A MODEL OF INFORMATION SYSTEM FOR RURAL DEVELOPMENT PLANNING AT DISTRICT LEVEL

A Case Study of Laikipia District, Kenya

By

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DECLARATION

I, Simon Wambugu Taiti, declare that this thesis is my own work and has not been submitted for the purpose of degree in any university.

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DEDICATION

To My Wife Catherine Karimi Wambugu and Our Children, Mariangela Ngatha, Herman Kariuki, Philip Kinyua and Anna Muthoni.

LIST OF ABBREVIATIONS

AEZ - Agro-Ecological Zone

AI - Artificial Insemination

ASAL - Arid and Semi-Arid Lands

DC - District Commissioner

DDC - District Development Committee

DDP - District Development Plan

DEC - District Executive Committee

DIDC - District Information and Documentation Centre

DO - District Officer

DPU - District Planning Unit

DRSRS - Department of Regional Surveys and Remote Sensing

NFD - Northern Frontier Districts of Kenya

NGOs - Non-Governmental Organizations

OD - Organizational Development

PIS - Planning Information System

RCSMRS - Regional Centre for Services in Surveying Mapping & Remote Sensing located at Nairobi

SPOT - "Systèmè Probatoire d'Observation de la Terre" (the French land observation satellite)

SRDP - Special Rural Development Programme

UNCED - United Nations Conference on Environment and Development (held at Rio de Janeiro in 1992)

UNEP - United Nations Environmental Programme

ABSTRACT

The thesis consists of a district case study conducted in Laikipia, Kenya. The objective is to construct and demonstrate a district planning information systems (PIS) model for planning at district level. It is based on belief that for sustainability, rural development planning at district level should be based on the Geddesian principle of *diagnosis before treatment*. Rural development consists of interventions, introducing sustainable betterment of basic needs supplies and living conditions of the people practising farming and off-farm activities in rural areas. The problem of information utilization is an impasse between research and decision-making. It has been recognized and described in different terms in the last two decades. Chambers named it the pathology of data accumulation by researchers. Wolde Mariam called it an aversion to the pain of thinking and the effortless inclination to look for untested prescriptions for vaguely comprehended problems. It is the root problem in the syndrome of dependency created by the traditional national economic growth policies and technology transfer for industrialisation. It has profound implications and consequences for a country's investment and benefit from research including often futility of the same. The same problem is the deep seated iceberg beneath the contradictions of pauperisation of masses and formation of small elite

groups commanding all the wealth in a country like Kenya. It is a problem with potency for terminal crash and disintegration of a nation. From the angle of planning at district level the problem is inextricably tied with the underlying perceptions of power sharing, devolution of authority or autonomy in decentralisation and necessity to guard against possible conflict between policy objectives and local interests.

Concern for the existence of a gap between available information and public decisions was initially observed in practices of Kenya's Game Department in the 1970s. Data were available although not always enough, but hunting licences did not follow recommended offtakes hence, the uncontrolled extirpation of rhino horn and ivory until the black rhino and elephant were declared endangered species by the IUCN Red Data Book through global advocacy network. The thesis responded specifically to the inception of District Focus strategy for rural development planning in 1983 because of the perceived challenge of arid and semi-arid areas (ASALs) planning at district level. The Kenyan imperative to own land for its own sake and lack of special policy framework to control speculation with land-use started stirring market forces and subdivision of arid land into small farm plots in the 1970s. This was contrary to the principles of ecological carrying capacity and sustainability. Decentralisation could, according to

Friedmann (1981), cause loss of perspective and conceptual grasp of issues hence degenerate to a passive accounting tool. Without tools using sound information to control, migration, population build up, spontaneous settlement and unsustainable land-use in ASALs the gap between researchers and decision-makers could open wider at district level while rural activities succumbed to the fate of drought, wildlife and persistent famine relief.

Methods used to gather data include archive searches, remote sensing and ground truthing, ground farm surveys and observation of current planning practice at district level. As an option for map production a geographic information system is used. The data collected include history, ecology, present land ownership and land-use, settlement densities, livestock numbers, crop production.

Key information required for planning that is obtained includes the following findings. The district's population doubled from 120,000 to 240,000 in the last ten years mainly by inmigration. This constitutes a second historic reversal this 20th century. Historical information shows Laikipia has experienced dramatic reversals of land ownership and land-use due to extraneous interventions. Although each new group gave no regard to the culture or fate of previous occupants, each had a specific mode of successful adaptation to the range environment. The indigenous people were the Purko Masai. In 1910 the colonial British Government marshalled the Masai out and replaced them with European settlers. Since 1963 the settlers have been gradually bought out by African groups. Secondly, Laikipia District is found to be sited across a sharp ecological gradient from the humid slopes of Mount Kenya and Aberdares Ranges to the arid and semi-arid plateau. Thus, a sharp ecological gradient creates contrasts in ecological conditions and land-use performance. These are the conditions in which the poorly informed population is being subjected into risk and uncertainty by uncontrolled land selling profiteers. Problems being faced by settlers include cultivation of high risk rainfed crops for lack of ready information on alternative varieties. For extra income unregulated grazing on unsettled plots is practised. For lack of water supplies unsanitary human habitations abound in new settlements. Rivers are diverted for irrigation in ways contrary to sound principles of water management. Wildlife exists in abundance but it is a liability for ravaging on crops and livestock. Compensation for damage of property by wildlife does not exist. Thirdly, the existing *District Focus* planning is found to be an administrative matrix arrangement of delivering central government services and stronger administrative control closer to the people without surrendering any power to locally based units. Hence it is *deconcentration* rather than decentralisation as it has been popularly believed to be. A DDC has no autonomy or mandate to make important decisions. It lacks statutory mandate for policy planning at district level. Under authoritarian chairmen who are central government administrators, the DDC perceives and operates the district by administrative units of district, division, location, sublocation, population not by ecological zones. Decisions for resource allocation tend to treat all areas uniformly since ecological differences are not in the terms of reference. Hence DDCs are operating routine procedures of collating project proposals in a way it cannot be said the projects are of strategic value for sustainability under the specific conditions and land-use trends in the ASAL conditions. Projects are selected to satisfy short term objectives with no long term perspective of major dynamics. In view of the intractable policy bottlenecks and control and dependence on instructions from above, planning at district level in Kenya is a travesty of the principle of decentralisation. Political will for use of research information for planning at district level is thus absent or apparently just mutely negative. Subdivision of former ranches into small plots contrary to logical criteria for rural livelihood is continuing. The DDC Chairman has no authority to entertain use of ecological considerations for decision-making and might try to do so only at his own risk. The District Information and Documentation

Centres (DIDC) started for District Focus planners has become a library for students rather than a resource centres worthy the interest of DDC members.

The design of the district PIS model is based on a framework of an empirical land-use classification with key and link elements of people, land, and land-use activities which is adaptable to any existing land-use conditions. It
provides a framework for observing and articulating relationships in changes and scenarios of various rural development phenomenon by monitoring and responding to changing circumstances. The model will enable planners and stakeholders at district level to transact and make decisions based on significant ecological adaptations and local experience using monitored information for guidance, participation and consensus. Given the guidance, decision-making by consensus is the prerogative of the local stakeholders whose participation is assumed to be absolutely essential. The model provides planners with veto power in cases of decisions exceeding certain thresholds. The district PIS model is superior to well known models of planning at district level some of which are based on a masterplan approach or on critical assumption of financial certainty, conditions which do not apply in rural areas of Kenyan and most developing countries. It is potentially programmable for repetitive procedures of diagnosis, documentation, search and

retrieval of information. District PIS model offers possibility of information networks between districts, co-ordinated regional and national planning. Essential conditions for implementation of the district PIS model under Kenyan conditions are stated. Further research is recommended on (i) costs and feasibility and (ii) a policy and legal framework for community and neighborhood action to provide for institutional development and autonomy of effective DDCs. A district PIS reflects commitment to continuity.

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CHAPTER 1. GENERAL INTRODUCTION

INTRODUCTION

Rural development planning is a quest for mobilising and accelerating change for the betterment of life of people living in rural areas. It has been defined as disturbance of existing conditions by innovations aiming to generate self-reliant enhancement of the quality of life with minimum of negative impact (IDRC, 1986). Other words used for the same process are sustainable intervention. Innovation is the process of delivering to people the knowledge generated by research in a form that has useful and enduring benefits in practical and social terms (IDRC, 1986). It is also a process of decision-making on investment of people and resources which involves risks. Risks should be assessed by the people of the area where development is taking place.

Friedmann & Douglass (1975) described rural development as an attempt to transform the countryside by introducing and adapting elements of urbanism and using available labour more efficiently.

The rural development strategy became a development paradigm after Worldwar II after realization that the older economic growth and industrialisation strategy had failed to deliver sustainable development. Instead it had caused contradictions through problems of rural poverty, overcrowded towns, unemployment, poverty, inequalities, food shortages and external dependency which Friedmann et al (1975) have called dualistic dependency. The main contradiction was the progressive pauperization of the rural masses and formation of a few elites commanding the national wealth. It was clear that the people living by practising farm and non-farm activities in rural areas in developing countries had the worst conditions of poverty, hunger, disease, and deprivation of human rights. A reassessment of national development strategies started emphasizing a shift to new development objectives namely basic human needs; agricultural economies; self-sufficiency in domestic food production; better living conditions; reduction of inequalities in incomes, etc.

All planning is based on the Geddesian principle of diagnosis before treatment. This is the basis on which system planners believe that information for planning is necessary (McLoughlin, 1969).

> We need to know how the parts of the system and the connections change, and how the system changes as a whole. We must try to understand what has caused these changes.

Against that background it follows that utilization of information and knowledge or non-utilization, hence futility of information, is the fundamental issue in policy and style chosen for implementation of rural development planning. It also follows that this issue has profound significance in attainable rate and direction of change as well as on the value of investment in scientific and technical research in developing countries.

At the *Earth Summit* held in Rio de Janeiro in June 1992 there was full endorsement of the overall goal of sustainable development as elaborated in the Rio Declaration, Agenda 21. Today many programs are proceeding to translate the Rio commitments into action under the theme of sustainable change. One program initiated by a consortium of World Wildlife Fund, World Resources Institute and Nature Conservancy International is documenting Best Practices in the field of participatory planning. It is certain that from past experience international development is emphasizing a shift from delivering technology packages to enhancement of indigenous research capacity, development of indigenous technologies in rural development efforts and participation.

According to Wynne-Edwards (IDRC, 1986) development consists of sequential steps in a staircase from a base to creative invention at the top. Each step provides an indispensable infrastructure for the one above. Planners should find out the necessary prescriptions for overstepping from one level to another. The question that remains is whether the malthusian trend of land-use has reached a terminal point of no return where certain populations must for evermore work for food only, which is the lowest rung of Maslow's hierarchy? Clearly it should be a major concern for scholars of the developing the world to dispose the foregoing conclusions which are predicative of laxity, by seeking to establish the true relationship of research and rural development planning, especially at district level.

The ultimate purpose of this study was to promote for public planning and decision-making at district level, the utilization of objective information resources as the basis of innovation and acceleration of sustainable rural change. For Kenya this would translate into constructing a mechanism for a unified approach to the analysis and consensus by the planners and local stakeholders and for making the existing District Information and Documentation Centres effective.

PROBLEM

Our departure points are the following basic premises. First, that generally good information is essential for accelerated development through sustainable interventions and innovations, but the problem is that it is not utilized to make decisions. The fact that rural phenomenon is complex is axiomatic and, beyond citing the Geddesian principle (above), we shall not go further into describing the potency or benefits of use of information generally. In fact the problem of utilization of scientific information in rural development was recognized for a long time. In Africa the actual trend of utilization of scientific and technical information in rural development planning is depicted by the independent observations of experienced development experts namely Mesfin Wolde Mariam (1986), Okoth-Ogendo (1975), Robert Chambers (1974) and Stephen Kituuka (1987).

Okoth-Ogendo (1975) observed that sometimes researchers are even puzzled by lack of what to do with data. Robert Chambers (1974) observed that the impasse of scientific resource information was a common pathology that killed many research studies and plans prematurely.

Wolde Mariam (1986), in his *Rural Vulnerability to Famine in Ethiopia 1958-1977*, concludes that planners of underdeveloped countries have aversion to rigorous thinking and a tendency to accept untested prescriptions from outside. He says that there is nothing deterministic about poverty and famine and that to reduce the problem of famine to natural factors or to raise it to international conspiracy of some sort is to miss the issue.

> The root of the so called underdevelopment is an aversion to the pain of thinking and the effortless inclination to look for untested prescriptions for vaguely comprehended problems.
>
> ...Famine is a human responsibility. ...Famine is the most concrete manifestation of the hypocrisy of cultural and religious values. ...Famine is a consequence of the failure to learn from the constant interctions between society and its physical environment. ...the burden of adjustment is on the society.

Kituuka (1987) found that some districts in Kenya have reached the brink of real malthusian crisis because of rise in human population and the tradition practice of subdividing family land among the children. Yet there was no sign among the planners and decision-makers of either the awareness or critical concern for what was happening.

Secondly, a information flow and utilization gap exists and hence, the apparent futility of research and dependency for innovation in rural development planning. Apparently here we can see a tip of the iceberg: the intrinsic and ugly problem of technology transfer is deep seated.

Thirdly, there is no universally or locally accepted or institutionalised model of how information could be systematically handled and utilized effectively for planning at district level. Burchell *et al* (1982) have observed: "We still do not know how to eliminate disintegration much less accomplish all the objectives simultaneously through an integrated strategy plan". Hence the problem of utilization of information for rural development continues, hence the common pathology and impasse of scientific research information that has killed research and plans in East Africa (Chambers, 1974). To make it worse, comprehensive planners have given a depressingly negative image of decentralised planning, that is even after suggesting the Agropolitan District (Friedmann et al, 1975; 1981). There is a disturbing notion given by Wolde Mariam (1986) that our planners have the inclination to effortless adoption of untested models and prescriptions for vaguely comprehended problems.

In an overview, this thesis proceeds from the viewpoint that disintegration is not deterministic or inevitable, nor are planners lax or unsympathetic. Nor is political will and commitment to improve the socio-economic conditions of undemanding peasants to be taken for granted. But, planners need a technically, socially and legally relevant and valid framework for applying information for sustainable rural development which can relate planners realistically to the people and facilitate dialogue. Until a valid framework is in place the is in a state of disarray, disuse and distrust while planners and decision-makers are muddling through with routine procedures of collating shopping lists of projects. Given a valid framework, planners must be determined to design plans and decisions that are superative in productivity and sustainability by using the available knowledge practically by the best possible means at hand.

Kenya's Problem of Utilization of Information in Planning

The initial stimulus for the study was a realisation of a *prima facie* information utilization gap between large body of available knowledge and what was actually being used to solve problems of rural society in Kenya. This was evident in operational programmes of government departments e.g. regional planning, water development, wildlife, etc for whom the author worked in different capacities. A major challenge to use of information at district level is that in the society there are a lot of grey areas that the planner has to work with. A typical example is the strong imperative for land ownership among Kenyans. That is why landlessness is the local name for dire poverty (Mbithi, 1984). Similarly, that is why a landless person is devoid of respectability and lacks sense of belonging in a rural community. We can assume it is a genuine and normal social characteristic of Kenyan people to want to own land for whatever purpose. Given the foregoing, it is normal also for a wise Kenya politician to be discrete in land policy issues by keeping quiet even if scientific evidence might suggest drastic reform. Among planners these social values require to be stated as assumptions so that if necessary effective necessary controls can be put in place to avert cryptic underhand deals such as the recent wave of grabbing of public lands in Kenya. Unfortunately under these realities planners tend to capitulate, either because of the power factor or incidental benefits.

Sustainability of Spontaneous Land-Use in ASAL Areas

The project approach, adopted for rural development planning in Kenya since 1960s, assumes certain understanding of the factors in complex relationships between resources and population. Complexity here refers to changing goals because of the dynamic nature of environment, changing population and behaviour of actors and scarcity or variation of natural resources in space and time.

This is the case in ASAL areas experiencing population influx and spontaneous settlements. To understand relationships in various productive activities, and then design sustainable interventions to remove constraints and enhance performance and productivity, so as to accelerate development, many questions about the people and the state of the physical environment require to be answered. Sometimes information is unavailable while decision-makers are inclined to emphasize short term and immediate solutions to urgent felt needs such as domestic water supply in ASALs. Even then it is unfortunate if planners fall back to the practice of producing arbitrary shopping lists of projects for intervention in the complex ASAL which have no strategic value for accelerated and sustainable development. .

Decentralisation

Awareness of the information utilization gap became acute with the inception in 1983 of Kenya's policy of District Focus for rural development planning which was perceived as decentralisation. The concern was capacity for planning and effective use of information especially in view of the observation of Friedmann (1981) on decentralisation namely:

> ...decentralised planning is open to pessimism among comprehensive planners because of the risks of lack of guidance, frustration of planners and the goal structure, failure to maintain conceptual grasp in the face of an immediate problem, retreating to the day-to-day trivia or routine of thinking and action to avoid direction, and thinking small, classic responses by romantic subjectivism.

Was decentralisation going to close or widen the gap of use of information mentioned above, and could it heal or exacerbate the pathology also mentioned above? Could scientific information on ecologic resources and socio-economic conditions be applied rigorously at district level to avert famine or would it become an irrelevant luxury and a disutility? Were opportunities for welfare jeopardised by wastage of resources such as wildlife, inefficiency or trial and error? Were we about to enter times of survival for the politically fittest? Was there provision for diagnosis of problems and needs or did District Focus mean that public decisions at grassroot level were to be made by the Chiefs? Was there room for debate and participation for local stakeholders? Only time or closer analysis could reveal the true nature of District Focus.

It should be clear from the foregoing discussion that the problem addressed in this study is the utilization of information for making important decisions at the district level after devolvement of power from the national level. The concern includes rational derivation of innovative solutions by use of scientific knowledge. It is a concern for good grasp of principles, issues and tools of adjusting processes for efficient performance and higher productivity. It is important to emphasize that the problem to which the thesis addresses itself is not the lack of information. On the contrary, as experts cited above suggest, information and know-how often exist to help decision-making in rural development planning (Okoth-Ogendo, 1975), but not always in a form that is directly usable, so planners have to reach out for translations (Outreach, 1992).

THE CASE STUDY DISTRICT

Any district in Kenya could have been taken for the case study of Kenya's District Focus planning since the strategy implementation started simultaneously in all the districts. Laikipia District was chosen for the case study mainly because of the presence and availability of research facilities and scholarships tenable to the district by virtue of the Laikipia Rural Development Programme (LRDP) and Laikipia Research Programme (LRP). LRDP's mandate included supporting applied research in farming systems and adaptive technologies while the Laikipia Research Programme conducted basic research. To these extents the choice of Laikipia was opportunistic but no less valid for it. As explained under methods in chapter four, methodologically it could not have been better for Laikipia availed a very special advantage of studying DDC activities by practical and authorised involvement.

In combination with opportunity just mentioned Laikipia district manifested illustrious conditions of vigorous transition of land-use and land tenure in an arid and semi-arid land setting - just the ideal conditions for an acid test for decentralised planning. Laikipia is a marginal spillover area for the neighboring densely populated agricultural districts of Nyeri, Nyandarua, Meru, Kirinyaga and Embu which are characterised by very high-densities of rural settlement. As can be expected push factors exert considerable force for people to migrate to Laikipia district where cheap land is available. Availability of land results from former European settlers who are willing, mostly at the age of retirement, to sell their land estates. Africans who are in need of the land are usually too poor to afford buying whole ranches as going concerns. Therefore people combine resources as land-buying companies and co-operative societies to raise share capital for buying and then subdividing the properties. The groups fetch massive following and Laikipia is rife with land speculators, land hoarders and escalators of land prices with the result that the land market is extremely imperfect. Finally subdivision of large ranches results in small farm sizes because of high demand and oversubscription by many people who can afford only a few shares. The matrix of small cultivated and uncultivated rectangles forms a drab chequerboard pattern in the former savannaland. The changing spectre of spontaneous rural development is dramatic for its rapidity, scale and intensity.

What is most dramatic and significant about trends in Laikipia as described above, however, is that these changes are taking place across a very steep ecological gradient. From the south east to the north west the gradient of increasing aridity starts from the cold and humid Mount Kenya across the Laikipia Plains to hot and dry conditions in Rumuruti and Kipsing Plains. According to the agro-ecological zone map of Kenya Laikipia consists of an ecological spectrum of zones I, II, III, IV, V and VI. For these reasons Laikipia District forms an agriculture-rangeland interface characterised by intermittent droughts. Along the gradient of increasing aridity is a corresponding degree of risk and uncertainty in rainfed agriculture. For these reasons Laikipia District offers a unique opportunity of studying utilization of information in overcoming thresholds of settlement and farming in the arid and semi-arid regions. The District offers especially the opportunity for testing models of spatial optimisation of land-use systems.

The availability of historical records of settlement in the district was a major advantage. The importance of these records is that they are not published and are hardly known or readily available to planners and decision-makers in the district due to lack of co-ordinated information and documentation systems. An irony of spontaneous change and the need of explicit information is seen in the apparent wastage and obsolescence of infrastructure in the former ranches after the property is transferred to African owners. The wastage accompanying the current land-use transition defies all understanding. Seldom is it seen as an important matter of public interest and policy to maintain amenities in viable condition for the good of new communities. Most of the ranch infrastructures such as boreholes, dams, cattle dips, spray races, roads, telephone lines, fences, etc, are dismantled only to be replaced with new installations built by using scarce Government grants or self-help contributions as population settle on their new plots. Laikipia district is an exceptionally privileged ASAL area because of a considerable amount of physical infrastructure that has been developed for commercial ranching. But this fact seems to be hardly exploited by planners and decision-makers for guiding the restructuring of the rural land-use systems.

The study was also focussed onto the operations and structure of the District Information and Documentation Centres (DIDC) planned for every district and in particular, Laikipia. DIDCs were originally conceived as the receptacles of reference documents of relevance to development for leaders and planners to consult in a district and formed an impotant part of the implementation of the District Focus for Rural Development policy. Without the above facilities and links the ground surveys covering a large arid and semi-arid district with the poor communication infrastructure would have been extremely difficult.

CONCEPTUAL MODEL OF AN INFORMATION SYSTEM

A conventional information system consists of a set of models which are constructed from data taken from events and case transactions of the actual phenomena (Fig. 1.1). The data not only reflects items, events or case transactions that have affected resource uses from preceding manipulations but also indicate the adjusted resource levels. Therefore the information can be used as a tool for controlling and monitoring the operations in an attempt to increase the efficiency of the entire system. The basic principles of an information system

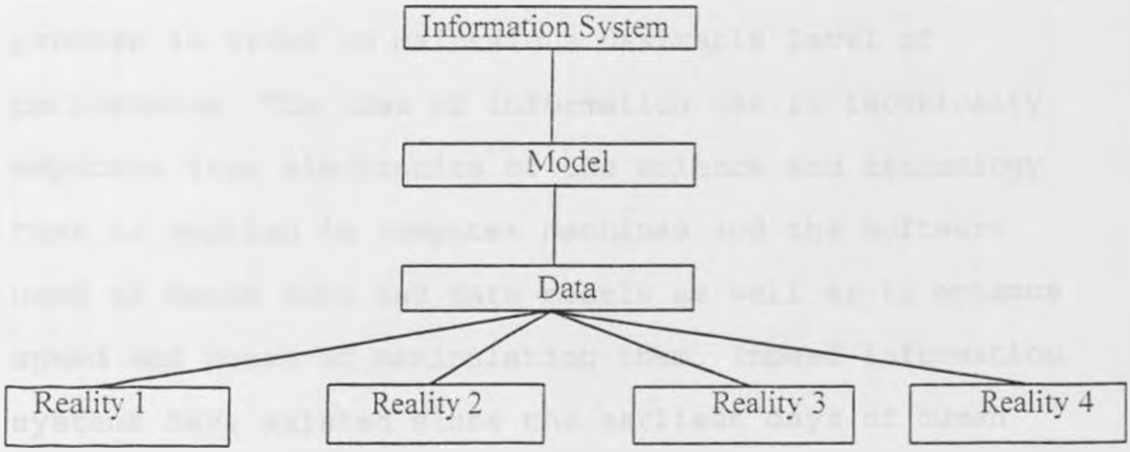


Fig. 1.1. Model of an information system

for management are the intrinsic relevance to the purpose and the dynamic nature. It is generally believed that the success of an information system in planning depends on how closely it reflects the reality, as well as on the accuracy of the logic in the technology used to handle the data and the models. The proposed district planning information systems (PIS) model is a strategy for supporting rigorous use of information to make decisions affecting people, land and activities in the district in order to enhance productivity and wellbeing.

The fundamental distinction between the information system concept and computer science and technology used must be made clear at this stage. Since computers are applied in storing and manipulation of data in modern information systems, sometimes information systems are incorrectly regarded as belonging generically to the domain of modern computer technology. The basic principles of information systems relate to the idea of dynamic adjustment or *control* of resource input to a process in order to maintain a desirable level of performance. The idea of information use is technically separate from electronics or the science and technology that is applied in computer machines and the software used to house data and data models as well as to enhance speed and power of manipulating them. Indeed information systems have existed since the earliest days of human culture as a means of making decisions for the protection, allocation or cultivation of resources. For example containers used to hold grains or flour had various observable levels that evolved ultimately giving rise to data units. The data was used to adjust resource levels and to reflect previous events. However, sophisticated information systems did not evolve until the Industrial Revolution in the 19th century. Today, information systems are used as foundations and operational tools of planning and analysis of data on projects and organizations in industry, commerce and agriculture.

THESIS STRUCTURE

This thesis is based on the view that decentralised planning at district level cannot automatically enhance sustainability by participation without using information. In other words, enhancement of sustainability requires that rural development planning at district level has both the planner's rigour for information use and participation by local stakeholders in decision-making. Hence the point of departure is to define a framework for a meeting point between effective use of information and participation for transactive planning at district level.

The study set out to examine the utilization of information for intervention in rural development planning at district level. Literature on existing models of planning at district level used in Kenya are discussed in chapter 2. A district case study approach is used for demonstration, adopting land-use as the strategic phenomenon on which to develop a framework for planning at district level. The study examines current utilization of information for planning at district level in respect to human population, land resources and activities i.e. land-use. Together with the planning and decision-making activities the gross effort of rural development planning at district level is viewed as a complex and dynamic district land-use system. A district planning information system (PIS) model reflecting the actual people, land and activities is developed. Part 1 of the thesis is devoted to background information including a review of the history of the study area and the literature on modelling approaches to rural development planning. It concludes with the identification and analysis of the problem and the objectives set in the study. Part 11 of the thesis describes the district case study methods and results of Laikipia District of Kenya. Part 111 presents modelling and applications and ends with conclusions.

PART I

BACKGROUND

Overview

Concepts required for theoretical understanding, modelling and implementation of information systems for rural development planning at district level must be derived from sound principles of knowledge utilization and analysis of the specific historical backgrounds. Part I of this thesis is devoted to a review to the case history of Kenya's rural development policy and the analysis of literature on models suggested in the past for rural development planning at a district level. Finally the core concept is that the interactions of population and resources which rural development planning at district level attempts to understand and to change by implementation of certain decisions are embedded in a framework of land-use systems. The character of information for planning must therefore relate specifically to the problems and planned change in the land-use systems of a particular district.

CHAPTER 2. BACKGROUND ANALYSIS

HISTORICAL BACKGROUND

Chronologically Kenya's rural development history can be divided into three successive periods: the pre-colonial era, the colonial era and the post-independence era. Each era is associated with a distinct pattern and trend of rural structure. The colonial era which lasted from 1896 to the advent of independence in 1963 had the most dramatic changes and far reaching structural changes. The post-independence era started in 1963 and continued to the present time.

The entire history of rural change is a chain of ad hoc settlement schemes created for special groups. In the colonial era they were for European immigrants and were created by forceful eviction of African communities and establishment of punitive legislative ordinances that tidied up the treacherous land acquisition. Through several land commissions, ordinances, prohibitions and excisions of land which were uncompensated for, the native reserves were created to ensure cheap labour sources for the European farms from these pools of disinherited squatters. The racial prejudice and pretentious paternalism had traumatic moral effects on Africans and resulted in resistance, mutiny and war in the late fourties and the early fifties. From the start to the end it was characterised by a dramatically strong sense of insecurity of land tenure and ownership which resulted in persistent restlessness among the new settlers. No wonder as early as 1896 the European settlers started seeking guarantees and sanctity of land titles which the colonial government had issued to them for the alienated African land. The Swynnerton Plan of 1954, in sequel to the previous land commission reports, introduced a land tenure reform to finally epitomize the African peasants in the already land- pressurised native reserves so as to legally distract them from the so-called *White Highlands*. The Swynnerton Plan was also used as a tool for rewarding a generation of educated loyal land owners with credit in return for their support of colonial policies. The post-independence era is characterised by rapid increase in population, migration and resettlement of former European large scale farms and ranches.

Colonial institution with a set of legal enactments which were necessary for secure European settlement in Kenya was the origin of the current rural structure and transitional socio-economic conditions. These backgrounds signify that Kenyans have strong grounds to externalise some factors that have contributed to the present socio-economic patterns in rural areas, including deprivation and absolute poverty. Indeed, the contrasts in land-use and rural transformation taking place in many parts of Kenya today arise from the same background of European policies on land, settlement and administration and the incidental disintegration of the former traditional socio-economic systems. As will be shown later these earlier transformations pervaded the case study district. Archived administrative records and literature on Kenya's land history (wa Githumo, 1981; Leo, 1983; Okoth-Ogendo, 1991) give descriptive details about land alienation and subsequent post-independence resettlement. Some of the major events and salient features in the profile of the European colonial organization in Kenya which made impacts on current rural development of are summarised below. In the context of the thesis they are cited because they form part of the current policies that impact on planning at district level.

(a) 1896 - First land registration system of issuing land certificates of occupancy was introduced by the Chartered Imperial British East Africa Company (IBEA).
(b) 1902 - The Crown Lands Ordinance was enacted with the first major conditions for land development by settlers given as land grants; Outlying Districts Ordinance declaring the existence of native reserves and agreements with tribal leaders was passed.
(c) 1904 - The purported first Masai Agreements with the colonial administration were concluded.
(d) 1908 - Crown Lands Bill was made, being mainly amendments to the 1902 Ordinance.
(e) 1910 - The Land Titles Ordinance was passed. The land registration system was extended to cover certificates of ownership.

(f) 1911 - The Masai were evicted from Laikipia District and other parts of the highlands north of the Mombasa-Kisumu railway for European resettlement, through the purported Agreements with Masai Laibons.

(g) 1915 - The Crown Lands Ordinance was promulgated; so far it was the most fatal legal blow on the African claims to their land and a most racial discrimination tool in the colonial settlement policy. This was a legislative sanction and a legal tool of acquisition of African lands by the British Crown, pre-empting all rights of Africans (natives) to land ownership. The ordinance gave the Governor powers of creating or abolishing reserves for native occupance while it gave European settlers 999 year leases of the land they had acquired.

(h) 1919 - Registration of Titles Ordinance.

(i) 1920 - The Land Tenure Commission to look into delineation of native reserves, forests reserves, methods of alienation of Crown Lands, leases and rents was formed. The commission recommended that racially segregated reserves be inserted in the Crown Lands Ordinance of 1915.

(j) 1922 - The Soldier Settlement Schemes to settle soldiers discharged from First World War in empty spaces in the highlands was created. Politically, the main purpose was to boost the European population in the colony.

(k) 1924-25 - The East African (Ormsby-Gore) Commission was established to look into the social conditions of

Africans, treatment of African labour force and taxation. The Commission reported the grievances and discontent among Africans over the land alienation by the European settlers.

(l) 1926 - The formal gazettement of native reserves.

(m) 1927/29 - The Hilton-Young Commission, concerned with the federation and co-operation among governments of Eastern and Central Africa, suggested settlement of the land rights question through some form of authoritative definition of African reserve boundaries and the establishment of "rule of justice" to enlist loyalty and confidence in British rule among the African population.

(n) 1930 - The Native Lands Trust Board was appointed to manage and control native reserves. The Board was headed by the Governor and consisted of ten other persons one of whom was an African. The functions of the Board were to advise the Governor on leasing of land in the native reserves to non-natives for 33 years.

(o) 1930 - The Kenya Land Commission (Carter Commission) was established to inquire into the working of the 1930 Ordinance, the needs of the native population with respect to land held in tribal or individual tenure, and desirability and practicability of setting aside further areas of land for present or future occupation by African communities, individuals or bodies of recognized tribes or detribalised natives. The commission recommended that the natives had little claim to land in the *White Highlands* and that for any legitimate claims they could get compensation made with alternative land in the contiguous areas peripheral to these *White Highlands*.

(p) 1938 - Implementation of the results of the Carter Land Commission which included among others the Crown Lands Ordinance Amendments with a comprehensive redefinition of the *White Highlands* and a Highlands Board appointed; Creation through enactment in 1938 of the Native Lands Trust Ordinance; boundary specifications of various native reserves, temporary reserves, native leasehold areas, Northern Frontier and Turkana areas; creation of Local Land Boards with the ultimate authority concerning land matters vested in the Governor.

(q) 1940 - Amendment of the Native Authority Ordinance by making ethnic boundaries fixed and exclusive. The Amendment empowered the Provincial Commissioners to order any natives found cultivating land outside their native reserves to return to the reserve.

(r) 1945 - End of World War II and establishment of new European soldier settlement schemes.

(s) 1952 - The start of the Mau Mau uprising and the Proclamation of State of Emergency in Kenya.

(t) 1954 - The Swynnerton Plan proposing individualisation of land in the native reserves. Formally the purpose of the Swynnerton Plan was an attempt to rationalise African land tenure in order to facilitate economic land-use. In reality it was a tenure reform aimed at creating a permanent African peasantry in the reserves while indirectly it would secure the European tenure in the *White Highlands* by offsetting migration and claims on the lands held by Europeans.

(u) 1955 - The East African Royal Commission approved the strategy proposed by the Swynnerton Plan.

(v) 1959 - The Land adjudication Act for defining the process of individualisation of land tenure in accordance with the Swynnerton Plan was instituted.

(w) 1963 - Registered Land Act for providing a system of title registration in African Reserves after the implementation of land adjudication was passed.

(x) 1963 - Independence, and thereafter Kenya became a Sovereign Republic.

Through the above processes of law enactment, the colonial administration, which was overly influenced by the politically powerful white settlers' lobby, had achieved three fundamental objectives. First, a new kind of socio-economic structure characterised by two social classes. At one extreme were the African peasants living precariously with their disinherited landless cousins who could be easily drawn into the labour cadres in the European farms as a class. At the other extreme were the European landlords owning estates covering large tracts of land. Secondly, along with the stratification there was a also a permanent segmentation and compartmentalisation of the Kenyan society along racial and ethnic lines. With legal controls in form of ordinances in the hands of colonial administration that served the capricious and political inclinations of European settlers the socio-economic order and political conditions ensured that the peasants' life would remain permanently precarious hanging on slender mercies of European settlers. As already observed above the Swynnerton Plan was the last and apparently the most potent colonial tool of sustaining a dynamic rural land-use structure as well as a long lasting socio-economic stratification in Kenya.

Post-Independence Era of Hard Options

Kenya's Independence in 1963 was a major turning point in rural land-use structure. First, matters of land can be seen in the context of the political euphoria and expectations of freedom for the African communities after being marginalised for the greater part of seven decades. Deliberate neglect of the non-European, especially Africans, by the colonial government in years before 1945 is notable in the historical profile drawn above. This fact indicates that Kenya's economic planning pattern conformed to the common pattern of economic development planning in many Third World countries that did not start until after World War II specifically in 1948. But it should be noted also that nearly the whole concept and practice of country-wide resource and rural development planning that currently forms a major pattern of economic planning in Kenya is post-independence phenomenon. The advent of political independence and national sovereignity for Kenya had the significance of catalysing economic change and opening the scope of comprehensive planning and optimization. Intensification of agriculture based on small holder subsistence production systems which include one or another cash crop for export, has been emphasized as a major policy objective. Kenya's future and destiny towards the 21st century in regard to its responses to external and domestic factors seems to be closely bound with its rural land-use systems like it was in the 20th century just ending. Domestic circumstances are becoming increasingly more difficult than those prevailing in the period 1963-1990. Two major sets of circumstances are relevant to Kenya's domestic policy decisions. These are the international economic conditions especially the stagnation and inflation patterns in industrialised countries and the trend of increase in prices of imported crude oil since 1973 which has not changed substantially up to now. In the Sessional Paper No. 4 of 1980 the Government of Kenya stated that careful consideration was being given to the possibilities of achieving the necessary adjustments to the external economic conditions. The other set of circumstances is the domestic ecological and socio-economic situation. This includes the problems of population growth, unemployment, lack of development funds at national level, the spillover of population and introduction of high-risk land-use systems in the arid and semi-arid lands.

District Focus Strategy

A major post-independence organizational change in Kenya is the strategy of District Focus for Rural

Development Planning launched in 1983/1984 under the fifth 5-year Development Plan. District Focus strategy was expected to shift the centre of gravity and the perspective of the planning system from Nairobi to a network of 45 district headquarters. A major implication of the above historical background is the primacy of sustainable land-use management for rural development. Kenya is 580,000 sq. km. of which 80 per cent is arid and semi-arid lands (ASAL) and a labour force of around 10 million people. Rural land-use activities provide employment for eight million or 80 per cent of the nation's population. About 80 per cent of land in Kenya is arid or semi-arid. Sustainable roads, water and health facilities have to be installed and gainful employment created. In the course of time ASAL areas will be forced to respond to increasing demands of renewable and non-renewable resources as well as employment opportunities for influx of migrant settlers. In view of these circumstances land-use in ASAL areas requires to be addressed specially in rural development planning. However, despite any shifts in overall demographic change, production, employment and spatial development patterns, and despite changes in education and industrial oriented skills, rural land-use is still unmistakably the most important source of incomes for the majority of Kenyan population. The national food security policy of Kenya requires that the agricultural sector intensify land utilization for food production in order to meet the national needs from domestic production. In this context it may be noteworthy that Kenya was one of the developing countries that benefitted from the breeding of improved maize varieties and hybrids.

Kenya's energy policy specifies the need to avoid strangling the national economy by the progressive increases in energy costs, especially the escalating prices of imported crude oil. It also stresses the need to adopt measures that will promote better utilization of the available supply of conventional energy sources. The potential use of alcohol, charcoal and wood imply the re-organization of land-use systems to enhance production of fuel raw material.

Laikipia District is a case of the *White Highlands* and was protected from African settlers by restrictive colonial policy for many years. Independence brought the necessary policy changes to set in motion unrestrained economic imperatives and self-determination with possibilities of land ownership and land-use by Africans. However, the characteristic mass movement of subdivision and resettlement lagged behind as compared to White Highland districts in the high potential agricultural areas such as Nyandarua, Nakuru and Trans-Nzoia. This lag indicates perception of the prevailing reality of arid and semi-arid conditions which acted as a real disincentive to the local stakeholder groups. In view of these conditions special participatory rural development strategies needed to be considered.

HISTORY OF LAIKIPIA FROM 1900 TO 1990

The Laikipia Masai

Before 1905 Laikipia District was the undisputed home of the Purko Masai living by nomadic pastoralism on the rangelands in the area under study. This form of land-use had at least three adaptive strategies. The first was the practice of keeping a diverse mixture of livestock species to maximize ecological benefits of good times and to minimize risks of mortality in the bad times. The other strategy was nomadism or seasonal movement of livestock and households in pursuit of better grazing and watering conditions in the rangelands. In this lifestyle household goods are portable and the donkey is important as an item of family wealth just like a car is important to a family in an urban situation. The third strategy is communal land tenure whereby all households in the community share grazing rights as well as jurisdiction and security. Thus the herdsmanship of zebu cattle, goats and sheep, the institution of *Moran* or warrior class, the periodic ceremonies and celebrations held for various purposes such as the *Eunoto* - the cerempny for the change of guard in which the incumbent *Moran* age group who are ageing, retired to marry and become *Moruak* or elders - and the typical community solidarity, were characeteristic parts of human and cultural adaptation to the high-risk arid and semi-arid environment. The characteristic Masai place names such as *Ol Jabet, Ol Moran, Ol Jogi, Uaso Ngiro* in

Laikipia district are reminders of environmental awareness and consciousness of the pastoral Masai society. Just as it was the case with other clans in southern Masai, the Purko Masai in Laikipia co-existed symbiotically with the Dorobo. The latter were a poor minority group among the Masai living off honey gathering mainly, having no cattle like the Masai proudly had them.

Colonial Intervention for European Settlement

At the turn of the 20th century British Government established in Kenya an imposing and powerful colonial governmental superstructure with a hierarchy headed by a White Governor stationed at Nairobi, followed by Provincial Commissioners. The Provincial Commissioner for the Rift Valley Province was stationed at Naivasha. Below the Provincial Commisioners were the District or Resident Commissioners. For Laikipia District the District Commissioner was stationed at Rumuruti. The new administration had divided the Masai community in Kenya into two separate administrative units. These were the Northern Reserve comprising mainly the Laikipia plains, and the Southern Reserve which included the Loita Plains, Mau Narok and Ngong. From the outset, the policy adopted by the colonial administration, which was highly influenced by the powerful European settlers, was to take possession of the entire Laikipia Plains for allotment and settlement by an exlusively European farming community as part of what later became the "White Highlands". In order to start an exclusive European development, the first major action taken was to secure land in Laikipia District to settle European migrants and to segregate them from the African natives. To implement the policy of exclusive European development of Laikipia District, coersion bordering on blackmail and treachery, were exerted on Lenana and the local Masai leaders in order to secure a consent of the Purko Masai to leave Laikipia District voluntarily. The Governor, at that time Sir James Hayes Sadler, and the District Commissioner of Laikipia in collaboration with the Masai appointed local chief of Rumuruti, Chief Masikonde, promised to find a new home in the Southern Reserve for the Purko Masai if they granted their consent to leave Laikipia.

		Cattle	Shoats
1906	Collyer's Census	64,000	1,750,000
1912	McClure's Census	160,647	1,068,100

Table 4-9. District Livestock censuses for tax assessment Source: Kenya National Archives.

Meanwhile, as the priority of moving out the Masai and their livestock from Laikipia was being debated between the Governor, the PC, the DC and Lenana at Ngong, ways and means of mobilizing the Purko Masai were being designed by the DC of Laikipia and the police. A Tax Collector was posted to the Rumuruti government station to levy taxes in cash and kind on Masai households. The Hut Tax was imposed on every household head. The European Tax Collector visited each Manyatta in turns for this purpose. The first livestock census in Laikipia District (Table 4-9) was carried out by the Tax Collector in 1906 as a means of estimating the Hut Tax for collection.

Cattle	199,264
Sheep	549,010
Donkeys	6,000

Table 4-10. Numbers of livestock that left Laikipia District in the exodus 1910-1911. Source: Kenya National Archives.

Eviction of Masai From Laikipia 1910-1911

Finally, the historic eviction was carried out in a massive operation regimented by the District Commissioner using police force in 1910, but it was not completed until 1911. The Masai households and livestock were matched tandem-wise in three widely separated profiles from Laikipia through the central rift valley area of Kenya to the Melili and Mau Narok areas of the present-day Narok District. One of the profiles passed through Kinangop and Naivasha destined for Engattit in Melili, while the other profile passed through Elmenteita ending in Mau Narok. The third profile passed to the west of Lake Nakuru and ended also in Mau Narok. The numbers of livestock that left Laikipia District in that exodus were as shown in table 4-10.

Policy of Separate European Development 1911-1963

With the removal of the Purko Masai, Laikipia District was further secured from the other natives by a demarcation of boundaries to the North to keep out the Samburu and in the North West from the Suk (Pokot) in the Churo area. To consolidate the separate European development strategy trespass ordinances and regulations were passed in 1915. This legislation was used to limit the rights of natives for movement and involvement in any activities other than as employees in the European farms. They were particularly aimed to curb stock movements in the so called "White Highlands". Settlement and development of Laikipia District by European settlers after 1911 were slow. The first settlers to arrive were people from Britain but after the World War I the settlers were mainly ex-World WarI soldiers. At this time the Laikipia plains were teeming with wild animals and some of the settlers especially the Dutchmen from South Africa, were quick to set on harvesting of buffaloes for income from sale of hides which were sent in loads to the railway at Naivasha. In time, ranching ventures were developed into a strong industry of mainly beef cattle and sheep keeping.

Isolation of Mukogodo Native Reserve 1934

The departure of the Purko Masai from Laikipia implied that the Dorobo honey gatherers who were left behind lacked their characteristic symbiotic relationship with the Masai and as a result wandered among the European settlements without permanent homes. By the 1930s the Dorobos could not any longer be tolerated in the ranches. The Mukogodo Native Reserve in the mountainous terrain to the North East of the district was isolated in 1934 to cater for occupation by these disinherited Masai-speaking Dorobos.

<u>The Mau Mau Crisis 1952-57</u>

The climax of oppressive colonial administrative history of Kenya including Laikipia District came in the 1950s when Africans started the violent Mau Mau revolt against the ruthless colonial administration and domination by Europeans resulting in a protracted warfare lasting for over six years. The war was mainly concentrated in the native reserves including the Districts of Nyeri, Meru, Kirinyaga, Muranga and Kiambu with the mountain forests being used by the Mau Mau for cover and as operation bases. However, as a European enclave within the "White Highlands", Laikipia District was highly sensitised to effects of the national warfare. Both the European settlers and the colonial administration responded by an emergency operation of repatriation of their Kikuyu labour force from the ranches, accompanied by confiscation of livestock and other properties especially those of Mau Mau suspects among them. From the ranches Kikuyu employees and their families were transported by truckloads to transit rehabilitation camps at Nyahururu (former Thomson's Falls) and Athi River. Others were sent directly to prisons and detention camps. The Mau Mau war ended in 1958; it was militarily neither victory nor defeat for the contestants, but Kenyans gained a fundamental political change which led to the advent of Kenya's internal self-government in 1962.

Impact of Political Independence After 1963

The immediate consequence of Kenya's independence was the removal of colonial laws and regulations restricting Africans from owning land and enterprises in Laikipia. Although the repossession of the land in the former White Highlands was considered as the highest political priority in the advent of independence caveats placed by the British Government forced Kenya Government to buy the land from the European settlers for allotment to the African population. This meant financial credit had to be obtained to compensate European farmers who were willing to sell their holdings. Furthermore, the Republic of Kenya as a sovereign state had emerged with a constitution which recognized a mixed pluralistic society in place of the former exclusive European development policies for Kenya citizens. The implication of the new constitution was that a citizen irrespective of the skin colour could own property or land in any part of the country. In Laikipia resettlement on the former European ranches started with schemes planned by the Government of Kenya under a project named the *One Million Acre Scheme* (LEO, 1984). This resettlement affected the following parts of the district: Marmanet, Ngarua, Igwamiti and Kalalu. These are high potential sub-humid agricultural areas. Thereafter, private transactions for sale and purchase of land started which have resulted in extension of spontaneous settlements into semi-arid zones which were formerly used for ranching. Land vendoring is big business and the cause of mass migration and current change of land-use in Laikipia today.

CHAPTER 3. PREVIOUS WORK AND LITERATURE

INTRODUCTION

Friedmann and Douglass (1975) introduced the model of the Agropolitan District with a critique of the failure of the traditional development strategy of technology transfer for industrialisation and economic growth. In Asia it had produced contradictions and a state of dualistic dependency characterised by concentration of modern activities in hyperurbanized towns surrounded by deteriorating conditions in the peripheral rural areas. It had generated dichotomous material conditions with a few elites controlling large wealth and progressively pauperised rural masses. It caused structural unemployment and underemployment and, through the neglect of domestic food production and concentration on exportable cash crops it had caused persistent food shortages. These trends have resulted in social unrest and grave consequnces which made the technology transfer strategy untenable. In the light of experience and reassessment of trends described above the overall global emphasis has shifted towards strengthening the rural development strategy. Finally the goals of sustainable rural development which include basic needs, environment, employment, participation etc were elaborated in Agenda 21 which was endorsed by 150 nations at Rio. Before we analyse Kenya's experience with any specific models of rural development planning, first we should note that the above observations are valid and highly relevant to Kenya as a developing country and from her past experience.

Secondly, the last 20 years which climaxed with UNCED at Rio de Janeiro in 1992 witnessed much commitment and efforts to develop models to help the shift from development objectives based on economic growth to those based on the sustainable rural development paradigm.

Lastly, in translating the commitment to the rural development strategy into action efforts and scenarios will reflect and depend on the underlying perception, will and capacity for effective utilization of information in change. This is the main challenge facing Kenya's rural development, which forms the overall context of my thesis. There is no doubt that generally the identification of data needs, the data handling procedures and impacts of use of information makes the overall problem of provision and use of information for rural development a highly complex one. But the foregoing background against which the present study of utilization of information for rural development planning at district level in Kenya was initiated shows that on the whole the district PIS model is the best way forward. The conclusion of the 1981 UNESCO Meeting of Experts on Provision of Data for Development attests to the above view:

> the awareness of the existence of information and its utility as a development resource is insufficient and needs to be promoted among relevant national authorities and users.

As a part of post-UNCED action plans, a consortium of the World Wildlife Fund, World Resources Institute and Nature Conservancy is carrying out a biodiversity support programme to identify and promote the *Best Practices* of social assessment for conservation. *Best Practices* are defined as those having characteristics of empowerment to community or participatory, integration in entire project cycle, consideration of actors at different levels, stakeholder-oriented, etc. Against these criteria it is contended that the district PIS model could emerge the best. In the light of the above background we shall proceed review models of rural development planning at district level that have been promulgated or applied especially in Kenya. The objective is to show that the proposed district planning information systems model for rural development planning at district level will be comparatively technically superior for application under Kenyan conditions.

MODELS OF RURAL DEVELOPMENT PLANNING IN KENYA

Thematic Maps

Participatory Rural Appraisal (PRA) includes a mapping exercise where rural communities are made aware of their environment. Worthington (1949) advocated strongly the need for special maps of the sub-regions of Africa, giving the detailed information necessary for the scientific assessment and the planning of developments. This was at the African Regional Scientific Conference held in Johannesburg in 1949. It was noted that "only when information concerning a variety of interacting factors is readily available can satisfactory decisions be made concerning development planning". It was noted that among the subjects which could be summarised in this way were physical features, climatic and hydrological conditions, vegetation and fauna - including tsetse flies, land-use -including animal and plant industry, population, tribal and political divisions, health and educational facilities, communications. It was noted also that some information under these heads was already available in scattered form and could be collated in form of map and atlases for the different regions. These views are strongly supportive and complementary to the proposed model of district planning information system. Mapping is a key element in the proposed PIS model but maps need to be used in an operational dynamic planning framework.

Integrated Rural Development Programmes

Some bilateral development agencies have fostered the Integrated Rural Development Programmes (IRDP) approach for their projects in Kenya. A current example of the integrated rural development programmes is the Kitui Integrated Rural Development Programme. The approach attempts to enhance selected services for existing land use by administrative units. The term *integrated* came into prominence in the development planning vocabulary originally and mainly through United Nations organizations in the 1960s. The term never gained any articulation as a concept or a practically useful tool for application in the planning or the implementation procedures. The "integrated approach" became more or less exchangeable with the terms "co-ordination" and "harmonization". As a result of this poor definition the "integrated approach" has been criticised for allowing a syndrome of vague thinking and for providing a means of avoiding responsibility for clear proposals as well as discouraging identification of certain important relationships and potential benefits of rural development plans in detail. The application of computer technology and the shift to digital mapping (Burrough, 1986) has led to the realization of the relative "inadequacy of narrow approaches to planning and methods of handling planning information". The rapid growth of modern computer technology resulting in a shift to geographic information systems (GIS) based on digital mapping seems to be raising hopes of integrated approaches. IDRC (1986) has shown the advantages the microcomputer has brought to the informatics industry through the microelectronics revolution of the 1980s. They have described how developing countries are taking advantage of the new information technologies, especially for handling their census data, in assisting farmers plan for their crops and to plan their national debts. The Servan-Schreiber vision (IDRC, 1986) of geographic information systems is part of this phenomenon. On the whole, however, the concept of integrated district planning has not been successful or sustainable. The trend has been that as soon as the project has ended operations return to monodisciplinary approaches.

