The author observes that techniques used by pastoralists are neither random nor irrational, but are deliberate and adapted to the vagaries of their environment. The author suggests that the basic principles behind Pastoralists resource management techniques are viable, valid and could be used as a starting point for the development of appropriate strategies for incorporation into development projects.

Perlov, D.C. 1984. Exploiting the forest: Patterns and perceptions in highland Samburu. In: Barnes, C, J. Ensminger and P. O'Keefe (eds.) ***Wood, energy and households: Perspectives on rural Kenya.*** **Energy and Development in Africa series no. 6. The Beijer Institute and the Scandinavian Institute of African Studies. Ppl41-163.**

The author examines wood use and conservation in Maa-speaking communities in the highland forests of Samburu. The author specifically investigates the nature of current wood use, the key factors affecting variable wood use, and community perceptions and adaptations to diminishing wood resources. The author examines traditional, cultural Samburu forest management prescriptions and how these determine and regulate the use of forest resources. The author describes the community's informal regulations governing wood use, and notes that these rules do not consider the relationship between economic activities and the consumption of forest resources, but rather they judge the activity according to its cultural acceptability to the Samburu.

Shepherd, G. 1992. Managing Africa's tropical dry forests: A review of indigenous methods. Agricultural Occasional Paper 14. Overseas Development Institute. 117p.

The author identifies and analyzes a range of indigenous forest management practices in dryland Africa, and provides an extensive bibliographic summary of identified studies. The author points out that rising population densities, and the weakening of local juridical and political authority, have often narrowed the range of people able to cooperate with each other for management, and thus the size of area which any one group can manage effectively. At the same time, the state's ability to protect forests in this region may now be so diminished that the best solution is to pass management and ownership to appropriate groups of local people.

CLIMATE FORECASTING

El-Jaili, M.0.1994. Farmers' indigenous knowledge of drought: A case study of Um-Ruaba district of the Kordofan region in the Sudan. In: Ahmed, M.M. (ed.) ***Indigenous knowledge for sustainable development in the Sudan.*** **Institute of African and Asian Studies. University of Khartoum, Sudan. Sudan library series 20. University Press, Khartoum, Sudan. Ppl52-177.**

The article explores ethnic knowledge, attributes and ethics that govern and characterized the relationship between the environment and its users. It presents the theory of farmers, and contrasts it with modern scholarly thinking. It analyses farmer perceptions of drought, its causes and consequences; and describes the indigenous meteorological techniques of climate forecasting. Farmers observe that drought and environmental deterioration are caused by demands of an increasing population. They also believe that the timing, severity and implications of drought are specifically displayed by Allah for spiritual reasons.

Jedrej, M.C. 1991. The role of rainmakers. In: Stone, J.C. ***(Ed.) Pastoral economies in Africa and long term responses to drought.*** **Proceedings of a colloquium at the University of Aberdeen. Aberdeen University Studies group Pp54-59.**

The paper contrasts the distribution of rainmaking institutions and meteorological systems between sedentary agriculturalists and pastoralists, It considers the techniques of rain making, how one becomes a rain maker, the key elements of the rainmaking procedures and challenges to the institutions and techniques of rainmaking.

Musyoki, A. and M.Khayesi, 1997. Drought management in Kenya: Traditional and

modern approaches. Kenya. In: Adams, W.M and L.J. Slikkerveer (eds.) ***Indigenous knowledge and change in African agriculture.*** **Studies in technology and social change N. 26. Center for Indigenous Knowledge for Agriculture and Rural development. Iowa State University, Ames, Iowa.**

The authors use a spatio-temporal approach to examine the changing responses to drought in Kenya. They note that traditional responses to drought occurred within the context of pastoralism and food sharing between families and relations. This response is based on knowledge of the bio-physical environment and subsequent evaluation of mechanisms for coping with environmental stress. The authors observe that recent governmental and non-governmental response to drought have ignored these traditional coping mechanisms, leaving the drought victims out of the panning, management and execution of relief operations, thus failing to brig about lasting solutions. The authors examine both traditional/indigenous and contemporary responses to drought in Kenya, and indicate the specific measures and agencies involved. By drawing upon traditional and modern responses, they offer a framework for coping with drought, which outlines specific policy measures, action programed and research activities required.

Mutiso, S.K. 1997. Indigenous knowledge in drought and famine forecasting in Machakos district, Kenya. In: Adams, W.M and L.J. Slikkerveer (eds.) ***Indigenous knowledge and change in African agriculture.*** **Studies in technology and social change No. 26. Center for Indigenous Knowledge for Agriculture and Rural development. Iowa State University, Ames, Iowa.pp67-85.**

The author describes traditional knowledge systems of meteorology and examines the scientific basis for farmers' weather folklore. He further determines areas of possible integration between scientific and traditional knowledge systems, and analyzes challenges associated with this integration.

