AI

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FINAL REPORT ON THE IMPLEMENTATION OF THE INTEGRATED PROJECT ON ARID LANDS PHASE III

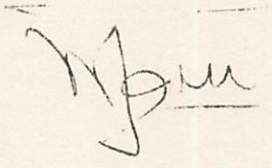
(1 July 1980 - 30 June 1984)

by

W.J. Lusigi
Project Co-ordinator

ACKNOWLEDGEMENTS

I would like to take this opportunity to thank those who contributed in every way to the success of this phase of the programme. I would like especially to acknowledge invaluable support received from the Federal Republic of Germany, the Government of Kenya and UNESCO.



Dr. Walter J. Lusigi
Project Co-ordinator

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TERMINAL REPORT ON THE IMPLEMENTATION OF IPAL PHASE III

1st July 1980 - 30 June 1984

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1. GENERAL. W.J. Lusigi - Project Co-ordinator

This terminal report of the Integrated Project on Arid Lands (IPAL) is the final report on the implementation of the project in its third phase which lasted four years, beginning 1st July 1980 and ended 30th June 1984. It summarises information contained in six progress reports prepared during this phase. For ease of reference and consistency, this report follows the format of the progress reports with additional sections to cover evaluation of the projects performance in the period under review. The project's progress reports and publications should be consulted whenever possible for any needed details. In addition to project overall objectives and results, the objectives and results of each project activity or component are presented separately. The appendixes contain further information that helps to clarify various aspects of the report.

A. Priorities and Objectives.

A first priority of the project in its third phase was to bring back under one umbrella the scientific co-ordination and administration of the former Traditional Livestock Management Project (TLMP) and IPAL. These two programmes which had been conceived as on project had due to various reasons fallen apart and were functioning separately. A second priority was to clear the backlog in the analysis and reporting of the projects work in its second phase. Thirdly a major priority in this phase of the project was to close the gaps that existed in the projects research data and to re-orient the project towards synthesizing the results to produce resource management guidelines for the area.

Long term objectives

1. To seek solutions for urgent environmental and sociological problems associated with ecological degradation and desert encroachment: (a) through research to understand management-oriented interactions between man and his arid environment; (b) through training and orientation in resource management technique associated with project studies.

2. To investigate all aspects of human ecology and social organization which pertain to traditional land use of the arid rangelands and which may contribute to beneficial changes in their management.

3. To investigate alternative forms of economy and land use consistent with the sustained health of the human environment.

Short-term objectives

1. To observe and record plant and animal ecology in relation to their use by pastoral man; to record the main factors relating to human ecology, particularly as they are influenced by climate; to synthesize these ecological data in the form of useable management models.

2. As part of a world network of research centres in arid zones, to institute a long-term, easily-administered monitoring framework, capable of recording key parameters of importance to man's use of the desert, and co-ordinated with other Kenyan development needs and bodies.

3. To institute training courses in applied arid zone ecology and management at both professional and technical levels.

4. To co-ordinate IPAL programmes with Government extension officers working in the district, and to provide support in the form of information from research and other IPAL sources which these officers need to effect improved management practices.

Structure of IPAL Phase III

In order to meet the objectives of IPAL, a multidisciplinary research programme was designed to focus on the following:

1. The Human Ecology component
2. The physical Environment component
   - Climatology
   - Geomorphology
   - Hydrology
   - Soils
3. The vegetation component
   - Range Ecology component
   - Woodland Ecology component
4. Livestock Studies component
   - Animal production component
     Sheep, goats and camels.
   - Animal Ecology component
     cattle.
5. Education, Training and Extension component.
6. Data processing and analysis unit.
7. Project Administration.

This structure follows the recommendations made by the joint government of Kenya, BMZ and UNESCO evaluation Mission in February 1980. As regards the terminology of the components/expert posts, it was necessary to take into account the denominations of the established posts (IPAL Phase II). Human Ecology, Geomorphology, Hydrology, Soils, Range Training and Extension, Data processing Units were new components started in Phase III as the limited resources of Phase II did not allow studies on these important components to pastoral activity to be included.