<u>Ecosystem Model</u>

In Kenya, nature conservation agencies have used the ecosystems approach to identify and delineate areas to be legally protected for wildlife and to draw their management plans. In the 1970s the Game Department used the term *ecounit* (Taiti, unpublished) for the purpose of delineating units of landscape for the Kenya Rangeland Ecological monitoring Project (KREMU) which later became the Department of Resource Survey and Remote Sensing (DRSRS). The concept of an ecosystem invented by A.G. Tansley (1935) is the basis of modern ecology or the study of organisms (animals and plants) in relation to their natural environment (Odum, 1971; Cloudsley-Thompson, 1967). An ecosystem consists of a tendency towards an ultimate steady climax state at its highest state of development and after disturbance it will tend to restore the same climax again. Another major principle in the ecosystem concept is the biogeochemical system comprising of the processes of energy flows and material circulation in the ecosytems (Odum, 1960). From a human population's point of view there are opportunities and constraints for livelihood determined by criteria of ecological suitability of specific activities and objectives such as production. An ecosystems is characterised by spatial variation, thresholds and lag effects which influence performance. As an ecosystem each region or district has its own particular set of interactions between a specific population and the environment (resources). The application of ecology to the planning of a region has hitherto involved two extreme points of view. One of these suggests that nature be left alone to take its course and this view is sometimes referred to as the principle of environmental determinism. Under normal conditions of rural development planning this practice is generally regarded as unacceptable. The other ecological point of view to be considered is the model of ecological management or management with nature (McHarg, 1982) in which the ecosystem is a framework and tool for analysis, diagnosis, prognosis and prescription that are needed for decision-making and design for dynamic phenomena. Recently a new concept of hierarchy and cybernetics of ecosystems was introduced (O'Neill, de Angelis, Waide & Allen, 1986). The hierarchical ecosystems perspective simplifies the problem of dealing with the evolution and the complexity of ecosystems. From the point of view of planning and having regard to management and control of a system, the hierarchy concept renders possible a cybernetic view of an ecosystem. O'Neill, de Angelis, Waide & Allen (1986) suggest that the hierarchical organization is the fundamental principle that we can use to formulate an adequate concept of ecosystems. The ecosystem approach as practised by park planners is narrow and a specific-purpose approach.

<u>Land Evaluation</u>

<u>Land evaluation</u> (FAO, 1976; Beek, 1978; Kenya Soil Survey, 1977) practised by the Kenya Soil Survey is a form of comprehensive planning approach. It is a methodological procedure developed by FAO in 1976 for the purpose of agricultural planning. The basic concept in land evaluation is the 'land utilization type' (LUT) which means a relevant or prospective land-use defined with specific reference to the product and the physical ecological requirements in respect to

other factors for instance soil nutrients, moisture, etc which influence its performance. Any rural landscape under consideration for a particular LUT can be assigned a rating of ecological suitability in respect to the selected options. Beek (1978) distinguished a general purpose land evaluation from a specific purpose land evaluation. The former is a standard procedure for all land-uses, and is intended to evaluate their capability to support generally defined land-uses. The latter is a procedure tailored to evaluate land for suitability to support a specific combination of land utilization types. The fitness of any landscape is expressed in terms of yields to be expected from it considering the optimal inputs required. Multiple land evaluation involves more than one land utilization type, each having its own specific land requirements all being considered simultaneously for the same unit of landscape. For instance inputs and outputs in timber production and in recreation may interact in the same forest area. Integral land evaluation means that analysis of socio-economic factors is included in the procedure. The crucial stage of the land evaluation procedure is the matching of the requirements with the land qualities. The land evaluation procedure has already been advanced to be able to produce quantified options (Thalen & Schmit, 1986). Land evaluation recognizes the general complexity of reality for planning emphasized by comprehensive planners (McLoughlin, 1969): "institutionalised planning is obliged to be both long-range and comprehensive". It attempts to have the characteristic of 'striving for the total welfare of the public in so far as living conditions are affected by and through the environment' (McLoughlin, 1969). However, a principal limitation to the application of the land evaluation approach in rural development planning is the constraint of existing land-use. Land tenure conditions are assumed to be flexible or state property such that terms of allotment can be changed according to specifications of the chosen LUT. For Kenyan conditions a fundamental limitation to the application of a land evaluation model in rural development planning land tenure structure. That is why soil survice has not made a big change in rural development as it could if it was not tied to a land evaluation framework.

Agro-Ecological Zones Model

The concept of agro-ecological zones (AEZ) (FAO, 1978; Jaetzold, 1984) was used by the German Agricultural Team in Kenya to investigate the national extent and carrying capacity of arable lands potentially available for food production to support the present and future population. Six major gro-ecological zones have been delineated in Kenya. Application of the AEZ at district level is hampered by lack of specific technical prescriptions or innovations in terms of viable crop varieties to match and lack of a policy for controlling rural land-use according to ecological zones.

Farming Systems Approach

Farming systems concept is an empirical site-specific and local approach to the analysis of the existing land-use focussing on low-technology subsistence farming with a view of determining how it can be assisted in rural development planning. Work in this nascent field includes ITC (1975), Collinson (1982), Remenyi (1985), ICRAF (1988). According to Kanegieter (ITC, 1975) a farming system is "the way in which and the objectives for which an agricultural enterprise is managed in the process of adapting cropping patterns and farming practices suited to the conditions of the environment, available technology, and objectives of the farmer, such that it has a distinctive form of farm organization". In the farming systems approach to rural development planning small-scale farmers (peasants) are considered to operate with family labour and to be adaptive in decisions regarding technology and production level. The primary objective of these farmers is production of food for their own subsistence. Considered under conventional economics this systems is regarded to be an irrational self-exploitation of peasants that is perpetuated by the social attitude and general acceptance of the poor way of life as natural and inevitable (Wolde Mariam, 1986). These considerations make it difficult to treat production activities in a farming system entirely in the quantitative economic standards while considering interventions. Farming systems research is progressing strongly in different parts of the world with ACIAR in Australia and collaborators in African countries (Remenyi, 1985) and ICRAF programme in African countries (ICRAF, 1988; Collinson, 1982). The Land Management Division in Kenya's Ministry of Agriculture is following the farming systems approach in agricultural planning (Mwasya, pers.comm). Collinson (1982) described the farming systems programme carried out in collaboration with Michigan State University. Norman and Collinson (1982) have noted that development of new farming systems using state-of-the-art technology is possible but in reality small-scale farmers do better by evolving from the existing situation in steps compatible with their resources. The principle of farming systems research therefore aims at finding out potential development paths from the existing situations. Two major strategies of improving productivity are identified. The first strategy is improvement of technologies and practices while the second is improvement of appropriate policy and support systems to create opportunities for improved production and conditions conducive to adoption of technology. These are yet to be developed.

The Human Settlements Model

The Human Settlement Strategy of Kenya (Physical Planning Department of Kenya, 1978) concerns policy alternatives and strategies' for the preferable settlement pattern for Kenya for both urban and rural development. This model is accompanied by an analysis of the population, resource base and patterns of the current and estimated future employment and settlement. The scheme of implementation was organized along sectoral lines. Regional inequalities in distribution and opportunities for development were analysed for each sector. Existing programmes and plans of various ministries (eg housing, water, industrial location, education facilities, etc) were analysed to find out how they were geared towards the preferred strategy or how they could be adjusted to strengthen the desired settlement pattern. It was, however, significant that at the time when this model was formulated it was realized that the greatest opportunities for the planning and integration of development in human settlements in the future were best offered at the district level. It is surprising that despite the similarities between them the model showed no reference to the ekistic concept.

Physical planning is an important component and one of the key policy instruments for land-use planning in rural and urban development in Kenya. It is actively applied as a tool in the allotment of public land in planning and decision-making at district level. The physical planning originated from the British model of garden suburbs idea and was a reaction to the desire for low density settlements and open space communities in the burgeoning industrial cities. With a concern for the physical development of an area the emphasis is on form and function. A static set of economic and social parameters is used. The general practice is to design a single, end-state plan reflecting an overiding public interest and area, scope, legal standing and position of plan relative to the derivative regulations of official maps, zoning, subdivision, etc. Finally and while physical planning at higher levels has been very effective, for instance in the fields of transportation and sewerage, there are two issues of physical planning at regional level that have not yet been resolved. The two issues that require compromisation at regional level are: (i) regulation of land -use; (ii) rational distribution of population.

An important factor in the physical planning approach is populaton density. Whitby et al (1971) has pointed out that the general assumption in physical planning in Europe is that rurality signifies residual populations or the left-over of urbanization trends that accompanied the industrial revolution. This assumption is hardly valid for the situation in many developing countries such as Kenya where on the contrary rural settlement is predominant and on the increase. Some examples of studies that illustrate the importance of rural settlements may be cited at this juncture. One of them is the study of the problem of spontaneous rural squatter settlements in small farms, large mixed farms, plantations, outspans, national parks and game reserves in Kenya by Mbithi and Barnes (1975). This type of settlement raises great concern for rural development planning with respect to districts in arid and semi-arid lands (ASALs). A second one is the study of the consequences of land adjudication in the Mbere Division of Embu District by Brokensha and Njeru (1977). These authors reported widespread land sales, decline of clan and family control of land. Their report also showed radical changes in vegetation cover together with an increase in lack of co-operation, hostility and person-to-person conflicts in land matters. These are characteristic problems of rural settlement for which physical planning shows no concern and offers no answers. Chambers (1974) in his discussion of the management of rural develoment in Kenya and East Africa made the conclusion that area planning was unwarranted:

> The frontier in area planning is, then, to abstain from premature plan formulation and to explore, develop and evaluate other activities and procedures from which greater benefits may be gained. The frontier lies less in plan formulation than in development of management procedures.

From the foregoing discussion the obvious conclusion is that the physical planning model offers little promise to the problems facing rural land-use planning at district level.

<u>The Rangeland Economy Model</u>

Under the FAO/Kenya Wildlife Management Project 1971-1976, Thresher and Shah (Unpulished)) attempted to construct a model of rangeland economy. The purpose of the model was to rationalise the utilization of wildlife for the Masai group ranches in Kajiado District as an alternative or complementary to the economic activity of traditional livestock production enterprises. According to the plan proposed at that time, the Masai communities would benefit from conservation of the wildlife in their group ranches through systematic cropping for meat and organized tourism. The Ministry of Tourism and Wildlife would maintain a range and wildlife monitoring programme to support the operation of the rangeland model in practice. Data on wildlife and rangeland conditions including rural land-use, wildlife-livestock interactions, vegetation and forest was acquired from routine systematic reconnaissance flights (SRF) by means of light aircraft, satellite imageries and ground surveys. Light aeroplanes fitted with vertically belly-mounted cameras and digital radiometers were used to take photographic images and radiometric probes of vegetation from low altitude (Ottichillo, Peden & Mwendwa,1986). The available information was transferred to the main user government ministries of wildlife and lifestock development for application through a databank, regular reports and seminars. For the purpose of the above scheme a national rangeland monitoring project in the name of Kenya Rangeland Ecological Monitoring Unit (KREMU) was launched jointly by the former Game Department and the Range Management Section. Technical assistance to build up the capability for monitoring by systematic reconnaissance flights using light aircraft including training was given by the Government of Canada (CIDA) through the World Bank. In the subsequent turn of events KREMU was transformed into the present day Department of Resource Surveys and Remote Sensing (DRSRS). However, there has been hardly any significant practical applications of data because institutionally the supplier-user link has been broken.

Threshold Model

The threshold concept (Kozlowski & Hughes, 1972) was originated and pioneered by Boleslaw Malisz in the milieu of town planning in Poland in 1963. The original basic concept on which the model process of threshold analysis was founded was stated by Kozlowski & Huhges as follows:

> ...towns encounter physical limitations to their

> development due to topography, land-uses and technology of infrastructure. These limitations, called development THRESHOLDS, are not irremediable and can be overcome but only at 'additional' development costs, or THRESHOLD COSTS. Thresholds therefore impose a marked effect on the continuity and strategy of urban development.

The scope of application of the threshold concept to rural development planning at local level has been investigated in Kenya by Stephen Waigwa Gitonga (Gitonga, unpublished). He used the threshold methodology to study and map boundaries of physical ecological limitations of agricultural development in Ngarua Division of Laikipia District. From the work of Gitonga it is evident that threshold analysis has considerable untapped potential for contribution to rural development planning at district level.

Diagnosis and Design (D&D) Model

The International Centre for Research in Agroforestry (ICRAF) has developed the diagnosis and design (D&D) method for the special purpose of planning and extension of agroforestry in the countrysides (ICRAF, 1985; 1987), Olson,1987). It is supposed to be one of the methods holding considerable promise for landscape engineering (aesthetic and architectural land-use planning), reclamation and municipal engineering in respect to recreational parks and reserves, private estates. Olson (1987) studied the feasibility of application of D&D to rural landscape planning in the Ngong Hills area near Nairobi in Kenya, using air photo-interpretation. The Ngong Hills area was formerly a part of the sparsely settled rangelands of Masai pastoralists which abutted onto the City of Nairobi.

Today Nairobi city is expanding rapidly with the results that have heavy demands and pressure being exerted on the adjacent lands. In this context the Ngong Hills area is experiencing mixed problems of spontaneous high density settlements, transformation to intensive agriculture, an obvious speculative land market, overgrazing and deforestation. Land units of homogeneous physical characteristics were delineated and described by means of stereoscopic aerial photo interpretation (API). The general categories of landscape were classified into valleys, slopes and uplands each being subdivided further into subcategories according to inherent variation. Furthermore the availability of earth resource satellite data for scientific remote sensing since the 1970s have increased the scope of landscape analysis and planning of inaccessible rural areas. The study of Olson found that diagnosis and design rendered possible the integration of the ecological and social basis of landscape planning in rural areas. The main limitation of D&D is the emphasis on landscape rather than human needs.

The Agro-Economic Groups Model

Gibbon (1987) used a combination of farming systems research approach and remote sensing techniques to identify target groups of farmers among the smallholder population of the marginal arid and semi-arid (ASAL) parts of lower Meru District. The major objective of the study was to test the utility of remote sensing techniques in helping to identify recommendation domains for rural interventions. The basic concept was that, irrespective of their backgrounds, farmers appear to act consistently within any given resource environment and to respond consistently to external market stimuli. Hence it is possible to identify farmer groups within the rural environment, even if the internal cohesiveness of such groups may vary from cne place to another. A valid group was defined as "farmers within a given area who have similar resource endowments, access to new technology, market facilities and cropping practices". Such groups could be made the target groups for research so as to understand resource limitations and respective development priorities among the rural populations. It was argued that success of dissemination of research findings to farmers by agricultural extension service depends on some degree to the validity of the groups identified. Remote sensing techniques were also used as an aid to identify farmer groupings called agro-economic groupings (AEGs) which were defined as "smallholder agricultural areas which have similar crop, livestock and off-farm activities which may be distinguished on the basis of the spatial characteristics of the land-use under study". Agro-economic groupings could then be used to define homogeneous groups of farmers with similar resource endowments, access to market and socio-economic characteristics or "recommendation domains". Finally recommendation domains were used to suggest where new development initiatives should be focussed on within the district. Gibbon's study identified four agro-economic groupings corresponding to four main farming systems found in the study area. Air survey data, supplemented by data on crop planting practices, was used to distinguish between different agro-economic groupings but not the degree of homogeneity. Ground survey data of farm income levels was used to corroborate the air survey data in distinguishing the agro-economic groupings. Nine recommendation domains were defined, five of them being identified as priority areas for agricultural research and development attention in the lower Meru. Besides identifying the target groups, Gibbon also observed that a considerable amount of past research findings existed for the study area but there was little evidence of their availability or adoption by rural development planners and extension staff in the field. The main weakness of this model is that it lacks an explicit account of ecological resources component.

Felt Human Needs Approach

Kohler (1986), studied the transition of ASAL land ownership and land-use in Laikipia District from the European ranchers to African small scale farmers. He found that the latter population consisted of predominantly poor and conservative migrants who had been marginalised in districts of higher agricultural potential where farming was more competitive. Their numbers were, however, growing rapidly from on-going migration. According to this author, Laikipia District was not ready for development and therefore projects for rural development should be identified on the basis of people's felt needs.

The Composite Spatial Development Index

Kituuka (1988) studied the problem of measuring and evaluating rural development at the district level. This study was conceived because districts did not normally have conventional data based on classical and neoclassical economic theory. The computation of aggregates for gross domestic product (GDP) in the normal way was foreseen to present difficulties for the newly implemented Kenya's District Focus for Rural Development Planning. Furthermore rural growth in Kenya was not linked to easily measurable attributes such as volume of trade, investment, capital, production, labour, etc. Instead development of the rural economy involved non-quantitative social changes including attitudes of the traditional society in the rural districts. Murang'a District was used for case study. The main objective was to formulate rural development in quantitative terms amenable to planning exercises and to derive a composite index of value for comparing development in the divisions of the district. The values were used to construct a composite spatial development index (CSDVI) as a measure of district development. Accent was given to identification of district-specific data that could be used in evaluating development. Multivariate analysis was carried out on 50 variables identified in respect to five administrative divisions that comprised the district. The main conclusion was that physical and structural variables used together with economic and social indicators formed a satisfactory basis for evaluating development in a district or other sub-national area where data might be lacking (Kituuka,

1988)).

Community Participation Model

The important principle in the citizen participation model of rural development planning is to allow the masses to articulate their own problems and priorities in development. Since the 1950s, the concept of citizen participation in rural development planning has become increasingly popular in developing countries which are undergoing rapid socio-economic change especially through major structural reforms. Citizen participation is supposed to restore self-confidence, self-respect and high responsiveness of rural masses to development initiatives. The decisive action is the decentralisation of the decision making process and governmental control from the capitals to areas nearer the rural masses and maximizing the involvement and responsibility for decisions with the people at grassroot level in all matters that affect them.

Sewell (1977) observed an increasing global recognition of citizen participation by administrators and politicians and a greater variety of formats of it are now being practised with varying success. He considered citizen participation as one of the currently most potent and growing dimension in decision-making in rural development planning in future. However, in his analysis of theoretical perspectives of citizen participation in planning Sewell (1977) raised many significant issues concerning the attitudes and behaviour of the masses in public planning and decision-making process. Five stages of the evolution of concern and attention of the citizens towards policy issues have been identified and described:

Stage 1: Pre-problem stage

Stage 2: Alarmed discovery and euphoric enthusiasm

Stage 3: Realization of cost

Stage 4: Gradual decline of intense public interest

Stage 5: Post-problem stage

Sewell (1977) furthermore showed that citizen participation is embedded in a myriad of emerging problems. These include the question: Who should participate? Who is likely to participate? On what issues and at which stages in decision-making is participation desirable? How could valid and meaningful views on regional issues be obtained? What weight should be attached to the views of the well-organized and articulate interest groups as opposed to the views of the quiet, invisible and unorganized masses?

<u>The Advocacy or Control-Consensus Planning Model</u>

Many non-governmental organizations (NGOs) and pressure groups in Kenya have used the transactive style or advocacy to persuade government to make policy decisions in a certain direction. For instance land-use plans for the coastline of Kenya has been subject of intervention by advocacy from various local NGOs. In 1992 a heated debate was raised by the East African Wildlife Society concerning the allotment of large tracts of land in the Tana Delta to a private company for development apparently without sound consideration for conservation of the delta *wetlands* or for settlement of local village communities. A Presidential decree caused revocation of the allotment and this led to litigation in the High Court of Kenya. Another controversy over land development for the beaches in Mombasa arose in 1994 between a group called the Beach Operators on one hand, and the beach hoteliers on the other. The beach operators, who included curio vendors and local smallscale boat tour operators, were claiming the right to conduct their business on the beaches while the hoteliers were claiming exclusive rights for environmental maintenance and boat tour operations linked with large scale commercial boat tour operators. The former were joined by the local fishermen who claimed that in the creation of marine nature reserves and national parks the government was pre-empting their rights for fishing while the development of beach hotels blocked the way and rights for landing. At the time of writing the two debates are continuing.

Advocacy, which is often combined in decentralisation, is based on the assumption that effective planning must invoke measures shaped by experience and knowledge of people (Friedmann, 1981). It originates from a response to the economic biases and political inequalities fostered by technical solutions. Thus it is homologous with the concept of social planning which aims at redistribution of resources to counter inequalities resulting from workings of private market (Burchell et. al., 1982). Physical and economic planning seemed to ignore social problems and the vital part of community development played by social rehabilitation. Social planning gives rise to re-examination of purposes and methods of planning and incorporation of social policy in decisions. Features of physical facilities must be designed in a manner to meet social objectives. Three variables of social policy were identified; these were:

(i) Social needs which imply total amount of assistance required to serve a given population.

(ii) Social capacity: this is the total amount of effort and latent capacities of social groups measured as a community resource.

(iii) Social services: these include education, recreation, housing, health, welfare and individual family guidance.

Social planning shifts the focus of planning from decision making only to action (Burchell & Hughes, 1982). In the principle of control-consensus mix, it is believed that the scope of planned action must be large enough to be purposeful. The concern is not only on how rational a decision is but rather on how to maximize the quality of the decisions and their implementation. It must also contain a certain level of guarantee of completion by encompassing a correct blend of both power and congruity of objective. A correct mix of the control and consensus, in terms of decision-making and power, forms the control on one hand, and on the other hand forms a consensus with the responsiveness of the society. This ensures authenticity, restores self-confidence, and enables a society to mobilize their energies and resources and to implement the action with minimum resistance. The control-consensus function requires a transactive planner who is adept at bringing together the processed knowledge of planning and the experience and knowledge of those who are being planned for (Burchell et al., 1982). The legitimacy of social objectives was to be maintained by continuous challenge and fear of replacement of the political system with another. Today it appears that the future application of social planning is closely allied with advocacy planning focussing on special services for groups or populations such as the old people, the disabled, etc. *Social planning* and the derivative *advocacy planning* tend to emphasize the needs and preferences of a client population and are intimately concerned with systemic distribution of resources to counter social inequity. An advocacy plan pertaining to a specific client is typically a much more politicised proposal than social planning. Both types of planning represent a reaction to physical planning especially its orientation and emphasis on functional and efficiency aspects only.

The Agropolitan District Model

This model is mentioned here purely for the reason that it sets a relevant landmark in the global development of models for planning at district level. One may say that aspects of the agropolitan model were tried in Kenya through the Special Rural Development Programme (SRDP) mentioned earlier but without success. SRDP was an action research model set up with the full range of representative development potentials in Kenya in selected pilot divisions. According to Heyer, Ireri & Moris (1971), SRDP was "to apply technically proven development measures and test the potentiality of new ones". It also examined the viability of the division as an administrative unit.

Friedmann and Douglass (1975) proposed the Agropolitan District model as a substitute to the conventional national economic growth strategy after its failure and impacts were observed in Asian countries. The pursuit of the latter had resulted in contradictions through the concentration of population and modern economy in a few metropolitan areas, pauperisation of rural masses, unemployment and under-employment, formation of a few elites commanding the nation's wealth, persistent food shortages due to neglect of production of staple food crops through concentration in exportable cash crops. A condition of dualistic dependency prevailed. An alternative inward-looking and rural based strategy was required to avert the undesirable consequences mentioned above. The agropolitan model would transform the countryside by introducing and adapting elements of urbanism to specific rural settings to avert the drift of population to cities. Thus, existing rural settlements would be transmuted into a city-in-the-fields. the agropolitan districts would be adapted to become the basic settlement units for large cities with facilities for commuting. The strategy would reduce social dislocation in the course of development by preserving the integrity of the family, strengthening psychological security, and providing both individual and social fulfilment in constructing of new order of community. It would allow ecologically specific planning. There are some similarities between the agropolitan model and the proposed district PIS model. The weaknesses of the agropolitan model are first, the assumption that there is an adequate capital base for financing agropolitan developments, which is not the case in most Kenyan or developing country districts. Secondly, it assumes the existence of a nucleus metropolitan centre and a high initial population density.

SYNTHESIS

The main conclusions made from the foregoing review of literature about existing models of planning at district level in Kenya can now be stated. First, models which have been developed outside Kenya have inherent limitations for application to problems and objectives of rural development planning at district level in Kenya which are mainly basic needs. Some models, for example the agropolitan district model, assume certainty of a capital base for development of elements of urban infrastructure in the periphery to encourage acceptance rural housing and a commuter community. They also assume the existence of an urban centre with population above 20,000. Some are specific and hence too narrow and rigid in the algorithmic structure of the proposed decision-making indices. Some models are not sustainable because they are based on the economic growth paradigm which does not recognize basic needs hence they are renegade. Other models involve deconcentration of central government services and control without any devolution of authority and power to the local communities hence a top-dowtop-down relationship remains which predisposes initiatives to vulnerability and unsustainability. Finally, all models require information and therefor the district PIS approach cuts across the board. There is a general lack of objective taxonomy or scheme classification for planning models and assessment of use of information is a fundamental split in the middle. Whereas today the best practices for sustainable rural development planning are supposed to be participatory the argument of this thesis is that participatory planning also requires guidance based on reliable technical information or knowledge. The model required is therefore one that provides for both information and participatory consensus.

According to Bu*rchell* et. al. (1982) models representing narrow approaches to planning should be avoided. Furthermore, in considering whether to adapt them or not we should take into account the warning made by Ansoff (1969) who has admonished about the danger of institutionalising narrow approaches to decision-making.

> Users of narrow approaches expect to achieve goals only partially and as conditions and aspirations of people change or as accuracy of prediction improved, users of the narrow approaches would expect torepeat them or else public administrators would be handling complex decisions without credibility.

An example of such models is physical planning which is used for urban settlement and development planning in Kenya. Its primary concern is physical efficiency while failing to consider participation or social concerns of constituent stakeholders in decision making. Experience in Kenya has shown that physical planning has failed to cope with spontaneous land-use and abuses e.g. misappropriation and grabbing of public land by persons with political influence. Some models are socially unacceptable because they suggest radical socio-economic changes in the pre-existing land tenure and land-use situation. These are mostly the gestalte models. That means they are based on recognition of natural land units and of the possibility of structural change of land-use and land tenure to make way for homogenous land-use in each land unit. Examples of gestalte models are land evaluation (FAO, 1976), physical planning, diagnosis and design (D&D) (ICRAF, 1987), etc. Suggestion for application of such radical models to rural development planning at district level would be unrealistic. Experience gained from boycotts and litigation against land adjudication programme in some districts indicates that radical change in land tenure structure in Kenya is a fundamental policy issue that cannot be decided at district level. Others lack an institutional framework to facilitate participation or empowerment of rural communities or landowners in planning decisions. Most of the models have no provision for the necessary updating of the database in time, which means application of the model is not technically sustainable. For example the Human Settlement Strategy of Kenya makes no reference to the need or provision for information or data supply.

Land-Use Systems Concept

We have noted that the land-use systems model is the basis of the proposed PIS. The three crucial characteristics of the land-use systems model are the database, monitoring and prediction, the feedback loop. The land-use systems model also provides the framework for the general issues of environmental management.

Before we consider the land-use system a definition of land-use is desirable. Land-use is the purpose and the way in which land is conquered and exploited including the whole process from initial clearing of natural or man-made aspects to the improvements and achievement of objectives. More recently, the Advisory Council for Scientific Research in Development Problems of the Dutch Government (acronymed RAWOO) gave the following definition of land-use (RAWOO,1988):

> Land-use is the interaction between the user and the land. The land is determined by the physical aspects such as climate, relief, soil, vegetation, and fauna. These aspects vary to give rise to different types of landuse. The users of the land are determined to a great extent by the cultural and socioeconomic aspects, varying per group and region, and this, again, gives rise to different types of land-use.

In Kenya as in most countries six major sets of land-use are recognised. These are urban shelters, cropland, grazing land, forest, recreation and leissure, and special uses. In rural development planning it is necessary to define the scope of change and development in the relation to land-use and management systems existing in a region. Consideration should be given to the ecological processes taking place in rural space with a view of the possibilities of enhancing or mitigating them for public interest.

In these contexts, Garrett Hardin's famous *concept of tragedy of the Commons* signifies the case of land-use by a community where all are competing for resources and no one cares for conservation for the common good. During the past decade or so many countries, responding to their own perceptions and through international collaboration, have committed themselves to monitoring of land use and resources. Beek (1978) defined a land-use systems as follows:

> By combining a land mapping unit with a pertinent land utilization type (LUT) a land-use system (LUS) is constructed consisting of a collection of elements and their relationships, selected for their bearing on the questions being asked or the goals pursued, and related to similarly selected land-use systems in its environment.

Beek also defined the concept of land-use systems: "LUS is a model of the real land-use system". The land-use systems model was defined and described by Messerli & Messerli (1976) as illustrated in Fig. 2.1. It embraces two main components: the socio-economy and the ecology. There are three dimensions to the model: (a) identification of the actual land-use systems; (b) specification of issues of environmental management for the system, (c) organization of the information system of the model.

<u>Issues of Land-Use and Environmental Management</u>

Noel Brown observed (UNEP, 1979) that the primary concern of many methodological approaches to land-use planning and environmental management is "how to limit the breadth and scope of issues that should be considered in decision-making". The ten issues of environmental and land-use management that are currently recognized are (UNEP, 1979): (i) human base; (ii) resource base; (iii) goals; (iv) administration; (v) functions/responsibilities (vi) measurement; (vii) strategies; (viii standards; (ix) environmental impacts; (x) education and training.

(i) Human Base

Rural development planning begins with a concern for the people (Hopcraft et al, 1976). Human base refers to the socio-cultural, economic and policy characteristics or conditions of the target population which is the foundation of planning. It must be defined in terms of population size, settlement pattern, social and cultural status. As the district case study of Laikipia which is discussed at a later stage in this thesis will demonstrate, the human population in a district can be quite heterogeneous, having groups of diverse cultures, perceptions and basic needs.

(ii) Land or Resource Base:

In this thesis land means the all-embracing concept for natural resources and physical environment component. The main elements are the surface area of land, and its natural resources endowments in the form of landform, soil, rocks, water, climate, vegetation, animals, together with cultural wealth of roads, buildings, energy supplies, and various other amenities. Land, as a topic, has probably more literature than any other topic in Africa (Okoth-Ogendo, 1975), but the term "land" is ambiguous because of having no specific technical meaning which is accepted in all disciplines. Farm economists in the United States Department of Agriculture (Chryst and Pendleton,1958) say "land is many things to many persons ....Land, in the economic sense, is our entire natural environment - all the forces or the opportunities that exist independently of man's activity". In the common English definition land is used for many things. These include ground, real estate, district, country, nation of people, etc (Chambers 20th Century Dictionary). In Germanic languages in which much work in the field of land science has been done (Zonneveld, 1972) land means a large administrative area, and landscape (Landschaft) is a more comprehensive concept used in the same holistic sense as environment. Physical scientists have defined land (FAO, 1976; Beek, 1978) as "an area of earth's surface, the characteristics of which embrace all reasonably stable, or predictably cyclic, attributes of the biosphere vertically above and beneath this area including those of the atmosphere, the soil and underlying geology, the hydrology, the plant and animal populations, and results of past and present human activity, to the extent that these attributes exert a significant influence on the present and future uses of the land by man". According to Troll (Zonneveld, 1972) the term "Ecotope" is the smallest possible unit of land which has the holistic character in topological classification or typification of land. Zonneveld (1972) acknowledges the "ecotope" concept for the basic unit of the landscape and proposed that a hierarchical classification of land can be constructed from the ecotope as the lowest order. Various systems of classification of space in hierarchical manner exist and will be mentioned in the discussion later in this chapter. Beek (1978) gave the following definition: "land will mean all natural media, except the sea, having 3-dimesion space of hard ground, water or air, in which human habitats, working places, agricultural activities, utility corridors and open spaces may be initiated". Technically speaking such media include any parts of the lithosphere, lower atmosphere, hydrosphere except oceans, and the biosphere which may form normal ambiency of man. This is a concept of "land" which makes it synonymous with "environment" as it is used by the mandate of UNEP. It also embrace the holistic concept of landscape (Landschaft) of Troll as given by Zonneveld (1972). In the attempt to define the PIS concept and its role in management of rural development planning in a district which has a dynamic environment over the years consideration has been given to an important observation by Zonneveld (1972): "It is confusing to attempt to give old terms a limited scientific meaning; the only solution is to define your own concept before starting to write or talk about it".

(iii) Goals

The general goals of rural development planning include the enhancement of sustainable production capacity of the land; protection of public health with food and other basic needs; optimization of resource utilization; preservation of amenities. With a possible change in the order of emphasis and priority the same goals apply to land-use planning. Sustainability of land-use management is the default of a malthusian crisis. It means the use of land in such a way that land retains or regains its value from one production cycle to the next (RAWOO,1988). In respect to crop growing, livestock farming, agroforestry, arboriculture and forestry, sustainable land-use implies a careful temporal arrangement of the production cycle and a properly managed equilibrium between the available resources and the level of their exploitation. Non-sustainable land-uses are a major constraint in rural development that strongly bears on food security and wellbeing of rural populations.

(iv) Strategies

In planning, strategy means and includes policy or the way in which a decision-maker's attention is directed to the needs and opportunities for strategic change including the chronological steps and actions included in the change (Ansoff, 1969). Burchell et. al., 1982) divided planning into two categories: root approaches and branch approaches. Root approaches include methods where comprehensive information and theoretical criteria are used to produce blueprints governing the future order of development. In these contexts existing landuse is regarded as a constraint in the achievement of selected alternatives. Branch approach considers existing systems of land-use which are already in motion to be the baseline for development, subject to certain innovations, adaptations, controls and direction. Branch methods involve gradual and adaptive transition. In business, two basic types of strategic change are distinguished (Ansoff, 1969). These are expansion and diversification. Strategies of environmental management usually include the following: technological innovation; information (general schooling, public education, specialist training, public information); planning. Monitoring helps to answer the following questions concerning a semi-arid district like Laikipia: (i) Which factors bring about deterioration of land? (ii) Where is the delineation of areas with similar management requirements; (iii) where is the population density and land-use pressure? (iv) what is the state of human condition?

(v) Measurement

Measurement refers to procedures of quantification, data collection, sample designs, data analysis, reliability of testing, modelling of projections and impacts, and efficient data archiving. For example, the importance of the man-land ratio has been highlighted by Hayami and Ruttan (1972) as the critical parameter of resource endowment for a region. Also emphasized is the importance of trend analysis.

(vi) Standards

A generally accepted environmental point of view in management is that efficiency in production must take ecological balance into account, though usually critical standards are missing in land-use activities. Setting up of standards of land-use means consideration not only of yields but also human condition and environmental quality in quantitative or qualitative terms at points of practice.

(vii) Organization: Policy, Law and Governance

Every country has an established machinery and levels of authority for various decisions. For Kenya the importance of land-use policy and land laws has been described by Salter (1982) and Khaoya (1984) with special reference to the land law of Kenya particularly the Land Control Act of 1967. As President Mobutu Sese Seko of Zaire once told the IUCN General Assembly at Kinshasa in 1975: "Only political leaders have the power to make major decisions on land-use". This is truism has major legal and political implications in rural development planning.

(viii) Impacts

Environmental impacts are the undesirable final or side effects and diversions of technology with adverse results. The term acquired technical meaning from 1970 when the United States of America (USA) enacted the National Environmental Policy Act. Thereafter many other countries adopted environmental policies. The original definition of environmental impacts made in USA was: "the net change, good or bad, in man's health and well-being, including the well-being of the ecosystem on which man's survival depends, that results from the environmental effect and is related to the difference between the quality of the environment as it would exist with and without the same action". Dasmann et al (in Banage, 1976) offered the following definition for environmental impacts: "the rapidity, importance or magnitude of the changes associated with the dynamic natural mechanisms put into play following manipulation of the environment". According to Banage (1976) environmental impact is "the result of the effect on the same environment, set in motion by an action of man". According to the latter author environmental impact analysis includes the following activities: (i) definition of cases for comparison between the target activity, the alternate and a no-action alternate (ii) a framework for comparisons including qualitative and quantitative measurements or professional judgement. When it is desired to assess the speed (rapidity) or the magnitude of the impact, the original and the new environmental qualities are used as impact indicators. Impact indicators may be qualitative or quantitative and can be measured or estimated. In some cases impact indicators are only qualitative, being in the changes in traditions, values, or heritage. Impacts may also be complex rather than being direct or linear. They may also be displaced in time and space from the place of the original action. Assessment and prediction of environmental impacts can be very difficult, and consequently planners and decision-makers might show tendencies of ignoring, dismissing or discounting them as the price a society has to pay for development.

(ix) Functions and Responsibilities

This refers to organization or division of work for different agencies in regard to land-use planning. There are many local groups and sectors which can co-opted to handle environmental and land-use management

(x) Education and Training

Effective communication should contribute to rural development by helping farmers improve awareness and output. In reality the information and communication needs of the poor populations in the rural areas who are dependent on primary land-use are met in a very superficial manner (Yahya, 1982). Research reports, national radio and television programmes, newspapers, etc may not wholly convey information which is of immediate utility for the vast majority of farm dwellers in rural areas.

Theory for Construction of an Information System

The procedure of constructing an information system consists of the following steps (ITC, 1984): (i) problem analysis; (ii) relevant environmental factors in different fields of interest; (iii) information requirements; (iv) data specification; (v) technology for data gathering; (vi) resources for information system; (vii) systematic operational procedure. These steps are taken into account in the method used in the case study in chapter four. Further discussion of these steps will be met in later chapters

OBJECTIVES

Overall Objective

The overall objective of the thesis is to demonstrate the development and application of an empirical model of a planning information system (PIS) for rural development planning at district level. The basic assumption is that information systems, as seen earlier, are databanking procedures which are used as tools for deciding when and how to intervene strategically in a whole system so as to make more mileage or save on resources and time invested. The information must be relevant and valid for the situation. It must be formulated in cognizance of the planning cycle operating in the existing structure of planning. On the basis of the aforesaid the decision-makers could respond to a certain problem or simply take advantage of a given opportunity to enhance desirable effects. The thesis applies the same principle to planning at district level. The validity of land-use systems concept as the relevant basic theory for construction of an information system for rural transformation was discussed under literature review. The thesis attempts to rationalise the view that utilization and updating of available information on the existing land-use systems is the key and entry point for acceleration and enhancement of sustainable rural transformation.

Essentially the information system consists of a database of current land-use and planning procedures in a framework and perspective to comprehensive and participatory decision-making at the district level. In particular it should help to synchronise the collection, generation and utilization of information for intervention in awareness, education, advocacy, transfer or extension as productive technology or policy decisions. The desirable model should provide a framework for the necessary participatory dialogue between expert planners and implementors, local communities, stakeholders of rural activities, researchers and decision-makers. It should help to diagnose the entire rural system and identify issues and critical socio-economic problems and sensitive areas of the environment requiring intervention. It should include a checklist of determinants and criteria of undesirable impacts of developmental plans, designs and changes so as to prescribe mitigating action before implementation. Most important it should facilitate feedback and integration in the planning process by linking stages of problem analysis, goal formulation, assessment of alternative courses of action, implementation and evaluation of impacts. It should incorporate certain levels of future perspective and scope for evaluating different assumptions and scenarios for prediction of outcomes and in a pro-active sense of readiness.

It is emphasized that the basic idea of an information system for planning at district level is not framework and perspective to comprehensive and participatory decision-making at the district level. In particular it should help to synchronise the collection, generation and utilization of information for intervention in awareness, education, advocacy, transfer or extension as productive technology or policy decisions. The desirable model should provide a framework for the necessary participatory dialogue between expert planners and implementors, local communities, stakeholders of rural activities, researchers and decision-makers. It should help to diagnose the entire rural system and identify issues and critical socio-economic problems and sensitive areas of the environment requiring intervention. It should include a checklist of determinants and criteria of undesirable impacts of developmental plans, designs and changes so as to prescribe mitigating action before implementation. Most important it should facilitate feedback and integration in the planning process by linking stages of problem analysis, goal formulation, assessment of alternative courses of action, implementation and evaluation of impacts. It should incorporate certain levels of future perspective and scope for evaluating different assumptions and scenarios for prediction of outcomes and in a pro-active sense of readiness.

It is emphasized that the basic idea of an information system for planning at district level is not essentially one of a mechanically sophisticated electronic hardware and software system, though of course such technology is among the several options that can be adopted.

The Specific Objectives

The following are the specific objectives:

(i) To identify the nature of information that is required for rural development planning at district level and to demonstrate how it can be gathered efficiently.

(ii) To characterise the existing utilisation of information in district planning at present and to set out an empirical framework consisting of a database on current land-use, and procedures, for more comprehensive and participatory decision-making in planning at the district level.

(iii) To demonstrate the potential application of the model of planning informations system based on land-use systems concept in planning at the district level with reference to strategic decision-making at the operational level.

HYPOTHESIS

Assumptions

The following assumptions underlie the hypothesis:

(a) That planning at district level as decentralisation, shifts decision-making processes and governmental control from the capitals to areas nearer to the rural masses and maximizes the involvement and responsibility of local people for decisions affecting them. It emphasizes a concern for balancing rational decisions with authenticity or quality of the decisions and their implementation in terms of the needs of local people. The emphasis on the need and the provision for participation means that planning at district level is transactive. It aims at bringing together the planners with expert knowledge and information for planning, and the stakeholders who are being planned for with their knowledge, experience and advocacy for special interests, in order to reach a balanced mix of consensus and control.

(b) That a land-use systems model provides a comprehensive and unifying concept of the rural phenomena of population-resource interaction including spontaneous and planned change. Therefore planning of sustainable change in rural development planning at district level could address itself to land-use issues such as output, innovation, optimisation in space, etc. An important assumption and implication is that monitoring and dynamic analysis of land-use changes will be possible hence information will be available at district level.

(c) That from the orthodox school of comprehensive planners there is considerable scepticism, as we noted earlier, about decentralisation and responsibility for decisions with the people at grassroot level (Friedmann, 1981; Burchell et al, 1982). At the same time there is an increasing practice and belief in community participation and self-help as the most potent and growing dimension of decision-making in rural development planning in future (Sewell, 1977; IDRC, 1986).

The fundamental thrust of the thesis is that utilization of information with a database on the actual land-use systems for planning at district level provides a comprehensive model of totality; if participation of local people in decision-making provides for authenticity of interventions then a theoretical framework for complementality and closing the gap and polarisation between comprehensive and participatory planning is achieved. In the context of the thesis a theoretical framework of that nature is the model that is given the term <u>Planning Information System (PIS)</u>. The hypothesis deriving from the above train of argument is stated below.

Hypothesis

Given that the policy of decentralised planning at district level and people and resources for development are in place as stated above in the assumptions, then it is postulated:

> "that a conceptual model providing for the production and use of comprehensive information together with participatory transactive decision-making for interventions at the district level is possible".

> The alternative is: "that utilization of information in the comprehensive approach and participatory planning at district level are incompatible and therefor not possible".

In essence PIS is a bridging hypothesis. It implies that ultimately an integrated and synchronised junction between purely top-down comprehensive and purely bottom-up participatory approaches to rural development planning must be defined both in concept and in practice. There is no exclusivenessfor one or the other. Secondly the PIS hypothesis implies that indigenous planners at the district level have no excuse for disillusionment with lack of conceptual guidance retreating to trivia (Friedmann, 1981) and avoiding the burden of responsibility and initiative for adjustment of society to the environment. Similarly local comprehensive planners have no excuse to sustain a cynical attitude towards decentralisation or to depend obsessively on rigid utopian models which are intrinsically limited by local socio-economic realities when applied with community participation upon decentralisation. Finally, PIS implies emphasis on rigorous use of factual information to control hypocrisy in society which may ruin citizen participation and high responsiveness to community-based rural development initiatives at district level.

PART II

THE DISTRICT CASE STUDY

Overview

Part II of the thesis is concerned with field methodology and the results obtained in the case study of Laikipia District per se. As a whole part II exemplifies the reality of possibilities and problems of gathering and utilization of information for planning at district level without the planning information system. The tools and procedures of gathering and analysis of information which are demonstrated here are the ones considered later in the modelling of the planning information system.

CHAPTER 4. METHODS OF DATA COLLECTION

PRINCIPLES AND FRAMEWORK FOR PIS MODELLING

Preliminary Considerations

Planning is based on the Geddesian principle which emphasizes diagnosis before treatment and understanding of case situation before action (McLoughlin, 1969). On this basis the information that is needed in order to plan must be a description of the system we seek to control:

> We need to know how the parts of the system and connections change, and how the system changes as a whole. We must try to understand what has caused these changes.

As stated earlier under objective, the thesis aims at developing a model depicting processes and relationships of rural activities as a means of devising and applying developmental interventions at the district level. Hence the envisioned district PIS model will be a tool for analysing, explaining, managing and accelerating rate of productivity and change in activities in the district through monitoring, dynamic analysis of changes and use of the information for interventions to start, adjustment or renew change in response to opportunities or problems. Possible ways of using information include analysis and stratification into groups for different treatments, simulation and prediction of possible future states of land-use when certain constraints would be applied to the system. Such tests would involve the supposition "if... certain stated conditions prevailed". Thus PIS is a general tool of management of the land-use systems in a district. Mathematical modelling of particular events and the kind of specific data required for it is currently being done in other related studies.

Land-Use Systems

Identification of data requirements and a framework for analysing information is a basic step of developing planning information systems. The framework based on land-use systems was chosen for rural development planning at district level. Land-use systems are structures comprising many elements, components, dimesions, levels and dynamics.

Principles of Energy Flow and Syntropy

An illustrative analogy is made to the concept of energy flow which is used in ecology to account for radiation balance in photosynthesis and biomass production in living organisms (Odum, 1971). Application of the energy flow concept to rural development planning has analytical, synthetic and predictive value for sustainability of change.

The information flow in the planning and decision-making processes is equivalent to energy flow in the biological process. The district as a whole can be seen as a purposeful resource using system analogous to an organism which requires resources to give it energy to function.

Decision-Making by Consensus and Control

Although in bottom-up planning the decisions are based on consensus, a cybernetic control outlook of rural systems and the development phenomena is also justified (McLoughlin, 1972). If it is incorporated in the PIS from the beginning it is a crucial reminder of the need for balance between consensus and control as well as of an integrated approach to rural systems in District Focus planning. Consensus represents the acceptance for participation of the local people in decision-making in matters affecting them. Control represents action based on expert knowledge or information on dynamics. A cybernetic view provides also for predictive value of utilization of information systems.

Unifying Concept of Land-Use Systems

As stated in chapter two and will be elaborated in chapter six, the proposed district planning information systems model is based on a land-use systems framework which consists of the key elements: people, land, activities. The major components of a land-use system include the physical ecosystem and the socio-economic subsystem. In District Focus planning a land-use systems analysis could be used as whole units for purposes of identifying needs and choice of strategies and criteria used in setting out goals and objectives. Policy-sensitive issues of land-use and environmental management require to be identified and incorporated in the PIS framework.

Maps and PIS Model

Two kinds of modelling were applied to the results of the case study. These were mapping and designing of the PIS. Maps are one of the traditional and most practically useful forms of models for spatial information. Both socio-economic and ecological information are amenable to mapping. Maps were drwn of registered land ownership boundaries, settlement, vegetation, livestock densities and general land-use types. A data bank for the PIS was made in a pc Arc Info GIS which could be used to store, transform and recombine data collected in different fields for different products including graphs and maps.

METHODS AND TOOLS

Planning Survey Matrix

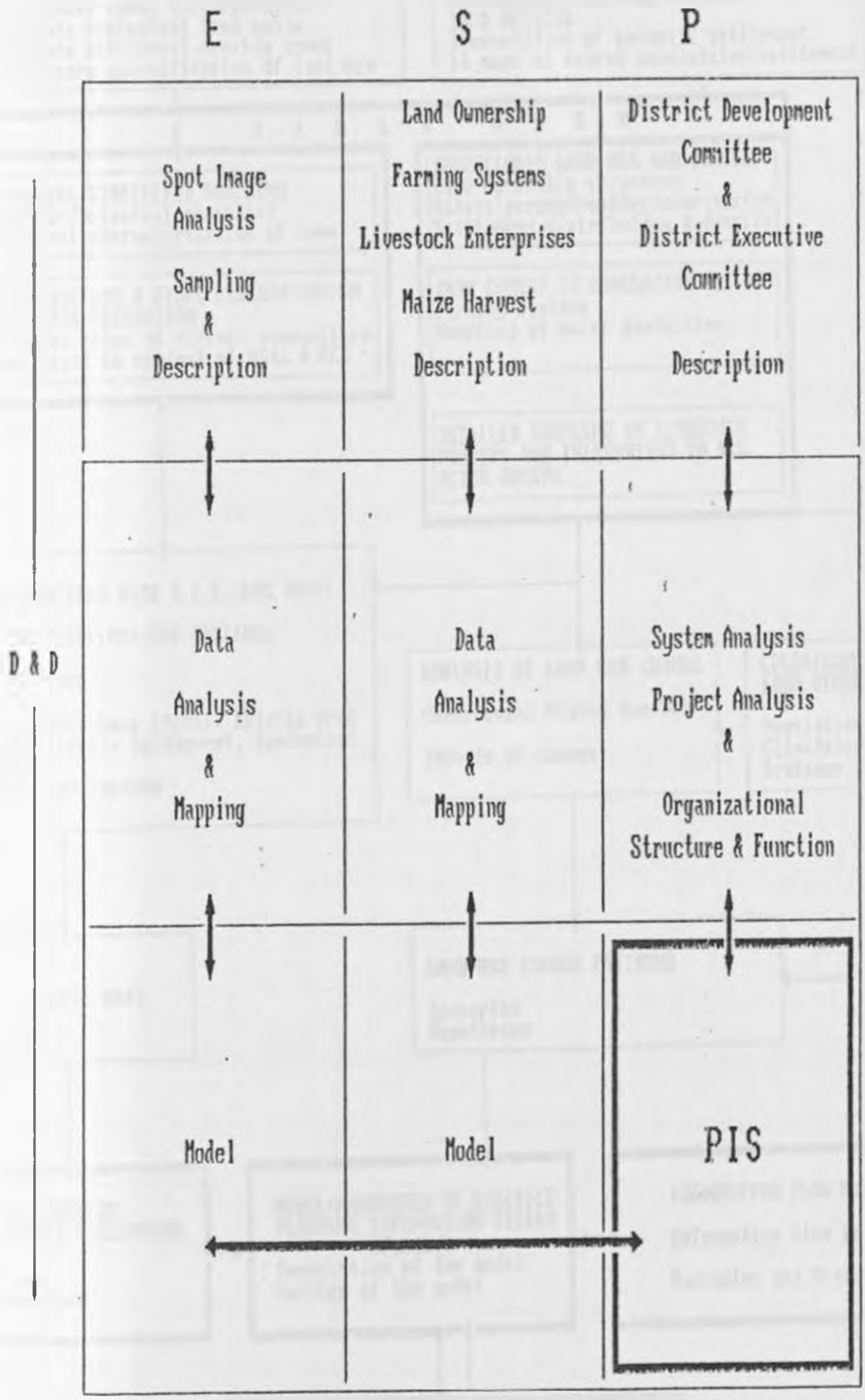
The matrix in Fig. 3-1 epitomises the basic planning survey procedures which were executed in the case study in Laikipia District. The same basic procedures were considered as appropriate for the ultimate planning information systems package. The three columns (E,S,P) and the parallel vertical arrows in them represent two major lines of parallel field investigations following the diagnosis and design (D&D) procedure. One of the major lines of analysis (L) covered land-use systems which comprise two main components namely ecology (E) and socio-economy (S). The other major line of analysis (P) covered analysis of policy planning of District Focus in practice. The three rows of the matrix represent three sequential stages of the diagnostic procedure. It is worth noting particularly that each line of diagnosis ends in modelling. The horizontal arrow across the boxes in the bottom row represents the construction of a framework of the comprehensive planning information system (PIS) model which finally integrates the different lines of analysis. Information which is generated by the planning survey should feed back mainly into decision-making at district level but must also filter vertically upwards and downwards to the national and the grassroot levels as well.