LAND TENURE

Bruce, J.W. 1988. A perspective on indigenous land tenure systems and land concentration. In: Downs, R.E. and S.P. Reyna (eds) ***Land and society in contemporary Africa.*** **University of New Hampshire.pp 23-52.**

The author reviews the literature concerning the nature of African indigenous land tenure systems, challenging the use of such terms as *traditional* and *communal* in their descriptions. He examines factors producing change in indigenous land tenure systems, and discusses these changes as they have occurred over the last century. The

author analyzes the effects of colonialism, commercialization, population growth, changing local institutions and post independence land law reforms on indigenous tenure systems. The author suggests some perspectives on indigenous tenure which may be helpful in understanding a specific tenure system. A final section takes up the question of land concentration.

Bruce, J.W. 1976. Land reform planning and indigenous communal tenures: A case study of the tenure *Chiguraf-Gwoses* in Tigray, Ethiopia. S.J.D. law thesis. University of Wisconsin-Madison.

This is a study from an agrarian reform perspective of an indigenous communal land tenure in Tigray province of Ethiopia. The author examines the potential input from indigenous communal land tenures in the planning and programing of agrarian reforms. The study describes traditional Tigray land tenure, highlighting the relationship between land tenure and social structure in that society. The author explains the development and evolution of the tenure *Chiguraf-Gwoses,* relating it to the *risti,* an exclusive communal tenure in highland Tigray. He examines the variety of forms and juxtapositions to other institutions in which it presents itself, then dwells at length on two central themes of the tenure which draw attention to it as having potential in agrarian reform: community control of land distribution and residence as a condition of access to land. *Chiguraf-Gwoses* was found to fall short of the claims made for it in the traditional model. The author suggests that indigenous communal tenures are generally inadequate for long term use in the development context, but could serve as a useful basis for the development of preferable tenure forms.

Migot-Adholla, S., P. Hazell, B. Benoit, and F. Place. 1991. Indigenous land rights systems in sub-Saharan Africa: A constraint on productivity? *The world bank economic review,* vol. 5, no. 1, ppl55-175.

The authors provide empirical testing of the relationship between indigenous tenure arrangements and agricultural productivity. They present data from a cross-sectional study of land rights systems in Kenya, Ghana and Rwanda. The authors argue that in rainfed cropping areas indigenous African tenure systems have so far been flexible and responsive to changing economic circumstances. Where population pressure and commercialization have increased, the indigenous tenure systems have autonomously evolved from a system of communal property rights towards one of individual rights. The authors found a weak relationship between individualization of land rights and

land yields in the regions surveyed.The authors describe the characteristics and evolution of indigenous land rights systems in sub-Saharan Africa, and argue that the contrast between indigenous African tenure and western property rights systems should be perceived not in terms of opposite extremes but as points along a continuum between communal rights systems and privatized rights systems. In response to population pressure, agricultural commercialization and technological change, indigenous African tenure systems have moved along that continuum in the direction of greater individualization of land rights.

Roden, D. 1971. Changing patterns of land tenure among the Nuba of central Sudan. *Journal of administration overseas*, vol. 10, no. 4, pp294-309.

The Nuba region of central Sudan has had a long tradition of private occupance in response to distinctive social or economic conditions. Individual tenure here may have developed as indigenous Negro groups sought refuge in upland massifs from Arab nomads and slave raiding expeditions during the 19th century. This probably reflected adaptation to a situation of land scarcity. The establishment of 'stable' governments during the present century made possible expansion of lowland cultivation and down-movement of upland settlement. The author assesses the extent of modification to traditional tenurial patterns which have accompanied these changes, focusing particularly on the practical operation of local customs. The author argues that the fundamental Nuba land tenure has not been changed by the downward movement of settlement, the associated expansion of lowland cultivation and ever-growing exposure to outside influences. They are still based on individual ownership with full rights of alienation. The basic pattern of land ownership has however been modified through greater flexibility of inheritance customs, changes in the composition of individual holdings, customary procedures of succession to property and introduction of extensive techniques of cultivation.

INSTITUTIONS FOR RESOURCE MANAGEMENT

Evers, Y.D. 1993. Supporting local natural resource management institutions: Experience gained ans guiding principles. In: Stiles, D. (Ed.) Listening to the people: Social aspects of dry land management. Proceedings of an international workshop held in Nairobi, 14-18 December, 1993. United Nations Environmental Program, Desertification Program Activity Center. Pp39-45.