It was not the approach of IPAL to study Man, Vegetation and Livestock in isolation. Obviously the aim was rather to understand better and improve the Man/environment system. Close collaboration, Co-ordination and integration needed, therefore, to be assured through the function of the Project Co-ordinator. His role would have been, however, an almost impossible one without a readiness of all scientist members of the project to make constant team work a daily task and to provide constant feedback between the component programmes.

A project of this size, working in an area with extremely great logistic difficulties needed a high level Administrative Officer operating under the instructions of the Project Co-ordinator.

B. Project Professional Staff, Consultants Fee Contractors and Graduate Assistants.

Mention has already been made of the significance of co-operation among the project staff. The projects staff team at all levels was indeed a key factor in achieving of the projects results in fulfilment of the set objectives IPAL's research team was composed of seven full time professionals supported by two short term associate experts and twenty four consultants. The full time experts who covered the full range of the projects major components ensured continuity in the field studies. The need for expert and consultant support in the different areas depended on the extent of participation of the specialist and on the degree of dependence of the others on the data from that portion of the project. Co-ordination of activities was an important requirement at all levels and this formed the major task of the project research co-ordinator supported by an administrative officer.

The success of a multidisciplinary study such as IPAL depends to a large measure on the degree to which participants operate as a team. Individual initiatives were encouraged within the framework that included sharing of basic data and collection of data, at least partly as a service to others. In Phase III of IPAL, this was achieved by frequent meetings of the scientific research team at which common approaches and difficulties were discussed. Although activities of greatest value to the group may have seemed routine for a particular individual, there was opportunity for related studies in which individual scientists could make more independent contributions.

In a project like IPAL, there were some scientists who were not attuned to working on field projects. These had to leave. Recruitment difficulties resulted in certain scientists having to be asked to supervise more than one specific sector. Mention must be made in this regard of the livestock ecologist and the project co-ordinator who took on the burden of supervision of the entire livestock programme and the range ecology programme respectively for the entire duration of the project on departure of the two experts covering these areas.

Mention must also be made of the special contribution of the pilots who willingly undertook flying missions outside their routine work. Co-operation of the scientists in taking care of the projects large number of visitors was simply outstanding.

Project Professional Staff

	Name	Title	Duration
1.	W.J. Lusigi	Project Co-ordinator	01.07.80 to 30.06.84
2.	J.G. Stephenson	Administrative Officer	27.08.76 to 30.06.84
3.	H.F. Lamprey	Senior Woodland Ecologist	01.02.76 to 30.06.84
4.	C.R. Field	Senior Livestock Ecologist	01.02.76 to 30.06.84
5.	M. O'Leary	Human Ecologist	01.07.82 to 30.06.84
6.	D. Herlocker	Range Ecologist	25.05.76 to 31.03.82
7.	J.H. Schwartz	Animal Production	19.08.80 to 16.01.81
8.	D. Walter	Associate Expert Geomorphology	05-08-79 to 11-11-81
9.	A. van Kekem	Associate expert in soils	27.01.81 to 28.05.83

Project Consultants

1.	A.B. Said	Goat Nutrition	01.04.80 to 31.12.81
2.	A.B. Carles	Sheep & Goat Productivity	01.04.80 to 31.12.81
3.	Kayongo-Male	Cattle Nutrition	01.01.81 to 31.12.81
4.	E. Mburugu	Human Ecology - Rendille	15.09.81 to 15.12.81
5.	E.H.O. Ayiemba	Human Ecology - Samburu	15.09.81 to 14.12.81
6.	G. Njiru	Range Economics	01.04.81 to
7.	I.A. Allen	Environmental Education	05.03.81 to 05.11.81
8.	E. Mubia	Human Health	17.08.81 to 30.09.81
9.	G. Bake	Geomorphology, Hydrology, Climatology	18.01.82 to 30.03.84
10.	G. Ongweny	Surface Water Hydrology	01.04.81 to 31.06.84
11.	J. Crees	Animal Production	15.04.82 to 14.07.82
			01.01.83 to 14.01.83