The Ecology Sub-System

The ecological component of the planning survey had two objectives. The first was to manifest the ecological potential of the district. The method chosen to do this was studying and mapping of vegetation in the whole district as an indicator of the ecological potential of the land and the past human impacts on it. The second was to make a methodological demonstration of the potentialities of remote sensing tools for rapid diagnosis of the state of land resources for planning purposes at the district level. Such surveys are potentially valuable for sound planning of new sub-division and new settlement schemes. The survey was made by manual remote sensing procedures of visual photo-interpretation of colour prints SPOT imagery and of black and white aerial photographs. Remote sensing was complemented by a ground truth survey of the floristic composition of the vegetation communities which does not come out clearly in Landsat and SPOT images due to the low resolution capability of these tools at the moment. Floristic composition is vulnerable to selective use of vegetation where particular species of plants are removed selectively for timber, charcoal, etc in preference to others, thus affecting the vegetation.

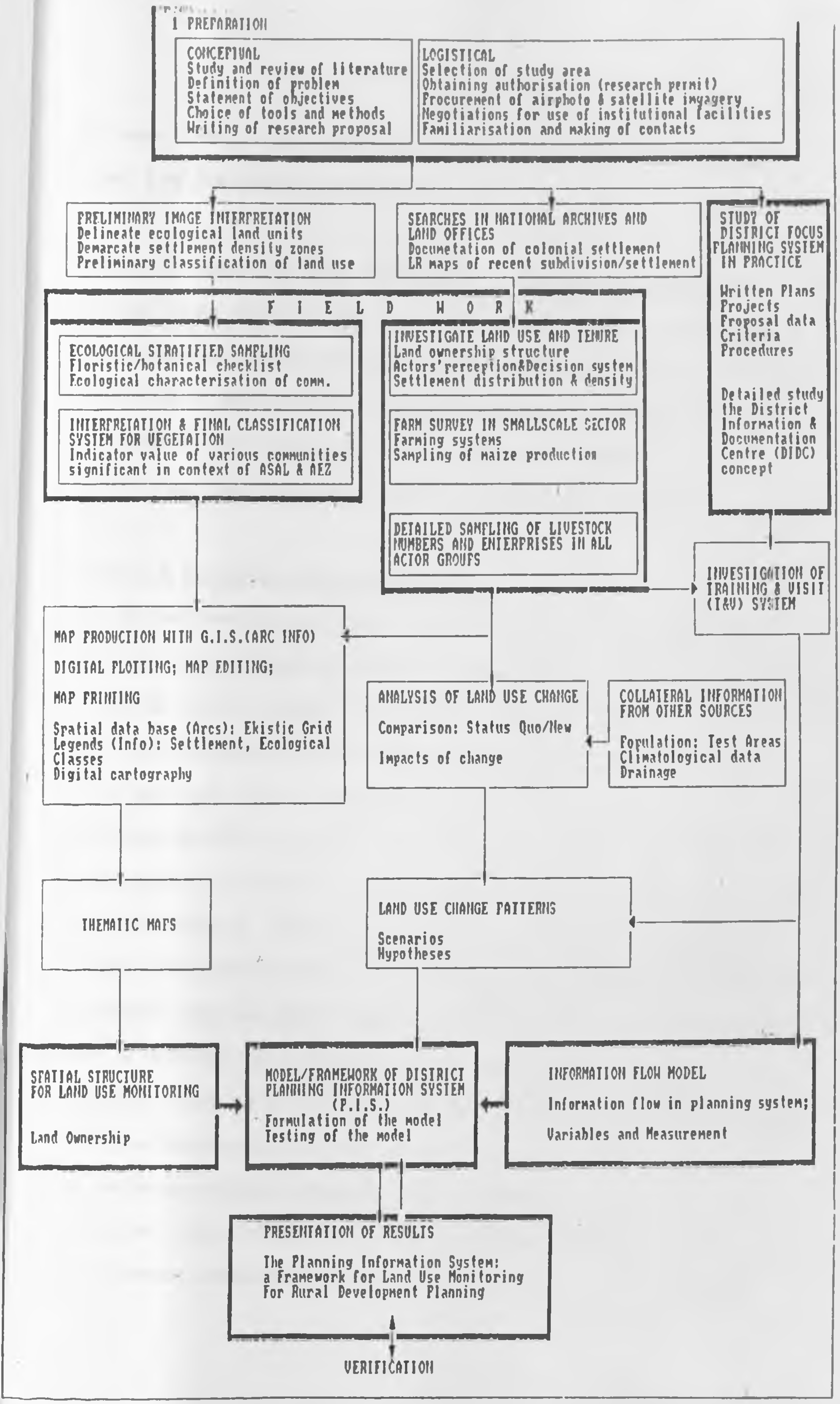
The Socio-Economy Sub-System

Socio-econmic information required for planning information system included the population dynamics, history of settlement, land ownership and the major land-use activities. The population size could be obtained from national census figures. The survey of the history of settlement was achieved through searches in official records found in the National Archives in Nairobi. The present land ownership was found by searches in the Ministry of Lands offices at the district and at the national level as well as from the private companies responsible for most of the activities of purchasing and sub-division of land. Information on current distribution



(Taiti, S.W., 1991: METODOLO)

Fig. 3-1. Methodology: E for Ecology; S for Settlement; P for District Planning; PIS for Planning Information System; D & D for Diagnosis and Design.



TAITI. S.N., 1990: METHODS

Fig. 3-2. Flowchart of methods and procedures used in the case study of settlements was obtained from the same SPOT images used for landscape analysis.

Current land-use was obtained by remote sensing and ground farm surveys for the whole district. Farm surveys were done by means of questionaire-based person-to-person interviews conducted on sample farms by adopting procedures described by Murphy & Sprey (1983) in Monitoring and Evaluation of Agricultural Change.

Study of District Focus Planning

The objective was to find out the nature of information and criteria planners used in responding to opportunities and problems of rural livelihood and in making decisions for intervention. The analysis would yield also the whole pattern of utilization and supply of relevant information for planning at district level. The author participated and observed in the actual planning and decision-making functions and processes of the DDC and various subcommittees as well as by studying relevant documents and holding discussions with other DDC members. Here it should be pointed out that the author was a member of the Laikipia DDC by virtue of being head of the Laikipia Research Project which was an integral part of the Laikipia Rural Development Programme. As a trained ecologist the author was a key resource person to the environment subcommittee chaired by the DO Environment.

The method of direct involvement in the real practice was very rewarding.

Methods and Tools

As indicated above the study adopted an overall procedural design of the Diagnosis and Design (D&D) as described by ICRAF (1983), Rocheleau (1984) and Olson (1987). The method was originally developed for planning of agroforestry. This method is characterised by strong emphasis on physical structure of the natural landscapes and of the farming systems prevailing in a region. The assumption in this study was that the diagnosis and design methodology had potential for more general application in rural developent planning. The basic diagnosis and design procedure is executed in four phases. These are pre-diagnosis, diagnosis (analysis and description), synthesis (modelling and simulation), and designing or prescription and implementation of the action. It should be noted that in this study "design" is represented by a special exercise in which a planner or a taskforce utilizes available information of the needs of the population and also draws from expert knowledge to formulate plans and prescriptions of action. This is the most crucial stage of interaction of local perceptions and expert knowledge and the one which determines the future or risk into which public resources are invested. Specific procedures and tasks which were executed in the different lines of the study in the consecutive phases of diagnosis and design will be described briefly below as follows.

(a) Pre-Diagnosis

The preparatory work involved a wide spectrum of essential basic activities including library work, archive searches, acquisition of crucial equipment (Topcon Mirror Stereoscope) and base maps, ordering purchase of aerial photography and satellite imagery, arranging for technical services, field recce, appraisal of previous research work, and preparation and testing of questionaires for farm survey and livestock surveys (Appendix 1; Appendix 2). Activities at this stage involved a fair amount of commuting between Nanyuki and Nairobi as well as between Nanyuki and rural area within the Laikipia District.

(b) Logistical Preparations

ARC/INFO GIS was chosen for application in the study because it was being used in several national and international institutions. A number of seminars and workshops on the application of geo-information systems (GIS) for handling of spatial data had already been held at UNESCO/ROSTA in Nairobi, UNEP/GRID and in the Department of Resource Survey and Remote Sensing. These seminars indicated that application of GIS was being popularised and might gain common acceptance especially among large organizations. In the course of time there was real scope for application of certain GIS models in rural development planning at district level. Computer software used were Lotus 1.2.3, Word 5.0, Flowchart and PC ARC/INFO GIS courtesy of the Laikipia Research Programme. Negotiations for collaboration and use of institutional facilities were made with the Regional Centre for Services in Mapping and Remote Sensing for photographic color image reproduction and GIS; Department of Resource Surveys and Remote Sensing for GIS and SPOT order services; the Kenya Herbarium for species identification; Department of Botany of the University of Nairobi for herbarium services and the Ministry of Livestock Development for livestock census; the Kenya National Archive for search in official reports on settlements and colonial land policies; Ministry of National Development Planning (Department of Rural Development Nairobi) for District Information and Documentation Centres.

Search for and procurement of maps and aerial photographs from the Survey of Kenya involved requisition for authorisation from the Ministry of Planning and National Development as well as from the Ministry of Defense. Special permission was required and obtained from the Director of Surveys to reproduce the Survey of Kenya topographic maps as base maps. Maps of land subdivision were obtained from the Lands Department of the Ministry of Lands. About 1500 prints of black and white aerial photographs at scale 1:50,000 were included in the coverage. The exercise of laying down the photographs and marking the flight lines on the base map, together with the analysis of landscape, settlement and land-use took a period of three months. An index of photographic coverage used in this study is presented in the appendix. The search for and order of SPOT images from CNES, France was done through the services of the Department of Resource Surveys and Remote Sensing (DRSRS) in Nairobi. Eleven frames of Spot colour film images at scales 1:2,000 and 1:250,000 were acquired. Enlargement to 1:50,000 scale on colour paper prints were produced on standard photographic paper at the Regional Centre for Services in Survey Mapping and Remote Sensing in Nairobi. Visual analysis of paper prints was carried out using film transparent overlays for annotations.

Planned visits to different parts of the study area by motor vehicle and a recce trip using light aircraft helped in orientation to the physical features and social conditions of the study area for the purpose of further plans for field work. Support staff to assist in data collection, processing and production by indoor methods and field work were provided by the Laikipia Research Programme. Technical Assistants (TAs) of the Ministry of Livestock Development helped in the livestock census of Central and Mukogodo Divisions in 1989. Research

Assistants were trained to perform several procedures of collecting, preparing the input, inserting the data sets in the computer and processing it, in cartography and other document production procedures.

DATA ANALYSIS

Preliminary Landscape Analysis and Classification

The aim here was to depict the ecological potential of district space and establish boundaries of·ecological land units of different land potentials at a reconnaissance scale using terrain attributes (landform, drainage, geology, soil and vegetation). Remote sensed data was the main tool. The basic sources of data being black & white aerial photographs at scale 1:50,000 and enlargements of SPOT colour print images at scale 1:50,000. For both types of data the image classification was done manually. Transfer of data from the original transparent overlays of the images to the base map was performed by means of digital cartography in the ARC/ INFO GIS. Preliminary image classification and interpretation was carried out on panchromatic black & white aerial photographs using a Topcon mirror stereoscope. Major physiographic land units were delineated using relief depth, the major breaks in slope and drainage lines in the stereo model of paired images. Three physiographic classes were delineated: I = Uplands; II = Terraced to undulating plateau; III = Lowland.

Manual image classification of vegetation types in the district using colour tone and patterns of the image was done on enlarged SPOT colour paper prints at scale 1:50,000. Adopting the classification proposed by Donker & Mulder (1985) nine image categories were mapped (Table 3-1). Land registration (LR) plan maps obtained from the Ministry of Lands were used in close consultation with the map of land use and land ownership 1982 drawn by Kohler (1985).

Two weeks were spent in searches and studies of historical documents at the Kenya National Archive in Nairobi with particular attention focussed on information concerning European settlements in Laikipia and the exodus of the original Purko Masai from Laikipia at the beginning of the 20th century. A classification and boundaries were drawn for the following categories of land ownership: government forests, pastoral group ranches, large scale private estates, large scale government and parastatal estates and smallholdings.

A preliminary classification of the major land-use types was derived from the land ownership structure corroborated with the map of land use and land ownership (Kohler, 1985). The major land use categories were: urban settlements, national forests, pastoralism, commercial ranching and smallscale mixed farming. Preliminary classification of settlement and delineation of boundaries between different categories according to density was made from SPOT images using the differences in color tone and pattern. Five classes were recognized. These were very high, high, medium, low and protected areas. Through personal participation in the DDC and DEC meetings and study of policy documents, the analysis of the current rural development planning at the district level was evaluated with the aim of identifying requirements, sources and gaps of information utilization in district rural development planning process. Special attention was focused on the potential role of the District Information and Documentation Centre (DIDC) in rural development planning in the district.

Diagnosis: Sampling and Description

(i) Farming Systems

The aims here were (a) to characterise agricultural management systems in the context of adaptation to ASAL spatial and temporal variations (b) to determine the types and labour demand of farm activities in relation to other factors influencing decisions of farmers in farming systems such as residence (on-farm/off-farm), off-farm income, farmsize, inputs, outputs, land tenure, cropping calendar, technology level, household size, marketing, role of livestock, community participation, labour and perceived constraints. The data would help to understand and to identify problems requiring to be tackled if land-use optimisation was to be achieved as per present economic policy. Contact farmers were selected systematically in all settlement schemes, thereby ensuring coverage of the entire district. Within each settlement scheme the particular farmers were selected through a randomization procedure. A questionaire was used to conduct person-to-person interviews of the selected contact farmers. The variables checked in the farm survey questionaire are presented in Appendix I. Repetitive sampling (monitoring) was carried out on production of maize which is the staple food crop of the smallscale farmers in the district as well as on national level. An extensive, systematic-district-wide, diagnostic survey of farming systems was conducted over the whole of Laikipia District. Data collected included land ownership, state of settlement and farming systems of the smallscale agricultural enterprises in all settlement schemes. Aspects of livestock development and livestock numbers were studied with assistance of extension workers in the Ministry of Livestock Development.

(ii) Monitoring of Yearly Maize Yields

The aim of this part of the study was to obtain data for analysing and modelling the performance of maize production in the prevailing conditions of farming in order to aid farmers in planning their crop production so as to use the land wisely as well as to suit the seasons.

At the annual harvest times in the small farms sample plots of 10 metres by 2 metres were taken by randomized sampling in the nearly or completely dry maize crop. The maize in sample plots were harvested separately from that of the rest of the farm and dried in the same way as the farmers dried their harvest by spreading it in the sun in daylight for a period of one to two weeks. The maize was then threshed and weighed using a Salter spring balance. The maize was given back to the farmer after the weighing was over.

(iii) Livestock Enterprises

The aim of this other part of the study was to determine the structural trends in livestock production in respect to ecological and socio-economic variables. A ground survey of livestock numbers and management systems was carried out in two Divisions namely Central and Mukogodo, of the four (now five) Divisions of Laikipia District. The method adopted was total counts in ranches and stratified sampling in the pastoral and agropastoral areas. A second questionaire was used for this purpose. The results, including numbers, stocking rates and the overall change are discussed.

(iv) Ecological Sampling

Activities included the interpretation of aerial photo and SPOT satellite images, ground truth surveys and botanical determinations, selection and sampling of transects within the identified plant communities.

(v) Observing the Flow and Utilization of Information

The aims of this analysis were first, to find out the extent of the utilization of available information and the approaches adopted and practised in the current planning systems. Secondly, to find out the sensitivity to the DPU application of formal criteria or standards to decisions in issues of environmental and land-use management. An example of such decisions made was the budgetary approval of proposals for financial allocation for different interventions in the new settlement areas having regard to sustainability. The third aim of the analysis was to observe and determine the overall quality, flow and filtering of information between the different levels and stages of vertical and hotizontal flow in decision-making in the district focus planning system. The District Focus Planning processes were observed during meetings of the District Development Committee, the District Executive Committee and other sub-committee meetings and functions. Special attention was paid to project identification and selection, forward budgeting for development, utilization and allocation of the Rural Development Fund (RDF) and other funds, information on resources for planning, Training and Visiting (T&V) system used for extension by Ministries of Agriculture and of Livestock Development.

CHAPTER 5. DISTRICT CASE STUDY: INFORMATION FOR PLANNING

"Climate sets the broad limits; cultural adaptation detemines the actual lifestyles".

Akinoola A. Agboola, 1989.

INTRODUCTION

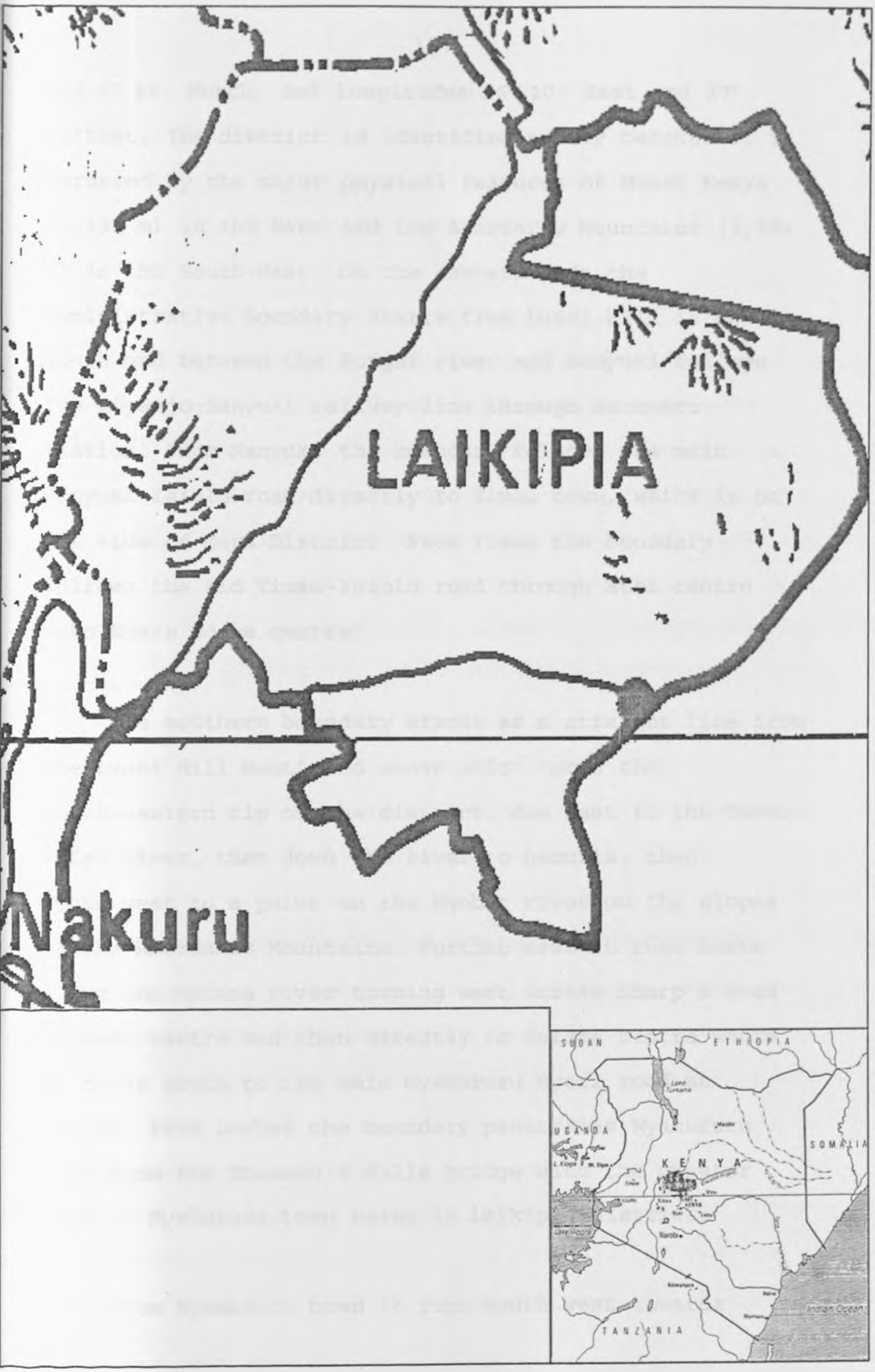
In chapter one the reasons for which Laikipia District was chosen for case study were stated namely that it was one of Kenya's ASAL districts experiencing extremely rapid land-use changes and also had research facilities. In chapter 3 the methods used for gathering baseline information on the ecological and socio-economic conditions in the district were described. This chapter is devoted to presentation of the results of the field study executed in the study area using the given methods. In reference to the proposed planning information system the results prove effectiveness and technical feasibility of the methods that were described above as tools for information gathering in rural planning at district level.

It is vital to note again that the *diagnosis and therapy* of the Laikipia District is designed and presented in the framework of the land-use systems model. Furthermore, using this approach at the grassroot level, land ownership is a basic element or attribute but the basic operational unit of land-use systems is the farm enterprise or farming system which is practised on the land. At this level PIS is concerned with the perception, adaptive strategies and sustainability achieved by the actor for survival in semi-arid conditions. At the district level five types of general land-use systems are recognized and they are also analysed in the PIS framewrk, including spatial and temporal changes.

The information obtained includes an original account of historical changes in land ownership and land-use and ecological data, which gives indication of the state of natural resources and natural potential of the land as well as impacts of land-use on the environment. The historical account of land-use systems describes the course of rural settlement and economic activities. In the period 1900-1990 (80 years) Laikipia District changed from a homogeneous land-use system of indigenous nomadic pastoralism, to the diverse and heterogeneous land-use systems that are evident today including commercial ranching, agriculture, etc. These temporal changes facilitate insight of possibilities and provide a basis for extrapolation and predictions which are necessary in planning at district level.

GEOGRAPHICAL LOCATION AND BOUNDARY

Fig. 4-1 shows the relative location in Kenya and the boundary of Laikipia District. The district is an area of 9,723 sq km (cf. Kenya: 569,429 sq km), located astride theequator and defined by latitudes 0° 17′ South



Fif. 4.1. Boundary and Location Maps of Laikipia District, Kenya

and 0° 45′ North, and longitudes 36° 10′ East and 37° 20′East. The district is identified easily because it is bordered by the major physical features of Mount Kenya (5,199 m) in the East and the Aberdares Mountains (3,999 m) in the South-West. On the eastern side the administrative boundary starts from Lusoi Hill in the South and between the Rongai river and Nanyuki follows the Kiganjo-Nanyuki railway line through Naromoru Station. From Nanyuki the boundary follows the main Nanyuki-Isiolo road directly to Timau town, which is on the side of Meru District. From Timau the boundary follows the old Timau-Isiolo road through Ethi centre onto Ngare Ndare centre.

The southern boundary starts as a straight line from the Lusoi Hill mentioned above which forms the south-eastern tip of the district, due west to the Ewaso Ngíro river, then down the river to Lamuria; then south-west to a point on the Ngobit river on the slopes of the Aberdares Mountains. Further west it runs north along the Mutara river turning west across Sharp's Road to Pesi centre and then directly to Salama centre where it turns south to the main Nyahururu-Nyeri road at Leshau. From Leshau the boundary penetrates Nyahururu town from the Thomson's Falls bridge with the greater part of Nyahururu town being in Laikipia District.

From Nyahururu town it runs south west towards

Subukia up to the Laikipia Escarpment of the Great Rift Valley which forms a distinct physical western boundary, thus encompassing the Marmanet Ridges within the district. The northern boundary is partly a straight line from a point on the Ngare Ndare river in the north east, running westwards to a point on the Ewaso Ng'iro river following the northern scarpline of the Mukogodo mountains, which slopes down to the Kipsing plains in Isiolo District. Then it follows the course of Ewaso Ng'iro river northwards to the elbow, where it turns off westwards again along the Kirimun Escarpment to Sukuta Mugie. From there it reaches the shoulders of the Rift Valley again at the Churo peak, about 100 km north of the southern tip at Subukia. The districts neighbouring Laikipia are Meru District to the East, Baringo District to the West, Nyeri District to the South, Nyandarua District to the South West, Samburu District to the north and Isiolo to the North East.

PHYSICAL ENVIRONMENT AND ECOLOGY OF THE DISTRICT

Three major physiographic land types were recognized visually in the terrain analysis on SPOT images and aerial photographs at scale 1:50,000 at reconnaissance level. These were the central plains, western uplands and deeply dissected eastern uplands. Greater physiographic detail to show elementary land forms in each of the three major physiographic land units was possible but for the purpose of clarity of the district-wide reconnaissance mapping the details were not depicted.

Central Plains

The central plains are the sprawling plains landscape which dominates the south eastern and central part of Laikipia District to the immediate north of the Aberdares Mountains and immediate west of Mount Kenya. They consist of a miocene basaltic plateau. At a closer view, the plateau is comprised of relatively flat to undulating plains and drainage valleys lying at altitudes of between 1500 m and 2200 m above sea level. From a development point of view the remarkable phenomenon of the broad saucer shaped plateau in the middle of Laikipia is that it slackens drainage in rivers entering the plains from Mount Kenya and the Aberdares, resulting in swamps. Examples of such swamps include the Burguret-Marura, Moyok (at the Solio Ranch), Mutara swamps, Pesi swamp and the Ewaso Narok swamp. In addition to the swamps impeded drainage and soils with vertisollic characteristics occurs over large parts of the plains between Nanyuki and Rumuruti, being most evident in the rainy seasons. It is evident that the geomorphology and drainage of this area has not been given much attention in previous work. Potentially such a study may have the most far-reaching implications for ecological planning of land-use, particularly water harvesting, and long term development strategies for Laikipia District and the upper Ewaso Ngiro in general.

Western Uplands

The western end of Laikipia District consists of an elevated land mass of Marmanet Ridges which stands in sharp contrast to the lower central plains. The western uplands are made of recent volcanic lavas ejected from the faults of the rift valley. The height of the ridges above the scarp of the rift valley forms a steep and rugged terrain. The administrative boundary between Laikipia and Baringo is located along the top of of the scarp.

Eastern Uplands

The north eastern part of Laikipia District consists of the highlands of the Loldaiga Hills and the Mukogodo mountains respectively rising to altitudes of about 2200 m.above sea level. These uplands consist of an outcrop of metamorphic rocks of the basement system. Like the western uplands the Mukogodo mountains mark the boundary of Laikipia with the adjacent district of Isiolo.

Water Resources

Hydrologically Laikipia District as a whole forms a distinct upper catchment of the Northern Ewaso Ngiro river basin. It flows northwards until it turns eastwards sharply at an elbow in Longipito area as it leaves Laikipia plateau. The balance of surface water flows is used principally in Isiolo and Wajir Districts. Finally the river ends prematurely in the Lorian Swamp in north eastern Kenya. The Laikipia plateau is shallowly dissected by a regular dendritic drainage pattern. The Ewaso Ngiro river system receices tributaries from a broad catchment extending from the northwest slopes of Mount Kenya to Sukuta Marmar, including the northern slopes of the Aberdare Mountains and the Marmanet upland. It finally forms a common trunk before it exits the plateau through the 'Crocodile Jaws' cataract. Drainage is controlled significantly by the geological structure of the area, especially in the area having metamorphic rocks. Besides the permanent rivers and streams, the drainage system in the district has a large component of ephemeral rivers as well as many dry valleys which have episodic flows of runoff after the rains (Ondieki, pers comm.). Obviously Laikipia District benefits from the water yields from the two mountain watersheds through tributaries of this drainage system which have sources in the adjacent districts. This fact adds weight to the argument that Laikipia in turn must not divert water from rivers in a manner that deprives supply to communities in other districts further downstream of the Ewaso Ng'iro river. Experts have said that although Laikipia District has sufficient potential for water development to meet current and future demands, currently dry season flows are overcommitted (WRAP, 1987). Without proper storage facilities the high flows continue to be lost unused. An estimate of the exact potential of the entire drainage system is the preoccupation of current research activities. Prospects of successful development of ground water using powered submersible or hand pumps are high for the central part of Laikipia.

From a physical environment and ecological perspective studies of water systems are conceived at different levels or scales. These are the continental, regional or district or river basin level, local catchments and micro catcmement levels. Past and current studies of water resources in Laikipia District have been done at three levels namely the district, the local and the micro. At the district level a district water plan study was completed recently by the Laikipia Rural Development Programme. This study was a response to the critical situation of water demand that is gradually unfolding with the trends of growth of rural settements, agriculture and urban development. The study showed areas of the greatest potential deficit and recommeneded a strategy for water development in the district. At a local level an important study which is currently under way is the determination of potential water yields of local catchments through episodic flows in the dry valleys of Laikipia plains. Another current study is investigating the water balance at the micro level of agronomic practices. It involves determination of soil moisture, water use by crops, evapotranspiration, and agro-ecological dynamics of different farming practices. These studies will answer some of the questions regarding short term priorities and long term strategies in water conservation and water development in the district.

Water Demand

As may be expected with resettlement water development is not only a high priority but also the most controversial issue of rural development planning in the district. The streams that emanate from Mount Kenya and the Aberdares suffer a great deal of extraction of water for domestic and stock requirements, irrigation and urban water supplies as they pass through Laikipia District (WRAP, 1987; Ondieki, pers. comm.). WRAP (1987) has made projections of water demand for year 2000 on the basis of different assumptions of the trends and projectionable growth and proposed different strategies of water development for surface and underground water resources.

State of Water Development and Utilization

At the height of their development in the 1960s all the ranches had piped water supply from rivers, boreholes, springs, dams or rock catchments. The infrastructure has undergone considerable destruction in the process of transfer of land ownership from commercial ranching to small scale farms. At present a great amount of water is lost inadvertently by inefficient irrigation furrow systems, runoff on overgrazed pastures and exposed rock and through inappropriate public works such as roadside drainage channels. Water development inventories carried out in recent years found the state of affairs as in Table 4-1.

Irrigation Policy and Standards

There is insurmountable felt need for development of irrigation which is locally perceived as the panacea to all problems of land-use in the unpredictable weather regime of the semi-arid environment. In response, the Government has allocated technical personnel in the form of a Provincial Irrigation Unit (PIU) for assisting in the designing and implementation of irrigation projects. The critical issue of

	1960	1987	1990
Water permits issued		621	
Legal abstraction (cumec)	0.4	1.4	
Boreholes		214	
Boreholes off use		94	
Population supplied		137,000	250,000
Head of cattle		152,000	180,000
Sheep and goats		180,000	
Shallow wells			

Table 4-1. Water development inventory of Laikipia District

any irrigation scheme concerns the standards of the design and the crucial requirement of information concerning high and low streamflows of the rivers under consideration. Generally a 95% flow is used for design of water supplies. The general issue is the lack of comprehensive watershed development planning with consideration to proper storage facilities to prevent loss of high flows. WRAP (1987) suggested that since the quality of underground water reserves is good demands for domestic use and livesstock could easily be met from drilling of boreholes, while demands for irrigation could be met from construction of large scale storage facilities.

ECOLOGY

Use of Vegetation as an Ecological Indicator

Among the five factors of natural environment namely geology, topography, soil, vegetation, and climate, vegetation is the one which is the easiest to vary and whose variation and changes are most easily observable. Therefore, it can be used as an indicator of the state of the ecological as well as socio-economic conditions of a community. One way of expressing the value of natural vegetation is that it is both a determining factor as well as an indicator of the state and dynamics of rural environment and land-use. Botanists and naturalists offer many other reasons for protection of all species of natural vegetation including the treasury of gene pool, direct uses of plants for food, fibre, drugs, wood, raw materials for industrial products, ornamentals and scienfic research, etc., indirect uses for climatic effects, enhancement of infiltration and maintenance of water supply capacity of watersheds and power of regulating water flow, habitats of wild animals, cover of soil to prevent erosion and reduce runoff, scenic beauty, conservation of soil fertility, conservation of solar energy, therapeutic value, indication of ecological potential for future land-use, etc.

Verdcourt (1968) has stated that water is the most valuable crop yielded by forests. The real meaning is that vegetation can act as the main factor determining the percentage of incident rainfall that forms runoff (runoff coefficient) contributing to floods. It also determines the rainfall infiltrating the substratum becoming soil moisture or recharge of ground water aquifer and consequently also the important factor in determining the ratio of peak flows and minimum flows of streams originating from a particular catchment or watershed. There are many factors why preservation and protection are difficult. First, there are many poor people exerting demand for fuel who cannot be expected to respect trees so much that they buy alternative fuels. Secondly, majority of most ordinary people can see no point in preserving habitats for animals which are uneconomic or are actually vermins and pests contributing nothing but loss. Cultural and aesthetic values are not enough guarantees for preservation if economic reasons are not in favour.

Natural vegetation has strategic value among land resources. This is because of the ecological relationships it has with other factors such as water resources, soil and climate, and for its sensitivity to human activities. It has potential for use as an indicator of the level of other resources as well as human environment at large. In this way vegetation may be used as a tool for monitoring changes in rural development. A baseline survey of current vegetation could provide a background of measuring and interpretting changes which are direct effects or impacts of policy decisions, land-use or the implementation of development projects. Vegetation is therefore, one of the most important components of an ecological data set for land-use and rural development monitoring programme. This instrumental view of vegetation is different from the concern or particular attachment to species and natural vegetation, and without prejudice to destruction of the upland cedar forests.

In matters of resource and environmental assessment it is normally desirable to find out the distribution and to account particularly for sudden changes of recogized plant communities over the entire region in time. Where reccurrent associations of topography, soil and vegetation or catenas are strongly developed, they could be used as mapping units but often such patterns are neither obvious nor recurrent. All aspects of vegetation are subject to natural and man-made changes in space and time. Pioneer vegetation colonizes bare ground and in the same way bare ground can result from desertification. Two important aspects affected by dynamics of vegetation are the structure and productivity.

The system of classification of the vegetation used follows the physiognomic approach proposed by PRATT, GREENWAY and GWYNNE (1966) for the classification of East African rangelands. Variables used in assessing ground truth include the following characteristics: landscape land unit characteristics; gross morphology (forest/bush/grassland /bare/water); dominant species; floristic (species) composition. Nine categories/vegetation types were diagnosed over the whole coverage of Laikipia District. Table 4-20 shows the scheme of classification of vegetation cover of Laikipia District.

Classification by Floristic Composition

In botanical nomenclature the basic type or *taxon* of the plants in a vegetation is called *a species* of which there is a variable number in any stand of vegetation. The number of species found in a stand of vegetation is referred to as the *species complement*. Economically *species* are important because they represent the distinctive resource elements with regard to potential uses of plants for industry, medicine, food, fodder, forage, habitat (cover), firewood, timber, afforestation, amenity, reclamation, soil erosion control, nitrogen fixation, etc. Although many species are domesticated yet not all species that possess positive characteristics are suitable for immediate domestication. Although the potential for domestication of such taxa and the option

Category	Land Unit and Floristic Features
1. Built-up area	Towns, villages, factories, etc.
2. Cropland complexes	Fields of crops, ploughed land or fallow varying seasonally according to farm practices
3. Water and wetland	Stationary surface water, swamp
4. Bare/Barren rock	Ecarpments, kopjes, badlands
5. Grassland	Pure grass community or open scrubland of grassland derived by removal and suppression of trees and bushes whose remnants are visible in form of stumps of _Combretum, Euclea, Acacia_
6. Scattered tree bushland	_Acacia drepanolobium-Themeda_ or _Acacia seyal-Themeda_; _Pennisetum schimperi_ and _P. mezianum_
7. Leafy bush and thicket	_Euclea_. _Acokanthera_. _Carissa_. _Grewia_ and _Rhus_.
8. _Tarchonanthus_ bushland	Leleshwa and _Rhus natalensis_ above 1900 m contour
9. Upland dry forest	_Juniperus procera_. _Olea europea_. _Teclea_. _Trichocladus_; glades of grassland or bush present.

Table 4-2. Typological scheme for the vegetation cover of Laikipia District. (Source: Taiti, 1992).

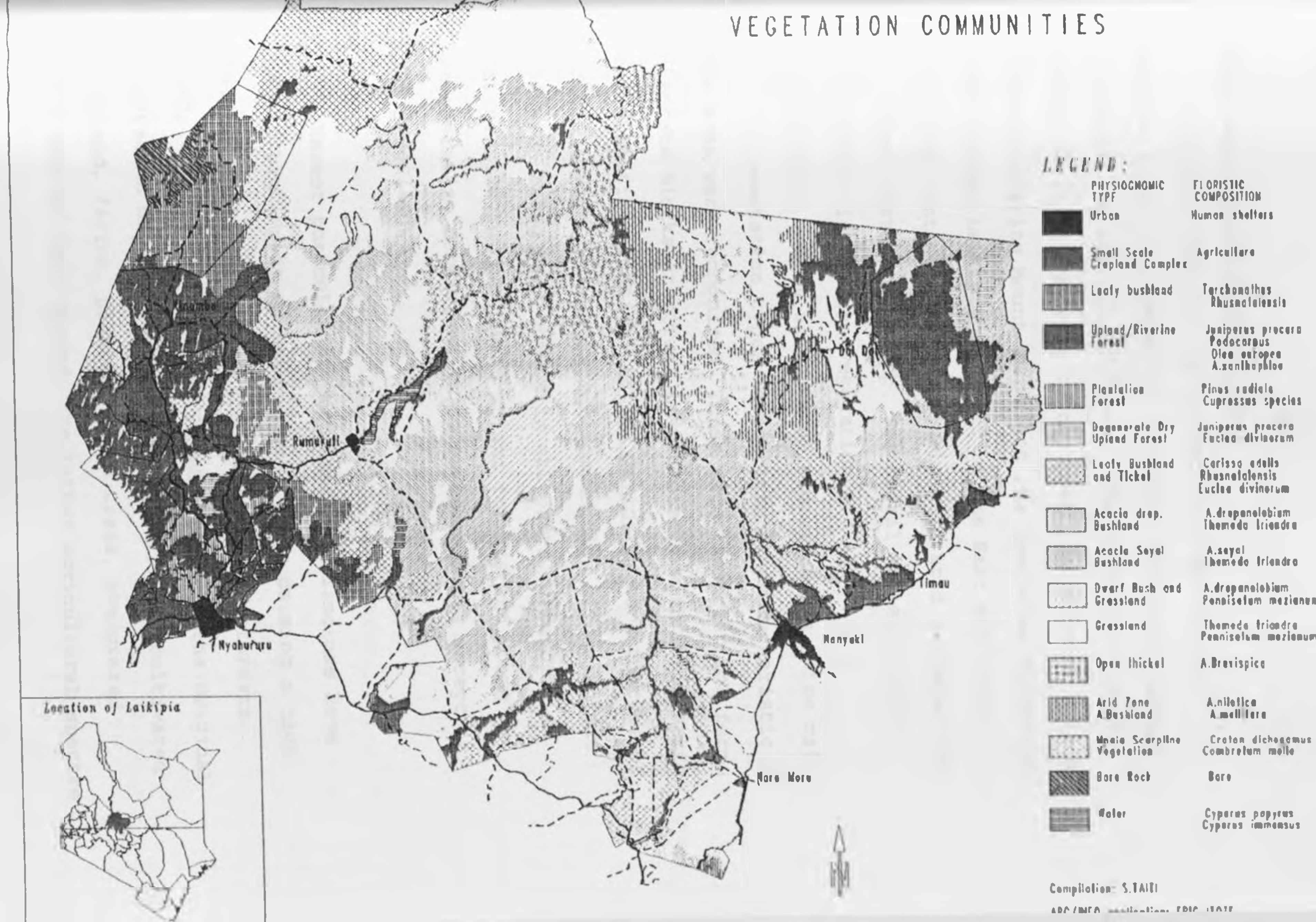
to maximize their utilization where they are abundant remains high they should not be ignored until the qualities have been studied. The loss of these species and their qualities is irreversible. Floristic composition involves assessment of the occurrence and relative abundance of species and families in the vegetation. For Laikipia District a directory of the species was compiled to form part of the ecological data/information bank.

Structure: Morphology and Geographical Distribution

Morphology of vegetation refers to the formation or three dimensional character of plants as individuals as well as in aggregates. Morphology is normally expressed in terms of the conventional morphological classes such as forest, bushland, thicket, grassland, etc., or in cover classes for the dominant plants in a stand or community type. Gerber (1985) produced a cover and land use map of Laikipia District. A vegetation map of Laikipia District drawn from SPOT imagery according to the methodological procedures described in chapter three is presented in Figure 4-2.

Cultural Patterns

It can be noted that Masai place names in Laikipia District denote the environmental interpretation of the locality in relation to relevant rangeland qualities but such traditional interpretation does not hold in time as do the physical changes. Culture in the landscape refers to visible regular or geometrical patterns of distribution as may result from purposeful handling, control or management by man. In the case of vegetation culture implies subjection to cultivation or other regimes of farming or domestication.The five perspectives above were adopted in the survey and description of vegetation in Laikipia District.


VEGETATION COMMUNITIES
LEGEND:
PHYSIOGNOMIC TYPE
FLORISTIC COMPOSITION
Urban
Human shelters
Small Scale Cropland Complex
Agriculture
Leafy bushland
Tarchonanthus Rhusnatalensis
Upland/Riverine Forest
Juniperus procera Podocarpus Olea europea A.xanthophloe
Plantation Forest
Pinus radiata Cupressus species
Degenerate Dry Upland Forest
Juniperus procera Euclea divinorum
Leafy Bushland and Ticket
Carissa edulis Rhusnatalensis Euclea divinorum
Acacia drep. Bushland
A.drepanolobium Themeda triandra
Acacia Seyal Bushland
A.seyal Themeda triandra
Dwarf Bush and Grassland
A.drepanolobium Pennisetum mezianum
Grassland
Themeda triandra Pennisetum mezianum
Open thicket
A.Brevispica
Arid Zone A.Bushland
A.nilotica A.mellifera
Mixed Scarpline Vegetation
Croton dichogamus Combretum molle
Bare Rock
Bare
Water
Cyperus papyrus Cyperus immensus
Compilation: S.TAITI
Rumuruti
Nyahururu
Dol Dol
Timau
Nanyuki
Nara Moru
Location of Laikipia

Description of Vegetation Types

Laikipia District is covered by a spectrum of savanna types of vegetation including grassland, Acacia thornbush and dry upland forest. The vegetation types form a striking contrast to the spectacular moist upland forests covering Mount Kenya and the Aberdares Mountains which border Laikipia District in the East and South. They also contrast the relatively more arid landscape in the north eastern backdrop. The floral and ecological characteristics of the vegetation are those of a transitional medium altitude-upland situation. Nine major natural vegetation types (associations) characteristic of the area were recognized. These major associations form discrete blocks or strata in conformity with topographic and climatic variation. Euclea divinorum is a feature of continuity in the vegetation communities of the entire district being very common in all parts, occurring in mature size in the intact upland forests and young or regenerating formations in other communities except in the grasslands.

Recent postcolonial settlement and land-use have made a big impact on natural vegetation causing a high rate of disappearance of the characteristic forests, bush, wood and grasslands. In substitution, the original vegetation has been succeeded by a matrix of cultivated cropland, farrow, planted exotic trees, overgrazed pastures and bare ground. The latter agricultural spectre forms the sixth category. The six major categories of vegetation are: dry upland forests, Combretum-Leleshwa (Tarchonanthus)-Acacia hockii-Dodonea-Hyparrhenia-Loudetia associations, Acacia seyal associations, *Ruai* (Acacia drepanolobium) associations, Acacia mellifera associations, Acacia brevispica-Croton, Themeda-Pennisetum grassland.

1. Dry Upland Forest (Juniperus-Olea Associations)

Dry upland cedar forests are the characteristic vegetation of the drier leeward sides of high mountains of East Africa. They consist of cedar (*Juniperus procera*) and the African Olive (*Olea africana*) as the dominant trees. Acokanthera sp., Croton dichogamus and Tarenna sp. occur as shrubs in the undergrowth. Hyperrhenia sp. is common at forest edges. Samples were taken at Sirimon, Ontulili, Mia Moja, Anandaguru, North of Doldol, Rumuruti Forest, Marmanet, Kiambogo, Lariak-Kagaa, Lariak-Lembus. The representative species of the dry upland forest associations includes the following:

Trees	**Shrubs and Herbs**
1. Juniperus procera	1. Acokanthera sp.
2. Olea african	2. Dodonea sp.
3. Podocarpus sp.	3. Dombeya sp.
4. Euclea sp.	4. Maytenus sp.
5. Cussonia sp.	5. Aspilia
6. Trichocladus sp.	6. Lippia sp.
	7. Rhus cf vulgaris
	8. Carissa sp.

Table 4-3. Floristic composition of dry upland forest

The main body of the dry upland forests in Laikipia District occurs in Ngarua Division in the West of the District covering the Marmanet and Ol Arabel ridges at the edge of the rift valley. In the East similar forests occur in the Central Division on the north-western slopes of Mount Kenya as strands extending from the mountain to the plains along the valleys. In the north Mukogodo Mountains in Mukogodo Division bears a dry upland forest of the similar description.

2. Combretum-Tarchonanthus Associations

The association is characterised by a poor spectrum of species including the following:

Trees	**Shrubs and Herbs**
1. Combretum molle	1. Dodonea viscosa
2. Erythrina abyssinica	2. Tarchonanthus camphoratus
	3. Acacia hockii
	4. Acacia brevispica
	5. Hyparrhenia sp
	6. Loudetia kagerensis

Table 4-4. The Combretum-Tarchonanthus associations

Combretum-Tarchonanthus associations occur in the higher altitudes in the west of Laikipia District covering the crests of unforested ridges and hills in the Ngarua Division especially along the Laikipia Escarpment. In the actual localities Combretum tends to occur in association with Acacia hockii and leleshwa (Tarchonanthus camphoratus) or Dodonea viscosa bushes, and Loudetia or Hyparrhenia grasses on relatively higher topography with very shallow and stony probably very acidic soils. It seems that the Combretum-Dodonea-Tarchonanthus -Loudetia-Hyparrhenia associations are typically transitional between the upland forest associations on the highlands and the Acacia-dominated communities in the lower lands. Tarchonanthus bush dominates the area of Ol Ari Nyiro Ranch (formerly Laikipia Ranching Co) surrounding the Mukutan Gorge.

3. Euclea-Croton-Carissa Thicket Association

This is a conglomerate of evergreen bush made of shrubs and scrambling thickets. It covers areas of Ndurumo and Muhotetu forming a zone between Marmanet forest and the plains around Rumuruti town. The thicket association features the following species complement:

Trees	Shrubs and grasses
Acacia tortilis	Croton dichogamus
Euphorbia candelabrum	Euclea sp.
	Acacia hockii
	Acacia nilotica
	Grewia sp
	Grewia sp
	Carissa edulis
	Themeda triandra
	Aristida sp
	Eragrostis tenuifolia

Table 4-5. The Euclea-Croton associations

4. Acacia Drepanolobium (Ruai) Association

The Ruai communities occur in medium altitude (1500-1800 m) semi-arid areas. They are associated with specific topographic and edaphic conditions comprising of flat or slightly depressed plains with poorly drained grey to black, vertisolic soils which are extremely sticky and very boggy when wet but prone to shrinking and forming of wide cracks when dry. The characteristic species of these associations are:

Trees	Shrubs and Herbs
	Acacia drepanclobium Euclea divinorum Themeda triandra Pennisetum mezianum P. schimperi Setaria cf sphacelata

Table 4-6. The Acacia drepanolobium associations

Generally there are no trees in the association. Ruai communities cover most of Central Division of Laikipia District as they extend from Solio Ranch (between Naromoru and Lamuria centres) in the south, to the Mutara-Rware area and (between the Mutara and the Pesi Rivers) westwards. They fill the plains of the Ol Pejeta, Segera, Mogwooni, Ereri, Kariunga, Kimuri, Kimugandura as well as the Loldaiga Hills, Kamwaki and Kisima Borana? as far as the Ngare Ndare River?. Nanyuki Town stands where the Ruai meets the forest of Mount Kenya.

5. Acacia seval Associations

Acacia seval is a small tree or shrub with a rather rickety stem having a yellow or orange bark and bearing black galls on the branches and twigs. The occurrence of A. seval is associated with edaphic conditions similar to those favouring Ruai (Acacia drepanolobium) the other

Acacia which bears galls, but marginal to them in a subtle way. The Acacia seyal community includes the following other species:

Trees	Shrubs and Herbs
Acacia seyal	Themeda triandra
A. tortilis	Pennisetum schimperi
Maerua sp	

Table 4-7. The Acacia seyal associations

6. Acacia mellifera-Acacia tortilis

These are typically arid plains associations occurring strictly in the northern reaches of Laikipia District especially in Mukogodo Division and in the lower valleys of the Ewaso Narok and the Ewaso Ng'iro rivers. Pennisetum stramineum, Sansevierra sp. and bare ground are typical of these associations.

Trees	Shrubs and Herbs
Euphorbia candelabrum	Acacia brevispica
	Croton dichogamus
	Carissa edulis
	Sansevierra sp.
	Loudetia kagerensis

Table 4-8. Escarpment associations

7. Escarpment and Badland associations

These are communities which occur in environments of steep, rocky köpjes and escarpments where bare stones and shallow soil in crevices occur. Similar vegetation (bare rock or ground and gullies) occurs where forest and thicket undergo degeneration and destruction by over - grazing. Characteristic species are given in table 4-8.

8. Riverine *Acacia xanthophloea* Associations

These are riparian communities dominated by *Acacia xanthophloea* exclusively with thickets of *A. brevispica, Rhus natalensis, Carissa edulis* covering the river banks.

9. Cyperus-Papyrus Wetland associations

These communities form swamp vegetation along rivers in various parts of Laikipia District. Invarably the name *marura* has been used on many of these communities even though strictly speaking the term *marura* means Papyrus. Swamp communities occur on rivers Burguret, Pesi, Suguroi, and Ewaso Narok.

10. Transitional Agriculture and Scrubland Associations

Expansion of settlement and Agricultural activities from the south has been followed at a rapid pace by removal of natural vegetation and consequent transformation of the landscape. The main characteristics of the process include instantaneous exploitation of all the wood for charcoal, ploughing for crops, uncontrolled communal grazing of unoccupied land leading to overgrazing. There is a transitional spectre of scrubland which persists before the agricultural landscape is fully developed. The scrubland exhibits sparsely scattered cultivated plots, heavily used grassland with stumps and regeneration of bushes which are stunted as a result of browsing by livestock as well as overgrazed or bare patches. The most conspicuous perennial colonizers include Acacia drepanolobium and Digitaria species.