The paper provides a brief synthesis of material describing experience gained from participatory natural resource management techniques from a developmental perspective. The author uses three case studies to highlight different types of management systems and common problems. The studies feature three different types of participatory natural resource management: first the survival of an existing forest management institution in Zimbabwe; second, the re-empowerment of traditional community institutions to address land issues in Tanzania; and third, the

establishment of new institutions through an externally sponsored wildlife project (CAMPFIRE) in Zimbabwe. The author cites problems faced by other projects as a lack of understanding by donor agencies of the social and economic dynamics of the production systems of rural societies they work with; and a failure to clearly define who within the community will participate, manage and benefit. The author also suggests some guiding principles for implementation based on a preliminary review of previous lessons.

Helland, J. 1982. Social organization and water control among the Borana. Development and Change, vol. 13, pp239-258.

The author demonstrates how some of the institutions of the Borana (southern Ethiopia) social organization employ a certain measure of control over the utilization of pasture and water resources, as well as over the reproductive performance of the human population. The author describes the structure of social organization and rules regulating access to natural pastoral resources, in particular water. The author contends that the Borana live in a well-balanced ecological adaptation and that this balance is maintained by a complex social structure which is closely related to the regulation of access to and the utilization of the critical water resource. The author argues that under the traditional circumstance of Borana pastoralism the organizational forms of Borana society constitute an adequate adaptive solution.

Johansson, L. And W. Mlenge. 1993. Empowering customary community institutions to manage natural resources in Tanzania: Case study from Bariadi district. Forest, Trees and people newsletter no. 22. International Rural Development Center, Swedish university of Agricultural Sciences. Pp36-42.

The article presents the array of customary and socio-political institutions central to the communication and articulation of indigenous knowledge, and crucial for regulating access to natural resources within the community. The authors focus on the *"dagashida ",* as the potentially most powerful of these customary community institutions. The authors describe the structure and constitution of the *dagashida,* and illustrate the democratic and participatory mechanisms by which the *dagashida* regulate the use of natural resources. They argue that these institutions can be re-empowered through an appropriate policy framework.

Little, P.D. and D.W. Brokensha. 1987. Local institutions, tenure and resource management in East Africa. In: Anderson, D. And R. Grove (eds.). *Conservation in Africa: People, Policies and Practice.* Pp 193-209.

The authors examine the role of local institutions and communities in the management of rangelands and forests in East Africa, which until recently were managed on a common property basis. Particular attention is given to those variables that are likely to make local resource management systems ineffective. The authors indicate that change in tenure patterns is one of a series of factors which have implications for natural resource use, and that in specific cases it becomes difficult to desegregate the causal effects of tenure from other, perhaps even more significant, variables. These include: changes in the level of decision-making; wealth differentiation; commercial market linkages; and demographic pressure. The authors present cases from Kenya, paying particular attention to the continuities and discontinuities in resource management policy from the colonial to post-colonial eras. In addition, they discuss indigenous systems and institutions of range management amongst the Samburu Masai and Il Chamus of Baringo, and the reasons for the breakdown of these systems. The authors use the case of the Mbeere, who occupy an area to the east of Mount Kenya, to illustrate the indigenous management of forest resources.

Mohammed, H.A. 1994. Traditional institutions and resource management in Darfur: Case study of Umkedada Province. In: Ahmed, M.M. (ed.) ***Indigenous knowledge for sustainable development in the Sudan.*** **Institute of African ad Asian Studies. University of Khartoum, Sudan. Sudan library series 20. University Press, Khartoum, Sudan. Ppll5-128.**

The study of the roles of traditional institutions is the focus of this paper. The author identifies two types of traditional institutions: native administration and ethnic indigenous. Native administration represents an old system of tribal administration that was institutionalized and incorporated within the framework of judicial and administrative system by the British authorities. Native administration is effective at local levels and is involved in dispute resolution, resource allocation and environmental protection. To perform these functions, the native administration calls upon the influence and support of traditional ethnic institutions. The latter have been successful in social mobilization for resource management, and both have worked well together. The author attributes this success to familiarity of the institutions to local cultures, problems and behavior, and hence their ability to inspire a sense of belonging and togetherness among the local people. The author observes that the traditional systems in Darfur region have survived political and administrative change

due to their ability to adopt and accommodate new functions.