Project Consultants

	Name	Title	Duration
12.	J. Adu-Bobie	Human Ecology	01.03 82 to 30.09.82
13.	J.M. Ndombi	Ground Water Hydrology	15.08.82 to 14.11.82
14.	P. de Rham	Orientation Seminar Organisation	30.08.82 to 03.12.82
15.	M.B. Musoke	Orientation Seminar Organisation	01.09.83 to 30.11.83
16.	John King	Water Balance in Livestock	01.05.83 to 30.05.83
17.	R.H. Borgeson	Ground water Hydrology	01.04.81 to 30.06.81
18.	S.K. Tubei	Animal Production	01.12.82 to 30.06.84
19.	P. Baur	Surface water Hydrology	15.11.82 to 31.12.82
20.	E. Kadenyi	Human Health	01.09.83 to 30.09.83
21.	A. Alusa	Meteorology	01.02.81 to 21.05.81
22.	A.J. Wilson	Livestock Ecology	31.12.80 to 30.06.81
23.	J.O. Kokwaro	Range Ecology	01.06.81 to 31.12.81 01.01.82 to 30.06.82
24.	R. Dolan	Statistical Analysis	01.01.81 to 31.06.81
25.	M. Savage	Administration	01.07.80 to 31.03.81
26.	J.W. Skiles	Systems Modelling	12.07.82 to 31.12.82
27.	Omara-Opyene	Veterinarian	15.08.82 to 30.06.83

Project Local Professional Support Staff

1.	J.K. Muiruri DVM.	Data Processing	01.06.81 to 30.06.83
2.	P. Gufu Oba BSc.	Education and Training	15.07.81 to 31.07.83
3.	E.R. Nkurunziza PhD	Plant Ecology	15.01.82 to 30.06.84
4.	F.K. Awere-Gwekye MSc.	Photo interpretation	15.02.82 to 22.06.83
5.	T. Rutagwenda DVM	Veterinarian	11.06.83 to 31.03.84
6.	H.V.J. Atsiaya DVM	Veterinarian	16.09.83 to 30.06.84

Project Staff

Graduate Students

	Name	Title	Duration
1.	R Okello	MSc. Entomology	01-11-79 to 30-04-81
2.	K. Sogomo	MSc. Geomorphology	12.11.79 to 31.10.81
3.	R. Bagine	MSc. Entomology	01.07.80 to 31.12.82
4.	T. Rutagwenda	MSc. Veterinary	01.07.80 to 31.12.82
5.	E.V.A. Okila	MSC. Veterinary	01.12.81 to 25.04.83
6.	B. Migongo	PhD. Range Ecology	01.01.82 to 31.03.83
7.	P. Gufu Oba	MSc. Range Science	01.08.83 to 01.08.85
8.	P. Simpkin	Animal Production	15.08.81 to 31.12.83

Local Support Staff

1.	Sylvester Masheti	Administrative Assistant	01.05.76 to 30.06.84
2.	Kimwere Kiguru	Senior Artisan	01.03.76 to 30.06.84
3.	Ilmwate Nawe	Senior Driver	01.07.78 to 30.06.84
4.	P.G. Asoryo	Field Assistant II.	01.04.82 to 30.06.84
5	James Kiritu	Artisan	15.07.83 to 30.06.84
6.	Charles Ratemo	Field Assistant I.	01.03.76 to 31.05.84
7.	Peter Lekeren	Field Assistant II.	30.05.80 to 31.01.84
8.	John Bullo	Field Assistant II.	30.05.80 to 30.06.84
9.	Alex Ngoroni	Field Assistant I.	01.11.77 to 30.06.84
10.	Sipilet Lekadaa	Herdsman	14.12.78 to 30.06.84
11.	Sokotei Seyee	Field Assistant	01.08.81 to 31.03.84
12.	Choro Galkorole	Herdsman	16.09.79 to 30.06.84
13.	Satim Dahole	Watchman	01.10.77 to 30.06.84
14.	Denge Dakota	Field Assistant	02.05.84 to 30.06.84
15.	Kenna Isaac	Field Assistant	01.02.80 to 31.03.84
16.	Letunen Lekoyaya	Hostel Attendant	01.01.80 to 30.06.84
18.	Sampson Kaaman	Watchman	01.09.81 to 30.06.84
18.	Almakoro Sahado	Watchman	01.09.90 to 30.06.84
19.	James Lekeren	Turnboy	01.07.80 to 30.06.84
20.	Galgumbe Galmagale	Headsman	27.09.80 to 30.06.84
21.	Ruth Ndavyo	Hostel attendant	01.11.80 to 30.06.84
22.	Job Gekara	Field Assistant I.	01.05.83 to 30.06.84