Vegetation As An Indicator For Land-Use Planning

The existing knowledge of vegetation of Laikipia District is in the form of the Vegetation Map of Trapnell (1975), and the *Land-Use Land Cover* produced by Gerber (1985). The approach and findings of the present study agree more with those of Trapnell. Jaetzold (1982) showed that about 80 per cent of the district lies in ecological zones IV, V and VI and can be rated in the lower half in the scale of ecological land potential. The present work goes further to indicate the composition and ecological relationships and land-use potential in the context of both the physical landscape and relevant land utilization as well as the impacts of recent land-use changes. A potentially significant role of natural vegetation in Laikipia District in rural development planning at district level is to be used as a guiding factor in planning for sub-division of land and for physical installations. Vegetation patterns conform to physical characteristics and ecological qualities of the landscape. A combination of vegetation and topographic characteristics could be used as a key for ecological potential of a site.

Zonation

For Laikipia, as it is also known to be the case elsewhere, natural vegetation is the only reliable indicator of the land potential from remote sensing images (Zonneveld, 1975). The overall distribution of vegetation community types conforms to the general south-north ecological gradient or polarity across Laikipia District as expressed in ecological zones 3 to 6 (Jaetzold, 1985). However, in addition there is a vast area covered by wetlands and waterlogged edaphic conditions which obscure the pattern of regional zonation almost totally. More specifically a Juniperus-Olea dry upland forest dominates the mountainous zone 3 in the south and south west while Acacia mellifera dominates zone 6 in the north. The transitional zone between the two extremes is characterised by conglomerations of Combretum associations with Dodonea viscosa, Acacia hockii and Hyparrhenia grasses. Tarchonanthus camphoratus (Leleshwa) dominates areas which have been cleared off the dry upland forest mechanically or by overgrazing. It forms a distinct zone on the lower edges of the upland forest from Ndaragwa through Muruku, Salama, Lorien Muhotetu to Lariak. Further north it dominates the bush vegetation in Ol Ari Nyiro estate (formerly Laikipia Ranching Co).

Significance of Edaphic Plant Communities

The significance of the vast Acacia drepanolobium and the Acacia seyal communities is that they are edaphics in nature. Their incidence, though they cover large space and form the dominant character of the local aspect, is exceptional to the general regional ecological zonation, being occasioned entirely by the local topography and drainage. The same can be said of the Acacia brevispica communities on kopjes, escarpments and denuded land, and of wetlands or swamps in various localities in the District. The incidence and magnitude of these edaphic communities in proportion to the other more climatically zonal communities of the area has considerable significance to development. According to the description of climate above Laikipia lies across a steep aridity gradient from the humid mountains to the arid lowlands. The implications are that water is a major limitation and there are increasing agro-ecological difficulties the further one penetrates the climatic transition. In general the three landscape units described above have distinct community types of vegetation associations. The plains are dominated by permanent swamps and seasonally waterlogged vertisolic soils supporting edaphic vegetation communities of Acacia drepanolobium and A. seyal. The mountains are dominated by upland dry forests of Juniperus procera, Olea europea, Cussonia sp., etc. as described earlier in this chapter. The gently sloping landscape between the central plains and the mountains are characterised by evergreen thickets and shrub bushlands especially Tarchonanthus camphoratus, Euclea divinorum, Carissa edulis and Rhus species.

Geology

The geology of Laikipia District consists of two major components: (i) the basement complex and (ii) the igneous rocks or lavas. The basement complex consists of precambrian metamorphic rocks which are part of the basement system of the continent of Africa. These are hard rocks, resistant to weathering but showing various stages of granitization. Mukogodo mountains are an outcrop of the basement dominated by quartzites. Igneous rocks dominate the surface geology of Laikipia District outside Mukogodo. They comprise of tertiary and quarternary lavas, mainly basalts, interbedded with tuffs and sediments associated with vulcanism of Mount Kenya and Aberdares on the eastern edge of the rift valley. The lavas from the older tertiary vocanic episodes are reduced to the miocene plateau which constitutes the flat landscapes of the Laikipia plains and is exposed at the escarpments and at numerous scarps and verges of the river valleys. The younger quarternary lavas form the Marmanet uplands with their deeply weathered pleistocene volcanic rocks. Aerial photographs show intensive faulting in the eastern part including the Mukogodo and Loldaiga mountains as well as in the Laikipia Escarpment and Mukutan Gorge area along the western boundary of the District. Recent sedimentary deposits are restricted to narrow riparian strips in forms of sand or clays.

Climate: Rainfall and Drought

The climate of Laikipia is characterised by variation associated with altitude. Generally it is humid to sub-humid from 2000 m contour upwards; semi-arid between 2000 m and 1600 m; arid from 1600 m downwards. There is a steep climatic gradient from the higher south east and south west to the north. The annual rainfall and evaporation vary spatially in accordance with altitude according to the Water Resources Assessment Project (1987) report. The sub-humid uplands receive over 1000 mm of rain and lose less than 1500 mm by evaporation while the semi-arid plains receive less than 700 mm of rainfall but lose more than 1800 mm by evaporation. There are two distinct rainy seasons corresponding to the onset of SE and NE trade winds (Monsoons) from the Indian Ocean. The long rains in April-May and the short rains in November-December, are generally recognized, with dry periods having occasional rains in between. The period of January-March is normally very hot and dry. Overall the eastern end of the district receives most of the rainfall in the period November-December while most of the rainfall received in the humid parts in the west occurs in the months of April-May (WRAP, 1987). Sometimes there is a third peak of rainfall associated with continental rains (Flury, 1986) occurring in the period between June and October thus forming a trimodal pattern. The isohytes show a steep gradient from the wetter south eastern and south-western extremities of the district on slopes of

Mt. Kenya and Marmanet ridges respectively to the more arid northern parts of Mukogodo, Kirimun, Rumuruti, Sosian and Marmar. Despite the overall gradient the spatial distribution of rain at any particular time is uneven and unpredictable. The south west extremity of the district (Nyahururu-Igwamiti) has a humid climate with rainfall average of above 1000 mm per annum. The north and northwest has about 400 mm of rainfall per annum. Recent episodes of drought (1961,1970,1984) showed a cyclic pattern with a return period of 10 years. There seems to be no systematic documentation of drought events or their degrees of severity.

Soils and Soil Erosion

Soils are important physical resources that require to be assessed for the improvement of yields in agriculture and water conservation. The scale or level of detail, soil variables and criteria depend on the purpose of study. Therefore planning at the district level may require information or specifications from different levels of detail. Possible application at district level include comprehensive plans for watershed development, and soil information to provive the empirical basis for adjustments of technical specifications for farm practices such as choice of crop varieties, fertilizer applications, tillage and water conservation, design of physical structures, layout plans at farm level extension, as well as physical planning of infrastructure, pre-investment surveys, etc at district level.

No detailed, semi-detailed or reconnaissance soil survey has been carried out for the district entirely. Speck (1978) who worked on the pedo-ecological zonation of the western slopes of Mount Kenya said that soils on the plains below 2100 m included phaeozems, vertisols and planosols with vertic characteristics due to alternation of wet and dry periods, and high amounts of montimorillonitic clay mineral. Desaules (1986) observed that soils of eastern Laikipia plains vary in their genetic, lithological and chemical characteristics as well as in their potential and suitability for farming. Generally they form a mosaic of different classes: histosols and fluvisols in the valley bottoms, ferric luvisols (brown/red hard soils), phaeozems (black) and vertisols (dark grey to black) soils. There are also broad patterns corresponding to the geological parent rocks which fall into metamorphic and the volcanic origins, as well as to the ecological zonation. Locally, however, and in a more detailed view the soil patterns correspond to the physiographic and drainage patterns. Consequently ecological associations of topography, soil and vegetation, or catenas, may be recognized locally. Desaules (1986) recognized and described the physical and chemical characteristics of some of the soils in the area: ferric livisols, phaeazems, vertisols and planosols, histosols and fluvisols. This information is potentially useful for a diagnostic and design approach to agroforestry in Laikipia. The descriptions of soil patterns and types by Desaules matched with the descriptions of vegetation which were found in this study. Details can be seen in Desaules (1986).

Soil Conservation

Besides the physical and chemical characteristics of soils which determine the qualities for agricultural utilization, equally important for the Laikipia District is the hazard of soil erosion. While it is a customary belief that soils in Laikipia are good but water is the limiting factor to higher yields, it is grossly incorrect to insinuate that Laikipia has no problems with soils for large investments are required to repair the damage caused by misuse of land resources in some parts of Laikipia. The most outstanding case being in Mukogodo Division where it is a direct consequence of several generations of overstocking and overgrazing of cattle, sheep and goats by the Masai pastoralists since the colonial times. Soil erosion and severe mass wasting are taking place in the pastures and rangelands of Laikipia at a scale that is beyond the physical, financial, and political capacities of the District to cope with.

Vegetation and Wildlife Habitats

This study has described the vegetation of Laikipia

District in terms of floristic composition, morphlogy and geographical distribution. The map shows that plantation forestry is confined to the mountains. The map could be used to plan afforestation in the plains. The trend of removal of woody vegetation and especially the effects of cultivation and overgrazing could be monitored. Land degradation could countered by incorporation of appropriate landscape works in rural development plans. Potentially remote sensing is a powerful tool for rural ecological planning. The seasonality of vegetation combined with surface water conditions in the central plains of Laikipia is a major factor in seasonal movements of elephants. The implication of the PIS approach is that information about the phenological patterns of vegetation and the distribution of surface water could enhance the management possibilities of the large herbivores. Remote sensing may provide a valuable tool for study of these patterns. Similarly information is required for planning of soil and water conservation, intensification of irrigated agriculture, range management and agroforestry. These are significant implications of the vegetation map for rural development planning in the District.

PRESENT SOCIO-ECONOMIC STRUCTURE OF THE DISTRICT

The Organization

Laikipia is one of the fourty-six administrative districts of the Republic of Kenya (Fig. 4-1) and one of the thirteen districts in the Rift Valley Province. As already noted in the historical account a district is administered by a District Commissioner (DC). Internally, the district is divided into four administrative divisions namely Central, Mukogodo, Rumuruti and Ng'arua. A division is administered by a District Officer (DO). Each division is divided into a number of locations and there were 18 locations in Laikipia in 1989. A location is administered by a Chief. Locations are divided into sub-locations the smallest administrative units of the country administered by Assistant Chiefs. Laikipia District is divided into two parliamentary constituencies namely Laikipia East comprising of Central and Mukogodo Divisions, and Laikipia West comprising of Ngarua and Rumuruti Divisions. Besides being the chief administrator the District Commissioner is also the chief executive and Chairman of District Development Committee (DDC) and District Executive Committee (DEC). The DC's office is also responsible for inter-ministerial co-ordination and security. For practical purposes of rural development planning and decision-making today as it was in the historical past, the District Commissioner is the most powerful policy instrument at the district level.

Population Growth and Migration

Table 4-11 shows the human population estimates for Laikipia District in past ten year census intervals. Figures for the earlier decades between 1896 and 1959 could not be obtained but can be extrapolated from the hut tax figures and from records of labour force in the ranches comprising the district. Laikipia started the period 1900-1990 with a phenomenal reduction of population in the period 1909-1919. This reduction reflects the eviction of the population of Masai pastoralists and the substitution by a small number of European settlers by the Kenya colonial government. In the intercensal period 1969-1979 Laikipia population grew at an average growth rate of 7.3 per cent per annum. According to the population estimate for 1989 it can be seen that there was an increase of 80 per cent from the figure of the previous census. This growth rate is very high by any standards. It is explained by migration of people from the neighbouring districts and settlement in newly acquired land holdings in Laikipia District. According to Kenya's Central Bureau of Statistics (Republic of Kenya, 1979) the demography of the population of Laikipia District is characterised by a preponderance of males, the sex ratio being 1:0.93. "For every single male there is 0.93 female in

Year	Population
1909	<100
1919	-
1929	-
1939	-
1948	-
1959	-
1969	65,506
1979	134,524
1989	241,000

Table 4-11. Population of Laikipia District in the period 1900-1990. (Sources: Kenya National Archives, 1989,1991)

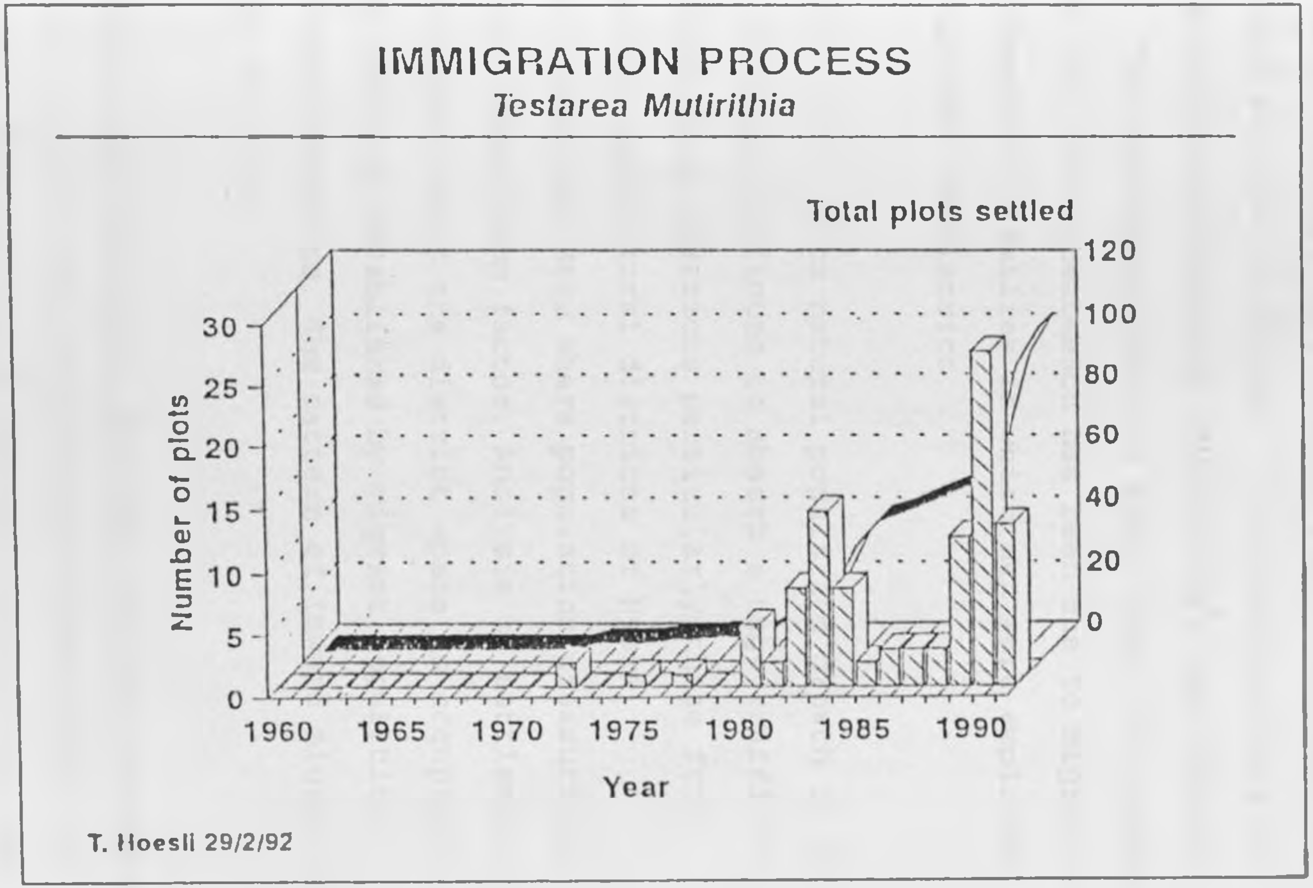


Fig. 4-3. General pattern of inmigration of peasant settlers in Laikipia District. (Hoesli, Unpulished).

the District". This characteristic is explained by the fact that men proceed to prepare the land in the new settlements before their spouses join them while many men employed in the ranches come without their families who live in the districts of origin. The age structure of the population shows dominance of the lower age category generally. The dependency ratio is also high, 100 people supporting 122. This phenomenon has been due to migration and resettlement of families in which men were employed in towns outside the district.

Besides the in situ natural population growth in the district, Laikipia continues to absorb a huge traffic of migrants from other districts particularly those from high potential agricultural districts of Nyeri, Nyandarua, Kiambu and Meru where population pressure on the land is a major push factor. Analysis of settlements showed that bout 30% of the district space is occupied by households recently established by migrant population from the other districts. The pattern of inward migration is shown in Fig. 4-3.

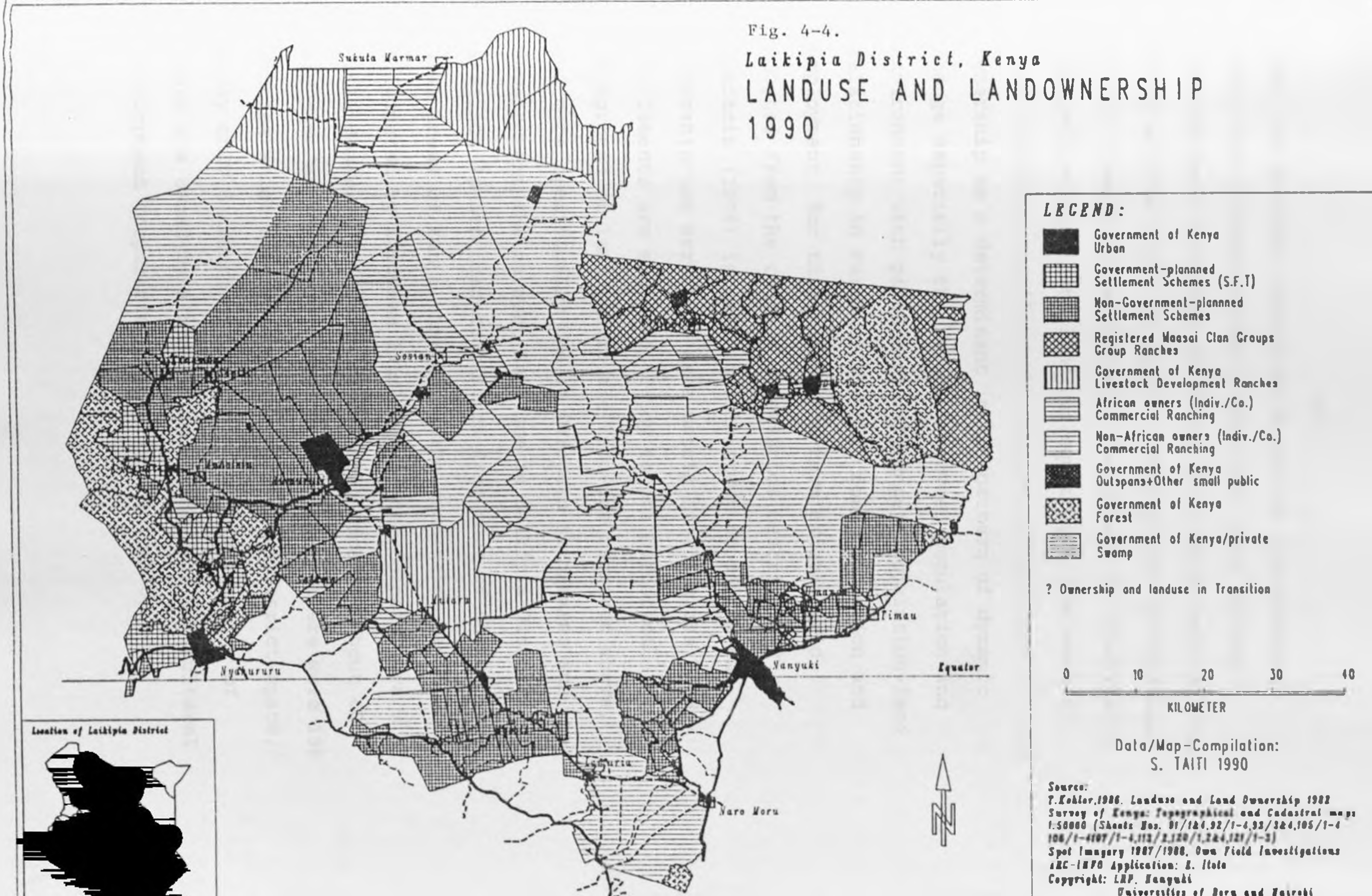
Land Ownership and Settlement: The New Land-Use Structure

Fig. 4-4 depicts the structure and distribution of land ownership and land-use in Laikipia District in 1990 based on results of the present study. From the composition of the owners and users of the land portrayed in the shading of the map it is quite clear

Fig. 4-4.

Laikipia District, Kenya

LANDUSE AND LANDOWNERSHIP 1990



that the decision makers and actors at the grassroot level are a heterogeneous population. They include pastoralists, ranchers and small-scale agro-pastoralists. As it will be shown in further descriptions of land-use below, a small but significant percentage of inhabitants consists of destitute landless squatters. The state of land ownership signifies the strategic importance of land ownership as a determinant in the pattern of dynamic change especially the relation between population and environment with particular referenceto population-land relationship in terms of shelter, food production and employment. For this reason the term ekistic grid, adopted from the concept of ekistics described by Doxiadis (1976) is used in this study to depict the ownership-use structure as a matrix in which the human settlements are embedded. Owing to the historical background of land tenure and land-use narrated above, and more specifically due to European settlement and development the current land-use in Laikipia District is distinct in its characteristics from that of the other ASAL areas of Kenya. Large private commercial ranches originated by European landlords in the colonial era still dominate the land-use spectre, covering about 60 per cent of the District space. Originally there were 158 ranches which covered 80 per cent of the district space; today only 54 ranches are remaining intact. A few of these are owned by a state corporation, the Agricultural Development Corporation (ADC), in the form of beef production ranches while a few are owned by the Livestock Marketing Division (LMD) of the Ministry of Livestock Development as holding grounds and outspans. Gazetted state forests cover 10 per cent while the Mukogodo Division (formerly the Mukogodo Native Reserve) formed 10 per cent of the total space. Fig. 4-5 is the map of land-use in 1992. Kohler (1987) observed that the important dynamics in the land-use in Laikipia were generated by a high rate of purchase and subdivision of the former European owned commercial ranches by local land buying companies and co-operatives based in the neighboring districts. The share-holders normally prefer to subdivide the land into privately and individually owned plots. Owing to the high demand of land over-enrollment of membership is common practice and consequently the plots allocated per share tend to be extremely small. The change in land tenure structure is accelerated by the demand and inflation in the prices of land. Most individuals cannot afford more than a few acres of land today. There is a lot of din and hustle in the land market with brokers selling and purchasing land in new settlements at all moments. This is accompanied by a massive campaign of cadastral surveys and registration of mutations. Large parts have been settled on the basis of unregistered demarcations and the insecurity from such tenure makes it difficult to develop the land. New arrivals are motivated by sheer necessity of securing homesteads and pathways to nearest water point as they

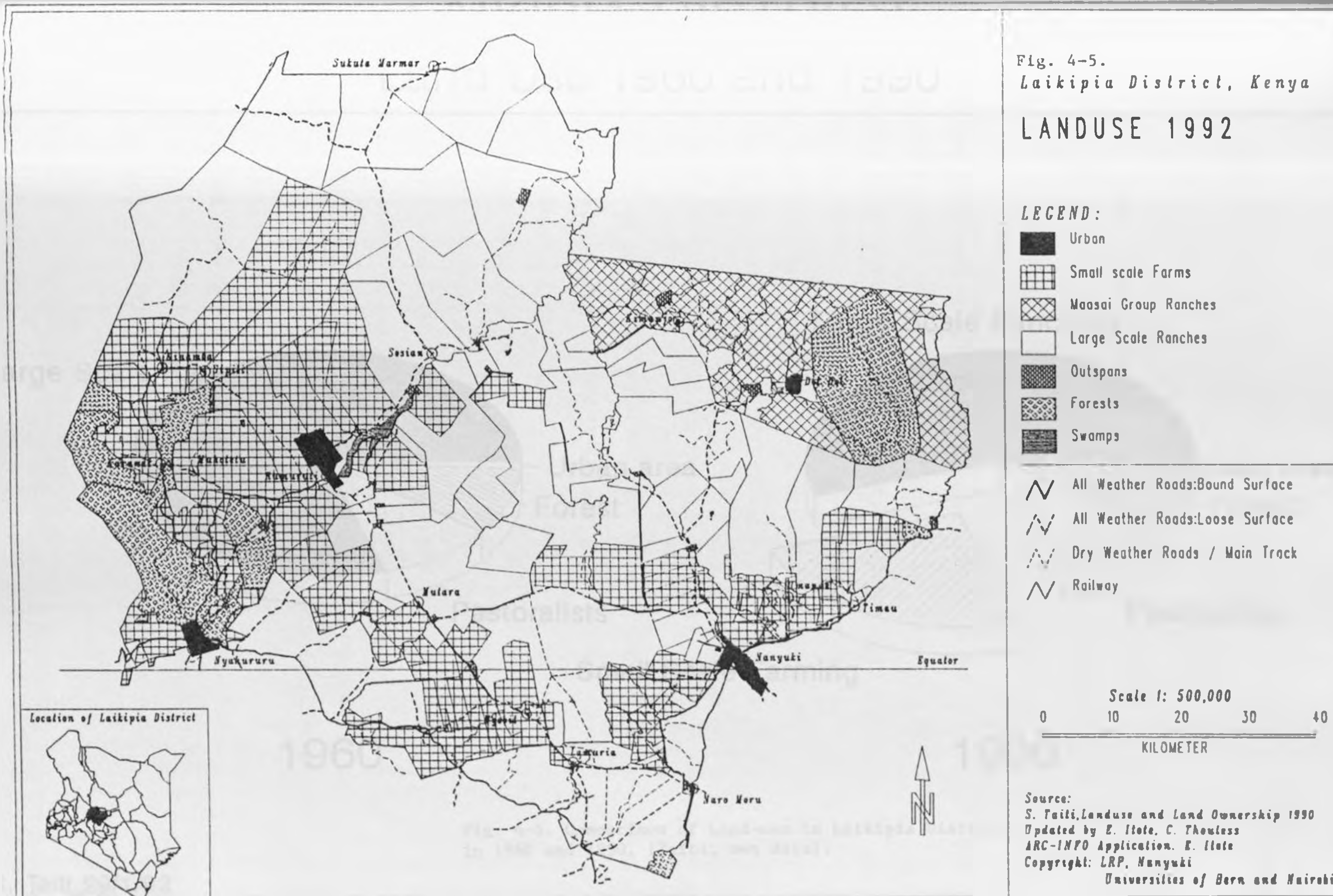


Fig. 4-5.
Laikipia District, Kenya
LANDUSE 1992
LEGEND:
Urban
Small scale Farms
Maasai Group Ranches
Large Scale Ranches
Outspans
Forests
Swamps
All Weather Roads:Bound Surface
All Weather Roads:Loose Surface
Dry Weather Roads / Main Track
Railway
Scale 1: 500,000
0
10
20
30
40
KILOMETER
Source:
S. Taiti, Landuse and Land Ownership 1990
Updated by E. Ilete, C. Thouless
ARC-INFO Application. E. Ilete
Copyright: LRP, Nanyuki
Universities of Bern and Nairobi
Sukuta Marmar
Sosian
Rumuruti
Mutara
Nyahururu
Nanyuki
Timau
Equator
Naro Moru
Location of Laikipia District

LAIKIPIA DISTRICT
Land Use 1960 and 1990

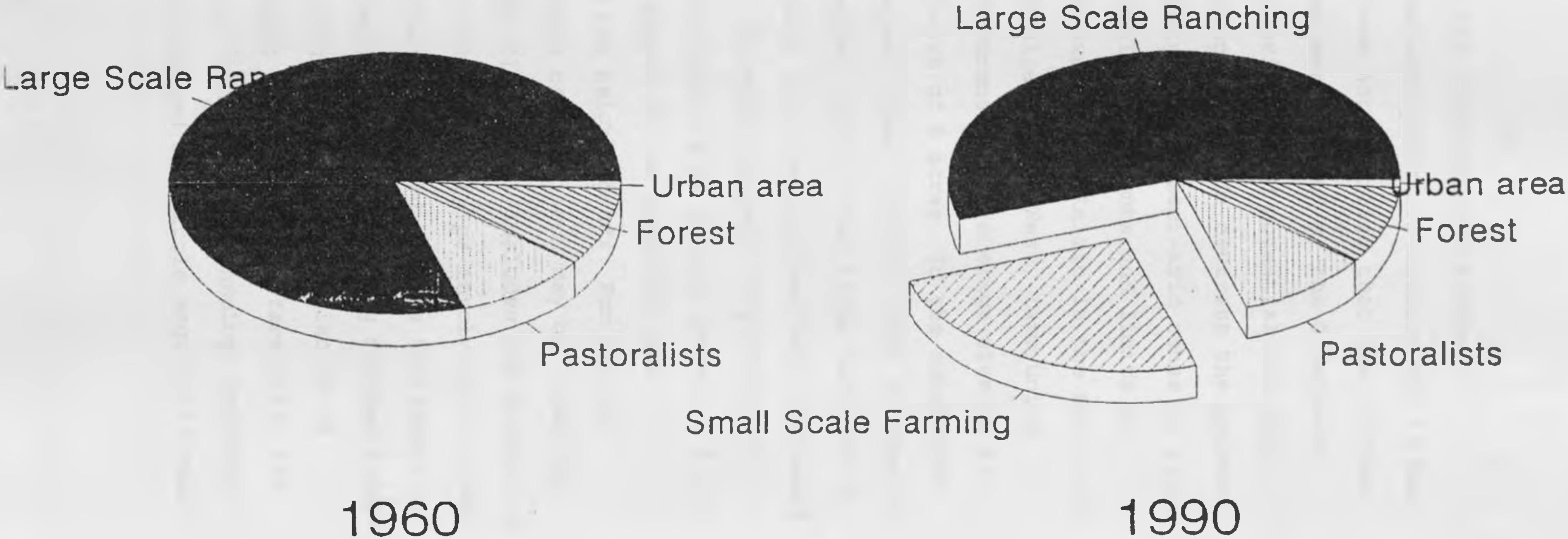
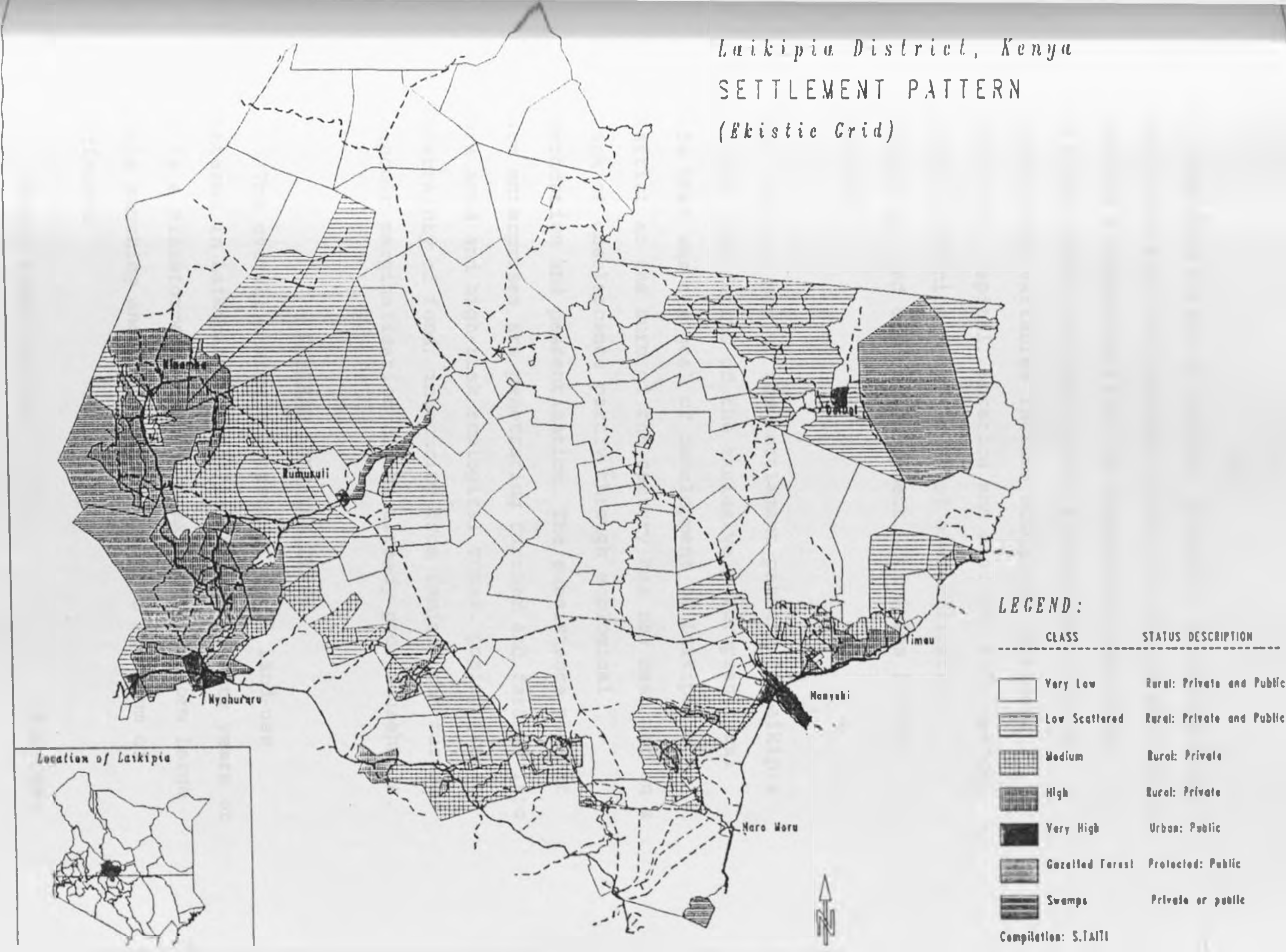


Fig. 4-6. Comparison of Land-use in Laikipia District in 1960 and 1990. (Taiti, own data).

clear and cultivate the land for subsistence. Opportunities for new employment are usually nil in the new environment. It was noted earlier that the original re-settlement schemes were planned by the Government according to the criteria of land potential and basic needs of the average household. In contrast the private settlements have penetrated the semi-arid zones in total disregard of ecological requirements and limits of rainfed farming. For example, at Kalalu in the East, and Marmanet and Ngarua Valley in the West, farm units allocated by the Government had an average size of 20 acres and a minimum size of 5 acres. In the subsequent privately planned re-settlement schemes, most of them in semi-arid land of poorer quality than those referred to above, the average plot size has progressively decreased to 2 acres or less. The main strategy of survival in these new settlements consists of a milk cow and a flock of sheep and goats grazed on the unsettled and unprotected land in the neighborhoods. For the new settler the constraints of livelihood may be viewed at different levels. The first level includes the productive land-use activities and relationships involving the land resources, the immediate household demands in respect to food and cash, and opportunities of making further income in the locality or neighbourhood. The variables of residential environment in terms of the farm size, the terrain, soil quality, climate and technology employed seem to be taken for granted and little enquiry is made



Laikipia District, Kenya
SETTLEMENT PATTERN
(Ekistic Grid)
Rumuruti
Nyahururu
Nanyuki
Timau
Naro Moru
Location of Laikipia
LEGEND:
CLASS
STATUS DESCRIPTION
Very Low
Rural: Private and Public
Low Scattered
Rural: Private and Public
Medium
Rural: Private
High
Rural: Private
Very High
Urban: Public
Gazetted Forest
Protected: Public
Swamps
Private or public
Compilation: S.TAITI

by intending buyers of shares. Secondly, the educational capacities and other personal qualities of the settler in relation to opportunities for alternative employment, self-employment or other forms of adaptation in the region where variables include education, previous experience, capital, location and distance from central places, communications, level of electrification, industrial and other development activities in the district.

Fig. 4-7 is a map of the settlement pattern in Laikipia in 1990. The fabric of the exclusively European rural life that was the goal of development of Laikipia District at the turn of the century has now been set on a track of obsolescence partly through ecological degradation and peasantisation. The subsistence peasant farm enterprises are penetrating farther and farther into more arid and high-risk ecological zones, posing greater uncertainty of food, insecurity from famine, and further economic marginalisation of the already poor households.

GENERAL LAND-USE TYPES

The overall change and trend of rural land-use patterns in Laikipia District in the last twenty years or so is a transformation from the extensive uniform large scale ranching and pastoral systems to a spectrum of different

Major Land-Use Type	**Per Cent**

(a)	Commercial ranching	57%
(b)	semi-nomadic pastoralism	9%
(c)	smallscale mixed farming or agropastoralism	25%
(d)	forestry	9%
	Total	100%

Table 4-12. Major land-use systems of Laikipia District expressed as percetages of total area.

land-use systems. The spectrum ranges from subsistence small scale farming or peasantship to high cost tourism in some of ranches. As described above most of the land underwent development for cattle ranching and game cropping both of which thrived on the natural rangeland with minimum improvements. Forest reserves were created on the mountains. Although no wildlife reserves have been created in the past wild animal populations have remained abundant up to this day. Since hunting was banned in 1974 the main effect of the presence of wildlife in the district has been a constraint to farming. For this reason wild animals are tolerated only because of their legal protection under the Wildlife Conservation and Management Act (Cap 376) Laws of Kenya. The trend of diversification of land-use has increased the scope of specialised production and economic interaction. On the other hand it reflects also a widening poverty gap and static social stratification that may require addressing in development planning at district level. The findings of the field work are described further under four observed general types of land-use namely (i) forestry,

(ii) commercial ranching, (iii) semi-nomadic pastoralism, (iv) smallscale mixed farming.

However, it is mentioned here that land-use planning has been limited to cadastral surveys and legal instruments of ownership. This emphasizes further the observation made above that land tenure legislation, land adjudication and registration, and market forces play the primary and biggest role in land-use change at the district level. Decision-making at the farm level is limited solely to the choices of the land owners of the land-use enterprises they undertake.

(i) Forest Reserves

As indicated under methodology, information about forests in Laikipia District was obtained by means of SPOT imagery supported by ground truth including checking of boundaries and the state of forests reserves. Personal interviews with the District Forest Officer provided the information on management policies for the forest estate. It is observable that forestry is a major component of the current land-use in Laikipia District, forming about 10 per cent of the total area of the district. There are eight separately gazetted forest reserves in Laikipia District namely Lariak, Ol Arabel, Marmanet, Ewaso Narok, Rumuruti, Ngare Ndare, Mukogodo and Lusoi Hill. The total area of these gazetted and protected forest is 67,184.1 hectares. At the time of this field work a change of the western district boundary was introduced under which the Ol Arabel Forest was to be placed on the side of Baringo District. The current Government management policy of forests in the district is to preserve most of the indigenous natural forests for the purposes of watershed protection and gene pool conservation. Aerial photographs taken in the early 1970s showed that a large amount of the latter type of forest on private land which was unprotected has been cleared in the last ten years for settlements in the Muhotetu-Ndurumo area in Laikipia West.

The indigenous forest of the dry upland Juniperus - Podocarpus-Olea type is described in greater detail under vegetation in this chapter. This type covers 62,285.42 Ha. The dry upland forests are characterised by open glades of upland grassland. In the gazetted forests, this type of forest which is protected for the purposes of conservation of watershed, is no longer cleared for the establishment of plantations. The "shamba" system in which squatter labour was allowed to clear natural forest and cultivate food crops for two years in the forest estate prior to the establishment of plantations in the third year was abolished in 1989. The cadres of resident squatter labour force formerly settled in forest villages were evicted from the forests at the same time. Grazing in the forest estate was also abolished. An exception to the latter move was the Mukogodo Forest where pastoralists living in the gazetted forest were allowed to continue doing so on the grounds that they did not affect the forest estate and that they had traditionally been associated with forest from time immemorial.

The established plantations of exotic softwoods cover 4898.68 hectares of the area. These plantations consist of cypress species (Cupressus lusitanica), pinus species (Pinus patula, Pinus radiata) and eucalyptus species. Cypress and pinus plantations are utilized for timber while Eucalyptus plantations are utilized for power and postal line poles, as well as building poles and firewood. The largest plantation is developed in the Marmanet Forest. The forests of Lariak and Rumuruti have plantations of exotic species of less than five hectares each. The forests of Mukogodo, Ngare Ndare and Lusoi have negligible plantations. The exotic species planting programme has been affected by the recent changes in forest management policy particularly the abolition of the "shamba" system. Great expectations are awaiting the national forest extension programme which is presently being planned by the Forest Department. A major threat to the forest economy in Laikipia District, especially for plantations of cypress and the indigenous cedar was drying due to infestation by the cypress aphid. The aphid is a pest which was imported to Kenya with wood from countries in the south although it spread locally by flying. Attack by the aphid reached an epidemic scale from 1989 through 1991 killing most of the cypress trees in the country.

Timber production in the district is high enough to meet local needs in the district and the surplus is exported to other districts. No direct exports to other countries are made from the district. The main concern in forestry in Laikipia is sustainability of forest utilization which is extremely high compared with rate of replacement. Four active sawmills operated simultaneously in the Marmanet Forest alone and the rate of logging, including supplies to sawmills located elsewhere outside the forest estate, was high. Quantitative data could not be obtained but it is implicit that timber production from plantations in Laikipia District is not sustainable. Hence production of timber and fuelwood for the medium and long term needs deserve a high order of priority in district planning. In particular further research is required to help establish sustainable rates of afforestation and harvest.

(ii) Livestock Enterprises

Laikipia District has a strongly developed livestock industry based on commercial ranching for beef production, and the fact was made evident in the historical account given above. It was mentioned also that before independence the commercial ranches occupied 80 per cent of the land in the district but since independence the number of ranches and the total area they occupy has dwindled as a result of sale and sub-division into many small individually owned plots. Currently there is a rapid transformation due to migration and settlement in small plots followed by tillage for rinfed agriculture. Production and breeding of beef livestock is already suffering a blight and may soon be lost. It is clear that there is no political will to intervene in this trend. From the district planning angle the important question is, 'What is preferrable, a sound livestock economy for a few people or smallscale arable farming for a large population?' This question is highly debatable and requires further investigation. This study attempted to find also the overall structure and characteristics of the livestock farming from the viewpoint of management systems considering management issues and interactions that could be influenced by policy planning in rural development planning at district level. Special attention was paid to the total numbers of different species

CODE	DENSITY CLASS	DESCRIPTION
1	HIGH	Less than 5 acres per LU
2	MEDIUM	5 to 10 acres per LU
3	LOW	Above 10 acres per LU

Table 4-13. Livestock density classes and stocking rates. LU: Livestock unit.

of livestock, stocking rates and development trends of the different management systems. Table 4-14 gives numbers of livestock obtained from ground census in Central and Mukogodo Divisions an area of 4565 sq. km. (half of the area of the whole district) in 1989 as described in chapter four.

Livestock Numbers and Management Systems

In general characteristics, livestock management systems in East Laikipia are extensive. Within broad classification variations in livestock management system are considered according to the objectives and the physical organization of the enterprises. The main objectives are divided between commercial and subsistence production systems. The physical characteristic of the enterprises are considered according to farm size and sedentariness or locational stability of the livestock and the actor in respect to the farm unit. Based on the above variables five main categories of livestock production systems were recognized namely: small scale, large scale, nomadic and sedentary. Intensive livestock production systems are rare in Laikipia. There were no large scale stall feeding or zero-grazing enterprises with exception of one pigsty in the Lamuria area which had 800 pigs. Bee-keeping is also considered to be an extensive system. Three main groups of actors in the livestock industry were recognized in the District namely traditional semi-nomadic pastoralists, commercial ranchers, and agropastoralists. Further information describing each of these groups will be given below.

Spcies	Central & Mukogodo	Entire Laikipia
Cattle	101,000	200,000
Sheep	152,600	305,000
Goats	120,200	240,000
Pigs	990	1,900
Camels	280	560
Donkeys	870	1,700
Horses	175	350
Beehives	9,870	19,500

Table 4-14. Livestock enterprises and numbers in Laikipia District. (Source: Own data from livestock census of Central and Mukogodo Divisions of 1989).

Table 4-14 presents the generic and numerical composition of livestock in Central and Mukogodo Divisions. The third column gives extrapolated figures for the whole district. The estimates for Central and Mukogodo Divisions was 101,000 heads of cattle inclusive of all breeds and calves. Assuming a symmetrical distribution for the eastern and western halves of the district then Laikipia as a whole has approximately 200,000 heads of cattle. The cattle herd showed a number of significant features. It was found that cattle occur everywhere and are more or less evenly distributed except in a number of identifiable ranches having relatively higher stocking rates. In other words, except the forest reserves there are no areas in Laikipia without cattle or with extremely low densities of cattle. In the two divisions sampled in the study cattle represents 64 per cent of total biomass of livestock in the area. Beef and dual purpose breeds of cattle predominate in numbers forming 80 per cent of the total herd. The Boran cattle is the pre-eminent basic stock for beef production. It is an indigenous breed of cattle originating from the arid northern districts (formerly NFD) of Kenya which is better adapted to withstand drought conditions than most other breeds of cattle in Africa. A considerable number of ranchers are commercial breeders of Boran stock maintaining classified pure stud animals. Together with its crossbreeds in the put-through stock, the Boran constitutes the most abundant breed or dominant component of the whole beef herd in Laikipia. Other breeds present include Sahiwal, Charlorais, Simmental, Red Poll and the German/Swiss Brown. This diversity tends to increase the spectrum of Boran crosses. Fourthly, dairy breeds form 20 per cent of the total herd and include the Friesian, Ayrshire, Jersey, Simmental, and the German/Swiss Brown. In general cattle are kept everywhere in all the ranches and TA units, the main differences being those of breeds and numbers that are kept in the different areas. A high degree of specialisation exists among the ranches whereby each ranch has adopted a certain breeding and grazing strategy. However, cattle is only lightly stocked over the larger part of the area (including Mukogodo Division). Only about 15% of farms were moderately stocked, including Solio, Kamwaki, Nanyuki Ranching, Matanya Mukima, Nyariginu Mutirithia, Umande and Ngenia.

The highest stocking rates of cattle were found in Mia Moja, Gitumbi Farm, Nturukuma, Allus Farm, Kibocha, Matanya and Kihato. The highest densities of shoats were

Division	Location	Cattle	Sheep	Goats	Pigs	Camels
Central	Nanyuki	4630	2755	2792	7	0
	Loldaiga	18112	34442	6929	0	278
	Tigithi	14427	12462	6913	800	0
	Ngobit	3586	12539	2345	0	0
	Sirima	11066	13508	3464	0	0
	Segera	14359	4103	5142	0	2
Mukogodo	Mukogodo) Ilngwesi) Ilndigiri)	28675	70200	90900	0	0

Table 4-15. Distribution of livestock numbers by Locations in Central and Mukogodo Divisions of Laikipia District. (Source: Own data from livestock census of Central and Mukogodo Divisions).

found in Lolmarik ranch, Mia Moja, Marura and Kihato. Sheep, unlike cattle, are found only in some farms and are totally non-existent in others. All TA units in small scale farms and Mukogodo Division have sheep but only some of the large scale farms keep sheep. Goats are not distributed in all farms: they occur in the whole of Mukogodo Division, all TA units in small scale farms but only some of the large scale farms. Many large scale farms do not have any goats.

Milk

Milk is the primary objective of livestock keeping among the smallscale farmers and the pastoralists in the district as stated above. Milk is produced from the ranches especially a few which keep small herds of dairy breeds such as the Friesian, Guernsey and Ayrshire, or dual purpose breeds such as the Sahiwal, Simmental and the German-Swiss Brown. A large proportion of the milk produced in the district is consumed locally by farm families and labourers. A surplus of about 50 per cent of the total milk production is available for the national dairy market. This surplus is sold either locally among neighbours or through the Kenya Co-operative Creameries (KCC) at Kiganjo in Nyeri. It can be noted that the milk output from cattle and goats in Mukogodo Division and most of the milk produced in the small scale farms in Central Division, together with milk obtained from camels and goats in the ranches, cannot be easily represented in the form of dairy data and can only be accounted for as subsistence. It was estimated that subsistence accounts for about 50 per cent of the total milk production in the area. No dairy processing or manufacturing enterprises were found in Laikipia District although records of the existence of commercial a cheese manufacturing plant in the past were available. Unlike the situation of beef farmers, those who produce milk must provide for its transportation to the market. Large scale farms use their own tankers or lorries to deliver milk to the Kenya Co-operative Creameries factory at Kiganjo. Small scale farmers have organized dairy co-operatives which collect and deliver milk to the factory by lorry.

Goats were raised on both large and small scale enterprises for the purposes of meat and mohair. The small African farms and the pastoralists in Mukogodo Division keep mainly the indigenous Small East African Goat which is a meat animal. Either sheep or goats or both are kept in about 50 per cent of the commercial ranches. Only a few commercial ranchers kept goats, and solely the exotic breed of Angora goat for mohair and to a less important degree for meat. All pastoralists, however, and a majority of smallscale farmers (agropastoralists) kept sheep and goats, foraging them mostly in commonly owned group ranches, unsubdivided or un-occupied private holdings. Together sheep and goats form 20 per cent of the total biomass of livestock and 60 per cent of the cattle biomass in terms of livestock units. Numerically, however, sheep and goats are three times as much as the cattle. The Dorper sheep (a meat animal originating from South Africa) and the Merino sheep for wool. These were the preferred breeds of sheep in the commercial ranches. The Masai pastoralists in Mukogodo keep mainly the indigenous Red Masai sheep (actually red or black in colour) for meat. Smallscale farmers normally keep a mixture of crossbreds mainly for meat. The bulk of goats in Laikipia are the indigenous breed of the Small East African Goat kept for meat by both the Masai pastoralists and the smallscale farmers.

Poultry and pigs farming in Laikipia are undeveloped. Chicken, ducks and turkeys are kept on a casual, small scale, and hobby basis around the homes by most small-scale farm households producing eggs for domestic consumption. However, commercial poultry enterprises do not occur. Absolute numbers of poultry could not be estimated systematically. The LRDP cockrel exchange project based at Kalalu in Loldaiga Location was a pilot poultry improvement project. It ended without remarkable results. Pigs are rare in Laikipia. Camels are a new and experimental element in Laikipia with no significant contribution to the livestock industry in Laikipia. They are kept only in a few ranches in the district. The purposes for which camels have been introduced range from domestic pets, milk and meat and use for tourism. Donkeys are common and economically important for normal porterage and draught. The population of donkeys was 860 out of which about 820 were in Mukogodo Division which is inhabited by the semi-nomadic Masai pastoralists. There were about 140 horses, about 60 of them in one ranch (Kisima Borana).

Stocking

The average stocking rates of different TA units and ranches were calculated on a basis of total numbers of livestock and the total land area. The stocking patterns of cattle, sheep, goats and aggregates are presented in Figures 4-1, 4-2 and 4-3. According to these data it can be concluded that Mukogodo Division is one of the areas under very heavy pressure of livestock and that shoats alone contribute a large part of overstocking in this area. A similar pattern can be seen in small farm areas in surrounding Kalalu settlement in Loldaiga Location and in Kihato-Gia-Ichagi west of Naro Moru. Understocking seems to be a feature of some of the largest ranches where not only is there a complete absence of shoats but the cattle are also understocked.

Fodder

Fodder crops grown in the area include maize stalks and napier grass which are found in small farms. Ranchers and pastoralists generally do not grow any fodder.