RESOURCE MANAGEMENT

Behnke, R. 1995. Natural resource management pastoral Africa. In: Stiles, D. (Ed.) ***Social aspects of sustainable dryland management.*** **UNEP. Ppl45-152.**

The author argues that the natural environments exploited by pastoralists are generally robust and resilient; and that pastoralist techniques of land management are not as dysfunctional as previously assumed. To justify these arguments, the author briefly discusses plant/vegetative adaptation in pastoralist environments, and pastoralists strategies for managing an erratic environment. The author also examines the fundamental adjustments in natural resource management policy which would be required if these assertions were substantially true.

Hjort of Ornas, A. 1990. Production versus environment? Planning resource management and ecological adaptation in Kenyan drylands. In: Bovin, M. And L. Manger (eds.) Adaptive strategies in African arid lands. Proceedings from a seminar at the Scandinavian Institute of African Studies, Uppsala, Sweden, April 1989. Pp91-107.

This article concerns ecological adaptations in Kenya's drylands, and focuses on related issues such as how soil and water conservation relate to current production activities. The author highlights livestock-based production systems, their capacity and vulnerability. Of special interest are the supplementarity of farming and herding, seasonalities in herd management, and the tendency towards part time farmers (herders) through town-based systems. The author also addresses the land resource side; the needs for proper soil and water conservation in arid and semi-arid lands. It builds on the significant case of Kenyan development and administration of the arid and semi-arid lands.

Pelissier, P. and S. Diarra. 1978. Traditional strategies, modern decision-making and management of natural resources in Africa. In: p.35-56.

The authors focus on describing the highly differentiated traditional resource use and management strategies of the populated regions of the Sudan African zone. In analyzing these strategies the authors single out two cases, which are situated at two extremes of the Sudan zone and in environments as opposite as coastal swamps and mountains. For both cases the authors outline the social organization under which the two systems function. The authors observe that modern interventions in the region have failed to exploit traditional techniques and knowledge of the environment on which they are based. They conclude that progress made with agricultural equipment engender a regression in community work, and that technical innovations result in social differences and economic inequalities.

Wamalwa, B.N. 1991. Indigenous knowledge and ecological management. In: Kiriro, A. and C.Juma *(eds.). Gaining ground: Institutional innovations in land-use management in Kenya.* ACTS press, Nairobi, Kenya.

The author provides a comprehensive account of the indigenous/traditional resource management techniques among the Akamba group of eastern Kenya. These management techniques were based on a combination of institutional measures and technological know-how. For example, the Akamba recognize four soil type, based on varying soil quality, which ultimately determined the type of crop and timing of agricultural activities. Environmental conservation strategies of the Akambas manifest both adaptive component as well as purposeful control of the environment, all aimed at spreading risk, ensuring equitable access to natural resources in order to secure the community's survival. The author argues that the answer to sustainability in natural resource utilization, particularly in Kenya's semi-arid areas, may lie in indigenous agricultural and pastoral communities who have survived for centuries in delicate environments.

GENETIC DIVERSITY

Bedigian, D. 1991. Genetic diversity of traditional sesame cultivars and cultural diversity in Sudan. In: Oldfield, M.L. and J.B. Alcorn (eds) *Biodiversity: Culture, Conservation and Ecodevelopment.* Westview press. Pp25-36.

This paper addresses the genetic diversity of traditional sesame cultivars in relation to Nuba cultural diversity in Sudan. The author draws linkages between Nuba cultural diversity and the diversity of sesame cultivars; and describes the cultural and ecological factors that affect cultivar diversity. Threats to traditional Nuba agricultural techniques and sesame genetic resources are outlined.

Berg, T. 1992. Indigenous knowledge and plant breeding in Tigray Ethiopia. Forum for Development Studies no. 1. Norwegian Institute of International Affairs: Norwegian Association for Development Research. Ppl2-22.

The highlands of Ethiopia and Eritrea are known as one of the major world centers of crop genetic diversity. This diversity is associated with a rich culture of traditional seed selection. In reviewing the literature, the author observes that information on crop genetic diversity is quite extensive, while very little information exists on the cultural aspects of the management of these resources. During the recent wars local communities in northen Ethiopia established seed banks which provided credit in the form of quality seeds acquired through traditional seed selection. The merits of these community institutions, the capability of the local seed selectors, the potential of linking up central professional institutions to the local community-based

organizations are discussed. The article finally relates the activities of the local seed selectors to the international debate on ownership of genetic resources and discusses the concept "farmers rights"in the context of organized community management of genetic resources.