Local Support Staff

	Name	Title	Duration
23.	Mohamed Wario	Senior Driver	24.12.80 to 30.06.84
24.	Diba Guyo	Field Assistant	13.1.81 to 30.06.84
25.	Mohamed Sheikh	Senior Field Asst.	27.12.81 to 30.06.84
26.	Roba Abudo	Field Assistant	10.01.81 to 31.03.84
27.	Romano Nasur	Station Superviser	15.01.81 to 30.06.84
28.	Philip Echakara	Station Superviser	19.02.81 to 30.06.84
29.	Kavula Ngulu	Driver	29.03.82 to 19.12.83
30.	Lewano Rering	Station Hand II.	01.04.82 to 30.06.84
31.	Katu Roba	Field Assistant	01.11.81 to 30.06.84
32.	Bagaya Galticha	Station Hand	01.01.81 to 30.06.84
33.	Duwesi Lenokerena	Herdsman II.	15.09.80 to 11.03.84
34.	Tikiyon Leyamyam	Station Hand	01.11.81 to 30.06.84
35.	Paul Wata	Field Assistant	01.11.81 to 30.06.84
36.	Esemere Aggrey	Field Asst. II	24.02.82 to 31.03.84
37.	Joakim Oundo	Field Asst. I.	24.02.82 to 30.06.84
38.	Michael Marekebo	Receiptionist	01.04.82 to 31.05.84
39.	Abduba Guyo	Watchman II	01.04.82 to 30.06.84
40.	Opiyo Odongi	Mechanic/Driver	13.08.82 to 30.06.84
41.	Talaso Wario	Secretary	19.05.82 to 30.06.84
42.	Husseifa Galicha	Station Superviser	11.09.82 to 30.06.84
43.	Dionzio Nyayoko	Driver/Mechanic	21.06.82 to 30.06.84
44.	Dominik Dabasso	Field Assistant	01.04.82 to 30.06.84
45.	Edin Ibrahim	Field Asst. II	01.04.82 to 30.06.84
46.	Nguram Lekole	Field Asst. II	01.01.83 to 03.05.84
47.	Augustine Ilmwati	Field Assistant	01.05.83 to 30.06.84
48.	John Regano	Field Assistant	01.05.83 to 30.06.84
49.	Reiti Galborana	Field Assistant	01.05.83 to 30.06.84
50.	Daniel Shiramo	Field Asst. II.	01.05.83 to 30.06.84
51.	Gwacho Halake	Field Asst. II.	01.05.83 to 30.06.84
52.	Akidong Sanget	Field Assistant II.	01.05.83 to 31.03.84
53.	Maurice Musumba	Field Assistant	01.05.83 to 31.03.84