Bee-Keeping

Bee-keeping was the main traditional occupation of the original Dorobo (O'Kiek) people of Laikipia. The colonial administration had created the Mukogodo Native Reserve for the Dorobo in 1934 where the tradition was perpetuated. Today bee-culture is a widespread activity in the district that is showing potential for technological and industrial growth. As mentioned above the base for honey production in Laikipia includes traditional and modern human skills in making and managing beehives. There are about 900 beehives in the area, 500 of them being in Impala Ranch. Beehives were not enumerated in Mukogodo Division but the estimates given in the project proposal of the Uaso Honey

Collection Central (Mbobua, pers. comm.) for the riparian zones of Uaso Ngiro only were 4,000 log hives and 4,000 bee colonies in tree trunks. From these figures an estimate for the entire Mukogodo Division was made as 9,000 hives. The total number of beehives in Central and Mukogodo Divisions considering the above figures together was approximately 10,000. The abundance of prolific nectar producing forage plants in the district allows for high productivity of bee colonies. Three types of hives used in the district are the traditional log hives, Kenya Top Bar Hive (KTBH) and wild tree trunks. Laikipia District has an abundance of highly preferred and prolific, high quality nectar producing wild plant species. Vegetation types or plant communities in which important bee-flower plant species are mostly found in Laikipia are given in Table 4-10. A beehive can be harvested two times per year yielding an average of 12.5 kg of raw honey per hive per year (Mbobua, pers. comm.). Based on this assumption the production of honey expected from 10,000 hives in the two Divisions of East Laikipia is 10,000 x 12.5 = 250,000 kg per year. If 10% of the raw money yield is marketable at Ksh.30 per kg the annual income for the area would be 25,000 x 10 x30 = Ksh.750,000. The distribution of beehives was clustered with major concentrations in Tharua and Lamuria area, Impala and Mukogodo. The rate of occupance of beehives was estimated to be high (80%). The Ruai Bee Keepers Co-operative Society was operating a honey refinery located at Lamuria which produces good quality honey. A second honey refinery is under construction at Aljijo in Mukogodo Division and was expected to produce 160,000 kg of marketable honey per year earning Ksh.800,000 as net income over and above domestic consumption and the marketable by products of wax. Bee-keeping and honey production projects are an important subsector of livestock development having a

Plant	Local Name	Community	Land
1. Acacia drep.	Ruai	Bush/Grassland	Plains
2. A. xanthophloea	Murera	Woodland/Forest	Riverine
3. A. mellifera	Munishoi	Bushland	Plains
4. A. brevispica	Girrgir	Bushland	Rocky
5. Dombeya ratund.	Olauo	Forest	Uplands

Table 4-16. Some common bee-plants of East Laikipia

specialist office in the Ministry of Livestock Development for their propagation.

Commercial Beef Ranching

The principal form of livestock enterprise is commercial ranching. There are 33 ranches ranging in size from 800 to just over 100,000 acres each. Beef cattle is the principal product of most commercial ranches. The prominent breed of livestock is the Boran cattle which is reared in both purebred and cross-bred stocks. The main qualities that make the Boran cattle desirable among Laikipia ranchers are its resistance to diseases and drought and the ability to gain weight rapidly when good conditions come round. As indicated above Boran forms the basic breeding stock and crosses with many exotic breeds abound in the area including Boran-red poll, Boran-simmental, Boran-german brown and Boran-charlorais. The sizes of beef herds differ between ranches. Herd sizes ranged from 700 to 9,000 head. Offtakes of 15% per year are normal, the slaughter animals being sold at the age of 3 years and having an average liveweight of 350 kg. The beef industry depends on well organized ranching system in which the generation of steers facilitates regular supply of both young stock to farms and mature and culled stock to the meat market. Breeding is an important and indispensable part of the beef industry. The sale of animals normally takes place on the farms mainly to butchers who take the live animals away in trucks. Thus the farmers are hardly involved in the transportation of livestock from the farm to the market. Most of the beef output goes directly into the local market. The local butcher undertakes the important functions of collecting animals from the farms, transportation from the farm to the arbbatoirs, dressing and selling the meat to the consumers. Nanyuki town has a thriving meat business which depends on its linkage with the ranches. In the last few years when the Kenya Meat Commission was in a moribund condition a number of agencies continued to sup ply Nairobi with meat from Laikipia. A small quota of beef was exported to Saudi Arabia. Beef ranching shows in overall, a fairly high degree of specialization. Ranching enterprises have been described above. The ranching systems in Laikipia include high potential rangeland, the amenable indigenous Boran cattle, cheap labour and the local market, and advanced stockmanship in management. About 50% of the ranches have perimeter fences and paddocks. The others are either unfenced or unpaddocked or both. Ranches which are

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(i) **Extensive:**

- Livestock, combined with game reservation for meat and tourism market.
- Commercial ranching: stock, meat, milk, wool, mohair.
- Short period grazing systems: Finishing of immature and underweight animals for market.
- Semi-nomadic pastoralism: subsistence cum market system.
- Agro-pastoralism: mainly extensive sedentary subsistence cum market system.

(ii) **Intensive:**

- Stall-feeding systems: Zero grazing and Feedlots

Table 4-17. Categories of livestock production systems

paddocked operate a grazing system based on rotation of animals from one paddock to another. Water is provided at strategic positions at the corners of the paddocks where a trough can serve two or more paddocks. In the large ranches the area enclosed in one paddock may vary from 100 to 1000 acres. Electric fences using solar chargers are common in the area. Compared with conventional wire fences electric fences are more cost-effective, especially in controlling the movement of large wild animals including elephants which quickly learn to avoid electrified wires under normal circumstances. For grazing purposes herds of cattle in ranches are usually divided into herds referred to as "mobs" of a few hundred animals, each "mob" being attended by a few herdsmen. Herdsmen may be armed with shortguns for safety from wild animals.

Management of the rangeland pastures in the ranches in Laikipia is generally light or zero management. Exceptions in this respect are a few ranches where selective bush control is practised and the wood disposed to charcoal makers. In these cases contracts of mutual benefit are established between the ranchers and the charcoal makers whereby the former gives away the bush for clearing and gets a more open pasture in return. The latter provides labour to cut down the encroaching bush (Acacia drepanolobium in the south, Acacia mellifera in the north and Tarchonanthus in the west) profitably. This is one of the few cases of symbiosis between ranches and the non-ranchers. Generally ranchers did not apply fire to the rangeland as a tool of management though wild bush fires burn the pastures occasionally. In contrast burning of grass and bush is a common practice of pasture management of the pastoralists in Mukogodo. The forest margin of the dry upland forest on Mukogodo mountains has been opened up by frequent burning and rattoning of trees for fodder. One rancher was chiselling furrows across the pasture to curb the runoff and to assist water retention and penetration in the ground. Severe overgrazing and pasture deterioration has occurred in parts of Mukogodo.

Tigithi, Loldaiga and Sirima. The main indication of this is the absence of Themeda and the dominance of bare land, or presence of Pennisetum mezianum or P. Schimperi, Aristida and Aloe volkensii. In Mukogodo much of the bare ground has given way to gullies and badlands thereby reducing drastically the actual and potential livestock carrying capacity of the land.

Short Period Grazing (Feeder-Trader) Systems

Feeder-Traders depend on buying and selling livestock which they keep on their own land for only short periods of time when the animal can add weight and beef quality from relatively intensive care and grazing before they are sold for beef. This is normally referred to as finishing. In Laikipia the strategy of finishing is explcited mainly by ranchers who have farms smaller than 5,000 acres. The system seems to offer a type of management that i s technically less demanding and ameable to joint ventures for small land buying groups. Feeder-Trader enterprises are livestock farm businesses whose objective and strategy consists of buying batches of immature animals and putting them through a short period of finishing or conditioning to a heavier weight and higher grade for the beef market by intensive grazing. Some farmers claimed they were able to sustain weight increases of their cattle by 1 kg per day. The period which the animals may be kept on the farm before selling is short, varying from five to six months. This type of livestock enterprises is practised usually by people who possess land too small in size (i.e. less than 5,000 acres) to operate economically as a beef-herd ranch. Animals are normally bought from pastoralists to the North outside the district though occasionally steers may be acquired from other ranchers as well. In the past LMD played the role of middleman between pastoralists and feeder-traders. Today, Isiolo town acts as an important midpoint and cattle market where feeder-traders may purchase animals directly from pastoralists in the northern and north-eastern areas of Kenya. From Isiolo animals are trecked to the farms normally on hoof. Feedlots in the strict sense do not exist in the study area. Sheep are raised in both small and large scale enterprises. The main products are meat and wool. Except in one large scale farm which specialised in shoats as the principal enterprise most ranches seemed to prefer cattle as the main occupation. Keeping of sheep and goats were normally a secondary or supplementary business. The principal meat sheep found in the study area were the Dorper and the Red Masai. The principal wool sheep was the Merino. Only four ranches out of 33 were involved in wool production. Wool was either exported abroad or sold to textile industries in Nakuru. The potential for wool production seemed to be under-exploited. It seemed that mohair, like wool, had potential that was not yet fully exploited. For sheep and goats, as in the case of beef cattle observed above, ranchers exhibited specialization.

Pastoralists

True pastoralists occur in Mukogodo Division. The type of livestock they keep includes crossbred zebu and boran cattle together with the indigenous Red Masai sheep and the Small East African Goat. Most families own small herds (2 - 10 heads) of cattle. The grazing land is held in common ownership in the form of group ranches. Committees of elders regulate grazing using traditional norms of controlling and exerting compliance by individual stock owners. Surplus milk may not be sold but may be given to neighbours. In the ideal pastoral tradition the larger the number of cattle a man had the richer he was considered to be, and the more socially powerful and influencial he could be in the community. The reality is different today. The rangeland in Mukogodo is so severely overgrazed that Themeda triandra has been replaced by bare soil and a mixture of Aristida and clumps of Pennisetum mezianum and P. schimperi. The only exception to this condition is the Anandanguru plain in the middle of Mukogodo Forest where the pasture is still comparatively healthy. In general grazing resources cannot allow every one to keep as many livestock as they wish.

Agro-pastoralism

These are the sedentary mixed small farmers having farms of very small size (i.e. 2 to 5 acres) and combining livestock with agricultural practices. Normal practice involves keeping large stocks of animals which depend on sharing with other pioneer settlers the unoccupied grazing land and public watering points in the locality. About half of the stock keepers among settlers in the small scale farms can be described to be in this group. The main characteristic is lack of selectivity for quality and quantity of livestock resources in management.

Agriculture

It was shown above that the resettlement areas where agriculture was practised by smallscale farmers were determined by remote sensing. Farm surveys were conducted in these areas in order to determine the characteristics of agricultural enterprises focussing on food crops with a view of the information required for comprehensive planning at district level for economic production or for subsistence. Detailed description of the methods is given in chapter three, but the basic design consisted of three components. These were (i) a preliminary diagnostic survey covering all settlement schemes in the district. The aim was to draw a scheme of conventional classification of the existing crop production systems. (ii) regionalisation of crop production systems using the classification as a tool. (iii) analysis of crop production. A systematic sample of farms was taken covering all settlement schemes in the district. For each scheme a systematic diagnosis/enquiry of characteristics of the settlement (date of inception, share values, farm sizes, farm practices, cropping calendar, etc) was carried out from knowledgeable persons (preferably a member of the founding committee). This was followed by a recce in the settlement scheme on the ground. After familiarisation with the neighborhood, a representative farm (a random choice?) was chosen for sampling. Person-to-person interviews were conducted on the farmers or their representatives. In total 117 farms were investigated. Fig. 4-17 shows the locations and distribution of farms investigated in the study. Biological aspects of production have basic importance and bearing to planning as they relate to the socio-economic issues of land-use namely food supply, incomes, markets, labour, credit, etc. For satisfactory growth and yields some crops are widely adapted, some are more narrowly adapted or specific in their requirements. Some tree crops require a dormancy period. Some are sensitive to rainfall regimes, temperature extremes or humidity, pH range, salinity, etc. Short term annual crops are much more adaptable than long term annual, biannual or perennial and tree plantation crops. Above all, the information related to production could be the core of overall rural development planning, particularly in setting of targets and evaluation of inputs and outputs for an agriculture oriented arid and semi-arid land (ASALs).

Crop	Commercial (C) Subsistence (S)		Part of Resettlement Zone
1. Maize (500+600)	S	C	All
2. Beans	S		All
3. Potatoes	S	C	All
4. Wheat		C	West, Kalalu, Ethi
5. Pyrethrum		C	West, Kalalu, Ngobit
6. Coffee		C	West
7. Tobacco		C	West (Igwamiti)
8. Peas	S	C	All
9. Cabbage	S	C	All
10. Tomatoes	S	C	Central Division
11. Passion fruit	S	C	Ngobit
12. Egg fruit	S	C	Central Division
13. Kale	S	C	All
14. Garlic		C	Loldaiga
15. Spinach	S	C	Lamuria, Kiamariga
16 Carrots		C	Central Division
17. Miraa		C	Nturukuma
18. Cassava	S		West
19. Castor	S		Loldaiga
20. Finger Millet	S		Kinamba
21. Macadamia nut		C	Kinamba
22. Orange	S	C	West, Central
23. Sugar cane	S		West, Central
24. Onions	S	C	All
25. Sunflower		C	Central, West
26. Sorghum	S		Tigithi (Matanya)
27. Bananas	S		Mwenje
28. Arrowroots	S		Kiamariga
29. Pumpkin	S		All
30. Sweet potatoes	S		Central
31. Beetroot		C	Lamuria
32. Yam	S		Mwenje
33. Water melon		C	Lamuria
34. Cucumber		C	Lamuria
35. Sweet corn		C	Lamuria
36. Turnips		C	Lamuria
37. Aubergines		C	Lamuria
38. Capsicum		C	Lamuria
39. Guava	S		Loldaiga
40. Soya bean	S		All
41. Cow peas	S		West
42. Bana grass	Fodder		West
43. Napier grass	Fodder		West, Central
44. Lucerne	Fodder		Lamuria,

Table 4-18. List of crops grown in resettlement areas of Laikipia District

<u>Variables of Smallscale Farming Systems</u>

The need for criteria for identifying groups of crop farmers with relatively similar characteristics or problems for purposes of effective specifications in extension work and rural development planning will become implicit from the foregoing discussions. The aim of the descriptions which follow is to characterise the crop farming systems by selected variables so that at the end of it a pattern of distinct groups of agricultural enterprises may emerge. Depending on policy, priority and purpose the strategy may be to use one or combinations or additions of the criteria used in the study for grouping crop production systems in Laikipia District.

Farm Size

It is a fact that the biggest majority of crop farms in Laikipia are smallholdings or plots of between 0.4 Ha and 2.0 Ha (1-5 acres). Definite exceptions to this generality are farms in Ethi where subdivision and shareholding were based on units of 17 acres and most of them have remained so without further splitting. Another case is OMC near Rumuruti with a small numbers of shareholders. Muhotetu also consists of one part with relatively large units and another section where plots are relatively small. Some commercial ranches have grown some crops at a comparatively minor or subsidiary scale in relation to the main livestock enterprise. The dynamics and impacts of such crop enterprises in the overall landscape ecology and socio-economy of Laikipia District was insignificant in comparison with the current impulse of crop development now pervading the agro-pastoral economy of the resettlement areas. The overall geographical distribution of the agro-pastoral resettlement areas is a crescent-shaped zone extending from Ethi-Timau area in the east, through Naromoru and Ngobit in the south, Nyahururu, Muthengera, Marmanet, Sipili and Kinamba in the west. A few ranches in this zone grow wheat on a limited scale. The horse-shaped band of new agro-pastoral landscape surrounds the broad plains astride the Ewaso Ngiro river still dominated by commercial ranches, and further north the Mukogodo Division occupied by the Masai pastoralists. Generally the latter areas are still rangelands where crops are not a significant element of the overall economy. In a broad front and slowly the constellation of small cultivated plots is growing northwards from the slopes of Mount Kenya, Aberdares and Marmanet. Table 4-18 gives a comprehensive list of crops grown in Laikipia District.

<u>Adaptation of Cropping Calendars</u>

The farming year of rainfed agriculture in Laikipia District is dictated by the two major rainy seasons in April-May and November-December. Figure 4-9 shows the cropping calendar in terms of the main crop-related activities of land preparation, planting, weeding, crop protection and harvesting. It was observed that farmers in nearly all parts of the district (for example Ethi, Kalalu, Mwenje, Rwathia, Mithiga, Siron, Wiumiririe, Lorien, etc), anticipated the April-May rains for planting of the main crop of maize, preparing the land in advance and planting early so that crops can take the maximum advantage of rain water for growth. Land preparation takes place in January and February when the weather is at its hotest, thus facilitating the drying up and death of weeds after ploughing. Planting is done in late March and early April just before the peak of the rains. By the month of May seeds have germinated and the first weeding is done. Spraying and dusting are done in June and July. Harvesting takes place at the peak of another hot and dry season in October and may continue into November. This pattern shows adaptation to the incidence of the rains. An important feature of the system is that the maize crop takes nine to ten months to mature. There are three significant exceptions to the above cropping calendar and dependence on rainy seasons which are worthy of special remarks. They are Kihato, Thome-Marura and Murera.

Kihato Settlement

The normal rainfed crop practices in Laikipia District have been described (Flury, 1987; Kohler, 1987). A notable exception to these practices was the off-season strategy found in Kihato-Gia-Ichagi near Naromoru. Here farmers respond to the November-December rains as the major rainy season for maize production. Consequently land is prepared in September-October and planting of

AREA	CROP	L	P	W	H	FB
Ethi	Maize	2	3	5-6	10	-ve
	Beans	2	3	5	7	
	Potatoes	2	3	4-5	7	
	Wheat	12			8	
Kalalu	Maize614	2-3	3	4-5	12	+ve
	Beans	2-3	3-4	4	8	
	Potatoes	2	3	4-5	8	
	Wheat	2-3	3-4		9	
Muruku-Kieni E.	Maize	12-1-2	3-4	5-6	10	--ve
Rwathia	Maize	1	4	5	12	++ve
	Wheat	1	4-5		10-11	
Mwenje	Maize	1-2	3	5	11	+ve
	Beans	1-2	3	5	8	
	Wheat	1-3	4-5		10-11	
	Coffee				9-12	
Thome Irrigation	Maize-a	2-3	4	5	10	++ve
	Maize-b	9	10-11	2	6	
Thome Rainfed	Maize	2-3	4		11	-ve
Kihato	Maize	8	11	4	6-7	+ve
Lorian	Maize	2	3-4		9	
Limunga	Maize	11-12-1-3	3-4		11-12	+ve
	Beans	11-12-1-3	3-4		8	
Ol Moran	Maize	2	3	5-6	None	--ve
Lariak	Maize	2	3		11	+ve
	Wheat	1-2			10	
Mithiga	Maize	1-3	3-4		10-11	++ve
Siron	Maize	2	3	4-6	10	+ve
	Wheat	4	5		9	
Igwamiti	Maize	1-2	2-3	5-8	12	+ve
	Wheat		5-6			
Mwireri	Maize	2-3	3	4	11-12	-ve
	Beans	2-3	3		7	
Matanya	Maize					
Ndurumo	Maize	1-3	4		9-11	-ve
Muramati	Maize	1-3	4		10	-ve

Table 4-19. The farming year and food balance in Laikipia District: L, land preparation; P, planting; W, weeding; H, harvesting; FB, food balance/year.

maize takes place with the onset of rains in November. Weeding and protection are done in January, February and March. The long rains in April-May are anticipated for tasselling and cobbing of the maize crop. Harvesting takes place in July. The great contrast between management systems in Kihato and those of adjacent Matanya were noticeable. In Kihato the crop calendar is a reversal of the crop calendars described above but it shows greater reliability of harvests in comparison to Matanya and other areas of the District. Harvest data collected for several years showed that although fairly low yields were obtained in all the years from the short rains crop in comparison with long rains crop obtained among other schemes it was available in all years. This is more conspicuous in years when there is widespread crop failure and when the neighbouring schemes where long-rain strategy was practised experience clear-cut crop failures due to drought. The system in Kihato-Gia-Ichagi may thus be called the One Maize Crop of Low-but-Sure Yield Based on Short Rains. This calendar of cropping is adaptive to ecological seasonality and reliability of short rains in the ASALs of tropical East Africa. Scientific analyses of rainfall patterns in the tropical ASALs show that the so called short rains falling in November-December are more reliable in the onset and in the quantity received than the long rains of March-May. Farming in Kihato demonstrates how a small region can benefit from adjustment to local ecological conditions by using specific information. Similar harvests were obtainable only under irrigation as observed in the Marura-Thome scheme near Rumuruti.

Thome-Marura Irrigation Scheme

Here farmers supplement the rains with flood irrigation. The signifince of this system is that farmers are able to make two crops in one year on the same piece of land. One crop is planted in March-April and harvested in October in conformity with the general crop calendar pattern for the District. The other crop is planted in November and harvested in June, a season that resembles the season described for Kihato. There is a period when the two crops overlap implying that land preparation, and possibly the planting as well for one crop, must be done while the other crop is in the last stages of maturing or drying before harvest. This system demonstrate a high degree of intensification through irrigation which has made it possible to double the per hectare and per capita productivity in subsistence crops.

Murera Horticultural Irrigation Project

This is a private project using powered overhead sprinkler irrigation system for production of a wide range of short period annual crops. These are onions, cauliflower, cabbage, aubergines, capsicum, tomatoes, cucumbers, water melons, etc. A professional manager, a large labour force and capital inputs are basic attributes. Since water is available and production of crops continues throughout the year the system is independent of the rainy seasons. There is a shift of constraint from the environmental resources to marketing information and technology for preservation and storage of the perishable products.

Planting Patterns In Relation To Farm Size

Farms discussed below were selected systematically from the original systematic sample that was used for the district-wide diagnostic survey of cropping systems. For purposes of demonstration it was necessary to have representative types satisfying the basic criteria of being true differentiation between adaptation and the constraint of farm size while actors were in the same ecological zone and in similar cultural and socio-economic conditions.

Ideally package specifications could be made available for each agro-ecological zone for different crops in regards to suitable varieties, cropping calendar, crop spacing, etc. The farm survey found that none of the farmers had ever been visited by TAs on their farms and information was not available. The farmers had devised their own designs in adaptation to the ecological and socio-economic conditions of the local climatic patterns and farm size.

Nturukuma Farm of 2 Acres

Farm No. 27 in Nturukuma was 0.8 Ha (2 acres) in size and represented a small farm with size less than one hectare (1-2 acres). The main characteristics were as follows. (a) Cultivation covered more than 98 per cent of the plot leaving hardly any free space in the homestead which was consequently a compact cluster of structures.

(b) Cattle were kept in a small enclosure or stall next to the farmers house by a semi-zero grazing system involving feeding or staying in the stall for all night and for a part of the day. For the other part of the day the cattle was driven outside the farm to forage in the unprotected grazing grounds in the vicinity of the farm which were used in common with neighbors. (c) A great deal of heavy labour was involved in the removal of manure from the stall to various points in the cultivated area, which was done with the aid of sacks. (d) In the cultivation of crops intercropping of maize and beans was the normal practice. (e) Besides the intercropping of maize and beans another practice was intercropping of different maize varieties. Maize generally requires a long duration to mature and there is always a risk of drought arising and crop failure. Interspersing the varieties in the same plots as well as in the rows by mixing the seeds of the early maturing 500 maize series and late maturing 600 series before planting would increase the farmer's chances to hedge from complete crop failure. In case of drought 500 maize series might survive, and in case of good rains both varieties would reach harvest one maturing earlier and the other one later. Furthermore planting them in the same plot and same rows reduced the amount of labour in weeding. (f) Fodder crop in the form of rows of napier grass was grown within the same maize garden at certain intervals and in alignment with contours so that they also protected soil erosion. (g) Tillage for crop was done with hoes, and most of the farm work was done manually. (h) The owner of the farm had no other employment. He and his wife stayed in the farm. (i) The primary objective of crop production was food for the family. Income for the family was a totally grey area of chance and uncertainty. This small farm demonstrated a management system with high degree of integration and optimisation on the smallest unit of land by intercropping and recycling of animal wastes. The economy of the small farm remains as a question of great interest.

Farm Size (Ha)	**Farm Characteristics**
< 1	Small homestead Maize varieties Mixed in rows No pasture
1 - 2.5	Large homestead Maize varieties in separate plots Small pasture
> 2.5	Large homested Maize varieties in separate plots + wheat crop Large paddocked pasture

Table 4-20. Adaptive characteristics of farm practices for different farm sizes in the same ecological zone.

Kalalu Farm of 3.5 - 6.0 acres

A medium farm in the range of 1.6 - 2.4 Ha was the Farm No.19 in Kalalu which was 2.0 Ha (5 acres). The characteristics were as follows. (a) Cultivation spared a fairly large grassy homestead with free space between various structures scattered around the farmers house including a cattle boma secluded from the residential house and milking shed. (b) Cattle and calves grazed freely around the homestead during the evenings and mornings even though they were driven out to forage in the common ground for most of the day. (c) Intercropping of maize and beans was the norm as for the smaller farm plots. (d) For the maize varieties there was no intercropping of short maturity and the long maturity varieties (namely the 500 series and the 600 series respectively). They were grown independently on separate plots. (e) A separate plot was allocated for the fodder crop (napier grass). (f) Tillage for crops was done using hoes and most of the labour was done manually. (g) The owner of the farm was an artisan who spent most time of the day out of the farm. The wife was the manager of the farm. (h) Farm produce was oriented to food supply for family and the market on a 50-50 basis.

Kalalu Farm of 18 Acres

Farm No. 23 in Kalalu which was 7 Ha (18 acres) represented large farms (>4 Ha). The characteristics of such a large farm were as follows. (a) A large grassy homestead compound with a fairly long road from the gate to the house. Adjoining the homestead was paddocked leyland for livestock and the cattle boma was far apart from the farmer's housewas. A large water storage structure was among the items in the homestead. (b) Cattle grazing was regulated within the farm, with grass paddocks (leys) of improved pastures with nutritious grass and watering facilities implying a higher carrying capacity. (c) Crop rotation was practiced with other enterprises allocated separate plots. In addition to maize, beans and potatoes wheat was grown for purely commercial purposes. (d) Fodder was separated from the food crops. (e) A hired tractor was normally used for ploughing the land. Problems of land preparation were related to shortage and delays tractor hire services. (f) The owner of the farm was a businessman staying in another district most of the time and the wife was the farm manager. (g) Farm produce was oriented to market because family food needs were covered easily.

Maize Yields

Yields per hectare of all crops (maize, beans, wheat, etc.) in Laikipia District are low generally except for potatoes in the Kalalu area (DAO, pers. comm.). Ratings of yields of wheat in the Kalalu area by the Ministry of Agriculture are at 5-8 bags per acre, which is considered uneconomical.

Irrigation

Irrigated agriculture, private and communal, in minor and medium scales, have been attempted in Laikipia District for both subsistence and horticultutal crops with qualified success. A few examples of irrigation projects which show signs of viability are discussed.

These projects are at stages of infancy requiring assistance in technical evaluation and management in order to achieve their potentiality.

Mia Moja Irrigation Project is located in Mia Moja settlement scheme in Loldaiga Location near Timau township. It depends on a gravity channel inherited from an old decrepit fish farm whose intake is in the Teleswani river. Water is utilized for domestic purposes and irrigation of subsistence crops. It needs an improved design and management.

Mutaro Irrigation Project is in Gatarakwa settlement scheme in Central Division has its intake in Ngobit river. It is designed and manned by the Provincial Irrigation Unit of the Ministry of Agriculture. Water is utilized for growing vegetables and maize for market. The important problem is regulation of excessive intake.

Raya-Kiamariga Irrigation Project is located in Kiamariga settlement near Mutara Centre and depends on water from Mutara river. A proper intake has been constructed by the Provincial Irrigation Unit at Raya. Water is used for growing vegetables on a small scale. The main problems include crop damage by wild animals from the neighbouring ranches, pests, diseases and marketing.

Marura (Tigithi) irrigation scheme is located at the confluence of the Naromoru and Burguret rivers in Tigithi Location. It is based on swamp water and canal water from the Burguret river. Conventional subsistence food crops of maize, potatoes and vegetables are grown at small scale. The main problems are the nature of soils and drainage. Pesi irrigation scheme is located in the Kieni East settlement and is based on the Pesi river in Rumuruti Division. It lacks proper design and management.

Marura (Rumuruti) irrigation scheme is located on the Ewaso Narok swamp at Rumuruti and is based on canals taking water from the Ewaso Narok river on both right and left banks and on drainage of the swamp. An old government prison's farm on the left bank is a major producer of fruits in the scheme. Another large scale enterprise producing horticultural crops is situated on the right bank. A constellation of smallscale farms using canals to grow ordinary subsistence food crops has been established around the Ewaso Narok swamp. Murera Farm at Lamuria is a private large scale irrigation scheme using a motor pump to take water from the Ewaso Ngiro river onto an overhead system of application. A large number of horticultural crops are produced for market. This scheme is capital-intensive in character and the only successful one of its type in Laikipia District. Segera irrigation scheme was located on the Segera ranch downstream of De Barta's Bridge. The project did not take off though it was started at a large capital-intensive scale. In general the major constraints are water availability and specialist technical assistance for evaluation of soils, design and management. From the point of view of availability or adequacy of water for irrigation the state of current water supply problems particularly excessive abstractions of low flows, and the development potential of water resources particularly the need of storage facilities for high flows, have been discussed under water resources. The problem of specialist and technical assistance is caused by unavailability of trained staff at the local level. Special training in irrigation is required for TAs to be able to tackle irrigation-related problems. For practical reasons specialists at the district level cannot meet the local needs realistically.

Species	Principal Uses
1. Grevillea robusta	Windbreak,timber,fuel,shade
2. Pinus radiata	Windbreak,timber,fuel
3. Casuarina	Windbreak,timber
4. Cupressus lusitanica	Windbreak,timber
5. Croton megalocarpus	Windbreak,fuel,shade
6. Jacaranda ovalifolia	Windbreak,ornamental
7. Pepper tree	Windbreak shade
8. Hackia saligna	Windbreak, shade
9. Eucalyptus species	Timber,fuel
10. Wattle tree	Windbreak, fuel,shade
11. Prosopis	Fuel,fodder
12. Leucaena	Fuel,fodder

Table 4-21. List of agro-forestry trees frequent in Laikipia District.

Pasture-Tillage Coverage Ratio

Estimates of the proportions of the landscape covered by cultivation in different settlement schemes in Laikipia District were made from satellite imagery. The cultivated area was estimated to be 250 sq. km. (25000 Ha) forming about 2.5 per cent of the whole district. Unimproved and often overgrazed pasture covers approximately 88 per cent. Forest covers about 9 per cent. Within the various settlement schemes cultivation covers a relatively small proportion of the landscape.

Scheme	% Cultivation	% Pasture
Ethi	30	70
Mia Moja	40	60
Kalalu	40	60
Ngenia	60	40
Matanya	25	75
Niumiririe	70	30
Kinamba	60	30
Mwenje	60	30
Lariak	80	20
Muhotetu	30	70
Marmanet	60	40
Ol Moran	20	80
Igwamiti	80	20

Table 4-22. Pasture-tillage coverage ratio in different settlement schemes in Laikipia District.

Themeda triandra in various degrees of association with Pennisetum mezianum, Pennisetum stramineum and Hyparrhenia filipendula, forms the bulk of the pastures except in Mukogodo Division where, as mentioned earlier, Themeda triandra has been completely suppressed by overgrazing of cattle, sheep and goats leaving bare ground dominating and a low cover of Aristida adoensis, Aristida adscensionis, Eragrostis and clumps of Pennisetum mezianum and P. stramineum.

Classification of Crop Production Systems by Farmsize

Definitions of a smallscale farmer vary. According to the MoA Farm Management Office responsible for co-ordination of T&V in Laikipia (Gichohi, pers. comm.) there are different definitions depending on specific purpose and subject to undefined income generation capacity.

In general the office considered smallscale farming to include all operations of less the 15 acres; medium scale, 15-100 acres and large scale, over 100 acres. For farm judging purposes, smallscale is 0-20 Ha; medium scale 20-50 Ha; large scale above 50 Ha.
Significantly, the above definitions (which are used in current extension co-ordination) recognize the discrete variation between the smallscale farmer communities and the ranchers and pastoralists. However, it could not recognize the significant continuous variation within the smallscale farming community. Consequently, and the real danger was that all smallscale farmers were treated as one homogeneous group. The data from the reality studied showed that to regard farmers with 2 acres as being the same with farmers having 10 acres is a fallacy. Therefore the typology used for extension (T&V), and hence for current rural development planning, did not fit the variation of farming systems, particularly the practices which are found in reality as demonstrated and described above under cropping practices pertaining to Farm No.27 in Nturukuma, Farm No.19 in Kalalu, and Farm No.23 in

Kalalu. An alternative scheme of definitions which fits the reality in Laikipia is found in the Farm Management Handbook of Kenya (German Agricultural Team, 1979) drawn on a basis of the smallholder credit scheme data (Table 4-18). With minor adjustments to the definitions in the Farm Management Handbook of Kenya were adopted for classification of smallscale farmers in Laikipia as follows:-

category	Hectarage	Acreage
Small farm	0 - 1.6 Ha	0 - 3.5
Medium farm	1.6 - 2.4 Ha	3.5 - 6.0
Large farm	2.4 - 4.0 Ha	6.0 -<50.0

Table 4-23. Farmsize classification for smallscale farms in Lakipia. Source: Farm Management Handbook of Kenya, 1979.

By Management Objectives and Strategies

This refers to crop enterprises according to biological group (annual/biannual/perennial , scale and strategy of the enterprise (industrial commercial; domestic subsistence), plan or design, role of animals, mechanisation or manual, marketing strategy (co-operative, clearing house, etc), tourism enterprises, and the household economy strategies.

By Source of Water Supply

This is a basic criterion for arid and semi-arid lands where water is a first order constraint of production and it divides crop farmers of Laikipia into two main classes: rainfed systems and irrigated systems.

Training and Visiting (T&V) Extension Service

In the Ministry of Agriculture at the district level a small team of specialists (SMS) representing different sub-sectors or divisions, is provided to train and give backstop support to the frontline staff who interact directly with the farmers at farm and local levels. SMS are responsible for financial planning for innovations, irrigation and drainage, special projects, advice to Locational and Divisional DDC, sanctioning of interministerial jobs, and monthly workshops. It is clear from the above set-up that only through the input of SMS that realistic contribution and mobilisation of research output for agricultural extension and development may be envisaged. To become applied at any level within the district or to make impact, research must be accessible and appraisable by the SMS. The normal establishment of specialists consists of farm management, soil conservation, land development, crop production and home economics. Fig. 4-8 shows the organization and flow of information between the specialist (SMS) and a contact farmer in the T&V system in the Ministry of Agriculture at district level. As a whole T&V is a strategy for continuous diagnosis and consultation and feedback or bi-directional communication. At farm level (LEVEL I) the farmer may express a problem or consult an extension officer on any cause (budgeting and costing, seed, crop varieties, labour, poor yields, farm layout, etc). A TA or a supervisor at higher level may notice a problem that

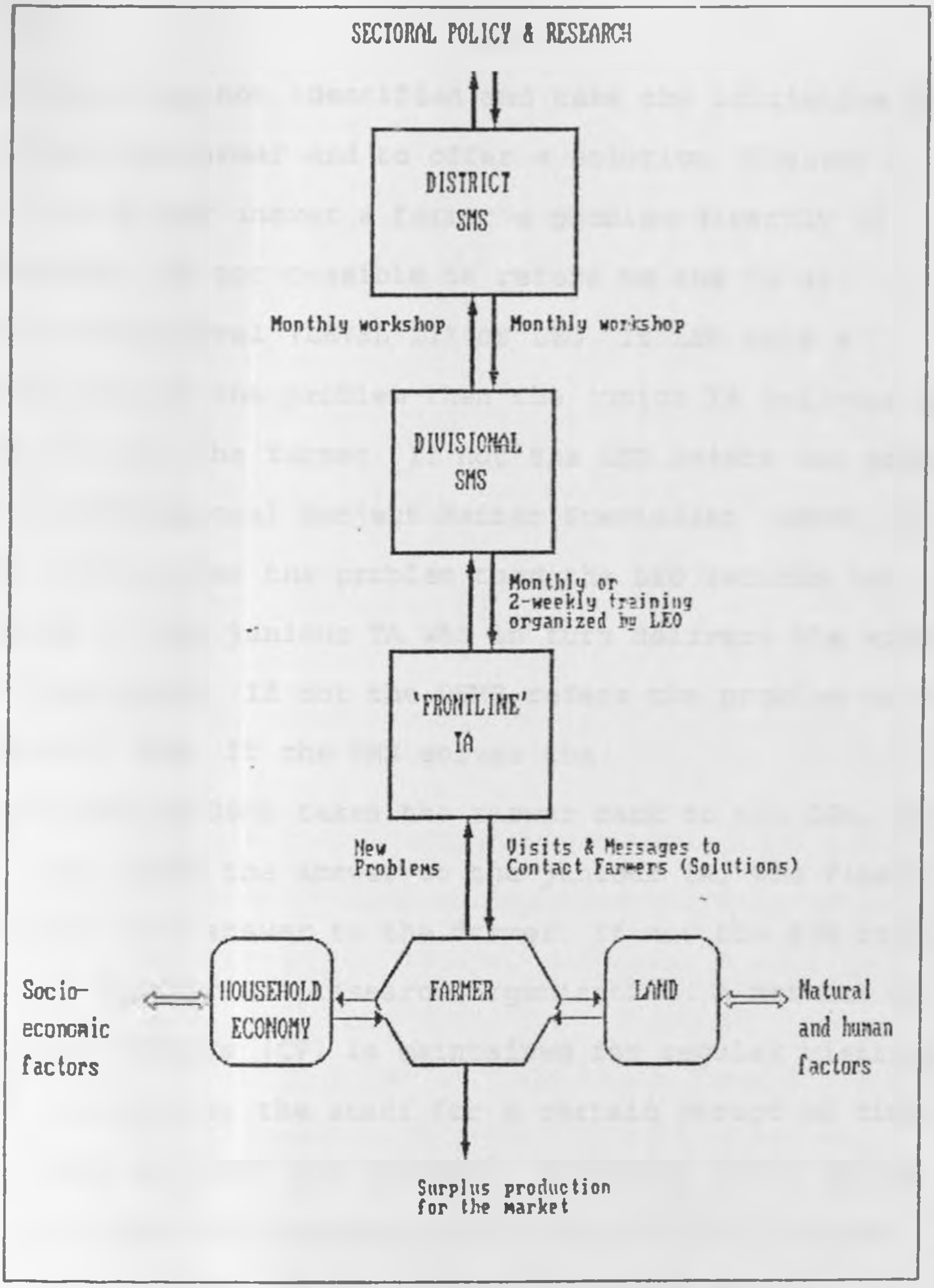

Fig. 4-8. Flow of information in Training and Visiting (T&V) extension services of Ministry of Agriculture. (Source: Taiti, own data)

a farmer has not identified and take the initiative to inform the farmer and to offer a solution. Thereby a junior TA may answer a farmer's problem directly if possible. If not possible he refers to the TA at Locational level (LEVEL II) or LEO. If LEO gets a solution for the problem then the junior TA delivers the solution to the farmer. If not the LEO refers the problem to the Divisional Subject Matter Specialist DSMS). If the DSMS solves the problem then the LEO returns the answer to the juniour TA who in turn delivers the answer to the farmer. If not the DSMS refers the problem to the district SMS. If the SMS solves the problem the DSMS takes the answer back to the LEO, who in turn takes the answer to the juniour TA, who finally delivers the answer to the farmer. If not the SMS refers to the appropriate research organization. A network of Contact Farmers (CF) is maintained for regular visiting and training by the staff for a certain period of time and then new ones are selected. Extension staff at the Location and Sub-Location levels are called Technical Assistants (TAs). A TA is highly regarded as an all-rounder, jack-of-all-trades. Indeed the success story of Kenya's small scale farming is attributed siginificantly to the role of the TA cadre or its barefoot equivalents of the past.

When the problem is of a general character then the answer is given to all TAs through the monthly Divisional

Training Seminar. Below the district level crop and livestock production are provided with a source of technical information in the form of a network of extension or frontline staff of the separate Ministries of Agriculture and Livestock Development, using the strategy of Training

Year	TAs	Total Farmers	CF	%	RATIO
1986	72	14,400	2,652	18	1:201
1987	55	14,400			1:263
1988	63	23,300			1:370
1989	60	23,300			1:388

Table 4-24. Staff-farmer ratio in agricultural extension service in Laikipia District.

and Visiting T&V). Field days or demonstrations are held for farmers together with extension staff when it is considered necessary to reinforce a message with tangible examples. Apparently the scope for trial and demonstration of many new methods exists, but sometimes farmers may get ahead of of the extension staff in acquiring knowledge, the main reason given in reports being the limits of finances. A major problem of introducing some potential cash crops in Laikipia District was reportedly faulty communication or the failure to channel information between promoters and farmers through the MoA for the necessary technical support.

<u>The Ox-Plough Project</u>

At the time of study the priority problem was

Message Transmitted	1986 (%)	1987 (%)	1988 (%)	1989 (%)
1. Spacing of maize plants	80	65	85	90
2. Fertilizer application, maize	85	-	55	85
3. Dusting in maize	35	-	25	40
4. Spacing in potatoes	70	65	90	95
5. Using certified seeds, maize	0	-	-	95
6. Early land preparation	-	-	-	-
7. Early planting, maize	-	-	-	85
8. Soil conservation measures	-	-	-	-
9. Farm layouts	-	-	-	-
10.Spacing intercropped beans	-	-	-	65

Table 4-25. Messages and rates of adoption by smallscale farmers in Laikipia District. Source: MoA.

mechanisation with special focus on the development of the Ox-Plough Mark II in response to problems involving private tractor hire contractors. The aim was to discourage use of tractors. An ox-plough project had been launched whereby ox-ploughs were provided on a lending basis to selected farmers in various areas on a criterion of acreage.

Constraints of Achieving Agricultrural Targets

Targets are set annually by projections of yields of the current year by a percentage but no objective basis for such increment has been defined. Maximization of current per capita and per hectare yields is the sole basis for realistic maximisation of targets. According to the DAO Laikipia the fallacy of fertilizer spoiling of soil was widespread because of lack of awareness that vigorously growing crops take up more nutrients. Together with the problems of unreliable weather and affordability, the problem of fertilizer use is magnified.

Marketing of Horticultural Crops

Technical and market information was a major problem in minor horticultural irrigation enterprises. A common problem encountered with horticultural enterprises in Mutaro, Kiamariga, Raya and other irrigation schemes was that dealers often induce farmers to grow crops but in the end dictate extremely low prices for them or fail altogether to collect products. The extension staff was advising them on the necessity of finding information as the highest priority, followed by formation of co-operatives and adoption of charcoal coolers and home processing of the surplus crop especially vegetable drying. In addition to messages the following projects were being carried out in 1990: gully control using gabions, vegetation or stones, etc; rehabilitation of overgrazed areas irrigation and drainage; 4-K Clubs Projects involving cockerel, rabbits; Young Farmers Clubs.

Diversification

According to District Agricultural Office (pers. comm.) attempts to assist farmers diversify with economic and drought resistant crops have not been successful. Cotton was tried in Matanya in 1982-1983 in vain. Sunflower, pyrethrum, pineapples and coffee have been tried in various localities with negligible results. Through political inducements, but against discouragement from MoA, farmers in west Laikipia have proceeded with growing of coffee and selling it in dried Buni form.

Problems Facing Extension Service

Normally the origins of messages transmitted in extension are not given. A matter of special interest in the T&V and extension work for agriculture in ASAL areas in general is the procedure and criteria by which problems eliciting technical responses are diagnosed and evaluated, considering the diversity of crop enterprises, multiplicity of activities, constraints and technical possibilities. For instance the issues may range from specifications for water conservation, irrigation designs, new crop varieties, fertilizer application, tillage, mechanisation, to pesticide control. One of the major weaknesses of T&V is in the modes of documentation and communication which are, to a large extent verbal or partly written and unsystematic. Elementary information can be difficult to use with different criteria or combination thereof. No definite procedure of evaluating new solutions with a view to approving them for public information or integration into normal extension practices exists. Pure discretion may determine the extension of an innovation. Another weakness is that no record or assessment of contact farmers' performance are made. Another major weakness in T&V practised by the staff is concentration of contact to limited well-to-do farmers at the expense of the others who may not be agreeable to the TAs.

Staff-Farmer Ratio

A major consideration for the effectiveness of extension service is the numerical T&V staff farmer ratio. Table 4-21 shows the staff-farmer ratio since 1985 when T&V started and when the population of farmers in Laikipia was estimated at 14,400 families (Ministry of Agriculture, unpublished).

Site Specificity of Messages

The other question concerns the source and quality of information that comprises the messages that are transmitted to farmers in respect of their problems and how customary perceptions and values or degrees of education influence decisions. Answers to these questions could not be obtained. It is difficult also to expect messages to be site specific without in situ experiments.

Adoption Rate of Technology by Farmers

A critical parameter of the efficacy of extension service is the rate of adoption of messages by farmers in their practices. To what extent do eating habits and other domestic or traditional practices the major constraints reducing the scope of adoption or thresholds limiting the rate of adoption? Table 4-22 presents rates of adoption of different T&V messages by smallscale farmers of Laikipia District in a sequence of years.

Wildlife

Figures of wild animals were obtained from the Livestock and Wildlife Data Summary 1987-1989 of the Department of Resource Survey and Remote Sensing (DRSRS, 1989). Both large and small wild animals ranging in size from the elephant to the dik dik are found in the Central and Mukogodo Divisions including a wide spectrum of plains game and colourful primates (especially baboons). Animals of special interest because of the numbers and interactions with livestock and people are elephants, common zebras, buffaloes, hyaenas, jackals and lions. Curiosities include the grevy zebra, the fringe-eared oryx and the hybrid hartebeest. The endangered black rhinoceros occurs in special protection areas in the ranches having private game reserves. These include the Ol Jogi, Solio, Ol Ari Nyiro and Ol Pejeta. The importance of wildlife in regard to livestock keeping lies in their large uncontrolled numbers and the negative impact these numbers have on the forage, thereby imposing a significant degree of competition for forage against livestock. In addition, large herds of migratory elephants which pass along the Ewaso Ngiro valley wreck havoc to fences and cultivated crops in the upper reaches of the river. According to knowledgeable old ranchers, each year the area of Chololo and Mpala ranches acts as the rendzevous of large herds of elephants coming from the northern direction of the Samburu National Reserve and its environs and hence the mass migration starts from there southwards. This forms what has been regarded as an annual crosscountry traverse of elephants starting with aggregation of herds in the area of the elbow of the Ewaso Ngiro river, then moving upstream and ending in disaggregation and dispersion of the herds into small groups in the Segera and Ngobit area. Other groups move westwards acrcss the Ewaso Narok river near Rumuruti to Laikipia West where they disperse in smaller groups. Attempts to drive out the elephants from the Ewaso Ngiro basin by force have been made in the past without any success. This migration of elephants from the drier northern areas is a seasonal adaptation, triggered by the onset of the rains in the southern and western parts of Laikipia District. Elephants are known to react positively to rainstorms over 50 km away. Enterprises combining livestock production and tourist-oriented wildlife management are on the increase in Laikipia. These ventures are normally based on large land holdings owned by individuals, companies or trustee agencies. A part of the land is normally set aside exclusively for wildlife and nature as a private game reserve or national park within the ranch. One such a reserve in one of the ranches consists of an area of 15,000 acres. The private parks and game reserves are usually enclosed by a strong fence including several strands of electrified wires to keep wild animals inside. The potential of these reserves and parks for conservation and tourism has not been assessed as an alternative economic land-use vis-a-vis commercial beef ranching. Private game reserves have, however, been established in several ranches in Central Division namely Solio, Ol Pejeta and Ol Jogi. They are managed privately by the owners receiving technical guidelines from the Kenya Wildlife Service. All the game reserves are surrounded with multiple strands of electrified wire fencing. Solio has attempted to construct an electric fence that could retain the migratory elephants but not to all time success. These game reserves contain a fair spectrum of plains game including giraffes, common zebra, grevy zebra, kongoni, Thompson's gazelle, warthogs, buffalo and ostrich. The game reserve in Ol Pejeta has at least one rhinoceros translocated from the Nairobi National Park. The vegetation in these reserves is mainly _Acacia_ bush with _Themeda_ and _Pennisetum_ grassland.

DISCUSSION

Information on Population-Resource Interactions

In this chapter information collected in the Laikipia District of Kenya about the population, resources, their interactions and change of land-use was manifested. Some overall trends and impacts of change in the district were observed. These included diversification, degradation of land through overgrazing and soil erosion, poverty characterised by landlessness, and famine. If decentralised planning at district level is going to be effective then this kind of information should be available and accessible.

Laikipia District has undergone an enormous transformation from an extremely low population and settlement density existing with nomadic pastoralism before 1911 to the present mixture of ranchers, semi-nomadic pastoralists and smallscale farmers. This includes diversification in the land-use. It took a period of 90 years in overall which includes the pre-colonial decade, five decades of colonial development and three decades of post-colonial re-adjustment. The overall change and growth has been from uniform traditional pastoralism followed by ranching systems to a wider spectrum including sedentarisation peasantship to high tourism. From uniformity in the ranching and pastoral systems, there is a wide spectrum of land-use between peasantship agricultural systems to tourism. Overall, there has been increasing complexity, diversity and growth from a "homogeneous plain" to heterogeneity and diversification. Laikipia has a rapidly diminishing man-land relationship. At the same time the dominant commercial ranching system is diminishing. These are characteristics of blighting and distress of the farming economy. At the other extreme of the land-use spectre are systems for touristic extravaganza in commercial ranches turned private wildlife reserves and running side by side with commercial ranching, pastoralism and peasantry. The land owners are the decision makers who control land-use in reality at the farm level. Heads of the households, usually husbands, make the strategic decisions of buying land, migration and the other major household undertakings. The cardinal determinant of smallscale farming systems is the farm size as much as technology is the cardinal determinant of largescale farming systems.

We find in Laikipia examples of obsolescence in form of environmental and socio-economic degradation of both the resource base and the human base. In this matter observation has been made of the situation of land-use and conditions of life in Mukogodo Division. As noted above this area was set aside in 1934 as a native reserve for Dorobos who roamed the European settlements in a destitute way after the eviction of the Purko Masai who had been their compatriots in a symbiotic co-existence. This area is suffering from extremely high pressure of overgrazing under semi-nomadic pastoralism, a growing population and socio-economic isolation. It is characterised by perpetual famine and stagnation. Destitute settlements of poor squatter communities have become an important feature in the rural spectre of Laikipia. An example of the destitute settlements that is the result of land-use changes in Laikipia is Likiji village located at the confluence of the Ewaso Ng'iro and the Nanyuki rivers. This village is a permanent boma which the villagers claimed was founded in 1927 by a squatter community laid off from employment in one of the ranches. It is one of the most desolate settlements in Laikipia in terms of accessibility and services. Until the time of study it was devoid of the basic services of water, health and school. The state of the physical environment and life in the settlement was the spectre of deprivation, hopelessness, poverty and squalor. Political will and action is required to transform such communities into healthy environments. On the contrary, such destitute villages are increasing with the expansion of spontaneous resettlement. Amidst the new small and old large farms there are clusters of spontaneous squatter settlements. In general sense these are slums, harbouring the households of the former labourers of the ranches who were rendered redundant from employment after the sale and subdivision of the commercial ranches. These settlements form centres of unemployment, destitution and despondency. Now these communities are eking their living mostly from casual employment and odd jobs among the migrant farmers, herding of sheep and goats and from sales of charcoal made from felling trees in forests and bushland in the vicinity. This makes forests in these areas extremely vulnerable to destruction especially in unclaimed and undefended plots. The irony of the current trend of land-use in Laikipia is how spontaneous re-settlement bordering on laisez faire has become the major basis of land reform for the 70 year-old colonial land tenure-land-use structure of a whole District within a rural development policy. This clearly reflects the failure of the present rural development planning process at district level to use basic information in planning. Despite recent drought and provision of famine relief in those settlement schemes and the older pastoral settlement of Mukogodo, the need for long term remedial prescriptions incorporated in the planning process does no appear to be forthcoming. In this context the role of the PIS in rural development planning becomes evident.