McKiernan, G. 1991. Our common bond: Indigenous knowledge and the conservation of plant genetic resources. In: Leakey, R.E. and L.J. Slikkerveer (eds.) ***Origins and development of agriculture in east Africa: The ethnosystems approach to the study of early food production in Kenya.*** **Studies in Technical and Social Change, No. 19. Technology and Social Change Program. Iowa State University, Ames, Iowa.pp241-245.**

The author draws on examples from case studies from East and West Africa to discuss the general characteristics of indigenous knowledge, and indigenous innovation and experimentation, as well as the inherent benefits each can contribute to enhancing and maintaining biological diversity. The author presents and discusses a new approach based upon the common needs and interests of western and non-western peoples.

Worede, M. and H. Mekbib. 1993. Linking genetic resource conservation to farmers in Ethiopia. In de Boef et al (eds.) ***Cultivating knowledge: Genetic diversity, farmer experimentation and crop research.***

This contribution reviews and describes the importance of local knowledge in traditional agricultural systems, and discusses the role peasant farmers play in the conservation of landraces and in the programs of the Plant Genetic resource Center/Ethiopia. The authors stress that the dynamics of traditional cropping systems should be understood before they are replaced with modern agriculture; and that peasant farmers should be supported with resources to become partners in the development of genetic resources.

WILDLIFE CONSERVATION

Elmahi, A.A. 1994. Traditional wildlife conservation: A vanishing tribal lore in the Sudan. In: Ahmed, M.M. (ed.) ***Indigenous knowledge for sustainable development in the Sudan.*** **Institute of African and Asian Studies. University of Khartoum, Sudan. Sudan library series 20. University Press, Khartoum, Sudan. pp81-114.**

The paper highlights traditional measures of wildlife conservation among tribes in the Sudan, and evaluates taboos, totem beliefs and practices among some tribes. The author illustrates how such beliefs and practices can contribute positively to wildlife conservation. The author outlines factors closely linked to the success of traditional measures in conserving wildlife, but laments that these are measures are rapidly vanishing or lost. He mentions that the remaining measures are no longer respected, but rather regarded as part of an old, functionless folk heritage.

GENERAL CONCEPTS AND IDEAS

Ahmed, M. M. 1994. The concept of indigenous knowledge and its relevance to sustainable development. In: Ahmed, M. M. (ed.) ***Indigenous knowledge for sustainable development in the Sudan.*** **Institute of African ad Asian Studies. University of Khartoum, Sudan. Sudan library series 20. University Press, Khartoum, Sudan. Pp1-42.**

This essay reviews critically the development of the concept of sustainable development and its relationship with the concept of indigenous knowledge. The essay defines the two concepts, and surveys the potential of indigenous knowledge for sustainable development in third world countries. While the author appreciates the utility of indigenous knowledge in effecting and enhancing sustainable development alternatives or choices for poor people and countries, he recognizes the substantial advances in medical, economic, biological, agricultural communication aspects of modern development. He recognizes the power of modern science in revolutionizing life on earth, and identifies as a challenge the ability to adopt a technological mix of indigenous knowledge and modern science in order to meet the social, spiritual, cultural and humanitarian goals of people to maximize their internal well-being.

Lalonde, A. 1993. African indigenous knowledge and its relevance to sustainable development: In: Inglis, J. T. (ed.) Traditional ecological knowledge: Concepts and cases. International program on traditional knowledge and International development resource center. Pp55-62.

This paper investigates some of the positive traditional management practices in rural Africa which have been adapted and passed down over countless generations in harmony with the short and long-term carrying capacities of the local ecosystem. Other positive practices are based on the experiential, involving travel in order to learn from the experiences of other farmers, hunters, gatherers, fishermen, herbal medicine healers and artisans. The traditional keepers and users of local ecological knowledge and wisdom are typically the key elders from rural African communities. The author uses case studies to illustrate lessons learnt by recent development initiatives in Africa. These include soil and water conservation strategies of the Barabaig pastoralists of Tanzania, Zimbabwe's campfire program; biological crop pest control strategies in Mali using neem tree bio-pesticides; and the recycling and fixation of soil nutrients by the traditional use of fertilizer in agroforesty in Nigeria.

Richards, P. 1979. Community environmental knowledge in African rural development. IDS bulletin, vol. 10, no. 2. Institute for development studies, Brighton, England. Pp28-36.

This paper is concerned with methodology for investigating and interpreting environmental knowledge in "peasant"societies in Africa. The author describes a study where community environmental knowledge has already proved significant, and outlines particular methodologies for collecting community environmental knowledge and for evaluating its content. He suggests areas and problems within failed rural development projects where an analysis of community environmental knowledge might be expected to be of maximum benefit.