Local Support Staff

	Name	Title	Duration
54.	Paul Galmagor	Extension Asst.	01.12.83 to 30.06.84
55.	Koite Ogum	Herdsman II.	23.08.83 to 30.06.84
56.	Feda Wikendi	Hostel Attendant	10.08.83 to 30.06.84
57.	Husain Yusuf	Extention Asst.	1.02.77 to 30.06.84
58.	Simon Karabá	Extension Asst.	30.10.79 to 30.06.84
59.	John Oche	Snr. Field Asst.	01.03.80 to 30.06.84
60.	Bante Galgalo	Headsman I.	26.07.79 to 30.06.84
61.	Alois Alkayo	Driver	01.10.83 to 30.06.84
62.	Diba Jarso	Watchman	01.09.83 to 30.06.84
63.	Daudi Boru	Watchman	01.09.83 to 30.06.84
64.	John Karija	Field Asst. II	13.02.81 to 09.08.82
65.	Lewen Lekekumani	Artisan	01.08.76 to 07.05.82
66.	Burkel Lekoli	Herdsman	01.06.78 to 04.03.82
67.	Setiyon Lengessen	Herdsmen III	01.12.80 to 31.12.82
68.	Loboiyah Lengessen	Herdsman II.	01.08.81 to 31.12.82
69.	Lemayon Lengima	Herdsman II.	10.02.81 to 30.06.83
70.	L'maiyolo Lengima	Herdsman II.	10.02.81 to 31.10.82
71.	Simmuten Lemangayah	Herdsman II	10.02.81 to 30.06.83
72.	Peter Peraine	Driver II.	04.09.81 to 31.11.82
73.	Lugi Lengessen	Watchman II.	10.01.80 to 30.06.83
79.	Morwa Labarakwe	Herdsman II.	01.04.78 to 30.06.83
80.	Njalugi Leiloibor	Herdsman II.	01.07.80 to 30.06.83
81.	Leressen Lengule	Herdsman	01.07.80 to 04.08.81
82.	Adan Amiyo	Field Asst. II.	21.01.80 to 08.08.82
83.	Samuel Labarakwe	Herdsman II.	01.12.80 to 03.09.81
84.	Marekonoi Lemosor	Watchman II.	01.07.80 to 31.12.82
85.	Lukuti Lemaram	Herdsman	27.09.80 to 11.02.81
86.	Etome Lakadaa	Headsman	27.09.80 to 31.12.82
87.	Mbaranoi Lemadada	Station Hand	01.07.80 to 02.09.81
88.	Galgallo Tuye	Field Assistant	15.01.81 to 18.03.81
89.	Boniface Lesurmat	Field Asst. II.	27.01.81 to 31.01.83
90.	Ahmed Salah	Driver	01.02.82 to 31.01.82
91	L'Paraiton Lesuranka	Herdsman II.	01.01.82 to 31.12.82

Local Support Staff

	Name	Title	Duration
92.	Leiti Lengoyan	Herdsman	01.11.81 to 07.10.83
93.	Juanita Rwambali	Secretary	11.01.82 to 31.12.82
94.	Job Learamo	Station Superviser	01.01.82 to 31.12.82
95.	Kenywa Kanyonga	Artisan	07.03.82 to 31.12.82
96.	Mazengia Gabere	Driver	16.02.82 to 17.05.82
97	Mathew Halake	Receiptionist	01.04.82 to 09.07.82
98.	Loworet Leparsante	Station Hand II.	01.04.82 to 31.07.82
99.	Lakasso Gudere	Wachman II.	01.05.82 to 11.05.83
100.	Margaret Sifuma	Secretary	09-06.82 to 30.06.83
101.	Francis Sindheya	Field Asst. I.	01.04.83 to 30.11.82
101.	Isack Learamo	Field Assistant	01.12.73 to 12.11.81
102.	Galgato Nguso	Watchman	01.07.80 to 31.10.81
103.	Yusuf Khalif	Snr. Field Asst.	08.12.77 to 09.08.82

Project General Service Staff

1.	S.M.K. Njoroge	Administrative Asst.	01.07.82 to 30.06.84
2.	R.W. Kahari	Senior Secretary	01.07.80 to 31.03.84
3.	R. da Costa	Junior Admin. Asst.	01.01.83 to 30.06.84
4.	M.J. Makundi	Secretary	01.10.81 to 30.06.84
5.	C. Gagah	Depot Supervisor	01.01.82 to 30.06.84
6.	R.M. Govedi	Messenger/Jn. Clerk	01.01.82 to 30.06.84
7.	J. Matheka	Messenger/Custodian	01.01.83 to 30.03.84
8.	J.M. Atsali	Watchman	01.07.82 to 30.06.84
9.	K. Mifo	Watchman	01.01.82 to 30.06.84
10.	J. Aguko	Jnr. Clerk Stores	01.07.80 to 30.03.84
11.	K. Kamau	Driver Mechanic	01.05.82 to 30.06.83
12.	L.C. D'Cruz	Finance Asst. II.	07.07.81 to 30.06.82
13.	C.N. Rucha	Secretary	21.02.84 to 30.06.84
14.	M.F. Ngatuni	Secretary	19.01.84 to 30.06.84

11. ADMINISTRATION

J.G. Stephenson

A. General

A frank appraisal of the strengths and weaknesses of the administration of the project during Phase III has been called for by the Co-ordinator. What follows endeavours to define these features so that constructive recommendations can be made for the benefit of this and similar projects in the future.