Subsistence stockmanship is the term given to livestock keeping activities that are geared mainly to supporting merely the subsistence of the households engaged in keeping them, mainly in milk. Although it tends to be invisible and tends to be taken for granted of un-determined it forms a distinct and major form of livestock enterprises in the area. The proportion of the farmers and pastoralists keeping cows or milk goats primarily for the purpose of supplying milk to their families and workers is higher than the commercial producers. Most of the small scale farms prefer dual purpose animals which can produce both milk and beef enabling the farmer to benefit from the two according to circumstances, a strategy which is commonly known as hedging. Although typical dual purposes breeds such as Sahiwal, Simmental and the German or Swiss Brown exist in the area, there seemed to be little information or attention on specific qualities amongst small farmers.

Distinct adaptive strategies were recognized among the practices of smallscale farmers according to the sizes of their farms. For convenience these strategies or different combinations of practices are here referred to as farming systems. Hence distinct farming systems were found among the smallscale farmers with sizes of their farms in categories of 2 acres or less, 2 to 5 acres; over 5 acres. The combinations of farming practices tended to relate strongly and may have significant implications for adoptation of technology by farmers. If it is recognized, the approach of target groups of farmers and farming systems from the criterion of farm size has further implications for application in rational land-use planning in the ASALs with regard to planning of allotment and development.

The distribution patterns of vegetation and surface attributes indicate the ecological potential of the district for human land-use as they do for the well adapted wildlife using these areas in large numbers as their habitats. These indicators offer more realistic and meaningful indicators for detailed planning at the district level than the concept of zones used for planning at national level. With the recent spontaneous peasantisation of the rangeland and pressure of land ownership, dramatic impacts of land-use changes are becoming apparent in the dense rural settlement where there is overgrazing and dependence on rainfed crop production. Equally dramatic is the loss of valuable vegetation types and species through deforestation, draining of swamps and overgrazing. The disappearance of valuable perennial rangeland grasses such *Themeda triandra* in Mukogodo which was noted earlier deserves a special mentioning again. This is likely to be the consequence of persistent overgrazing. The life cycle of *Themeda triandra* is sustained by burning regime and it could be killed easily in a management system which does no burning, especially in the ranches. *Themeda triandra* and *Pennisetum stramineum* are the most abundant rangeland grasses in Laikipia District outside the Mukogodo Division.

Uncertainty surrounds wildlife as a form of land-use in Laikipia District. This is partly because smallscale farmers hold wildlife in great spite for the losses accruing to them through the destruction of life, crops and other properties. Although wildlife is an indigenous land resource the land owners especially the smallscale farmers, lack access to it. This is because conservation and management are conducted through classic centralised legal approaches which are paternalistic rather than participative in respect to smallscale farmers. Local farmers may have to establish their own institutions of wildlife utilization for this form of land-use to have economic impact at the local or the farm level.

The obsolescence of land-use in Laikipia District proves the unsustainability and futility of paternalistic approaches and policies for land-use. Such was the 'exclusive white' policy that governed man-resource relationships in Laikipia in the earlier half of the twentieth century. The resultant unplanned, spontaneous resettlements and disregard of paternalistic rhetoric about land-use planning and long term benefits are typical populist responses of expressing political freedom from coersion and deprivation of access to land resources. A new role of planner has to be defined to allow dialogue and co-operation with the farmers as the new basis of decentralised rural development planning.

The use of remote sensing data facilitated rapid collection of ecological and socio-economic information including topography, vegetation mapping and rural settlement. Spot images used in combination with conventional aerial photographs proved to be effective for mapping of landscape. For vegetation mapping the coloured images were found to be unreliable for rangeland vegetation especially where reflectance from vertisolic soils obscured the reflectance of the grass or <u>Acacia</u> bush in the image. This means Spot may not be effective in detecting change and monitoring of short term impacts. Where resources may allow only one or the other, air photos are to be preferred for rural development planning. However, both ground truth and collateral sources of information are indispensable. Organizational variables such as law, policy, administrative regulations, etc often have dynamic effects on land-use and land cover that could need to be assessed and monitored from aerial photographs and satellite imagery. This is the case in Laikipia where organizational changes have been fundamental to most of the other observable changes. From this point of view remote sensing has tremendous potential for assessment of policy impact on rural development. General education and training on land-use for the masses seems to be another potent issue of rural development in which remote sensing could be used effectively. Governmental training provided in order to meet requirements of District Focus strategy should incorporate land-use as a major component. The fallacy of adapation or rural development planning in such a complex system without information became quite apparent from the diversity of issues involved. For instance there is a considerable variation and possible grouping of smallscale farmers according to farm size as shown above, yet the normal practice in rural planning is to treat smallscale farmers as one homogeneous group. Adaptation in the cropping calendar was demonstrated especially the low-but-sure yield of short rain maize strategy used in Kihato Settlement Scheme. By selective breeding an ideal animal for the ASAL has already been found for Laikipia in the form of the Boran beef cattle. In all these instances information relating to the specific objectives rather than trial and error, is necessary for productive adaptation and effective rural development planning.

Lack of information about land-use during the colonial period makes it extremely difficult to make temporal comparisons of the past and present land-use. Despite this fact an attempt was made to draw a comparison using the current diagnosis and the scanty information of the previous states of land-use (Fig. 4-4; Fig. 4-5; Fig. 4-6). The lack of documentation of past land-use was one of the reasons for the use of remote sensing as the latter offered prospect for future documentation and means for rapid appraisal land-use changes.

CHAPTER 6. DISTRICT CASE STUDY: CURRENT STATE OF UTILIZATION OF INFORMATION FOR PLANNING AT DISTRICT LEVEL

INTRODUCTION

The possibilities of understanding the rural reality in which developmental changes are being introduced by means of collecting and processing information were demonstrated in chapter 4. The information collected revealed that Laikipia District consists of semi-arid ecological conditions and land-use that are transitional and subject to drought and dynamic changes. These facts predispose rural livelihood especially rainfed agriculture to great risks and therefore peasant life is extremely precarious. The original land-use as based on extensive rangeland grazing first by semi-nomadic pastoralism and later by commercial ranching. Rainfed agriculture is new. Surface water is a limiting factor for most land-uses and in most of the area long distances are walked to get it. Land fragmentation into small plots and subsistence rainfed agriculture which are penetrating into zones of extreme aridity without advanced technology are exacerbating the problem. It was evident that the greater proportion of peasants and pastoralists are hardly able to produce enough food for subsistence of their families for the whole year. A phenomenon of seasonal hunger persists and the satisfaction of basic needs of food possesses the vast majority of the peasant and pastoral populations so much that they are trapped or arrested in it and struggling for survival. Off-farm incomes are sought for cash to pay for the burden of services of education for children, development of shelter and external obligations of rural infrastructure and manufactured goods. Often, however, there is lack of both marketable products and alternative employment. It was evident that peasants and pastoralists have adjusted to their perceptions of the normal rainfall seasons in their cropping calendar and migrations. In the mean time intensive cultivation and grazing have diminished the pastures and gulley erosion is playing havoc on soil resources in parts of the district. To the peasants, however, the ownership of land in itself is as valuable as life itself in that without land there is no respectability in the society.

Having reference to the socio-economic and ecological conditions described in chapter 4, this chapter describes the state of rural development planning at the district level with attention on utilization of relevant information. Here we are interested in the chain of explanation and decision-making that may allow scope of informed action at district level. We try to answer the following questions concerning decentralised rural development planning at the district level. (i) What is the present institutional structure of decentralised planning at the district level? (ii) What is the strategic point of planning and decision making processes where the consideration of information that was described in chapter four concerning the attributes of the land and the population is made? (iii) Who uses information? (iv) What kind of information is used or required in the planning process? How is the information used in the planning process? What are the sources of information? What tools of information are used?

DISTRICT FOCUS PLANNING SYSTEM

Decentralised rural development planning at district level in Kenya was institutionalised in 1983 through the District Focus for Rural Development policy (Republic of Kenya, 1984). The main purpose was to provide opportunity for governmental and non-governmental organizations, field staff and citizens to play a larger part in formulating programmes for the districts in which they work or live. Until that time a centralised system persisted in which practically all the prescriptions and administration of rural development planning and implementation were effected from the national headquarters in a top-down approach. With decentralisation taking effect the resonsibilities for planning, implementation, monitoring and control of rural development shifted from the top officials of government ministries in Nairobi to authorities established at the district level comprising of local representatives and officials of middle cadres. A policy paper on District Focus for Rural Development (the Blue Book, as it was popularly referred to in governmental circles) stated that the objective was "to broaden the base of rural development and encourage local initiatives that will complement the ministries' roles in order to improve problem identification, resource mobilization, and project implementation at the local level'. The Development Plan 1984-1988 (Republic of Kenya, 1983) stated that District Focus policy was based on the principle of complementarity between the ministries, representing a sectoral approach to development, and the districts respresenting spatial components where the sectors were joined in common for the support of rural development.

> Responsibility for the operational aspects of district-specific rural development projects is being delegated to the districts. Responsibility for broad policy, and the planning and implementation of multi-district and national programmes will remain with the ministries.

Belshaw and Chambers (1973) have said that the general attitude and belief held, and the way in which employees related to the work environment and how they are treated by their superiors under the centric ideology fitted perfectly well in McGregor's Theory X. According to theory X, the superiors generally believe that the staff are rather ignorant, incapable, untrustworthy and lazy unless they were forced to work. They have relatively little ambition, prefer to be directed and wish to avoid responsibility. Similarly, in centralised planning all initiative and control of rural development planning resided in the headquarters of various ministries at Nairobi. There was a great interest in the anticipated scenario of decentralised rural development planning at district level in comparison with the previous top-down system centres on the use of information as a tool for decision-making.

UTILIZATION OF INFORMATION

Although the District Focus policy provides for the use of district-specific information in a general way no adequate procedures of acquiring, analysing and applying such information are specified. It therefore appears that the entire idea of information was an afterthought that was appended to the policy in a cosmetic fashion subject to further elaboration by the client. Before we can design an information system for the sector we need to have a closer look at the structure and procedures of planning in the present day planning system at the district so as to identify clearly the subject, the users and required inputs.

Figure 5-1 shows District Focus for Rural Development Planning from a systems view point. The boxes are used to represent rural development processes, procedures, and controls of rural development planning at the district and sub-district levels. First, the rural development processes represented by the boxes with uneven shapes at the bottom include productive farming

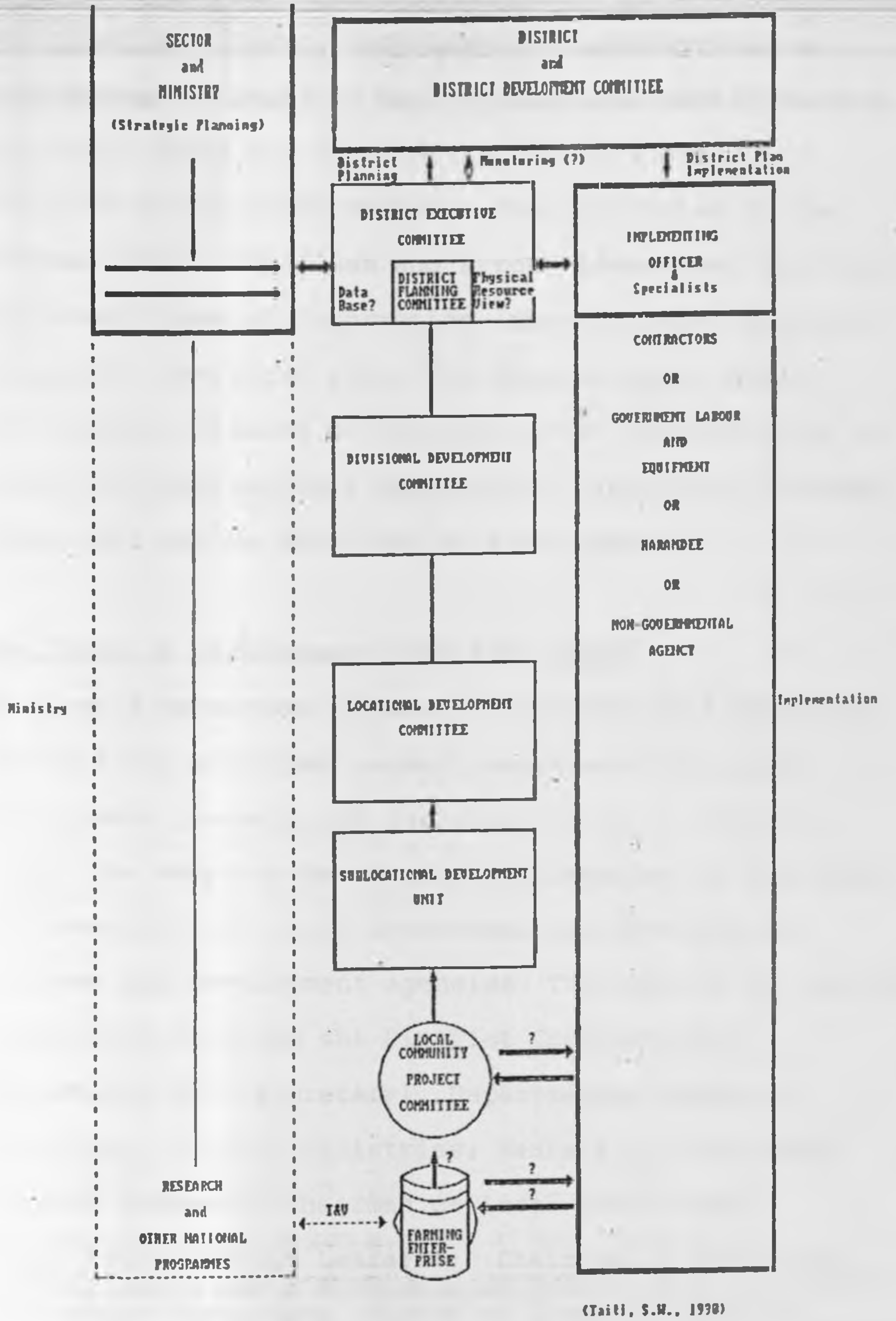

Fig. 5-1. Kenya's District Focus Strategy: the planning and decision-making system at district level.

and other activities, marketing and infrastructural development projects in both private and public sectors. The black boxes are the loci of controls or decision-making which regulate the activities in the process boxes. The lines and arrows connecting the boxes represent flows of information (instructions, requests, proposals, raw data, etc). The diagram shows rural development planning at district level as comprising of a number of institutional entities and procedural systems which will now be described at some detail.

The District Development Committee (DDC)

As already mentioned the District Development Committee (DDC) is the principal policy instrument for rural development planning and decision-making at district level. The composition of the DDC comprises of the local parliamentary and Local Government representatives, planners and development agencies. The members of the DDC in Laikipia included the District Commissioner (Chairman), DDO (Secretary), Departmental Heads of development related ministries; Members of Parliament (elected Leaders); Chairmen of Local Government Authorities (elected Leaders); Chairmen of Divisional Development Committees; Clerks of Local Authorities; Representatives of development related parastatals; Representatives of major development programmes. According to the Development Plan 1984-1988 (Republic of Kenya, 1983) the main responsibilities of the DDC are:

(a) to establish local development priorities ensuring they are set out in accordance with district specific needs

(b) to better integrate and co-ordinate the implementation of projects undertaken by various Government agencies, NGOs and self-help groups

(c) to monitor the technical work.

The composition of the DDC is supposed to encompass a wide spectrum of views on development needs of the district so that project proposals which are approved are expected to represent a strong mandate of local support. Within the district there is no defined limit of the jurisdiction of the DDC. In effect the DDC has become a key and relatively autonomous entity in the realms of rural development management and public decision-making at the district level.

The uses made of rural development information in the DDC may be enumerated in terms of the basic activities of rural development planning process. These are (i) diagnosing problems and identifying needs, (ii) prescribing solutions, (iii) policy making, (iv) programming, (v) implementation, (vi) evaluating of impacts and re-planning. The nature of the information that is normally used in the DDC is borne in the project proposals submitted by groups or individuals through the primary sub-committees at the grassroot level and passed upwards and those proposals from government ministries. Besides the project information other sources consist mainly of verbal communication and grey literature in form of leaflets and circulars. The DEVSIS study report found that grey literature and leaflets contributed 60 per cent of rural development information (IDRC, 1976).

District Executive Committee (DEC)

As noted earlier the District Executive Committee (DEC) is the highest sub-committee of the DDC and the composition of includes the following: District Commissioner (Chairman); DDO (Secretary); Departmental Heads at district level; Heads of governmental development programmes; District Officers. The latter are the Chairmen of the Divisional Development Committees. As a rule the DEC should be convened once a month to make recommendations in advance of meetings of the full DDC which are held quarterly. , However, in the actual practice and particularly during the period of this study (1989-1990), DEC meetings were held less regularly and less frequently, and in some years only once within a few days of the next DDC meeting.

The DEC is the technical planning and implementation organ in the district. It has the responsibility of vetting all project proposals forwarded to the DDC for decision-making from Sublocational and Locational sub-DDCs through the Divisional sub-DDCs. Thus the DEC is the forum and the stage of the planning process at district level at which any scientific and technical information or criteria pertaining to the feasibility of proposed projects could be applied. Theoretically the DEC is the authority that should ensure that all stages of the project cycle at district level from proposal writing to the final evaluation are perfect. The DEC also has mandate to ensure sound technical quality for projects by making necessary comments, recommendations or rejection. It was observed also that the character of DEC meetings, especially the degree of participation and debate, were seriously affected by the personal qualities of the DC as Chairman. Most of the DCs were oversensitive to critical views and gave hardly any stimulus to discussion of issues. It is obviously notable that members are largely officers of the central government. This has fundamental implications in regard to principles of decentralisation and participatory planning. It is decentralisation and participation for government staff.

District Planing Unit

The District Planning Unit (DPU) is a small sub-committee of the DEC wich is headed by the DDO. Its main functions are to assist the DEC in drafting and liaison for planning and implementation.

Sub-District Development Committees

There are development committees subordinate to the DDC at all administrative levels below the district level namely division, location and sub-location levels. These sub-DDCs (as they are referred to usually) are presided over by the respective administrative officer.

Monitoring and Evaluation Functions

This function of the District Development Committee lacks specifications of methodology and responsibility for its execution. Fig. 5-1 represents monitoring and evaluation as a two-headed arrow or process which does not proceed very far from the DDC box. In fact it stops at the box labelled DEC, meaning the practice is undefined. For the lack of clarity in the nature and procedure of this function at the district level a question mark is placed next to the arrow. Sometimes it is suggested that monitoring and control is the role of the District Development Planning office equivalent to the project implementation for other ministries and in which the planning office itself has not got direct involvement. However, monitoring and evaluation are provided for at the provincial level. The Provincial Monitoring and Evaluation Committee comprises of the Provincial Commisioner and all provincial heads of departments. Like the noted case of the DEC, its operations and effectiveness is subject to the character and temperament of its Chairman (ie. the PC) and the

Provincial Planning Officer who is the honorary secretary.

<u>District Information and Documentation Centre</u>

After decentralisation of planning to the district level, it was felt that decentralisation of information was necessary. Consequently a District Information and Documentation Centre (DIDC) was specified as a project of the District Development Committee (Republic of Kenya, 1986). The main purpose of the DIDC is to provide a general resource and reference centre of development information in the district to help operations of the DDC and to reduce dependency on Nairobi. The DIDC is the responsibility of the DDC and directly under the District Commissioner and the District Development Officer. It has been clarified that the DIDC shall not be a general library.

Target users of the DIDC have been defined as the development planning community including the committees, government officers and DDC memebers. Guidelines have been provided for establishment of standard housing, furniture and other physical facilities of the DIDC. Staff to man the DIDC has been appointed and trained through a 3 weeks orientation training and one year of library assistant course. Documents to be stocked in the DIDC will include unclassified documents and reports, published and circulated documents, district statistics, maps, atlases, district and national plans, research reports, technical reference materials for sectors, bulletin boards, audio visual aids. A priority theme specified from the national level of planning is population planning and policy implementation at district level. Information flow from the DIDC to the planning process was left to the initiatives of the District Planning Unit (DPU), a sub-committee of the DEC comprised of the DDO, Statistical Officer and District Programme Officer. The principal source of information supply and technical support services to the DIDC is the Clearing House in the Rural Services Co-ordination and Training Section (RSCTS of the Rural Planning Department in Nairobi.

Financial Resources for Rural Development Planning

The following were the principal financial resources of the district: (i) Ministry funds for district-specific projects, (ii Rural Development Fund (RDF , (iii) European Economic Community (EEC) Micro-Projects, (iv) Special donor-supported programmes, (v) Local authority and town council resources, (vi) Multi-district ministerial programmes, (vii) Local self-help, and other potential resources. In the case of Laikipia District nearly all the categories of resources were available. The ministerial funds for district-specific projects were the principal financial resources for development in the district. These funds were allocated by the individual ministries for projects approved by the DDC and that fell within the prescribed ministerial guidelines and ceilings. The RDF and the EEC Micro-Projects programmes were funds given as development assistance from foreign donors and formed the second most important source of funding for district-specific projects. The category of Special Programmes included various bilateral co-operation and technical asstistance programmes. The Laikipia Rural Development Programme (LRDP) was a bilateral technical assistance programme supported by the Swiss Development Corporation.

PLANNING PROCESS AT DISTRICT LEVEL

By design and objective, planning at district level has been divided into four sets of responsibilities and planning activities. These are (a) co-ordination of planning and implementation by the district administration, (b) sectoral policy and budgeting by government ministries, (c) citizen participation in the subordinate development committees (sub-DDCs), and (d) monitoring and evaluation. Accordingly and in practice the District commissioner executes the co-ordination function while the heads of ministerial departments concentrate on budgets and programmes of their respective departments. Elected representatives contribute on behalf of the community.

District Responsibilities of Co-ordination

The district, through its District Development Committee (DDC) with the District Commissioner as the Chief Executive Officer for rural development activities in the district, is responsible for: (a) co-ordination of rural development planning, (b) management/allocation of development resources, (c) project implementation, (d) overseeing local procurement of goods and services. The planning and co-ordination responsibility covers short term as well long-range planning, involving identification of local development needs and establishment of priorities as the basis of preparing District Development Plans. The age-old problem where District Development Plans tended to be unconstrained shopping lists of all the projects wanted in the district has been identified and emphasis given on financially feasible priorities that can be funded with the available resources. For integration of implementation a co-ordinated work programme and schedule of project activities is prescribed particularly for projects requiring inter-departmental co-operation. The responsibility of co-ordination is specified as the planning of district-specific rural development; o-ordination of plans among relevant bodies particularly ministries, covering Government projects as well as projects initiated by local authorities or those of self-help (Harambee) efforts.

Financial Management in Project Implementation

The challenge of utilizing funds in a manner that maximizes the benefit to district residents is pointed out with regard to funds that may be available for development activities. The district has thus become an important unit of accountability for financial resource management as a consequence of becoming an operational centre for rural development. This responsibility involves co-ordination of sources of project finance both governmental and non-governmental which may be available in the district. Various methods of handling input for implementation are specified according to the nature of complexity of project jobs: government labour and machinery in ministries; under contract with private enterprise (contractors); Harambee efforts; co-operation with provincial offices of ministries. Efficient use of labour and equipment for implementation is emphasized. The District Tender Board is the authority for local procurement. In the shift of authority from national headquarters to the districts, flexibility is allowed in procedures for obtaining supplies and services for DF and emphasis placed on managers (or AIE holders of ministries) procuring inputs for district-specific projects locally.

Ministrial Responsibilities in District Focus

The responsibilities of ministries are complementary to district responsibilities. They include: (a) sectoral policy and strategic planning, (b) district-responsive budgeting, (c) technical support for district development, (d) adapting accounting procedures to the District Focus procedures. Ministries are responsible for formulating and directing national policy for sectors, the chief avenues of doing so being the national development plan and policy discussion papers. Ministries are responsible of strategic planning as well as of the management of multi-district and national programmes. However, such multi-district and national programmes particularly the selection of project sites, must be guided by district priorities and integrated in district monitoring or other project implementation responsibilities. Ministries are also responsible for forward budgeting and annual estimates of their expenditure the main requirement being that each ministry disaggregates the budget on a district-by-district basis so that each DDC can anticipate the resources available for district-specific activities or multi-district projects that may have local impact for co-ordination purposes.

Technical Authority of District Development Planning

Ministries will be expected to strengthen the professional capabilities of their district staff by training and redeployment of senior technical staff from the national and the provincial headquarters to the district level. The provincial staff are equipped to provide specialised technical assistance to the districts making larger the pool of professional skills for local planning. While the ministries remain responsible for the resources and for full control, procedures have been made to ensure that transactions can be efficiently serviced in the district by the District Treasury. In particular the Pay Master General can debit the appropriate ministerial budget allocation and pay the District Treasury directly thereby saving the new system from cumbersome routing procedures for payment vouchers that existed in the past.

Participation of Local Citizens

A provision for local communities to make their preferences or aspirations known in decision-making on matters that affect their environment or lives is one of the soundest arguments for the District Focus policy. In practice the procedure for taking local wishes and local knowledge into account and for securing local commitment to a rural development project consists of dialogue in meetings of development committees at sublocation level. Proposals and recommendations generated at the grassroot level are vetted successively by the sub-DDCs at the Locational and the Divisional levels before they can reach the DEC and finally submitted to the District Development Commitee for decision. District Focus provides for participation by both government field staff in the particular locality and representatives of the local people. Experience in Laikipia showed that there are technical difficulties in local participation with regard to identification of projects and formulation of programmes. In order to enhance the quality of local participation there is need to address the technicalities with a view to identifying solutions and formulation of standards for the purpose of acquiring the necessary information in planning the project.

Formulation and Budgeting of Plans

(a) DDC Agendas

Agendas of the District Development Committee (DDC) and the District Executive Committee (DEC), in form of proposals from local development committees, ministries or departments of the government, are tabled for discussion by the Secretary who is the District Development Officer (DDO). The nature, content and range of agendas varies from meeting to meeting and from one item of the agenda to another. For instance the draft district development plan appeared as one item of the agenda. Proposals originating from the grassroot development committees at the Sublocation and Location levels, after approval by respective Divisional Sub-DDCs, together with proposals from the ministries and local government authorities, converge at the DEC for vetting. If they are approved and recommended by the DEC the proposals reach the final stage of the decision of the DDC.

As noted above the DEC is the forum in which the planning process can exercise rigorous criteria to evaluate proposals and plans and to influence policy decisions in regard of use of objective information for ecological suitability, socio-economic relevance and technical or financial feasibility. It is in the DEC more than in any other stage of district focus that application of technical or expert information is implied and expected. We shall see below whether the appropriate quantitative or qualitative information is used in decision-making at these levels. Recommendations of the sub-DDCs are passed upwards in the hierarchy finally reaching the DEC through the District Officers who are members of both the DEC and the DDC by virtue of being the Chairmen of Divisional Development Committees.

Debate in the DDC

The frequency of meetings follows directives which are set out in the Blue Book according to which the DDC should hold four ordinary meetings in a year at regular intervals of three months. Early in the year the Chairman and the Secretary draw the yearly schedule of meetings of the DDC and the DEC after which the Secretary informs the members through written notices which are sent directly to the individuals concerned. As each of the dates draws near (about two weeks before the day) a notice of the meeting, this time indicating the agenda of the meeting, is sent to the members. Table 5-1 shows the typical items comprising the agenda of an ordinary meeting of the DDC in Laikipia District. The DC presides over the deliberations of DDC meetings. This is an obligatory personal role without deputisation. In the chamber he is franked by distinguished members of the community namely local Members of Parliament, the Mayor of the local Municipality and the Chairman of the County Council. However, none of the latter may act as Chairman in

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1. Chairman's introductory address;
2. Review of on-going progress and confirmation of minutes of the previous meeting;
3. Consider new proposals submitted by Divisional Development Committees;
4. Establish priorities for future projects;
5. Examine and endorse the district's annual submission of project proposals to the ministries.
6. AOB

Table 5-2. A typical list of agendas of DDC meetings. Source: DC Laikipia.

the absence of the DC. The District Development Officer is the Secretary of the DDC, assisting the DC in introducing the agendas and recording minutes of the deliberations and decisions. Besides he is responsible for giving technical guidance to the DDC on matters of procedure regarding budgeting and disbursement of development finances especially the Rural Development Fund. Normally the matters tabled in the DDC, whether originating from sub-committees at the grassroot level, Government Ministries or individuals have passed through the preceding DEC meeting whose members are also members of the DDC. Therefore few critical comments on such matters tend to arise at the DDC meeting and the few that may arise come from mainly the relatively few representatives of public and policy makers.

DISTRICT DEVELOPMENT PLAN 1989-93

Introduction

The District Development Plan (DDP) is a document compiled every five years in conformity with the national development plan period, stating in general outline the strategies and priorities for implemetation in the district during the plan period. Guidelines in the form of instructions and deadlines for the writing of the five year plan are given from the Ministry of Planning and National Development in Nairobi to the districts through the DDO. The DDO distributes the guidelines to the Departmental heads of all ministries represented at district level, together with a request to write and submit chapters of the DDP for their respective sectors. Finally the DDP is assembled by the District Development Officer (DDO) from proposals submitted by the individual ministries and departments. The DDP consists of three main sections: (a) background information about the district (b) development strategy (c) policy orientations and priorities of major sectors.

After its preparation by the DDO the DDP is tabled for debate in the DEC first, and in the DDC finally. When it is approved by the DDC the DDP is forwarded to the Ministry of Planning and National Development for printing. Hence it is an authoritative document for purposes of further planning and implementation.

Priorities of the DDP

The following were the priorities of the DDP 1989-93: (a) Improving production and natural resources utilization; (b) Improve and extend basic infrastructure; (c) Improvement of social services; (d) Institutional Support System.

(a) Improving Production and Natural Resources Utilization

Under this head it was intended to increase food production to meet the needs of the rising population. All arable land would be brought to cultivation and land already under cultivation would be brought to improved management. The labour force in the district would be educated more on the need to utilize resources at hand more efficiently to better themselves through improved capacity to earn more for meeting their basic necessities such as clothing, school fees and better nutritional habits.

(b) Improving and Extending Basic Infrastructure.

The aim was "To facilitate improved production".

(c) Improvement of social services

(d) Institutional Support System

The strategy to be followed will lead to complete decentralisation. The ministries that had not decentralised or had only partially done so will be required to make haste by sending their staff to the district to facilitate co-ordination and thus to rende the district Focus strategy a success. Local authorities will be required to devise ways to improve their finances in order to be able to finance the many projects they have planned to implement during the plan period. From the foregoing outline of the objectives and priorities of the current DDP it requires no elaboration to see the importance of information about land-use monitoring to assist the formulation of a sound District Development Plan. However, no indication of the provision for collection of data or feedback for future planning and implementation is made in the plan. Table 5-3 gives a list of the items of agenda of a typical DDC meeting with an indication of the nature of information that could be rquired.

Item	Data Required (M/NM)
Introduction by Chairman	NM
Selection of RDF projects	M
Selection of Minor Roads Programme	M
Progress reports	M + NM
Settlement roads	M
Project monitoring	NM
Construction of DIDC	NM
Procurement of materials	NM
Application for a private medical clinic	NM
Projects for phase III of LRDP	NM
Assistance to Youth Polytechnics	NM
Maintenance of access roads	NM
Preparation of the District Forest Master Plan	M
District Development Plan	M + NM
Forward budgeting	M
Project implementation	NM

Table 5-3. List of items of business in a typical DDC/DEC meeting.

A REVIEW OF SOME DDC PROJECTS

Projects passed by the DDC can be analysed with particular attention in the nature of criteria used for reaching decision and the relevance or potential application of quantitative information or measurable data for identification, evaluation and approval of projects passing through the DDC. The following scheme of variables are used: 01 originator, 02 objective, 03 beneficiary, 04 financier, 05 land resource, 06 land-use impact, 07 main criteria, 08 passed/impassed, 09 +/-formal proposal. Tables 5-4 and 5-5 present qualitative parameters of some projects and decisions which were passed by the DDC in year 1990.

Project 1: County Toll Station on Nyeri-Nyahururu Highway.

A toll station was proposed by the Laikipia County Council at a specified location on the Highway between Nyeri and Nyahururu. The proposal was anounced and approved at one seating of the DDC without a formally written proposal. No quantitative data were presented or demanded for its justification or suitability of its location. There were no comments or objections. According to the above scheme this project could be analysed in the following way.

Project 2: Likii Fish Project

The Likii Fish Project was proposed by a self-he^lp group in Likii Village within Nanyuki Municipality. The production of fish for sale would benefit the self-help group. There was no data about the technical feasibility of fish farming. Financial support was granted by a donor

01	Originator	County Council
02	objective	revenue
03	beneficiary	County Council
04	financier	County Council
05	land resource	infrastructure
06	land-use impact	tax/cost
07	main criterion	none
08	passed/impassed	passed
09	+/- formal proposal	formal proposal
10	project serial number	none

Table 5-4 Some qualitative parameters of a successful project passed by the DDC.

agency and the Nanyuki Municipal Council had allotted a suitable site to the group. It was approved by the DDC.

01	originator	Community
02	objective	income
03	beneficiary	community
04	financier	donor agency
05	land resource	water
06	land-use impact	income (+ve)
07	main criterion	land available
08	passed/impassed	passed
09	+/-formal proposal	none
10	project serial number	none

Table 5-5 Some qualitative parameters of an unsuccessful project passed by DDC.

The project could not be implemented within 12 months after approval or even two years after funds were made available because of a dispute over the ownership of the site land. The DDC urged for rapid processing of the solution.

Nature of Information and Criteria Used

Rural development in Laikipia is hampered by two major factors: first, deficit of food and other basic needs for the population settling in marginal areas. Secondly, lack of viable designs and decisions for technological innovations in water conservation and development and especially for smallscale irrigation. For responses to proposals for rural developoment assistance the Laikipia Rural Development Programme adopted the criterion of *felt needs* of the poorer communities in the district. These were communities of the smallscale farmers, pastoralists and urban poor. Assistance was also given to community self-help development projects in water supplies, informal industrial sector, communications, smallstock and on-farm crop trials.

Debate, Consensus and Decisions in DDC

What is the depth of debate and what factors influence decisions in the DDC? Decisions about development projects in DDC meetings were based on consensus and general acclamation. This was possible with little debate about technical or scientific attributes of proposals and plans. Unless one or one's field was specifically mentioned every officer tended to remain quiet. Several implications could be derived from this passive conduct of public planners at district level. First, there is fear and lack of experience, unpreparedness and lack of information seemed to play a part. Unpreparedness means that participants who were otherwise capable of proper or qualified for planning and decision-making business might simply not make full use of their potential contribution to the decisions if they attended the forum without adequate awareness or prior preparations to deal with the issues. They could also lack information about the situation. For fear, transactions might be stifled by avoidance of critical or constructive contribution to the debate, indicating restraint from free and honest expression of opinion for fear of real or imagined forms of repercursion from the Chairman or other quarters in the system. Hence a departmental officer might prefer to keep a low profile as long as the Chairman is the DC who is also the district boss. An inexperienced delegate might prefer to remain quiet or as discrete observers.

DISCUSSION

Except in the sense of land ownership District Focus planning lacks a physical resources perspective to planning so much that in fact it has a total blackout of the ecological thought of resource planning and spatial integration. The information pyramid in the hierarchy is very short and ecological information is excluded from the upward flow before reaching the apex, mostly being left at the bottom. There is a logistical sense of co-ordination and inter-departmental co-operation achieved through joint annual work-plan schedules of project implementation activities. However, integration of ecological and socio-economic factors in decision-making is not a major concern. Following of the popular short term goals totally and neglecting long term perspective precludes ability to predict or anticipate temporal changes that may lead a district to disintegration and crisis of basic needs of the population without anyone sounding warning.

Currently rural development planning at the district level concentrates on plan formulation and budgeting for projects with hardly any concern for rigorous use of information to improve quality of decisions. Consequently there is danger that the normal on-going operational programmes will be ignored. Belshaw and Chambers (1973) used the analogy of "the tip of the iceberg" for the large projects in comparison with the neglected, less visible field programmes. While planning concentrates on formulation, budgeting and implementation of projects, monitoring, evaluation and review of these activities are neglected. Monitoring and evaluation should provide a feedback of impacts and lessons learnt.

From the point of view of field staff management, planning at the district level lacks incentives and encouragement commensurate with the level of performance required of such relatively isolated professional staff. Earlier in this chapter the centric ideology which holds that initiative, discretion and control reside in the capital city was criticised for implying that field staff were untrustworthy, ignorant and lazy. As can be seen in Fig. 5-1 the procedural cycle of planning and development management at district level consists of a single feedback loop through the District Commissioner. This indicates that decentralisation has resulted in overcentralisation of control in the office of the District Commissioner and in effect one ministry of provincial administration. One advantage of this structure is that ccasionally problems which are less explicitly defined in terms of sectoral responsibilities are likely to be addressed through the local or administrative initiatives of representatives. However, such initiatives often kindle political fireworks and many DCs would not venture without specific authority.

On the whole the organizational structure of planning at the district level (Fig.5-1) barely qualifies to be called a system in the strictest sense of the word since it lacks a complete feedback loop between the district and the grassroot levels. Except for supervision of project implementation there is no provision for downflow of information from the DDC to the population. On the other hand, the flow and feedback of information continues to go between the staff at the grassroots and the ministerial headquarters but not to the district. A lot of information which flows into and through ministry systems in form of non-measurable data and information by means of person-to-person or telephone conversation that contributes significantly to decision-making. In comparison to Districts, the Ministerial or sectoral databases are fairly advanced in the sense that research materials, reports etc relevant to the functions of the ministry end up in the ministerial headquarters. Many of the transactions and events that produce data that mirrors the district, the staff that collect data and many of the data blocks which exist in the district are normally also in the hands of ministries. Some kind of report with a mixture of measurable and non-measurable data goes to top management in each ministry regularly in the form of monthly or annual reports. Since District Focus strategy has shifted the responsibility for planning and implementation at the district level from ministries the latter have considerable reserve of technical capacities. These reserves could be deployed in planning to produce data models for development planning. In reality this is not the case and in fact the district data base gets little of the expected potential contribution of sectoral information from the ministeries.

At the national level the general objectives of District Focus strategy are clear as stated in the Development Plan 1984-1988 (Republic of Kenya, 1983). At the district level, however, the statement of objectives in the District Development Plan (DDP) gives only vague ideals that do not qualify as objectives based on district-specific knowledge. It might be asked therefore: What kind of data does the DEC/DDC use? Or for what purposes is information used in the DEC/DDC? What is the framework for Project analysis in the DEC by which anti-priorities can be distinguished from priorities? What are the provisions for decision concerning the poor squatters and indigenous Dorobo-Masai in the total transformation phenomenon? First ,budgeting and accounting are the principal activities in which quantitative data is used in the DF. Emphasis had been laid on adapting new accounting procedures so that the District Treasury could service ministries efficiently and to avert problems of prodigous routing of payment vouchers and delays of payment that hampered transactions with local suppliers of goods and services.

Kenya's District Focus does not have provision for rural research or systematic database to support project analysis, implementation, monitoring, evaluation or review. This situation is counter to the responsibilities of the DEC which requires area-specific information for analysis, design and control of projects. District Focus provides for District Information and Documentation Centres (DIDC). The limitation of the DIDC is that information is provided from Nairobi and there is no guarantee for district-specific information. The original proposal and guidelines for the development of District Information and Documentation Centres (DIDC) were incomplete lacking any framework for the structure of information for planning. Provisions for prior public awareness creation and education are missing. Thus migrant farmers in the remote arid and semi-arid areas have no access to public information. District land-use planning is missing. Effective use of the DIDC will depend on finding an appropriate database structure and tools for transfer of information. The success and future of planning at district level will critically depend on the information sector especially the breakthrough in the formulation of user-friendly tools and outreach. The planning information system described in the next section is one attempt in that direction.

PART III

MODELLING

Overview

Parts I and II of the thesis have described and demonstrated through the district case study that information required for rural development planning at district level concerns population-resource interactions or simply land-use systems. Methods of gathering and updating the information were described in Part II. In the current state of operations of Kenya's District Focus strategy the DEC and DDC fail to utilize information because of structural and management bottlenecks which as civil servants they cannot break through.

Part III is devoted to the construction of a model of a tool for enhancing utilization of information in planning at district level using a conceptual approach and entry point of land-use systems. We are aiming at a tool that could help decision-makers at district level to be more free to utilize available knowledge and to minimize the constraint of policy and administrative bottlenecks.

Meanwhile for the case study district of Laikipia in Kenya a lot of new scientific information which did not exist before the study was produced in the process.

CHAPTER 7. DESIGNING THE DISTRICT PLANNING INFORMATION SYSTEM (PIS) MODEL

A MANAGEMENT SYSTEMS APPROACH TO DISTRICT PLANNING

The starting point of designing an information system for rural development planning at district level is to use the available background knowledge of the reality to establish answers to certain basic questions. First what are the objectives of planning at district level? What do the people in the district do for livelihood? What information is needed for planning and practical decisions at grassroot level? Where is the information obtained? Is the information complete, timely valid and readily available for utilization? Is there demand for the information? At what cost is the information available? What constraints hinder the development of an information centre? An attempt is made to answer these questions as they relate to planning at district level in Kenya with reference to Laikipia District.

It was mentioned earlier that the scope of planning at the district level is not intended to be limited to clerical or deterministic routine procedures but includes strategic policy decisions as well. The main constraint of using information for rural development planning lies in theory construction or formulation of adequate concepts. Once such a concepts are found theory still remains the technical heart of planning as well as the foundation on which the body of procedures and tools of monitoring, dynamic analysis and control could be constructed to form the planning information system. As a preliminary consideration we should explain what a theory is and why valid theory is a prerequisite for public planning and policy decisions.

ASSUMPTIONS

In designing the model of a planning information system for planning at district level several significant preliminary considerations and assumptions should be stated as fundamental reference points. Some of these assumptions come directly from the the district case study findings and understanding of the general structure and function of rural development planning at district level. They are identified also with certain theoretically desirable qualities of planning at district level or missing principles in the current situation. We would finally be demonstrating how the PIS model based on land-use will help to achieve the need in comparison to how other known models for decentralised planning have performed.

First, it is assumed that the Geddesian principle which emphasizes diagnosis before treatment and understanding before action (McLoughlin, 1969) is the valid theoretical basis of planning at the district level. Under this assumption the PIS model is a general tool of management that may not necessarily provide for explanation of causal relationships between specific variables or for prediction of specific events of land-use. The basis on, and purpose for which information is needed is to understand what are strategic causes of changes in the land-use systems and what adjustments or controls are possible in different systems. In that view PIS will be a tool for explaining the overall behaviour of rural development in terms of land-use systems in the district or separate or local land-use types as components or sub-components of the whole district. Various ways of using information for intervention towards adjustment or renewal can be anticipated including monitoring, prediction and foreword warning about possible future states of certain land-use systems. Many tests and questions could be made in the form of: "If .... certain stated conditions prevailed, then ...".

An important primary assumption is that the model of information currently in use is that of the District Information and Documentation Centre (DIDC) which is in essence a simple library model. A major weakness of the DIDC concept is that it is static, having no provision for dynamic perspective of application, procedures or sources and updating of information. A significant provision was the socio-cultural profile but it is just a study to describe cultural backgrounds hence a static view of people with no perspective or provision for the applied spatial, procedural dynamics relating to current changes and planning functions. The information produced in socio-cultural profile would be required for the PIS. The concept and form of the District Information and Documentation Centre (DIDC) is still at an undeveloped and infantile stage where it is seen and used as a conventional library. From the foregoing we can start to see the need for the planning information systems as the tool to be used for demanding that certain information and criteria be taken into account in planning and decision-making. To some degree and without assuming a cybernetic outlook, with a PIS and clear objectives we should be able to relate the past changes to the possible future conditions and to control and shape that future accordingly. With reference to the objectives stated in chapter two what is lacking in order to formulate a model of information system for the DIDC is an organizational concept of the district management to help understand the realities and identify the key issues to guide, predict and anticipate the future. Given an integrative concept of the rural structure and interactions between population and resources for planning rather than the existing emphasis on planning for subdistrict administrative units planning at district level is likely to become more effective. With the subdistrict administative hierarchy in place now the role and participation of the people at grassroot levelis pre-empted by the institution of administrators whose commitments are not with the resources and the people below them. Their real concern is more with relationships in their administrative duties and loyalty to those above them than with understanding of the people-resource interactions.

Another assumption is the need for participation, consensus and control at levels of planning and decision-making at district level. Consensus means the acceptance for authentic participation of the local people in decision-making in matters affecting them. Genuine consensus involving local communities and planners means that planners use information to give necessary guidance about implications wrong decisions. Thus control means action based on expert knowledge or technical information on a dynamic situation. This should not imply the use of a cybernetic approach, but rather emphasize the need for civil servants to veto decisions that might have drastic consequences.

By adopting the gestalte land-use systems approach planning at district level adopts an integrated approach which emphasizes whole units and continuity in the sense of ensuring good qualities run through the entire land-use system or project cycle. This also means that policy sensitive issues of land-use management require to be identified and incorporated in further development of the PIS model.

Maps are one of the most convenient and effective forms of documentation and presentation of spatial ecological and socio-economic information. Planning at district level could make maps a tool for documentation, presentation, comparative analysis and integration.

Concerning sustainability of rural change the application of the ecological concept of energy flows as an analogy to rural development planning has analytical and predictive value. Information flow in planning and decision-making processes is comparable to energy flow in biological processes.

District Focus planning in Kenya has created a matrix organization in which personnel in the district team have their functional superiors in the ministry headquarters in the capital but operate under a district superior. Thus ministry personnel may get the "what to do and when to do" instructions from their district superior and the "how to do" instructions from their ministerial superior. In such a matrix management structure the functional and the district superiors may occasionally conflict in matters of emphasis or specific details. As the functional superiors are responsible for resource distribution country-wide their perspective might clash with the district authority's desire to intensify performance locally while getting insufficient attention. Although the district administration is normally able to resolve such conflicts the effectiveness of matrix management of rural development planning at district level in Kenya remains a challenge to be overcome. Working in a matrix organization poses conflicts of vertical and horizontal loyalties, but administrative officials and local leaders have continually tried to hold the district together as a functional whole.

The rationale for a management approach to rural development planning at district level could simply be based on and implied from the general disatisfaction with the inadequate conceptual formulation of development management and inefficiency the current planning practice. However, the most cogent argument for an information systems approach to planning is based specifically on the imminent crisis of uncontrolled land-use change and economic blighting of rural areas despite huge recurrent expenditure on resource management. According to results of the case study the characteristics of the district included an ecological resource base consisting of a gradient of altitude, temperature, rainfall and vegetation between the mountains and the lowlands. The population size and its demographic characteristics have changed greatly in the last ten years mainly beacuse of migration from the neighboring districts.

Three major groups of stakeholders in land-use in the district were recognized namely pastorlists, ranchers and agropastoralists. The socio-economic background of the district consisted of distinct historical eras of population-resource relationships marked by major organizational or political changes. The latest or current historical era is the post-colonial period which is characterised by reduction of the number and proportion of ranchers from the original 158 to the present 58 through subdivision into small plots. At the same time, through the purchase and resettlement of the small plots the number and proportion of agropastoralists has increased at a very high rate. For the same reason the demand and utilization of space, water, wood and practically all natural resources has increased tremendously. In the case of water the rate of abstraction of rivers, especially for irrigation, has raised concern for imminent depletion of river flows and down-river water supplies. It is evident that the current planning at district level is oblivious of key issues especially clear objectives, of long term changes in the population-land relationships occurring in land-use and may not address itself to them effectively.

DATABASE, FLOW AND USE OF INFORMATION

It is critical to identify a practically valid and useful database having regard to issues for which decisions will be made at district level. Every database structure consists of key elements, activities or processes, dynamic action blocks of related activities, and events. Events are interactions between key elements involving time for example decisions. The collection and flows of information requires to be perceived in terms of vital horizontal interactions and cycles or feedback loops between different key elements and blocks in the land-use systems. It should also be seen in terms of vertical flows between the population at the grassroot level and public planners-cum-decision making authorities in the DDC at the district level. In view of the above the primary components of the database at district level are activity blocks bearing sectoral names identical or closely related to existing Government ministries. In some cases several ministries may be combined into one activity block. Below the activity blocks many elements of the land-use system will be identified such as land, transport, security, etc. The time dimension of the database includes provision for events involving time. All decisions are events and so are rains and droughts, meetings, wheat harvesting seasons, disease outbreaks, agricultural shows, settlement on newly bought land, etc.

At present the downward flow of information peters out after the box representing project implementation thereby breaking the cycle. It could be said the flow at

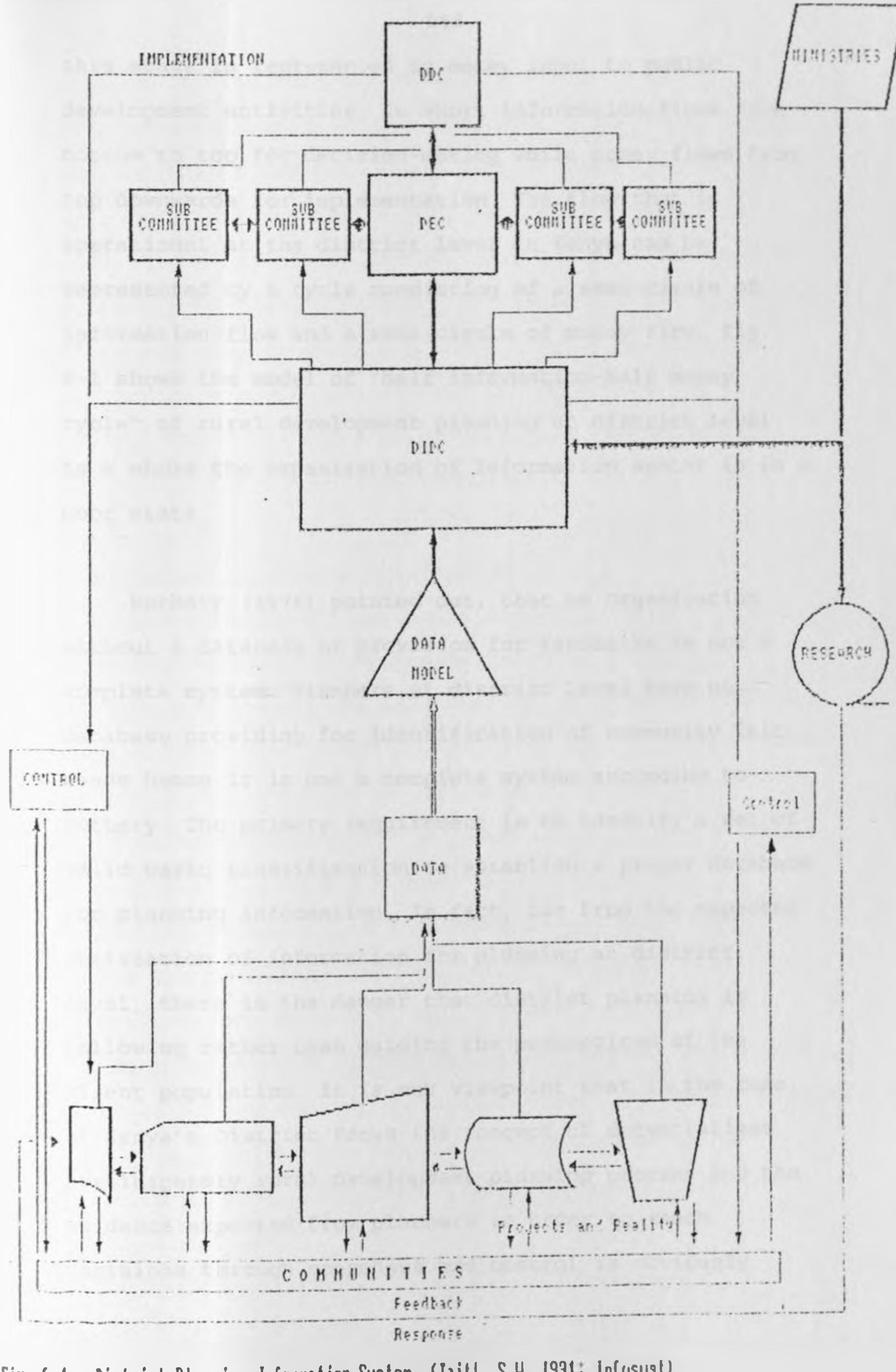

Fig. 6-1. District Planning Information Systen (Taitl, S.W., 1991: Infosyst)

this stage is represented by money input to public development activities. In short information flows from bottom to top for decision-making while money flows from top downwards for implementation. The flow that is operational at the district level in Kenya can be represented by a cycle consisting of a semi-circle of information flow and a semi-circle of money flow. Fig. 6-1 shows the model of "half information-half money cycle" of rural development planning at district level. As a whole the organization of information sector is in a poor state.