It is true to say that the Integrated Project in Arid Lands is widely acclaimed as being a viable on-going and dynamic project. The duration of its current phase (Phase III) was originally planned for July 1980 to June 1983. As it has transpired, more time was needed for completion of this phase's culminant report - the Management Plan and as a balance of funds on the budget remained at the end of the three years, the project's life was extended to the end of 1983. It has now received a further extension of six months ending the 30th June, 1984, to accommodate the opening of the Federal Republic of Germany's new financial year 1st April, 1984, when renewed funding from them is anticipated for the next phase - the implementation of the management plan, known as the West Marsabit Integrated Development Plan.

From an administrative point of view, the major factors which have assisted the project in developing momentum, growth in stature, and maintaining a dynamic character, are:-

1) "Esprit de corps" - the team spirit;
2) Exclusive administrative control of the Field Support Staff cadre and the special Terms and Conditions of Service specially designed for them;
3) The aeroplane, and
4) Radio/Telephone network.

On the first factor, little need be added than to make the obvious observation that the nature and viability of any project or organisation depends first and foremost on its leader. The "Esprit de corps" of IPAL has been high throughout and good relationships have been maintained between all ranks, with but few exceptions. To achieve this, the greatest care must be taken in giving due respect and consideration to the other man's (of whatever rank) province of responsibility and the way in which he carries out his responsibilities. And what is equally important is that the authority of a person above or below is not cut across by one's own orders without prior forthright reference to that person. By and large, these precepts of responsibility have been instilled into the system and so have promoted a noteworthy sense of purpose and enthusiasm at all levels.

On the second factor, the subject will be expanded under "Staff" below. However, my comment in general is that any project, particularly of IPAL's magnitude, must, from the start, identify its most important contributory elements to the achievement of its objectives. I believe we have done this successfully in creating the conditions for our field support or "feeder" cadre of permanent employees so as to promote in them an enthusiasm in their work and a sense of achievement through training and experience. The scientific experts responsible for the various scientific programmes on an integrated level have, with few exceptions, been fully aware of this end. To them is due much of the credit for this considerable degree of 'enthusiasm' and training now to be found in these subordinate levels. In this regard lies one of the project's greatest achievements. This cadre of trained enthusiastic support staff will be indispensable to any future implementation and extension programmes for the management of these arid lands. Let it be noted that the emphasis which various review missions and UNESCO have placed on "training" has herein been met to a satisfying degree.

On the third factor, suffice it here to say that we could never have handled a project of this size in the time given over such vast distances and maintained the project's momentum without the plane.

The network of radio communication with all stations or spheres of activity has provided that day to day control to keep things in operation.

On the broad plain of the project's relationship to its parent controlling body, UNESCO in Paris, there have been marked advantages and disadvantages. These will be touched upon in brief and general terms here, and in more particular later on.

There are, of course, the decided advantages gained by being under the auspicious name of UNESCO in operating a project of this complexity in a developing country. Staff members of professional and general service have their statutory terms and conditions of service. There is an aura of prestige enveloping the project which affords it decided advantages in operation. There is the security of funds which cannot be infringed upon by other interests or influences, and to a degree the absence of restrictive red tape in the disbursement of these funds. Such could never be the case were the project operating under a bilateral agreement with Government. These factors have undoubtedly created the favourable climate in which the project has been enabled to operate efficiently through this research phase and achieve its goals.

There were however some difficulties experienced which were largely brought about by difficulties in communication with headquarters from such a remote field programme. This resulted in delayed responses to requests for urgent action on various matters which included, terms of service for our field employees and contracts for both consultants and expert staff. Orders for certain critical pieces of equipment were not received in time etc. In time specific projects such as IPAL were almost frustrating.

If the foregoing paragraph appears to be excessively depreciative, it is not so intended. We surmounted the obstacles one way or another, and have brought the project to a satisfactory conclusion, thanks to the ernest endeavours of our staff and the co-operation and back-up of our headquarters' compatriots. The 'pros' and the 'cons' have emerged through experience. Their enumeration is done with constructive intent so that ways and means can be sought for the more realistic handling of such projects. After all, the purpose of any project must be the achievement as efficiently as possible of its objectives, and not the hide-bound adherence to set patterns.

Tribute must be paid to the expeditious manner in which the Bureau of Personnel and the Medical Benefits Fund Department make reimbursement on claims.

Structure of Project Administration.

The administrative set-up for the management of the project throughout its entire scope has proved to be satisfactory in almost all respects.

At the centre is the Co-ordinator, responsible for policy, direct control of all scientific programmes, and the overall responsibility of all aspects of the project. The Administrative Officer is responsible to the Co-ordinator for putting into effect his administrative directives and managing all administrative matters.

In broad terms, the administrative management duties cover:-

(a) Giving back-up service to all scientists and programme officers in the field, so that they can carry out their work, unhampered by administrative requirements. This involves the purchasing, obtaining, registering, storing and transporting and safe delivery of all materials and goods required by these scientists and programme officers and their field support staff, as well as the administrative requirements of Marsabit headquarters and research sub-stations. These services are provided from Nairobi. The Administrative Officer has to assist him, a number of staff of the General Service, namely, an Administrative Assistant, an Accountant, an Accounts Clerk, a Messenger and, in the project's supply depot, the Depot Supervisor (Purchaser) and the Stores Clerk. The two Secretaries of the General Service are managed directly by the Co-ordinator.

(b) Controlling the administration of the project headquarters in Marsabit. To assist here there are the Administrative Assistant II and the Station Supervisor, both of whom are of the Field Support Staff, responsible to the Administrative Officer. However, owing to the fact that the Co-ordinator is resident on the station for most of the time, and the Administrative Officer

is not, it has worked out that much of the day-to-day routine administration is covered by the Co-ordinator, leaving the control of vehicles, building matters, supplies and staff payments to the Administrative Officer. Marsabit, being the District and County Council Headquarters and the seat of office of two Members of Parliament, involves our headquarters in a good deal of local and district politics, and this takes up a fair amount of the Co-ordinator's time. During the Co-ordinator's absence from the station, administrative management has devolved onto the Administrative Assistant II. This has meant that senior officers have had to come under the control of a more junior officer for routine administration. Whilst this arrangement was not the ideal, generally senior officers have been co-operative and this, coupled with the discreet firmness of the Administrative Assistant II, has made it work.

(c) Controlling the administration of field research sub-stations. Each of these stations has been placed under the overall control of the scientist whose research programme is mostly concerned with that station and area. The scientist is assisted by either a Senior Field Assistant or a Station Supervisor, who supervises the routine affairs of the station, scientific programmes, etc. The Administrative Officer, however, controls directly all matters concerning hiring, firing, promotion, transfers, payment and discipline of all Field Support Staff and casual workers, and the supply and development aspects. All staff status matters of a station are naturally discussed between the Administrative Officer and the scientist in charge before action is taken. The scientist deals with the petty day to day matters arising in his station, referring any matters of status or discipline of his staff and policy to the Administrative Officer. This system, as opposed to the alternative of the scientist managing all these matters himself, has worked well in that there has been good co-operation and understanding between the scientists concerned and the Administrative Officer.

B. Staff

It is axiomatic that the success of any project, especially one of this nature, is dependent on the people who implement it. The basic principle must therefore be "the best man for the job", but other factors interpose, such as political expediency, which have to be weighed up. Our experience has shown that in those few cases where principle has been superseded by "other considerations," the results have rarely been justified, indeed some selections have not only been a complete failure, but also an embarrassment. Generally our staff selections have been made with care and the project has reaped decided benefits therefrom.