Rothery (1976) pointed out, that an organization without a database or provision for feedbacks is not a complete system. Planners at district level have no database providing for identification of community felt needs hence it is not a complete system according to Rothery. The primary requirement is to identify a set of valid basic classification to establish a proper database for planning information. In fact, far from the expected utilization of information for planning at district level, there is the danger that district planning is following rather than guiding the perceptions of the client population. It is our viewpoint that in the case of Kenya's District Focus the concept of decentralised participatory rural development planning process and the guidance expected from planners in order to reach decisions through consensus and control is obviously missing. In chapter five it was noted that rural development planning at district level lacked clarity of the domains of control on spontaneous land-use changes, a monitoring strategy and a database for the purpose of feedback. Owing to the lack of monitoring, database and control information, planning at district level is devoid of sensitivity to crucial dynamic changes in resource levels and degradation, poverty and dependency on famine relief. These are signs of degeneration and imminent malthusian crisis in rural land-use.

The Missing Ecological Perspective

The concept of planning at district level in Kenya misses a physical or ecological resource perspective; totally putting all emphasis on routine budgeting and implementation of projects. The clear socio-economic bias of the planning policy is prejudicial to sound utilization of ecological information and resource data for optimal planning and hence lacks effective organization and use of a database. One domain where there are particular implications of ecological considerations is that of environmental planning and management. Without an explicit environmental policy and information on resource levels planning at district level may move towards obsolescence, a process that is hastened by rise of spontaneous land-uses, especially in arid and semi-arid lands.

Budgeting and Sustainability of Externally Financed Projects

Budgeting continues to emphasize and isolate development projects from the normal operations and activities of government ministries. Since scarcity of funds is recognized as a major constraint in general there is danger that development projects may not be sustainable after they are phased out of the project implementation and development budget. Reference was made earlier to the preference donors for isolation of development projects and the Laikipia Rural Development Programme was cited as a case in point. Trajectory analysis must decide how to discount development projects financed from exogenous technical assistance and loans to the sustainable stage if cases of the commonly referred to "white elephants" are to be avoided.

Monitoring And Evaluation or Management By Exception

Thanks to competence in horizontal co-ordination noted above, district planning has its strongest point at project implementation. This can be attributed to several reasons including enthusiasm for technical field work, incentives of monetary benefits from field allowances, etc. However, the monitoring and evaluation functions are generally neglected for lack of guidelines or specifications to the procedure, content and responsibility. The district has no special staff for systematic monitoring and evaluation. Ultimately monitoring requires policy decision on what information will be collected, how information will be used, how it will be processed and evaluated for decision-making, the cost and the work load distribution. Finally technical responsibility for monitoring and evaluation involve collection data and modelling for strategic planning management. Monitoring requires a data base with tools and capacities for projection, interpretation and prescription and remains at present time as a big challenge for effective district planning.

Finally, planning without information or management by exception is a fallacy. The concern for management by exception is that it leads to loss of control, waste of resources and policy entropy as stated policy objectives and goals tend to be dubious. The problem of management without information at district level is real and therefore policy decision is needed for provision of periodical evaluation.

<u>Transfer of Technical Information</u>

The communication channels and networks along which information goes to the rural development planning system include the following: ministerial project implementation and frontline staff; local project committees, sub-DDC and the District Information and Documentation Centre. Through public barazas, field days and short courses information is passed to the population. There is, however, no specific provision for direct education and training of the client public.

Overcentralisation of Control at District Level

The large population of individual actors, the wide range of issues, the large area and the multiplicity of activities in a district means a wide span of control for the Chairman of the DDC. The possibility that disagreements and impasses concerning major issues may arise between the parties involved in decision-making at district level implies that provision for a higher political forum of appeal is desirable for the organization of planning at district level. Matters of land control relating to sizes of farms and protection of land for public amenities that are too cumbersome for the DDC are possible candidates for routing into the special channel of appeal mechanism. It should be noted here that although the policy of District Focus for Rural Development has been implemented since 1983 there is no legal enactment in the law of Kenya to give the DDC, DEC and any other organs the necessary statutory powers to decide, act, implement or incur expenditure on public funds in the process of rural development planning. The present set up and operations are in existence due to political appeal and will but the practice lacks legal basis.

Participation of the Poorest Population at the Bottom

At the local level participation does not harness the human resources fully for identification and implementation of projects. Many people at grassroot level lack awareness, some lack the required contributions while others are disinterested mainly for reasons of absolute poverty. In general communication with the rural poor is an overriding consideration in enhancing participation. The inference to be drawn here is that rural development planning by District Focus lacks strategies for awareness creation, participation and mobilization of human resources at the grassroots level. Under these conditions the poorest who have the greatest needs among smallscale farmers can remain poor as victims of circumstances.

District as an Open, Dynamic and Probabilistic System

The district is an open system interacting with outside receiving external inputs and giving outputs at different levels. These flows have the forms of human population, water, soil, farm products, cash, solar energy, rainfall, raw materials, wild animals, etc. entering or leaving the system through natural flows in the ecosytem. In-migration and out-migration are continuous in time and space. Areas of small scale farming are increasing gradually while those of large scale farming are decreasing also gradually.

For an open system a potent issue for consideration is the recycling or re-investment of balances of income from land-use activities. The primary question is whether profits are made available as further input in the system and whether incomes and profits are re-invested in internal processes in the district, or whether they are taken away outside the district. Theoretically these questions have fundamental implications for the trajectory of development of the district and no doubt for policies of external assistance of rural development planning at district level.

The assumption of technological determinism has an overriding influence on the strategies of rural development planning in general. The reality as represented by nature, the history of land-use and events of farming activities tend to be dynamic and probabilistic; examples being the occurrence of rainfall, pasture conditions and crop yields, settlement, migration, etc. In the whole trajectory of change in Laikipia in the period 1900-1990 has been a very unpredictable trend. One of the major goals of planning is to minimize probabilism or environmental determinism and augment cultural determinism of plans at district level by means of systematic monitoring and evaluative or prescriptive modelling.

Optimisation

In summary, the economic land-use in Laikipia is on the blink of disintegration and obsolescence through continual mutations of larger holdings to smaller parcels of land, loss of a beef livestock industry not only for the district but also will equally affect the neighbouring districts, and indiscriminate peasantisation of semi-arid land. It appears from the trajectory of growth 1900-1990 that Laikipia has no choice but to level-off the rate of positive feedback and morphogenetic growth by spatial optimisation of land-use. The maximum diversity and stratification of the existing beef industry could be enhanced by symbiotic land-use systems. Meanwhile district planning remains in the danger that too much attention is being paid to parts and elements of the system and little attention being paid to the tragedy facing the whole. Without the overall perspective and optimisation then the sustainability (survival) value of planning at the district level for ASAL will be minimal.

The Need for a Management Emphasis

It was noted in chapter one that over the last decade District Development Committees in Kenya have proceeded with the dialogue of rural problems and solutions without a practical basis for evaluation of past or future outcomes of their views and initiatives. The inadequacy was identified with concentration on project formulation and neglect of improvement of the management of ongoing activities. These ongoing activities receive two thirds of total annual budget of government expenditures in form of recurrent allocations hence they ought to be considered as input to rural change. Equally there was inadequacy in monitoring and evaluation of projects. The implication is that there is a conceptual void in the improvement of management which makes systematic assessment of impacts and feedback of experience in rural development difficult. For this reason a unifying framework for management of all rural activities would be of great benefit. A common frame of development management would enable planners and decision-makers at district level to co-operate in co-ordinated application of information to problem identification and evaluation of rural transformation of the district as a whole. It could facilitate diagnosis of needs, impacts and opportunities for new proposals. It could make consensus and control in the district more meaningful being arrived at from an informed debate.

As noted already, effectiveness of planning from the grassroots depends on successful management of control and consensus in the transactions of planners and decision-makers (Friedmann, 1981). It is quite possible that a district, after decentralisation, becomes little more than a passive accounting system. To avoid disorientation, in-built tools of management system approach are required. Without tools for information utilization adaptiveness can lost leading to prolification of projects without strategic developmental value.

CHAPTER 8. APPLICATION OF THE DISTRICT PLANNING INFORMATION SYSTEM (PIS) MODEL

BACKGROUND

This chapter describes the applied aspect of the model of planning information system (PIS) with reference to the issues of rural development planning at district level in Kenya. As noted earlier the preliminary considerations for the design and construction of the information system for planning at district level included the following. (i) General issues of rural development management for it is in the context of those issues that all desirable shifts and reversals for decentralised planning can be considered in the PIS; (ii) empirical facts of the situation especially the nature of the client community; (iii) the coverage; (iv) services to be provided; (v) the systems plan or design. In this thesis each of these considerations has been satisfied by the information given in the preceding chapters describing the theoretical background and nature of the problem, the purpose, the objectives, and the reality of the case study district. Therefore at this juncture we may assume the facts are given and there is only need to highlight them briefly and then proceed with the applications planning information system per se.

TRAINING OF IMPLEMENTORS AND USERS

District Information and Documentation Centre

It is necessary to define the implementors and users of the district planning information system. Institutionally the most obvious locus of implementation is the District Information and Documentation Centre (DIDC) while the most anticipated users include District Development Officers and other officers at district and sub-district levels. The primary issue is training and awareness creation for DIDC staff and for the potential users. Another set of functions of the District PIS includes dissemination, inquiry, referral, abstracting and indexing services. At the height of its envisaged functioning the DIDC would not only be providing the latter services but also serve as a powerful district resource centre for consultations and research for rural development planning.

The people who would be expected to make use of the information include elected and nominated members of the national legislative assembly, district admninistrators, civic leaders of local government authorities, universities, NGOs, bilateral development agencies posted in ministrial and parastatal organizations at district level, researchers and businessmen. The bulk of the district population living in rural areas and engaged in primary land-use activities have lower levels of literacy and limited access to formal information. They could be served by a system of awareness materials in form of leaflets or bulletins. At the grassroot level organized groups based on common interests such as neighbourhood could be catered for in various ways including lectures. Visits or tours guided by experts offer real potential for the use of information at community level.The existing District Focus management system is too couched with authoritarian rather than participatory approach. A special awarenwss programme would be require to change the present attitudes and managerial hindrances to informed participation and consensus. The main issue of the complexity of planning land tenure and land-use in Kenya, however, is the political sanctity of land ownership. Past interventions and changes changes of land tenure and land-use eg the land adjudication programme, have been costly and future changes will require rigorous scrutiny befor their implementation. This implies that without political or legal authority planning at district level is bound to a fundamental constraint that may undermine effectiveness in the short term and the destiny of land-use in the long term.

Monitoring and Evaluation

Some of the less successful functions of the DDC and the Provincial monitoring and evaluation committees have been noted in chapter seven. The current state of culture and realistic projections of future development require to be considered in deciding the appropriate technology level for designs and plans and PIS model could be used for these purposes. For instance the concept of Group Ranches which was implemented among the pastoralists including those of Mukogodo Division of Laikipia in the 1970s to facilitate development of pastoral areas, seems to have failed to evoke effective change in the traditional land-use system. Contrary to the original concept the Group Ranches have become practically a tool serving political purposes more than it serves real community purposes and there is currently a strong tendency towards subdivision and individualisation of land ownership. The ox-plough project started by the Ministry of Agriculture in Laikipia District also demonstrates social attitudes towards technonlogy in rural land-use. Most smallscale farmers seem to prefer to use either conventional hand implements such as jembes (hoes) for land preparation and for planting crops, often hiring casual labour to do so manually, or to use motor tractors for the purpose. It is not easy to understand the aversion to ox-ploughs in Laikipia considering the terrain of the landscape is flat or gently sloping, and the overhead costs are more affordable. It appears that sociological reasons involving attitudes are the only plausible reason for the aversion to the ox-plough. As already indicated in chapter 5, there are many small clusters of population characterised by extreme poverty. For them basic needs rather than capital are a major difficulty.

The size of the geographical area to be covered by the PIS is defined by the district boundary which is based on political decision and therefore it is a socio-economic unit. In many cases the district space may not be identical to an ecological entity. Moreover, individual coverages reflect the state of reality at a time and may need to be monitored to show temporal or spatial changes. The overall significance of the above is that precision is necessary and that information from any coverage requires to be labelled with data such as methods used, date, location, etc.

OPERATION OF THE DISCTRICT PLANNING INFORMATION SYSTEM

Fig. 7-1 showS the model of the planning information system. Seven steps of construction of the PIS are now described below. There are analysis, basic model or concept, planning domains and issues, data specifications, technique of data gathering, establishing systematic operational procedures, resources.

(i) Analysis

The starting point of designing an information system for rural development planning at district level is to use the available knowledge of the ground reality to establish answers to certain basic questions including the following. What are the objectivess of planning at the district level? What do the people in the district do

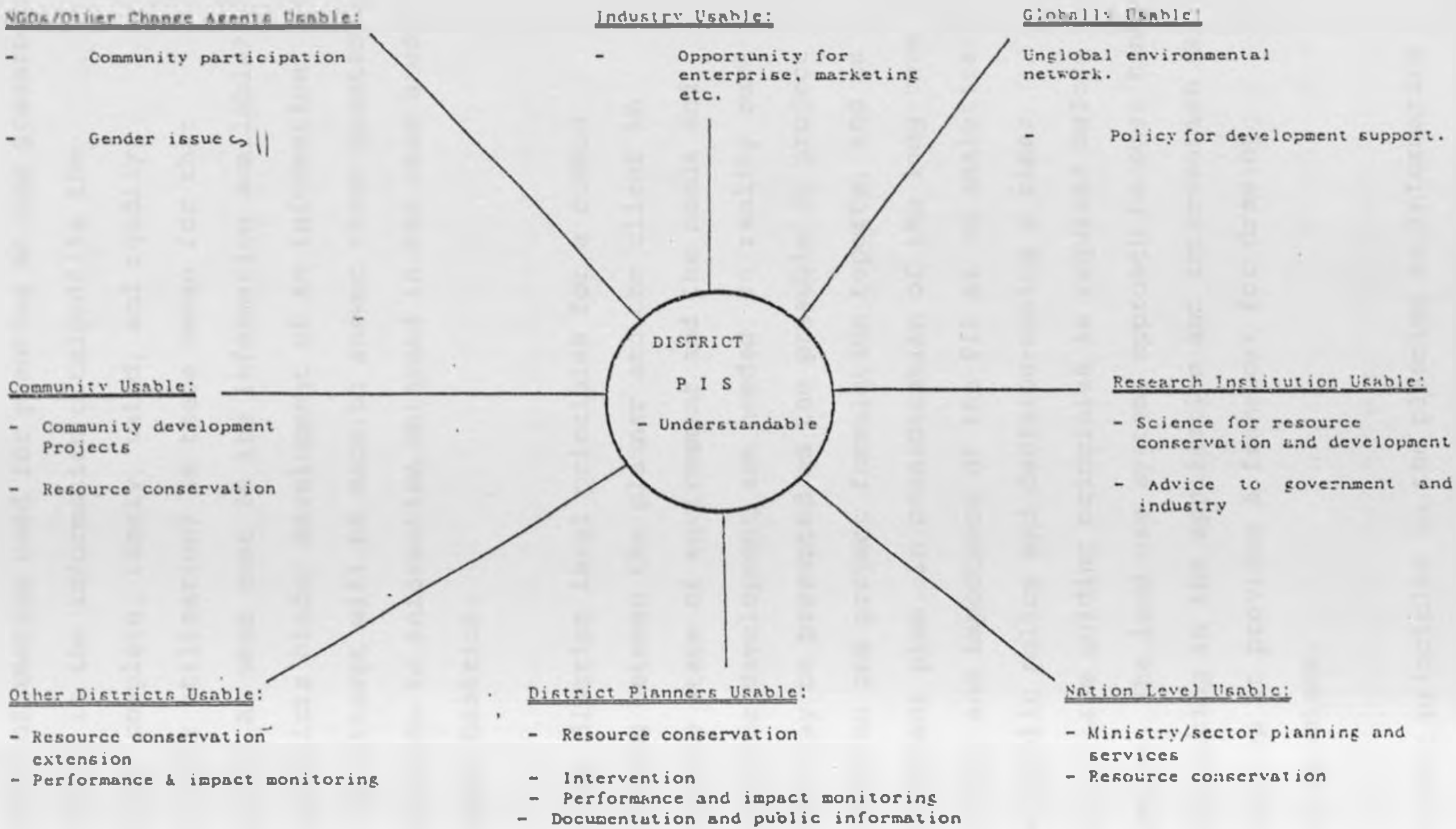

Fig. 7-1. Potential users of the planning information system at District level.

for livelihood? What information is used for planning? How is the information used for planning at the grassroot level? Where is the information obtained? Is the information complete, timely, valid, and readily available for utilization? Is there deman for that information? At what cost is the information available? What constraints hinder development of an information centre? An attempt will be made to answer these questions with reference to information obtained in the case study of Laikipia District.

At the district level principles for a common understanding between the planner and the client in regard to the state of environment and the needs and strategies for development are needed. In reality such principles may be presented as the preamble in project identification and project formulation reports, and in the development plan. In consideration of the long-term implications and importance of the PIS as an analytical tool for public policy and decision-making a clear statement of the guiding principles is required before designing it. The land-use systems approach becomes handy to policy making in the application and intervention at this stage as it provides a framework for drawing planning premises.

The key principles in the planning an information system are the definition of organizational objectives in the ongoing change or management and also the important recommendation demains. These are then identified to form the prime level data base of the planning information system.

(ii) **Basic Model or Concept and Fields of Relevance**

As already stated the overall principle of the PIS is that the land-use systems concept (FAO, 1976; Beek, 1978) which provides an adequate framework for comprehensive and integrated rural development planning at district level. The two main components of a land-use system are human base (socio-economy) and ecological base.

Human (Socio-Economic) Base

Within the land-use systems concept human base represents social considerations of the population in regards of its demorgraphic and social characteristics. A society is characterised by a certain perception and values from education or experience of trauma in previous conditions and transfer of these must be based on effective communication of information to the actors. Similar intensions, plans, assumptions and criteria of measures require to be communicated and disseminated to the relevant public in a transparent way. People could then be expected to be aware and to understand social considerations and the implications of development actions as matter of course. The following is an example of a simple scheme of classification of priority measures according to the social circumstances: class I. Emergency, class II. Urgency, class III. Exigency.

LEVEL	PRIME LEVEL DATA FILES
District level	Policy goals, popultion, space, education, strategy
Local level	Community, catchment/land unit, physical thresholds, water yield, impact, maps
Farm level	Farm size, household size, homestead size, shelter, income production, adaptation,employment

Table 7-1. Prime level database of a district planning information system.

Ecological Resource Base

The ecological principle presents consideration of the permanent and dynamic attributes of the landscape in which productive human activities are set. The permanent and dynamic attributes include dimensions of physical space and the ecological base of the variable topography, soil, drainage, climate, biological energy flows and material circulation, and regional ecological gradients. The main aspects of land-use which is influenced directly by the nature of ecological base is biomass production and its variation in space and time. The main concern in rural development planning is to overstep thresholds and augment the potential production of the land (Kozlowski, 1972). Optimisation rather than maximisation of land-use potential may be necessary for the consideration of

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MANAGEMENT PREDICTION OPTIMISATION LAND-USE SYSTEMS

POPULATION WATER OBJECTIVES DATA SETTLEMENT SCHEMES

PRIORITIES CROP LIVESTOCK HOUSEHOLDS TECHNOLOGY LAW

POLICY PLAN ENVIRONMENT FOOD FARMSIZE LANDSCAPE

OFF-FARM INCOME SOIL EROSION GROUPS INDIVIDUALS NGOs

LAND-OWNERS WILDLIFE LOCAL-GOVERNMENT TOURISM SPACE

SELF-HELP HISTORY ECOLOGY PRODUCTION CARRYING CAPACITY

MODELS SCENARIOS INTERACTIONS CRITERIA FUND-ALLOCATION

CONTROL MONITOR DATABANK DECISION PUBLIC INFORMATION

MEAT BUDGET PROJECTS THRESHOLD ANTIPRIORITIES STRATEGY

LINKAGES INVESTMENT SURPLUS PLANNING SEEDS IMPACTS

SELF-SUFFICIENCY INDUSTRY RESEARCH OVERGRAZING

PLOUGHING METHODS

Table 7-2 Process diagram with key elements, link elements, causal relations and interventions possible at the district level.

conservation. At the district level different strategies of conservation-oriented land-use planning may be used in accordance with farm sizes, local practices of land management, cropping patterns, land-use and land tenure structure. Land-use plans could be achieved at all levels. These include the farm level, local or community level or regionalised at the district level by adopting a combination of tools which are already in ordinary use with emphasis on approriate technical designs in accordance to categories of landscape and ecological zones. The emphasis on the adoption of ecological zonation in development planning should apply equally for example to the zoning of agricultural extension as well as to land adjudication practices.

Principle of Comprehensive Planning of an Integrated System

The highest consideration for planning is approaching the district as a whole system with different perspectives: ecological diversity, economic performance, and a future trajectory of growth. Optimization implies that district planning starts from the diagnosis of reality and not with utopia. Initial diagnosis and monitoring of land-use systems is a prerequisite to identification of problems, potentials and realistic objectives as well as for regional integration and sysntropy or energy building for the whole system. Systems of land-use with extremely high opportunity cost or wastage or cardinal resources require to be allocated the minimum or no resources provided land ownership is not directly interfered with. The policy of optimal development implies selection; optimisation rather than satisfisation in resource allocation.

(iii) Planning Domains and Issues

Topics which are considered customary to planning and on which data and ready information are collected and documented in the PIS are referred to as domains. In the rival development planning processes it is customary also to identify certain key issues of environmental management and set out parameters of indicating their status as the criteria for consideration in decision making. Ten such general issues will be build into the framework of the PIS to constitute a dimension of key domains. The ten issues of environmental management are given in the table 7-3.

The basic concern in the formulation of the planning information system for a district is to identify the activities that are undertaken which require information. Further to these the definitions of the primary functions, objectives and standards are basic considerations. These in turn determine the kind of data base or master files appropriate for the system. It is necessary in this context to begin by considering the key and link elements and the processes which compose the land-use systems as well as impacts of planned interventions at three levels. These are the household level, the local level, and the district level. In chapter two and four the components and elements of the land-use systems were mentioned. In chapter five the recognized goals of the district development planning were described.

The Prime Level Database for a District

The nucleus of the planning information system is the prime level database. The key components of the prime level database of the land-use system are human base, ecological resource base, historico-Socio-Cultural background, economy, technological level and organization.

DOMAIN	DATA MODELS
1. Human Base	population projection
2. Resource Base	social stratification impacts of cyclic drought
3. Goals	poverty alleviation; optimal land-use; higher production
4. Impacts	Monitoring and evaluation
5. Measurement	research data; monitoring
6. Standards	indicators of human values
7. Strategy	Participation, consensus, specific standards/criteria
8. Responsibility	Technical mastery; expertise
9. Governance	Authorities at district level
10. Awareness/knowledge	Education and training, specific transfer strategies public information community mobilization

Table 7-3 Recommendation domains are the key areas of concern of a general planning information systems.

(iv) Data Specification: Identification of thresholds

The concept of a threshold or limiting factor is familiar in biochemical processes. Money is a scarce factor in most circustances. Finance aside, however, one or another specific resource or environmental factor is found to be exerting an over-dominant limiting influence to development of the community of any particular district and locality. The implication of a limiting factor is survival and any costs are less than the benefit of life. Cardinal limiting factors for different groups, communities or ekistic units (Doxiadis 1976;

Kozlowski, 1972) require to be identified so that they can be addressed specifically in planning. Resource allocation for overstepping or satisficing the constraints imposed by the different cardinal limiting factors could be accorded priority in an objective manner. Similarly interventions on specified cardinal limiting factors could be monitored to keep track of impacts, which could also serve the purpose of measuring of performance and growth. Water was considered to be the cardinal limiting resource in Laikipia District.

(v) Techniques of Data Gathering

For methods of data gathering to sustain the PIS reference is made to chapter three for the methods used in the case study. Particular mention should be made of the great potency of remote sensing techniques especially aerial photographs at scales larger than 1:50,000. Satellite images and aerial photo-interpretation are thus considered to be of complementary value for reconnaissance ecological surveys. For larg scale work requiring higher resolution aerial photographs offer considerable advantages to satellite data. Questionnaire interviews are recommended for social surveys.

(vi) Establishing Systematic Operational Procedures

Document Filing

The crucial aspect in the design of an information system is the systems plan (Rothery, 1976). The purpose of a systems plan is to identify the work, to order the work by priority and to organize the documents, files and methods upon which operations shall be based. The entire system of files, documents and procedures introducedmust facilitate retrospective searching and retrieval of specific items of information once they have been identified and demanded by a user. Two major systems of filing information in storage and retrieval centres are the 'document filing' and the 'surrogate filing'. Document filing involves placing the actual document in the storage system. The physical arrangement of documents in the storage may follow an alphabetical order of author names. This is preferred by, users who have come to know about the information through references cited in literature or through personal recommendations. A second method of arranging documents is to follow the numerical series of publications. This method is preferred for Government reports which are normally cited by the 'volume' or serial number and year of publication. A third method is to follow subject classes and this is the method used in most conventional libraries. Flimsy documents may be kept in envelopes and assigned accession numbers.

Surrogate filing is the practice of filing a representation of the document instead of the actual document in the store. An example of a device which can be used instead of the real documents is a card catalogue contains information about the real documents including the authors and subject names under which such documents were indexed in the storage. There are three major schemes of subject classification for library purposes: Dowey Decimal Classification, Library of Congress Classification and Universal Decimal Classification. The main limitation of these schemes for a long time was that they are unidimensional; a document dealing with more than one subject can be filed at one place only. Multidimensional classification schemes are also possible especially with computers coming into common use in the documentation field as data banks. Multidimensional software is available in the market and multi-subject surrogate filing and co-ordinate searches are therefore possible. Computerised data banks may have extra capabilities of calculation, print-out, graphics, etc as options of great advantage to users.

<u>The Comparator</u>

The comparator is the planner's theatre where the technical fuctions of planning are executed. The functions include: the prime lvel data base, the repository of raw or partially processed data; planning standards and data models for quality control. This also includes parameters and standardised criteria for reference in decision-making in respect to calibration and approval or disapproval of proposals and designs; monitor system capability for regular observations and measurements of processes, consequences and determinants of factors with a view to modelling and prediction.

Location of PIS

Planning of the PIS involves also organizational considerations. The parent institution, which may vary from one country to another, determines where the PIS is organizationally placed. The ideal organizational principle is that the PIS should be free to interact dynamically with its users availing them with ample opportunities to influence how it works. If users are a homogeneous community then the PIS is best located where the user group is to be found. However, if the user group is heterogeneous the PIS should be located with a consideration of maximum autonomy for instance as a section in a department of the post office or as an independent unit altogether.

Decision Pyramid

The vertical height in the organization in which information travels before the decision for which it was provided is made in a bottoms-up system constitutes the vertical decision pyramid. Information may undergo considerable reduction as it flows up in the pyramid since it is likely to undergo sieving at the successive levels.

<u>Availability of Computerised Information Systems Software</u>

Manual procedures of transformation of basic data and production for useful outputs of planning information have to be considered first in developing countries. These include manual interpretation of remote sensing data as a method of rural surveys a used in this case study as noted in chapter three. However, computer-based methods, including digital analysis, processing and graphics, are increasingly coming to common use. Pc versions of specialised geographic information systems such as pc Arc Info, ILWIS, etc are now available in the market for those districts which can afford then. It is inevitable that in the near future establishment of planning information systems will be based mainly on the assumption of the availability of high capacity, powerful, fast, computers for handling of information. In our local scheme even small companies are now using these for their daily operations. District planning set up can financially afford the capability given the objectives they fulfil and the capital involved in project implementation.

<u>(vii) Resources</u>

An important consideration is the feasibility of a PIS and its sustainability with regard to the capital and recurrent costs and maintenance. Planners, politicians and donors are still locked in their beliefs and attitudes towards hardware, high technology, quick

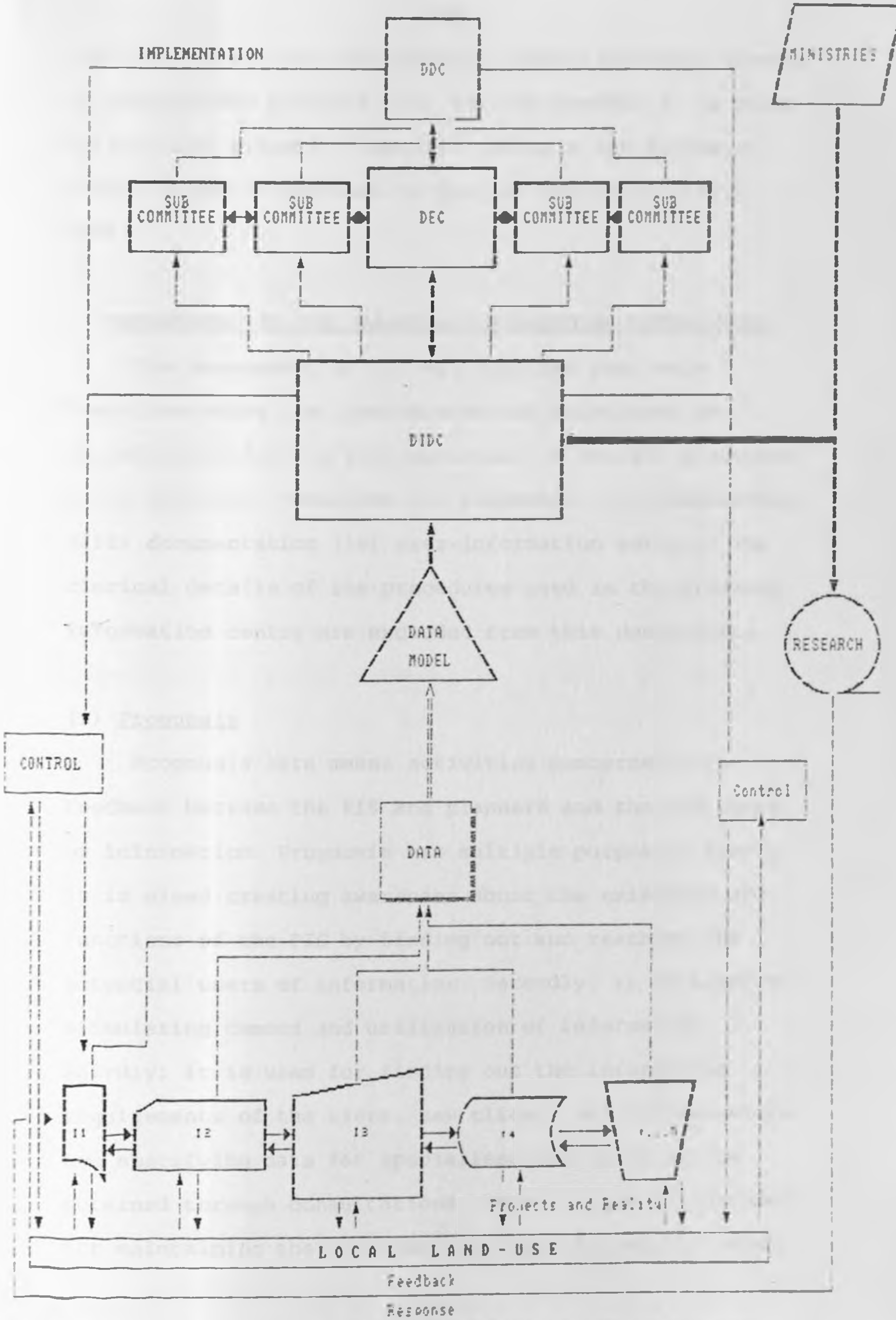

Fig. 7 2. District Planning Information System (PIS) Model based on the land use system
Where I1. I2. I3. I4. I...n are proposed interventions. (S.W.Taiti.1992)

results, short term involvement, urban interests, glamour of development projects etc. For the present it is right to say that situation-specific criteria has become a widely accepted approach to project analysis (ILRI, 1989).

MANAGEMENT OF THE PLANNING INFORMATION SYSTEM (PIS)

The management of the PIS combined four main functions which are interrelated and which must be co-ordinated for the full potential of the PIS structure to be realized. These are (i) prognosis, (ii) monitoring, (iii) documentation (iv) user-information service. The clerical details of the procedures used in the planning information centre are excluded from this description.

(i) Prognosis

Prognosis here means activities concerned with feedback between the PIS and planners and the end-users of information. Prognosis has multiple purposes. First, it is aimed creating awareness about the existence and functions of the PIS by finding out and reaching the potential users of information. Secondly, it is aimed at stimulating demand and utilization of information. Thirdly, it is used for finding out the information requirements of the users, new clients and collaborators and specifying data for specialised use which may be obtained through consultations. Above all it is intended for maintaining the necessary dialogue for mutual trust, technical collaboration, healthy transparency and participation.

(ii) Monitoring

Monitoring of rural development means surveying the matrix of rural land-use systems as demonstrated in the case study in part II of the present thesis. The main purpose of monitoring is to obtain baseline information to accountably support initiatives for adaption and corrective action in on-going human activities through development projects. Monitoring is an important component of any management process. In general business management, three principal aspects are normally encompassed by monitoring and control. These are (a) financial control covering the organization, methods and processes; (b) performance control covering production, stocks, quality, machine utilization and store; (c) cost control covering labout, material, expenses and costing systems. Distinction is usually made between the function of monitoring and control which is management accounting, from financial accounting. The latter begins and ends in two main techniques. These are budgetary control and standard cost control. In the case of the PIS for rural development planning at district level monitoring provides the PIS with ecological and socio-economic data to compare the actual results with the previous levels, the planned targets and the general national or international standards. It should be observed here that the results of monitoring and evaluation of impacts of the implemented rural development projects at district level may reveal the efficiency or inefficiency of resource management. This has a great risk of abuse in situations where participation and debate are inadequate. This implies that revelations made from monitoring can become the cause of sensitivity or even conflict among the planners, implementors, political leaders and donors who are involved and accountable in rural development projects.

Monitoring involves identification and measurement of spatial ecological aspects as well as human activities with a view to diagnosing their magnitudes, performance patterns and trends. Among the methods currently used for monitoring is remote sensing and ground truth surveys as demonstrated in chapter three and four. Questionnaire surveys are normally used for collecting socio-economic data. Sampling is normally used for collecting ecological data such as rainfall, vegetation structure, etc. Various models and concepts can be applied to analyse and synthesize the data obtained from monitoring. The model of the trajectory of comprehensive growth discussed in chapter six is an example of such an approach. After the initial diagnosis of the state of the district system information is collected periodically by sampling. A multiple of levels of reality could be used for monitoring for example farm, local settlement of community and district.

(iii) Documentation and Modelling

The priority in documentation is to produce a general index of files on the key domains of the planning information system to help workers who are logging new data, operating the input and transformation or handling the user clients. The index should conform to the nomenclature in the thesaurus described below. Documentation and modelling are here combined as compatible bedfellows in the PIS. However, there is a very fundamental and practical difference between the nature of the two which we should clarify as follows.

Documentation and Data Structure

Documentation for the PIS involves the a multi-dimensional classification of information, logging and storage of income data, and retrieval of information for user upon request. The most crucial aspect of documentation in regard to the purpose, relevance, specification and applicability for rural development planning and utility at other levels, is the information structure. There are many systems of classification and ways of logging incoming data including computer-based geographic information system (GIS), that are available in the market. They must be compared before a choice of one is made for application in the PIS in the particular conditions of rural development planning.

Information for planning at the district level should be structured with multiple levels of resolution having, for example a farm level, local level and the district level so that it provides scope for aggregation and disaggregation according to the target users. Due to the multi-disciplinary nature of planning activities the planning information system consists of many domains, each domain catering for a single sector such as agriculture, water, soils, human population etc, or for many sectors such as ecology, socio-economy, etc. This means that development of the PIS needs linkages and co-ordination between research institutes, government ministries, departments, parastatal and non-governmental organizations. More significantly, however, the PIS data structure should be designed taking into account the characteristics of the rural structure in the district as reflected by existing baseline information about the district. Such information was demonstrated in this case study as presented in chapters four and five. In particular the logging of historical data should be in the original order by year of the events so as to form time series. This allows analysis from the dynamic perspective of the land-use systems model.

Secondly, for spatial rural development at district level, the resolution of data should be decided with attention being given to practical use of socio-ecological entities defined as units of catchments and settlement which are delineated by combination of catchment boundaries with the existing land ownership and land-use. With reference to the previous work and literature cited in chapter two these units are designated as <u>ekistic neighbourhood ecological organizations</u> (ENEO) in recognition of the concept of ekistic neighbourhood originating from Doxiadis (1976). The role of the ekistic units defined on the basis of the local catchments is to provide a unifying framework for activities and interactions of socio-economic and ecological factors at the local level as a tool for integrated planning at district level. Rooted on the land-use systems model this scheme of data structure enables management of the original matrix organization in a systems framework of population resource interactions. These units can be used to evaluate and map thresholds of rural development along the lines of the study of Stephen Waigwa in Ngarua mentioned in chapter two. Furthermore, in Laikipia these units are more significant and tangible to the rural populations who are involved in the management of land-use. Therefore they can become a realistic tool of data structure in the PIS as well as in extension work which is up to now based on arbitrary boundaries of boundaries of areas of jurisdiction under Technical Assistants (TA units). Compared to the socio-ecological groups which were identified as ecologically sound target groups for similar purposes by

Hugh Gibbon (1987) in Lower Meru, the ENEO is closer to the reality.

Modelling and Blackboxes of Land-Use Systems

The driving force behind the integration and the feedback, which was described above under prognosis, comes from the modelling component. To clarify this point we refer again to the land-use systems model upon which the PIS is constructed, which is discussed in chapters two and six, and to the issues of environmental management discussed in chapters two and seven. Two characteristics of the land-use systems model are remarkable. The first is the integration of aspects of the physical environment and the socio-economic aspects and the secondly is the provision of a feedback loop between the PIS and the user community. Modelling included simulation exercises and operational research oriented experiments and discussions. In the comparator or planning information theatre of the PIS edifice, we can envisage a tool box for decision-making, comprised of the general overall model of PIS. There are sets of specific modules for different domains of planning and also an assortment of new, quantifies criteria in different stages of testing and application for simulation exercises that are derived from research. The proposals for approval and disapproval of general application of models for routine decision making is effected through authoritative discussion of impacts and allied technical specifications of operational and control standards with respect to measurable attributes. Examples of the elements in the comparator are: ethno-historical data, agricultural growth models, population growth models, cyclic drought models and food reserve strategies. Certain areas which prove to be difficult to understand might remain un-articulated for some time. Such areas could be treated as greyboxes where information is vague or blackboxes where the information is totally blank. In their places stated assumptions could be used for simulation and decision-making until sound knowledge based on research becomes available. on the whole, the modelling component distinguishes the PIS approach from static-end-view physical planning models used for urban planning in Kenya. With the advent of powerful and cheaper computers, new or advanced techniques which aid planning and control research have become accessible to planners in developing countries in ways they can be used effectively for research purposes. There are many tools which could be tested if the modelling research facilities are available in the districts. Examples include simulation, operational research, game theory, queing theory, linear programming, network analysis, etc.

(iv) <u>User-Information Services</u>

Initially the information service can be launched on a small scale allowing for gradual and continual development as the products and capacity of the PIS increase through district monitoring and research. Finally the output of the planning information system consists of planning information for use by the public in respect to the various domains and issues of environmental management. Questions received from planners and other users can be given answers at different levels of specificity, generalisation, including literature listing and abstracts. It is assumed that the system planner will have used appropriate guidelines to ensure the necessary consistency of information relative to the needs of the targeted users rather than a stereotype duplication of a conventional library cataloguing system. This means that the system planning must be done in consultation with experienced planners and resource persons in the field of information science. Extension messages and manuals transformed from experimental research of crop trials and cultural techniques derived from on-station and on-farm trials could be supplied to extension workers. Maps and graphic presentations produced from monitoring and research could be assembled into a district atlas. Scenarios could be drawn by simulation of change to help in choosing the optimal course of action for various situations.

Queries and Searches

Queries are questions submitted to the comparator which require immediate search and answers on day-to-day basis. The procedure of answering queries would require to be specified for consistency in regards to policy and standards of accuracy, most specifically to the relevance for planning. For example, the matter in question could be drought and famine relief, and the aim being to find out the spatial extend of the phenomenon, the strategy of action to be adopted for intervention, possibilities of the future using "if" scenarios. Obviously many planning questions may not be answered adequately from the existing information and might require to be assigned further investigation by researchers.

District Planners' Thesaurus

Planners and decision-makers at district level require a general purpose directories and authoritative technical manuals giving useful classification, vocabulary and specific terminology for description of projects selected for planning. A *district planner's thesaurus* is a document that could be prepared to provide operational definitions of technical terms used in planning domain and may also provide brief descriptions of procedures, basic nomenclature, and standard coding, cross-referencing and indices. It acts as a planner's manual and it is therefore an indispensable resource document for the PIS user community. Along with other guidelines for planning at district level which are sent to Departments a thesaurus is potentially useful day-to-day tool. Another name for the thesaurus could simply be "directory" and a national thesaurus for all districts is to be preferred. An essential part of the planning thesaurus is a planning nomenclature. The purpose of a nomeclature is to streamline understanding and usage of terms and procedures of planning at district level. Ideally the nomenclature should cover both the socio-cultural and ecological domains.

DISCUSSION

At this stage we may look back at the foregoing account of the design and construction of the basic model of an information system with reference to the main objective of the present study, the basic concept of land-use systems, the steps of given by the ITC which were discussed in chapter two. Considering how we have been able to assign the information obtained from the case study there is sufficient evidence to show that a basic model of a PIS based on the land-use systems approach has been realized. This means that in general a planning information system is possible.

As we observed in chapter two most of the existing models lack provision for feedback. The key principles characterizing the planning information systems approach to district planning are the provisions for feedbacks (positive and control feedbacks) and for integration of information on socio-economic and ecological domains. Following is an analogy drawn to illustrate the above principles. In the first place the rapid socio-economic and physical changes in the ASAL of Laikipia District are a great challenge to the populations practising rural land-use there be they pastoralists or smallscale farmers. According to one of the general notions of biological sciences, unadjusted systems are less able to resist outside disturbances as compared to mature systems in which components have had time to make adjustment to the environment (Odum, 1973). This means that adaptive responses must continue to operate in decision making at all levels in order to minimize high risks in production strategies, environmental degradation and the threat of further marginalisation and poverty. For a dramatic analogy the principle of homeostasis is being introduced here to illustrate the adaptive role that planning at district level has to assume. Homeostasis, as the adaptive mechanism operating in individual living organisms, especially in the human nervous system, is well known. Homeostasis operates also at the higher level of an ecosystem (Odum, 1973) and the district has to be considered as an ecosystem which is experiencing change.

Further analogy may be drawn between information flow in the planning process and energy flow in photosynthesis which takes place in green plants. The essential features are the syntropy or the increase in potential energy in the system, and adaption or survival strategy based on the utilization of the abundant and therefore the cheapest raw materials in the environment (hydrogen, oxygen, carbon and nitrogen) and the synthesis of higher energy value compounds which can be stored until they can be withdrawn for use when the environment is less favourable for photosynthesis or for support of new generation as in the case of the endosperm in a seed which acts as a durable store of readily available food which can support new life when the weather (moisture) is good and germination can begin. It is a strategy which endows the fragile embryo with a high degree of independence until it develops roots and can feed for itself.

The ability of plants to channel the synthesis process of many paths of reactions and into diverse transient as well as terminal products, all characterised by high energy chemical bonds between the most ordinary elements which can be reprocessed to a further stage according to prevailing conditions and dynamic balance of possibilities is another aspect of adaptation found in the process of photosynthesis. Adaptation is demonstrated by the fact that the whole process is a deterministic cycle with many channels and intermediate energy products but no specific end point since some of the transient and assumed end products are continually used in processes of growth and replacement. Energy flow in the latter has been compared to information flow in the planning system, direct analogy being drawn between the utilization of information to make powerful decisions and need for adaptation in the planning process and the biochemical assimilation of energy-bound carbons and adaptation of many paths and many plant products in photosynthesis. For a long time it was believed that carbohydrate was the product of photosynthesis in the sense that the fixed carbon dioxide necessarily appears in this form before being incorporated in fats, proteins and other classes of organic substance. According to Fogg (1968) there is not substance that can be described as the product of photosynthesis in any special sense because there are several pathways of biochemical reaction involved based on carbon dioxide as the main raw material. There is no unique biochemical pathway for the carbon fixation and no fixed relationship between the reactions of photosynthesis.

The PIS provides a unifying framework in which data can be handled at many levels and from different perspectives. Any policy consideration may be programmed into the information system for the purposes of accounting, appraisal or control. The principle of integration provides for complementarity and completeness of all heterogeneity or specializations in the system (eg land-use systems) under consideration.

The principle of organization development provides a purposeful and objective prespective to change management. The major concern is in creation of valid basis of choosing domains of decision which should be strengthened. Towards the improvement of decision making the causal factors and other contributing factors are selected for research in conjuction with provisions made for feed-back in the system. Thus an organization or enterprise adapts and survives through information gained from research and planning as well as through new kinds of analysis and simulations (Rothery, 1969). Such studies may use not only current data but also historical data. The OD approach is founded on the following set of beliefs; (i) a view on the measurement of performance of the system as a whole rather than of the individual; (ii) the process rather than the content; (iii) problem-solving rather than academic concerns; (iv) continuous rather than short term perspectives; (v) objectivity; (vi) change is a norm and ongoing; (vii) participation and team work are essential; (viii) the process of change involves action research, diagnosis, data, feedback and intervention; (ix) a change agent or consultant is involved.

Organization analysis in a system overview which has a number of aims. These aims are (i) to assess the conditions or state of play; (ii) rates of flow of materials, money, information, etc; (iii) communication lines, network, media etc for control; (iv) choices and decisions which change information flow; (v) potential for innovation based on information, rules of operation, ability to change, and alternative outputs. Therefore analysis of the district planning system as an organization for the purpose of an information system involves determination of the database. The procedure will start with general questions regarding the identification of boundaries and structure of the system, and specific questions relating to information flow in the functioning of the system.

Extension of PIS Model to Other Districts

Ultimately each district requires its own PIS to support management of rural development. As already shown through the preceeding discussions, an integrated systems and modelling approach to the whole district is necessary in order to identify linkages between components, elements and processes of interaction. In particular, the spatial and functional of resource use and and interventions are crucial to successful management of development. Successful development of PIS is a necessary condition and an automatic breakthrough for the DIDC. A good model of the DIDC in the form of a planning information system achieved in one district would in turn require to be extended for application in other districts as well. Finally following this line of development an inter-district information network and exchange of modules between planning information systems is likely to be realized. If the full potential of this was realized, a national database, located at the existing Central Bureau of Statistics would be possible.

The Trajectory Concept

There are many kinds of simple and sophisticated methods of projection or simulation of aspects or sub-systems (eg space, population or economy) of a region. Details about these can be found in various works (Chadwick, 1966; McLoughlin, 1969; Friedmann & Alonso, 1964). These projections of separate aspects have a place in the planning information system. Economic growth indices are also one of the major tools of country economic planning and review in Kenya since independence (Republic of Kenya, 1980; Ruigu & Ngethe, 1986; Kituuka, 1988). Kenya's District Focus strategy aims at making area-specific planning and decision-making possible so as to stimulate regional growth patterns and improve efficiency of rural development planning (Republic of Kenya, 1984). It is not a matter of relevance but of consequence that regional growth models might automatically become the obvious tool for district planning. Fittingly growth has rightly been addressed in recent studies and theory building for rural development at district level (Kituuka, 1988). The argument here is that when the concern of comprehensive district planning is the larger problem of the trajectory of development in time then economic growth per se becomes only a single facet in the whole and only part of the vector of total growth.

For the model of the trajectory to be adequate other facets of the overall system which require to be reflected in it are the physical resource base, human base, goals and objectives, standards, impacts, administrative and policy planning organization, mass education and training. These facets were described in chapter 3 as issues of land-use management. The trajectory theory of rural development is embedded in the general systems concept. This study in turn implies the embedment of land-use system in planning information system (PIS).

Systems Approach

The basic principles of systems theory were discussed in the literature review in chapter two. Here it suffices to reiterate that systems approach has been used in dealing with the problem of explanation, description, prediction and prescription in complex situations of interacting activities (McLoughlin, 1969; Rothery, 1969) and to give a basic outline in theory construction.

Systems theory begins with a perspective of man in a context of a natural system (McLoughlin, 1969. Thus the term system means environment, a set of connected or interacting things or parts, or in short 'a complex whole'. Man's place in the natural environment or system is characterised by ecological relationships. It was noted in chapter three that originally man had a deterministic view of the environment and tried to adapt but in time he gained technology and assumed power to change the environment. Stafford Beer noted that the definition of any particular system is arbitrary (McLoughlin, 1969 so that "the problem of stating the system we wish to study is by no means easy".

The human environment or system consists of parts termed elements and components, and connections or linkages between the parts. The linkages are made of human communications. In the analysis of a system we first identify the elements Rothery, 1969), and these can be further grouped into key elements, link elements and control field indices.

Processes are transactions or events involving interactions between groups of key elements and link elements. Theoretically between a few interacting elements the number of possible processes is very large but in reality the number of practically relevant processes is limited or finite. The aim of a systems diagnosis is to identify, describe and articulate the structure ande categorise processes. A process (Fig. 6-2) consists of stages, the following being the typical ones: External and internal processes are recognized categories (Rothery, 1976). Internal planning processes are either deterministic or heuristic. Deterministic are the clerical operations concerning day to day decisions based on clear rules which can be handled by subordinate staff. They invoke short term responses. Heuristic processes are strategic or policy matters affecting long term operations. They are not subject to well defined rules and correspond to technical optimisation problems. Effects of changing a process in an organization especially changes due to introduction of data processing may bring considerable shifts of work loads.

INPUT -------------- ACTION ----------- OUTPUT

measurement measurement

CONTROL

DECISION

Fig. 6-2. The consecutive stages of a process. Measurement is a control function; the decision block involves complex conditions qualitative (eg. A>B; B>C; C>A,), qualitative or totem fashioned. (Source: Rothery, 1969).

Decision-Making

The significance of a database at the district level is to enhance competence and preparedness to make decisions concerning problems requiring solutions. The database structure will consist of files and directories for different activities, key elements, assemblies of key elements, combinations of activities forming dynamic action blocks, and sectors. Sectors or ministries could be viewed as the activity and thematic blocks by which the DEC collects information, applies it by developing tools for decision-making, and updates it. Planning decisions can be divided into two regions namely simple cut-and-dried administrative and technical matters which a planners at district level can handle, and policy issues which are less sharply defined and require the competence of a more senior office to handle. At the district level the district head of a Government department is competent to answer most technical and administrative questions and problems arising in coure of planning activities in the DDC. However, there are many problems requiring consultation with the national headquarters in Nairobi before a response can be made at the district level. The two categories differ by degree.

Information Availability and Updating

Values of attributes or variables which describe elements of a system are not necessarily continuous but may be supplied from sampling at intervals. This means there may be discontinuity of available information, but update intervals may require to be specified.

Noise

Systematic observation and measurement are the main though not necessarily the only sources of information that should influence policy decisions and actions.

Unwanted information affecting decision or action is the noise and is normally undesirable (Fig. 6-3). Systems involving people tend to result with increase in agitation and noise and response time may be difficult to establish. The implication of this principle for planning at the district level is the possibility of wastage of time and resources as a result of

```
                 NOISE

    INPUT ----------------- ACTION --------------
                              |
OUTPUT                        |
                              |
           measurement        |        measurement
                              |
                              |
                              |
                            CONTROL
                              |
                              |
                              |            NOISE
                              |
                              |
                              |
                            DECISION
```

Fig. 6-3. Irrelevant and unwanted information forms noise and may affect decision and action.

diverse interests tending to influence planners and decisin-makers so as to act in favour of certain groups or individuals at the expense of the genral public interest.

<u>A Cybernetic View of Land-Use Systems Control</u>

The complexity of systems in reality begins in their structure and extends to processes and their outcomes.

The challenge of the planner lies in charting the course and controlling the track of development and particularly in deciding how to responding to new public proposals in respect to the stated objectives. Attempts to understand the complexity of systems have led to cybenetics, the science of control and communication in complex systems (McLoughlin, 1969) that has grown from this setting.

District Land-Use Systems As the Entry Point in PIS

Underlying this study is the concept that rural development planning in the Third World is essentially structural change or transformation of rural land-use (Fig. 6-1) from mostly indigenous, traditional types which are characterised by poverty and low standards of living, to more modern industrial and predominantly urban structure with high standards of living (Chambers, 1974); this was noted in chapter three. By simple deduction from the above it can be affirmed that the information required for rural development planning is information about land-use. The main problem is the complexity of the reality. This makes land-use the logical point of entry in rural development planning in general.

In chapter 4 and 5 we gave descriptions of rural phenomena in Laikipia District covering the current state of land ownership, settlement and its history, productive activities in smallscale and largescale enterprises and planning. That data demonstrated the complexity of a comprehensive approach to rural development planning. This indicates that although the suggestion of land-use approach to a comprehensive theory for the rural phenomenon above may appear straightforward the problem comes with the possible content, range of variables and breadth of the information that is implied by the complexity of land-use and planning. The primary concern in a land-use approach to rural planning and therefore the justification of systems method is how to limit the breadth and scope of the issues that should be considered in decision-making.

The Land-Use Systems Model

Considering the above conditions the model of a land-use system was found to be fit as a unifying theory for handling the decisions for resource use and resource allocation at district and farm levels and in the context of consensus-control framework of bottoms-up planning. In the context of planning information systems (PIS) it provides sound basis for heuristic guidance as well as a base of modelling of socio-economic or ecologic processes. As already shown in chapter three the land-use systems model (Fig. 6-2) reduces descriptive information of land-use in reality to two components: physical environment and socio-economy. The physical environment component includes land resources namely topography, geology, water, soil, climate and vegetation. The socio-economy component includes human population, organization (policy, law and administration), culture and economy. Each of these sub-components can be subdivided further into elements. In this model land-use is defined as the interaction of the components and the performance of a land-use system is the resultant of that interaction. There is a flow and feedback between the performance and the components which results in impacts.

<u>Dynamic Characteristics</u>

Significantly equal emphasis should be given to socio-economic and ecological perspectives in the District Focus strategy. Dynamic characteristics of the land-use model with bearing to planning and decision-making are: space, population, human behaviour, projection in time, natural changes, policy impacts and hierarchy.

<u>Modelling of the Trajectory</u>

The basic assumption is that the prime concern of the planner in a district is the trajectory of the comprehensive development by changes in performance of the land-use systems. The definition of comprehensive growth is pivotal to the trajectory theory. Definitions given in the model below are only for illustration.

<u>The State Vector (v)</u>

For any one year the state of the district system as described in a plan survey could be reduced to a state vector v where the time serial would then become:

vo, v1, v2, v3, v4 ... vn (for years t1,t2,t3,t4 ...tn)

Comprehensive Growth Vector (V)

Comprehensive growth can be represented by an arbitrary vector V, being the difference between the state of the system in one year and the state of the system in the following year, thus:

$$V = vo - v1 \ (vo, v1, v2, v3, v4 \ldots vn)$$

where:

V is the comprehensive growth,

vo is the state vector of the system in base year T0,

v1 is the state vector of the system in year T1.

Variables of state vector v are unspecified but include the following:

Gross production

Population

Area of cultivation

Land Resources Balances (quantity and quantity)

space, soil, water, forest, etc.

Fuel consumption/Fuel growth (Afforestation)

Number of land owners

Number of dependents

Number of dwellings (Settlement)

Index of heterogeneity:

Number of large scale farms/enterprises

Number of smallscale farm enterprises

Services available

Quantity of infrastructure

Obsolescence of the land-use system

Trajectory Analysis for Laikipia District

The term "trajectory analysis" is used refer to the utilization of available information to make an evaluative and prescriptive account of past performance and necessary adjustment of a rural development plan. Management of information for planning rests first on the consideration that such use of information is anticipated. Secondly it rests on a dynamic perspective of change in time the application of rigorous deductivism and the validity of the model or the particular theory or concept of regional planning chosen for the purpose.

Principle of Deductivism

"A theory is a general statement about the state of the real world" (McLoughlin, 1969). In other words "a precise statement regarding formal relationships, usually including relationship of cause and effect". In relation to the reality which planning is attempting to manipulate a theory provides the base for valid description, explanation, prediction or prescription, systematically and logically deduced in reference to tested knowledge. A theory reflects relationships of the different elements or components of the phenomenon under observation by the various levels of causality namely correlation, probability or deterministic causality. When detailed information is available theories yielding complex explanations could be possible McLoughlin, 1969). The normal practice of using theory in public decision-making has origins in the classic philosophy, principles and description of scientific methodology. There is a large amount of literature about the principles and roles of inductivism. Deductivism and intuition in science (Medawar, 1969) is normally taken for granted in practice and that at the moment cannot be discussed adequately in the scope of this work. It suffices to say that deductivism or, using Medawar's words "starting from the general to the particular" is the recognized principle of valid decisions. In the words of McLoughlin: "prediction or projection clearly cannot be done in the absence of a theory, or a generalising statement about observations made presently or in the past". From these backgrounds it is accepted as a matter of principle that strategies by which complex systems of people and resources will be organized in the lower circuits of economy and rural development planning require to be proposed on basis of sound theory.

The Theory at The District Level

As stated above the basic assumption is that the prime concern of the planner in a district is the trajectory of the comprehensive growth and change of land-use. Now the job is to analyse the trajectory of Laikipia District as a system. It is assumed that the graph of the trend is representative of comprehensive growth index of the district.

A Hypothesis of Positive Feedback and Morphogenetic Growth

Fig. 6-2 shows the trajectory of comprehensive growth of Laikipia in the period 1900-1990 in a systems view. From the trajectory diagram it can be inferred that Laikipia District in the past thirty years has experienced interactions with positive feedback leading to recognizable morphogenetic growth processes of population increase and diversification of land-use. The following characteristics of growth can be distinguished: (i) period of positive feedbacks and rapid morphogenetic growth; (ii) diminishing returns due to spatial expansion of land-use into thresholds of aridity in ASAL.

Period of Positive Feedbacks and Rapid Growth

It was noted above that during the period of thirty years 1960-1990 land-use in Laikipia District underwent dramatic changes especially the increase in the spectrum of land-use systems, a phenomenon of socio-economic change that was associated with political transfer of resources, particularly land ownership, following independence. It was shown that government planned resettlements were limited to approximately 50,000 hectares in the relatively humid and high potential areas in Central, Ngarua and Rumuruti Divisions. Subsequently private, mainly commercial and co-operative, resettlement projects have handled approximately 200,000 hectares. Major characteristics and differences between the private and government resettlement projects were also noted. On the basis of this data important observations can be made on the overall picture of recent changes in land-use in the district. First it can be deduced that colonial policy imposed limitations to land-use change in Laikipia District before independence. Secondly the post-independence era of land-use change in Laikipia has been characterised by positive feedback and growth from a homogeneous rangeland economy to a pluralistic and heterogeneous land-use spectre. There are four major groups of rural actors in the district at the moment. These are: largescale mainly ranches, pastoralists, smallscale farmers, and landless communities. The latter category includes squatters in ranches, fully employed workers and traders in municipalities, towns and urban centres. Thirdly no major industries have been developed in the district from surplus capital from livestock or other agricultural enterprises of the past decades, and the district seems to remain as a source of meat, grain and wood for consumption and export to other districts.

Period of Diminishing Returns

As land-use intensity expands into semi-arid and then arid zones, factors of resource quality for production especially aridity, and factors of human capital, have become extremely limiting and growth has entered diminishing returns. The trend of diversification and heterogenisation of land-use triggered by transfer and subdivision of commercial ranches into small agricultural plots has reached a climax after which further subdivision will only cause shrinkage of the diverse spectre of land-use and transformation to uniform peasantry.

Spatial Integration And Symbiosis

The degree of interaction and symbiosis between different categories enterprises was not assessed. There is scope to do so as further research work.

Simulation of a Possible Future

Fig. 6-2 shows the historical profile of land-use in Laikipia District between 1900 and 1990. Fig. 6-3 is comparison of land-use economy in the past, current and future based onthe present trend. The method of simple extrapolation is used. In general three distinct scenarios (Fig.7-2) with corresponding sets of implications related to land-use growth and change of Laikipia District can be distinguished: climbing higher, stalling-and-spinning, and levelling off.

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Scenario 1: Climbing Higher

Climbing higher signifies continued growth of population and production characterised by subdivision of estates and crop production. Possibility of this scenario presupposes the natural resource endowment, human capital and technology transfer were unlimiting. In the actual reality of Laikipia District the two sets of factors are in fact the major thresholds constraining rural development.

Scenario 2: Stalling-Spinning and Crashing

This scenario signifies disintegration.

Scenario 3: Levelling off and trimming

Levelling off and trimming signify optimisation or stabilization.

Principle of Development Control

In practice, a cybernetic outlook of controlling society and development is not only untenable but is also repugnant and may not be justified. However, the principle of control in terms of societal guidance (Friedmann, 1981) is a basic aspect of purposive and orderly social change. This can be achieved through legal enactment. The patent debate in present day Kenya is whether it is desirable to do so in order to alleviate absolute poverty and to avert further environmental degradation in ASALs. It may also be necessary for optimisation of land-use.

Optisation of Land-Use by Zoning

Optimality implies there is no conflict. Optimisation is a scientific technique which is used to determine conditions that will result in compromise and balance. The technique has therefore been developed as a tool for decision-making under circumstances requiring control of risks and chance. Spatial optimisation of land-use is possible in Laikipia because of three factors: ecological gradient in the landscape is known; spatial pattern and stratification of land tenure and land-use between the smallscale and largescale or extensive grazing systems enterprises coincides with ecological zones; conflict of smallscale farming with wildlife particularly elephants which are abundant in the semi-arid zone deter cultivation and the Kenya Wildlife Services have already proposed a land-use zoning policy in Laikipia District.

As mentioned earlier Laikipia is a special case of ASAL because of the historical land tenure structure. As the phenomenon of transformation of land ownership and land-use proceed the district offers a rare opportunity for optimal land-use zoning with particular regard to resolution of extant conflicts between enterprises especially agriculture and wildlife conservation, natural ecological gradient and optimal stratification or regionalisation of farm sizes.

Application at the Farm Level

Factors which influence land-use in Laikipia District were considered in chapter four. All the forces which influence land-use in a district are concentrated at the individual farm unit. As a reult a farming system tends to be a complex system of many components and interactions. Defining the objectives of a farming systems requires a systems analysis of the farming enterprise. The state of land-use in the farm is determined particularly by characteristics of the owners in respect to location of residence, main source and amount of income or occupation now and in the past, family size and age structure, farm size, water supply and ecological factors (soil, drainage, climate, etc), available information and technology.

In his discussion of the relationship between man and environment McLoughlin (1969) observed that actions to modify the environment can be seen to derive from responses to the perceived state of the environment immediately before the action is taken. The significance of perception in the settlement and land-use history in Laikipia at the different epochs was explored. Furthermore, it was noted that culturally land-use in smallscale farming is like creative work of art and has complex emotive and cognitive dimensions to it which can be prejudicial to purely economic judgement and decisions of the farmer. Consequently the farmer and the technical expert may perceive farming from different perspectives. In Laikipia District the emotive dimension in owning a piece of land, irrespective of its economic potential may have its basis in the cultural values of the small scale farmers.

The application of optimisation at the farm level is considered as the use of empirical data to reach optimal decision. This can be illustrated by two examples: (i) policy decision concerning minimum farm sizes for the different agro-ecological zones; (ii) decisions concerning the choice of farm practices for higher production and minimum input, such as soil moisture conservation techniques as compared to relatively unfeasible irrigation.

<u>Optimisation of Minimum Farm Size</u>

As was shown in chapter 4 that farms in the ASAL of Laikipia District occur in different sizes. The main concern is about the optimal size of an agricultural farm unit for an average family unit in various zones of different ecological potential, that could be specified for official adjudication and registration of agricultural land in the ASAL. It was noted in earlier that in the colonial settlements demarcated before 1960 the smallest ranching units comprised about 1200 Ha (3000 acres) in the best land in the district especially in the relatively high potential areas of Marmanet and

Nyahururu. In Government planned resettlement schemes demarcated after 1960 farm size ranged from 2 Ha (5 ares) to 8 Ha (20 acres) for smallscale farming in the relatively potential areas of agro-ecological zone 3. In the privately planned resettlements, especially the newer ones, the modal farm size in agro-ecological zone V is 0.8 Ha (2 acres) as exemplified by settlements in Wiumiririe, Matanya, Mwireri, Ol Moran, etc. Farm practices described for farm sample numbers 27, 18 and 17 demonstrated that the minimum farm size required for survival and sustainable technological adaptation in the Kalalu area (zone IV) for an average family was 2 Ha (5 acres). Surplus for investment can be expected to acrue from 8 Ha (20 acres) in this zone. From an economic point of view it is emphasized that a farmer having 0.8 Ha (2 acres) and another farmer having 8 Ha (20 acres) in these general conditions live in very different standards or worlds far apart. It can be concluded that farm sizes cause the main factor of socioeconomic stratification of the population in small scale farms.

Agricultural Farm Practices

Three classes of successful crop farming by adjustment of the crop calendar and other extra-ordinary methods were noted in chapter four. They included (a) reliable maize yields in Kihato-Gia-Ichagi near Naromoru (b) double cropping of maize by flood irrigation in Thome-Marura near Rumuruti (c) all-season production of horticultural crops by overhead irrigation in Murera. Whereas the farmers in sample farms numbers 27 and 18 demonstrated optimisation in terms of the farm size (space) the former optimized by application of technology. Meanwhile agro-ecological experiments carried out by Liniger (in print) at Kalalu and Matanya demonstrated that use of mulching guaranteed yields of maize in drought conditions when farms without irrigation or mulching faced a general crop failure. Different situations will require optimisation strategies specific to their resource endowment and human conditions.

CHAPTER 9. CONCLUSION

The District PIS Model

The objective of this thesis was to design and demonstrate a model of planning information system for use at district level assuming the paradigm of decentralisation was the basis of Kenya's District Focus strategy. In chapter four procedures of gathering and managing information for planning at the district level were demonstrated. In chapter seven a district PIS model was brought into perspicacity and assigned a framework and data based on the relationship between rural people, land and activities. The conclusion of the thesis attempts to synthesize and summarise the various points of the total experience and demonstrations in the foregoing chapters, to show that the district PIS model is technically superior and feasible. In total the conclusion is that thesis has realized the objective which it set out to achieve.

Besides designing the district PIS model the thesis has produced a considerable wealth of new information about Kenya's District Focus strategy and the state of land-use and lessons learnt from settlement history of Laikipia District in the 20th century. This knowledge should reach the actors at various levels now and in future. The conclusions given below include: a critical evaluation the District Focus noting problems which can be anticipated at the implementation stage of the model in Kenyan conditions; the distinctive charactristics and superiority of the district PIS model in comparison to other existing models.

Scope of Application in Kenya's District Focus Strategy

The study revealed that Kenya's District Focus strategy, even though it is called decentralisation, is deconcentration (Coralie et al, 1976). Structurally it is an administrative matrix arrangement by which the central government manages to penetrate the periphery by delegating work to be done at local level under the supervision of middle and lower level administrators. Little or no devolvement of substantial powers of decision-making has occurred although it adds to the pivotal importance of District Commissioners who manage the interface between rural population and the central government. Relationships within District Focus organization remain strongly hierarchical and authoritarian. Unlike County or Municipal Councils, DDCs have no autonomy or important discretionary powers for authority to hire professional staff or for statutory approval of new plans. While it might have improved the effectiveness or efficiency of delivering services to the people, the concern of the District Focus impetus must have been to devise a more ramifying network of stations for delivery and control of the periphery by the centre. It is certain that the central government has retained or even strengthened the total control on rural development planning. All these indices reveal and help to differentiate District Focus as deconcentration from decentralisation.

Major structural limitations to the utilisation of information for planning at the district level were found. When a model of planning information system was initially conceived it was assumed that Kenya was politically committed to the decentralisation paradigm or strategy whereby power is devolved to relatively autonomous units undertaking planning and making important decisions at district level. With the above assumption District Focus strategy was envisioned as a system in which power was transferred from the centre to districts for effective decisions to enable people to take advantage of opportunities revealed by good knowledge of local ecological resources. In that view, the model of planning information system would provide an appropriate framework for utilizing information to make implementation of the strategy operationally effective and efficient in accelerating rural development. These assumptions were contradicted by findings of the assessment of the use of information in the current District Focus planning in the district case study.

Therefore, under Kenya's District Focus strategy, Planning at the district level is incapable of effective utilization of research information for accelerated or equitable rural development. This is primarily because of lack of autonomy from the central government. The argument is not that individual sectors or ministries cannot collect and use of information for the purposes of routine management decision-making at district level. Rather it means that issues touching on fundamental policies can only be resolved by decisions in the ministerial headquarters in Nairobi.

The DIDC was developing as a low keyed library (servicing school students) rather than the expected planning information system. It might become too static and limited for effective mobilization of information for purposes of accelerated rural development activity. Although rather inefficient the Training and Visiting (T&V) of farmers by the Ministry of Agriculture was designed on a diagnosis and therapy model.

Even if District Focus utilized research information to identify the needs, the DDC lacks adequate financing for priority development projects. Furthermore it lacks means of ensuring re-investment of local savings in the district. It lacks legal autonomy to instituting innovations such as work-in-lieu-of-tax for members of the local communities. It also lacks effective ways of preventing transfers of funds from rural areas to metrocenters or attracting funds for rural development from metrocentres to the district by reversing the adverse terms of trade between rural farmers and city populations. Owing to lack of financial resources and autonomy to generate data for planning developmental interventions at district level, using diagnosis and therapy principles is usually not possible or realistic. These observations indicate that besides weak instrumentation District Focus is also beset with policy limitations. The authoritarian management style of district administrators as chairmen of DDCs is not sustainable without the political goodwill on which District Focus is totally dependent. Especially for the latter reasons, District Focus is incompatible with participatory approaches. Lacking a provision for participation of business and property owners decision-makers may have no sense of the personal, hence it is not sustainable.

Systematic communication of development information in the public at grassroot level is limited. Great reliance is made on verbal pronouncements in official barazas held occasionally by DC's and Chiefs. As these barazas have limited attendance by actors at grassroot level, especially those working away from home. Therefore many people never receive the official messages hence their scope of response and participation in further developments is limited.

Authoritarian Management

District Focus management is often rudely authoritarian. The DDC chairmen who, as administrators are the most powerful actors at the district level, often abhor criticism and deal intolerantly with suggestions of alternatives. Most decisions made in the DDC, DEC and sub-DDCs pass without democratic dialogue or consensus as many officers refrain from commenting for fear of provoking the wrath of the chairman. Thus ignorance is institutionalized by the DDCs through management to the risk of those affected by decisions. The PIS model will institutionalise knowledge and transparency. Since members are only senior politicians and government officers of district rank the DDC is a forum foreclosed to participatory practice. Planning in District Focus lacks mechanisms for genuine advocacy or appeal even in cases of dispute of decisions made by the DDC. The thesis provides for independent chairmen of DDCs, participation of NGOs and local interest groups

Preoccupation With Project Development

District Planning concentrates on formal projects with

specific objectives, election of project committees and budgeting. There is risk of minor improvements that could be handled by on-going service programmes under recurrent expenditure of ministries becoming neglected until a project can be created.

Project Evaluation: Risk of Antagonism

In the current district planning system monitoring and evaluation lack clearly defined objectives, methodology, timing and responsibility and they are inadequate. Attempts at evaluation by the DDC tend to be sensitive an risky undertakings as suspicion and antagonism start cropping up if project implementors of projects under scrutiny view the statements of success or failure as biased.

Prerequisites for Implementation of PIS Model in Kenya

District PIS offers a developmental path to a new future of rural development management systems at district level in Kenya with the following provisos:

1. Legislation for Community and Neighborhood Action:

Create new legislation for community and neighborhood action with a provision for a District Development Committe with an elected Chairman as the highest forum for voluntary community based activities at district level.

2. Utilization of Information for Plans and Vetoes:

In that form DDC the central government administrators and other officers will function not as chairmen but as planners and advisors with responsibility of preparing plans and controlling project development by veto. That is provided the veto power will be exercised only in the interests of the nation or environment. For instance a veto might be warranted if despite advice to the contrary decision is made approving implementation of a major irrigation project in the catchment area of an upstream district while there is evidence of drastic consequences affecting downstream users of the river. Similary, there will be provision for local people to veto extirpation or abuse of natural resources in the district without approval by the DDC and guaranteed benefits to the local communities.

3. <u>Project Development:</u>

The DDC will have discretionary powers based on community mandate to make and consider written project proposals for approval in the district forum, and where necessary to hire and fire project-specific staff as specified by approved proposals.

4. <u>Participation:</u>

Provide for participation of NGOs and legally recognized special interest groups in the DDC so as to maximize equity.

5. <u>Responsibility for Implementation and Evaluation:</u>

Central government administrators will implement, supervise and evaluate both the rural development projects sanctioned from below by DDC and those sanctioned by the government.

Concluding Observations on the District PIS Model

The thesis has elucidated the empirical district PIS model which is an abstraction of the socio-economic and ecologic reality and changes in a district. Thus the status of rural land-use systems could be captured into a framework of district planning information systems based on the land-use systems framework. The district PIS model thus provides for observation, analysis and articulation of cause and effect relationships for management of change at district level. In the land-use systems framework rural phenomena, change and various levels of causality can be hypothesized, studied, tested or proven for greater validity of description, explanation, prediction and intervention for accelerated development. The model is consistent with the theory of general systems for organizational development.

With a land-use systems approach in the district PIS model emphasis is laid on getting valid scientific insight of resource potentialities and the management factors. Plans start with the farm as the smallest unit and the farmer as the smallest prime actor. From the farmer then comes the household and the community, and then comes the gender issues at the household and community levels. Changes in the system in reference to long term goals and resource inputs are defined by the trajectory of growth which planners must use to draw short term objectives and to prescribe adjustments for attainment of goals.

It is invariably important to emphasize issues, questions and variables of human population, resources and interactions that need to be taken into account when appraising projects in rural development planning at the district level. These issues, and how they can be generated, were discussed in thesis. Proper choices could be made and major mistakes, conflicts and destruction averted by utilization of specific information about population and resource levels. Since the district PIS model emphasizes enhancement and achievement of the full potential and sustainability of the land-use system it is important for planners to consider the knowledge of local actors or indigenous strategies and capacities for overcoming problems.

The underlying concept is that when the district PIS model is operationalised, the prime concern of the planners at the district level is to evaluate the present and possible development scenarios. They can then prescribe interventions which are adaptive to local conditions (social and economic conditions, ecology, technological capacity, etc) for sustainability. Hence all change, whether slow, gradual or dramatic will, in the long term, depend and reflect local people's solutions, character and aspirations achieved through the use of the PIS model rather than fate of political expediency as Laikipia District is today. Another underlying value of the district PIS model is that strategies of arbitrary translocation of technology may create too high expectations and frustrations in rural development efforts as they have done in Asia. The result is the phenomenon of *dualistic dependency* (Friedmann & Douglass, 1975).

Limitations should be mentioned at this juncture. The first one is the deliberate disregard of information because of hypocrisy and interests for uncontrolled commercial exploitation of resources for profit motives as in the case of land property and forests. The history of land-use in Laikipia District shows how political expediency and commercial decisions, motivated by profit for a few individuals exploiting the masses, ignored objective information and might continue to do unless rational practices were adopted. Examples were given as the case of Masai eviction from Laikipia in 1911 which gave room for European settlers; resettlement of Dorobo Masai in arid area of Mukogodo in 1934; the repatriation of Kikuyu families during the Mau Mau war; the failure to plan settlements and peasantization of ecologically marginal lands which is spearheaded by profit seekers.

Costs

In discussion of the PIS for district planning in a developing country such as Kenya, critical consideration must be made of costs. Generally the lack of resources may prohibit the application of the PIS if it is based on high cost hardware and sophisticated software. The answer to this concern is that in the final analysis, costs of a district information system for rural development planning are not major in comparison to colossal opportunity costs of project failures, famine relief, unemployment and underemployment of human resources and the continuous loss and disintegration of land, water soil, forest and wildlife resources. The constraint could be overstepped by choice of appropriate equipment. PIS has characteristics of a sophisticated expert system but only if too much emphasis is laid on the use computerised GIS systems, which in fact is an option. There is the likely danger that the local people participating in the experiments may be fatigued, frustrated becoming dissentful and unco-operative owing to unreasonably high demands imposed on their time of without any real benefits accruing to them. The answer to this concern is to make the entire planning cycle participatory so that from the first step the district PIS program is executed in partnership with the entire rural population in the district. Initially it may start with willing communities in small pilot areas. There is also need to further examine costs by actual feasibility study which cannot be covered in this thesis.

Cybernetic View:

The must be concern on the inherently cybernetic view of control of a district social system which is implied in certain parts of the argument in this thesis. The answer to this concern is that to some extent the cybernetic approach is justifiable in this case on purely heuristic basis. On the other hand projects concerning recovery, rehabilitation and settlent land reform in ASAL areas such as Laikipia might have to depend on creating mass awareness of the need of strict discipline.

(b) <u>Findings Specific to Laikipia District</u>

<u>Rural Structure and Trends</u>

Laikipia, the case study District, is a classic example of areas affected by historic abuses of political power and deprivation of resources to indigenous people to eventual famine and environmental degradation. Now the DDC is content with distributing famine relief supplies to Mukogodo pastoralists and the smallholder settlers and squatters in recent spontaneous settlements near Rumuruti and Timau. But the continuing spillover of population and trend of dynamic changes in the ASAL district in the past thirty years is not sustainable. PIS could help to elucidate this tragical situation, and prescribe strategically radical intervention for change in land-use, which the present DDC is incapable of devising without power and information-using decision framework.

Ecologically Laikipia District is characterised by a steep environmental gradient caused by transition between the high, cool and humid mountains in the south and the low, hot and drier arid and semi-arid lowlands in the north. The gradient creates definite physical thresholds for land-uses which depend on water including settlement and agriculture. The vegetation of the area varies with altitude and climate from upland dry forests of Juniperus, Olea and Euclea. a matrix of Acacia bushlands, pure grassland to bare rocks on scarps, kopjes and dry sandy riverbeds. Its has a zonal character conforming and reflecting the overall ecological gradient. Because of the wide biotic spectrum and diversity of the vegetation in the district Laikipia ranches offer a favorable habitat for a wide range of wild animals which occur in great abundance. Extensive grazing by semi-nomadic pastoralism and commercial ranching are the principal land-uses. Inevitable conflicts between wildlife and private land-use constitute a planning problem of major importance.

Currently the socio-economic pattern and dynamics of land-use in Laikipia District are influenced by a population consisting of three distinct actor groups, unlike in the past when pastoralists or ranchers existed alone. These are the land owners (semi-nomadic pastoralists, ranchers mainly European origin, small scale farmers (agropastoralists), governmental and non-governmental agencies including commercial business and land-buying companies. These groups are described in detail in the thesis.

The district PIS model provides for inventorisation and monitoring of these ecological and socio-economic attributes. For instance the population of small scale farmers in Laikipia is not homogeneous in regard to farm size, location in ecological zone, capacity, etc. For purposes of targeting technological interventions it can be stratified further into classes differentiated by farm size. Farm classes were: <1 Ha, >1 <2 Ha, and >2 <8 Ha. Different farm sizes were found to behave differently in adoptation of farming practices particularly in planting and sequencing of different crop varieties. The risk factor and the performances were influenced by the different farming practices. In general the data shows that several distinct classes of farming systems are telescoped at the lowermost end of the spectrum of farm sizes from 0 to 8 Ha (20 acres) which encompasses the majority of small scale farmers in Laikipia. This finding has implications for extension work especially for selection of target groups of smallscale farmers for purposes of farmer training in T&V system of extension services. These findings corroborate the farm classification data given by the Farm Management Handbook.

Interventions to Stabilize Land-Use Trends

In the last three decades change in rural land-use in Laikipia District was characterised by morphodynamic growth typical of a positive feedback model. From relative uniformity or homogeneity that prevailed in Laikipia District at the beginning of the century when colonial settlement took effect, and also in the 1960s, the heterogeneous spectrum of land-use systems represents considerable morphogenetic growth. Heterogeneity signifies that a process of positive feedback characterised rural change in the post-independence period. Population increase was accompanied by increasing heterogeneity, diversification and complexity of land-use systems. With the complex pattern of change it is not possible to divorce the present from the past but it is difficult to predict the future from the present. The whole district system is now at the climax of diversity and growth and theoretically the present combination of land-use systems should be optimised at any opportunity. After jumping the ASAL threshold the process and rate of positive growth seems to have entered a phase of diminishing returns. The current and future trend of growth is a scenario towards a down climax returning to a homogeneous peasantry in ASAL, acute degradation, economic obsolescence and entropy. Laikipia is well placed to choose a policy of land-use optimization now or it could enter a 'stall-spin' crisis. The other alternative is to pay for high technology.

Farming Systems Strategies

Crop calendars adopted by smallscale farmers show remarkable adaptation to the annual rainfall regimes. As noted earlier, the most remarkable differences in crop calendars were observed between Kihato Gia Ichagi settlement and the neighboring Matanya settlement. Kihato Gia Ichagi adopts the strategy of short rain maize crop which is characterised by 95% low-but-sure yields while Matanya adopting a long rains strategy for their principal maize crop is characterised by 75% crop failure. The district PIS model provides for stratification of treatments on community boundaries.

PIS Model: The Best Way Forward

The historical background shows clearly that political will and regimentation are the factors that has played the greatest role in generating the present pattern of reality in Laikipia District in the 20th century. Hence the present pattern cannot be blamed entirely on the lack or poor rural development planning in District Focus. Forceful political interventions restricted the local communities and owners of the land from participating in decisions that affected them and from access to the resources. But District Focus is contributing to perpetuation and deterioration of situation. The latter is the most cogent basis for suggesting the district PIS model is the best way forward to gaining broad based knowledge awareness and intervention.

Recommendations of Further Research

The district PIS model is a tool for which there is a lot more to be done. The following are some of the areas requiring further PIS-related studies.

Feasibility Study of District PIS Model

Further work is required to elaborate concept and procedures of the district PIS model. Many grey and black boxes have been left in the thesis. Immediate attention should be paid specifically to a checklist and thesaurus, costs in terms of a feasibility study for implementation of the model with specified modes of monitoring, dissemination and storage and utilization of information at district level.

Farming Systems Land-Use Studies

Comparative studies of lans-use and farming systems should be carried out focusing on spatial and farm size optimisation for different ecological zones and defined adaptive technology levels. Special attention should be paid to factors influencing the use and non-use of ox-ploughs. A study of existing crops should be done to characterise them into crop groups according to their agreoecological selectivity by duration of maturity and water requirements to assist farmers in adaptation.

Wildlife Utilization Studies

Laikipia District has abundant wildlife resources that require special attention paid to them with a view on innovations that could enhance economic potential for further development. Optimal levels of utilization consistent with long term conservation require to be determined, implemented and monitored.

SUMMARY

Besides the district PIS model, perhaps the other main result that has been achieved in this study is calling to the fallacy of decentralisation in Kenya's District Focus strategy. It was concluded that DF is a deconcentration strategy practised through a matrix organization of officers at the middle and lower levels. For the purposes of thesis deconcentration is a bluff, and an irrelevant paradigm, but attention is called to its existence and practice. The district PIS model we have described in this thesis is not identified or applicable with deconcentration but with true decentralisation.

As noted in literature review, one of the best known models for planning at district level is the agropolitan district or city-in-the-fields model of Friedmann and Douglass (1975). It was promulgated for the purpose of achieving accelerated rural development and as an alternative to the model of growth poles and growth centres (Kuklinski, 1972) which had failed to deliver, especially in the Asian countries. The model is based on the concept of developing a *city-in-the-fields* in a district by introducing elements of urbanism to specific rural settings. The assumptions of this model limit its application to specific conditions and level of rural development which cannot be presumed for many districts in Kenya. More significantly it is dogmatically urban oriented in outlook and lacks a conceptual framework appropriate to primal conditions and the needs for adaptation, flexibility, diversity of production and synergies of rural development.

It is evident that the district PIS model described in this thesis is superior to well known models of rural development planning at district level and that it has the potential for application under very diverse conditions.

Finally, the fact that only recently FAO embarked on a Development Planning Manual shows that in fact the problem of rural development planning methodology is still a valid agenda at the international level.

The overall conclusion is that the hypothesis which was stated at the end of chapter three is confirmed.

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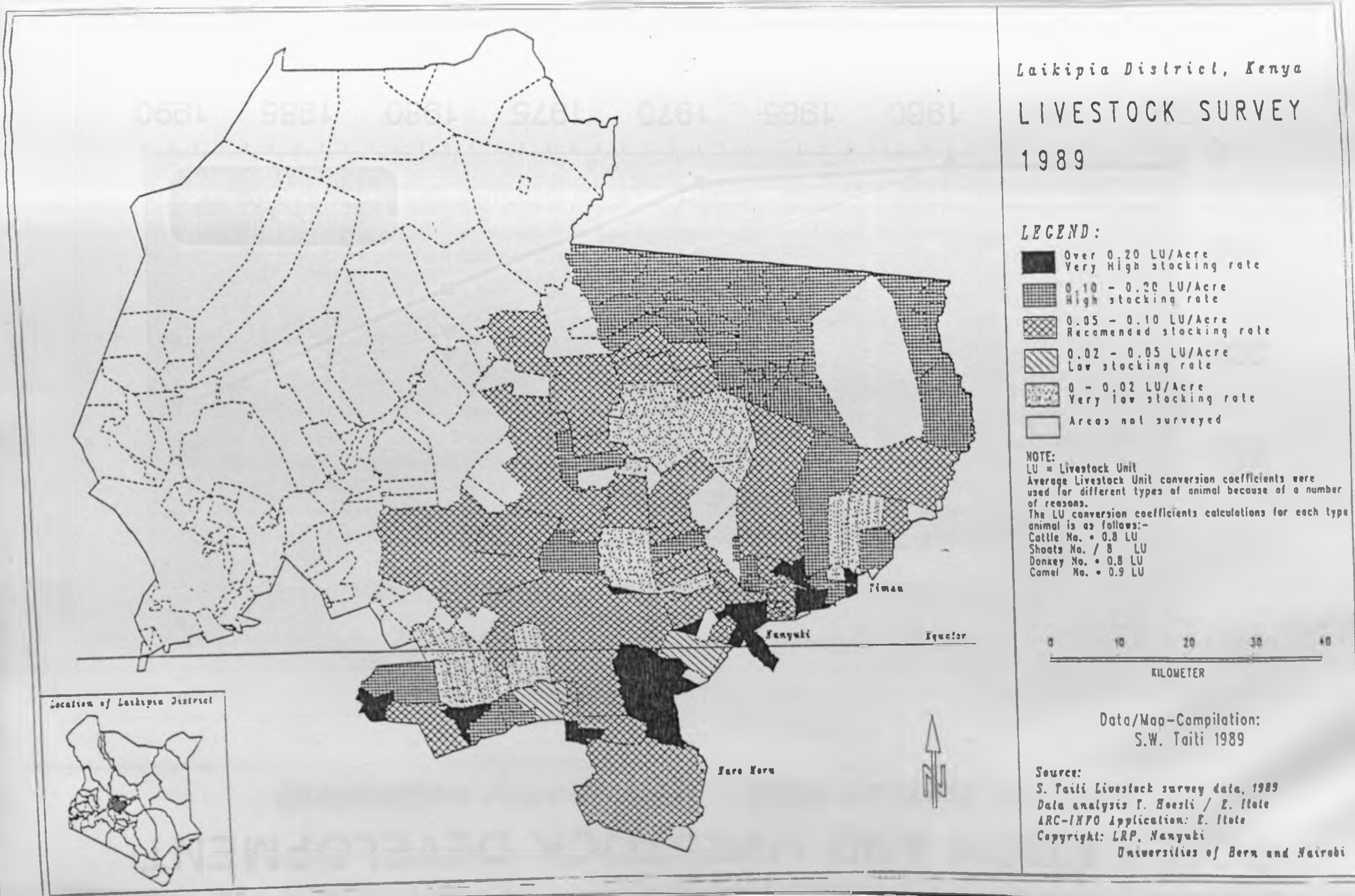
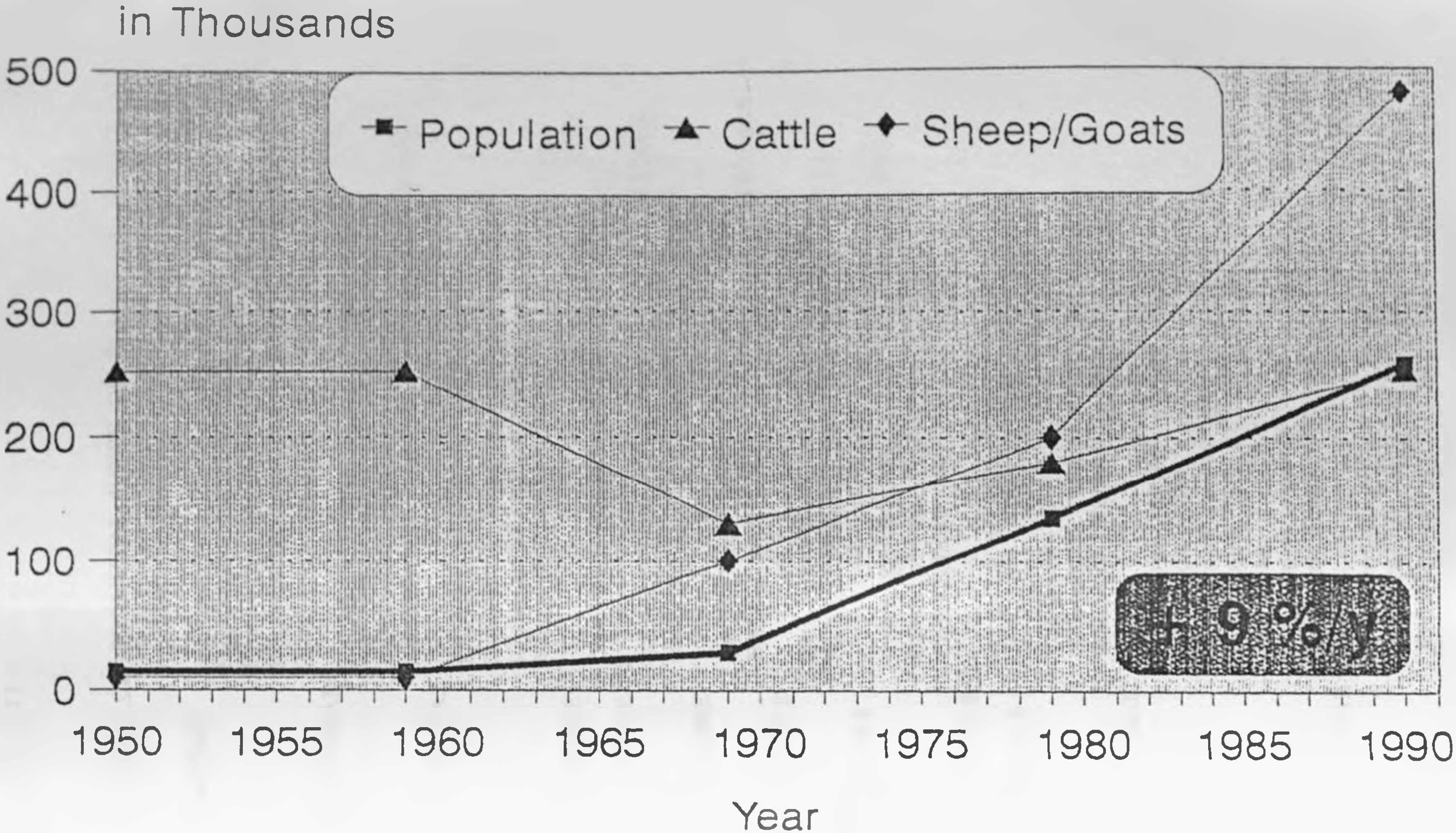
APPENDICES



Laikipia District, Kenya
LIVESTOCK SURVEY
1989
LEGEND:
Over 0.20 LU/Acre
Very High stocking rate
0.10 - 0.20 LU/Acre
High stocking rate
0.05 - 0.10 LU/Acre
Recomended stocking rate
0.02 - 0.05 LU/Acre
Low stocking rate
0 - 0.02 LU/Acre
Very low stocking rate
Areas not surveyed
NOTE:
LU = Livestock Unit
Average Livestock Unit conversion coefficients were used for different types of animal because of a number of reasons.
The LU conversion coefficients calculations for each type animal is as follows:-
Cattle No. • 0.8 LU
Shoats No. / 8 LU
Donkey No. • 0.8 LU
Camel No. • 0.9 LU
Timau
Nanyuki
Equator
Naro Moru
Location of Laikipia District
0 10 20 30 40
KILOMETER
Data/Map-Compilation:
S.W. Taiti 1989
Source:
S. Taiti Livestock survey data, 1989
Data analysis T. Hoesli / E. Ilote
ARC-INFO Application: E. Ilote
Copyright: LRP, Nanyuki
Universities of Bern and Nairobi

POPULATION AND LIVESTOCK DEVELOPMENT

Laikipia District 1950 - 1990 (partly estimated)



APPENDIX III

A CHECKLIST OF BOTANICAL NAMES OF PLANTS OF LAIKIPIA DISTRICT

ACANTHACEAE
- Barleria acanthoides CB. Cl.
- Barleria spinisepala E.A. Bruce
- Hypoestes verticillaris (l.f.) Roem cf. Scult
- Justicia exigua S. Moore

AMARANTHACEAE
- Cyathula polycephala Bak.
- Puppalia lappacea (L.) Juss.
- Sericocomopsis hildebrandtii Schinz

ANACARDIACEAE
- Lannea floccosa Sacleux
- Ozoroa reticulata (Bak f.) Engl.
- Rhus natalensis Krauss.
- Rhus vulgaris Meikle

APOCYANACEAE
- Carissa edulis (Forsk.) Vahl

ASCLEPIADACEAE
- Gomphocarpus integer N.E.Br. Bullock
- Gomphocarpus stenophyllus Oliv.

BALANITACEAE
- Balanites aegyptica (L.) Del.
- Balanites glabra Mildbr. cf. Schlecht.

BORAGINACEAE
- Heliotropium steudneri Vatke
- Heliotrpium sublatum DC. Martelli

BURSERACEAE
- Commiphora africana (A. Rich.) Engl.
- Commiphora samharensis Engl.
- Commiphora sp.

CAESALPINACEAE
- Cassia didymobotrya Fres.

CAPPARACEAE
- Capparis fascicularis DC.
- Capparis tomentosa Lam.
- Maerua triphylla A. Rich.

CELASTRACEAE
- Maytenus arbutifolia (Hochst. ex A. Rich.) Wilcock
- Maytenus heterophylla (Eckl cf Zeyh.) N. Robem
- Maytenus putterlickioides (Loes.) Exell. cf. Mendoza
- Maytenus senegalensis (Lam.) Exell.
- Mystroxylon aethiopicum (Thumb.) Loes.

COMBRETACEAE
- Combretum molle G. Don.
- Combretum heteroense Schinz.
- Terminalia spinosa Engl.

COMPOSITAE
- Aspilia pheriseta Schweinf.
- Aspilia pluriseta Schweinf.
- Gutenbergia reppelli Sch. Bip.

Helichrysum glumaceum DC.
Kleinia kleinioides (Sch. Bip.) M.RF. Taylor
Osteospermum vailantii (Decne) Norl
Psiadia punctulata (DC) Vatke
Tarchonanthus camphoratus L.

CONVOLVULACEAE
Ipomoea tenuirostis Choisy

CRASSULACEAE
Kalanchoe citrina Schweinf.

CRUCIFERAE
Brassica rapa L.

CUPRESSACEAE
Juniperus procera Engl.

CYPERACEAE
Cyperus amouropus Stendel
Cyperus dentatus Linn. f.
Cyperus immensus C.B.Cl.
Cyperus teneriffae Poir
Cyperus tomaiophyllus K. Schum.
Kyllinga alba Nees

EBENACEAE
Euclea divinorum Hiern
Nuxia congesta Fres.

EUPHORBIACEAE
Acalypha sp.
Bridelia micrantha Baill.
Croton dichogamus Pax
Euphorbia crotonoides Boiss
Phyllanthus fischeri Pax
Phyllanthus maderaspatensis L.
Phyllanthus sepialis Mwell. Arg.

GRAMINEAE
Andropogon pratensis Hack.
Aristida adoensis Hochst.
Aristida ? adoensis
Aristida adscensionis L.
Aristida kenyensis Henr.
Bothriochloa insculpta A. Camus
Cenchrus ciliaris L.
Chloris gayana Kunth.
Chloris roxburghiana Schult.
Chloris virgata Sw.
Cynodon dactylon (L.) Pers.
Cynodon plectostachyus (K. Schum.) Pilger
Cymbopogon pospichilii (K. Schum.) C.E. Hubbard
Cymbopogon casius
Digitaria abyssinica Stapf.
Digitaria milanjiana (Rendle) Stapf
Echinochloa haploclada (Stapf) Stapf
Enneapogon cenchroides (Roem. cf Schult) C.E. Hubbard
Enneapogon schimperanus (A. Rich.) Beauv.
Eragrostis barrelieri Daveau
Eragrostis heteromera Stapf
Eragrostis superba Peyr.
Exotheca abyssinica T. Anders.
Harpachne schimperi A. Rich.
Heteropogon contortus Beauv.
Hyparrhenia cymbaria (L.) Stapf.
Hyparrhenia filipendula (Hochst) Stapf.

Leptocarydion vulpiastrum (Denot.) Stapf.
Lintonia nutans Stapf.
Loudetia arundinacea (A. Rich.) Steud.
Loudetia flavida (Stapf.) C.E. Hubbard
Loudetia kagerensis (K. Schum.) Hutch.
Microchloa kunthii Desv.
Panicum maximum Jacq.
Pennisetum catabasis Stapf. cf. Hubbard
Pennisetum mezianum Leeke
Pennisetum schimperi A. Rich.
Pennisetum squamulatum Fresen.
Pennisetum stramineum Peter
Rhynchelytrum repens (Willd.) C.E. Hubbard
Setaria caudula Stapf.
Setaria phleoides Stapf.
Setaria pumila (Poir) Roem. cf. Schult.
Setaria sphacelata (Schumach.) Stapf. cf. Hubbard
Sporobolus festivus A. Rich.
Sporobolus fimbriatus (Trin.) Nees
Sporobolus pellucidus Hochst.
Themeda triandra Forsk.
Tragus barteronianus Schult.

HAMMAMELIDACEAE

Trichocladus ellipticus Eckl. cf. Zeyh.

LABIATAE

Becium sp.
Leucas calostachys Oliv.
Ocimum kilimandscharicum Guerke
Stachys hildebrandtii Vatke
Tetradenia riparia (Hochst.) Codd.

LILIACEAE

Asparagus falcatus L.

MALVACEAE

Dombeya rotundifolia (Hochst.) Plach.
Hibiscus fuscus Garcke
Hibiscus fuscus Garcke (Purple flowers form)
Hibiscus greenwayi Bak. f.
Thespesia danis Oliv.

MELIACEAE

Melia azaderach L.

MIMOSACEAE

Acacia abyssinica Benth.
Acacia brevispica Harms
Acacia drepanolobium Skpestedt
Acacia elatior ssp elatior
Acacia gerrardii Benth.
Acacia hockii De Willd.
Acacia mellifera (Vahl) Benth.
Acacia nilotica (L.) Del.
Acacia reficiens Wawra ssp. misera Vatke Brenan
Acacia senegal (L.) Willd.
Acacia seyal var. seyal
Acacia tortilis

MYROTHAMNACEAE

Myrothamnus flabellifolius (Sond.) Welno

MYRTACEAE

Syzygium guieense (Willd.) DC.

OLEACEAE

Jasminum fluminense Vell.

Olea europaea L. ssp. africana

PAPILONACEAE

Erythrina abyssinica DC.
Indigofera trita Taub.
Indigofera volkensii Taub.
Medicago sativa L. (cultivated)

PROTEACEAE

Faurea saligna Harv.
Protea kilimandscharica Engl.

RHAMNACEAE

Rhamnus staddo A. Rich.
Scutia myrtina (Burm. f.) Kurz.
Ziziphus mucronata Willd.

RUBIACEAE

Canthium phyllanthoideum Baill.
Kohantia caespitosa Schinz.
Pavetta assimilis Sond.
Pentanisia ouranogyne S. Moore
Tarenna graveolens (S. Moore) Brem.
Vangueria infansta Burch

RUTACEAE

Clausena anisata (Willd.) Benth.
Teclea nobilis Del.
Teclea simplicifolia (Engl.) Engl.
Zanthoxyllum macrophylla (Oliv.) Engl.
Zanthoxyllum usambarense (Engl.) Kokw.

SAPINDACEAE

Dodonea viscosa Jacq.
Haplocoelum foliolosum (Hiern) Bullock
Pappea capensis Eckl. cf. Zeyh.

SCROPHURALIACEAE

Bartisia abyssinica (A. Rich.) Benth.
Pseudosopubia hildebrandtii Engl.

SOLANACEAE

Solanum incanum L.
Solanum indicum L.
Solanum hastifolium Dunal

THYMELACEAE

Struthiola thomsonii Oliv.

TILIACEAE

Grewia similis K. Schum.

VERBENACEAE

Lantana trifolia L.
Lippia ukambensis