1. Professional Staff

Working administratively with this cadre of officers, which includes UNESCO professionals, consultants, fixed fee consultants and fellowship students, has been pleasant and rewarding. Unfortunately, there have been a few instances where somewhat restrictive regulations had to be made applicable to all because of the overstepping by a few of privileges afforded to these senior officers. Restrictions had to be placed on the use of vehicles in Marsabit and Nairobi, and a strict control exercised on movements from the study area to Nairobi. The latter control is regulated solely by the Co-ordinator who signs a Travel Approval form for planned movement within and without the study area. The form has its further use in that it provides the basis for Travel Allowance Claims.

As was mentioned under Administration General above, it has been the policy to lift as much as possible of the administrative burden from the scientists in order to leave them free to pursue their own studies. Field Support Staff are assigned to scientific researchers who direct their subordinates only as far as their scientific supporting roles require. Close liaison is maintained between the Administrative Officer and scientists in matters of subordinate staff welfare, transfers, discipline and leaves.

It is mentioned here that the professional staff voluntarily took cuts in their Travel Allowance rates from near the time of inception of the project.

This was because the UNESCO rates were completely unrealistic to their safari circumstances, and because the budgets would never have stood the heavy drain which the full UNESCO rates would have imposed. Additional comment is made later on this subject under paragraph I, Financial.

2. Professionals on Fixed Fee Contracts

The project has engaged from time to time a goodly number of these from local services with considerably varying degree of effectiveness. From our early experience of some, we soon learned that no matter the scope of the study, it is important that careful terms of reference be drawn up to which the fixed fee contractor agrees, supported by a signed Memorandum of Agreement on the contractor's modus operandi detailing all required back-up services and equipment, before the contractor is allowed to commence his project.

3. General Services Staff

The project was founded on the only two staff categories provided for by UNESCO - the Professional Category and General Service Category. It soon became apparent that the General Service Category rules simply could not be adopted for any of the project's support staff, other than those who lived and worked in Nairobi. These employees are much in the minority, as by far the greater proportion of the support staff work under vastly different conditions in the study area of the arid lands of Kenya. The project tried deploying a General Service driver to the study area with unsatisfactory results. The disparity in salary levels and conditions of service leaves the two services - the General Service and the Field Support Staff-poles apart.

This situation is obviously undesirable in a project of this size. There is the need for a careful study to be made of the position with a view to forming a unified and integrated support staff service. As all these employees are locally engaged, the terms and conditions of service would have to be related more to those for Kenya parastatals and related organisations, but, it would be hoped, incorporating as many of the benefits provided by UNESCO as possible.

The secretarial load has, throughout this phase, been excessive for our regular secretarial staff. This has meant frequently farming

out typing work and placing the secretaries on long hours of overtime. The adverse results of this have been that the proper maintaining of office records and files, and administrative correspondence, and typing of accounts documents, have been neglected. There is need for the Administrative Officer to have his own secretary who could be used when necessary for other secretarial work.

4. Field Support Staff

These are the "salt of the earth" for this project. They provide the material for the scientist researcher to form the base lines of his research, and to pronounce his dicta thereon. It is they, more than anyone else, who have to live and cope with the harsh conditions of the arid lands. One cannot hope to get value from them without affording the terms and conditions of service, and security of employment which are commensurate with their conditions. To those of the project entrusted with its management, this was all too apparent, but the UNESCO organisation seemingly had no way of suitably accommodating this situation, neither would the "nettle be grasped" when time and again a solution was sought. After some traumas, emanating both from the field staff themselves and from Paris, a practical, albeit ultra vires, solution emerged at the commencement of this phase in the form of the issue by the Co-ordinator of "Terms and Conditions of Service for the Field Support Staff of IPAL." These service terms were based largely on the Kenya Government's Harmonised Terms and Conditions of Service for Research Institute" and the Draft Scheme of Service of the Kenya Agriculture Research Institute (KARI)." It can be said that the application of these terms and conditions of service have promoted the progress and success of the project, probably more than any other single factor. The staff have shown a marked degree of keenness and devotion to their work, often giving much longer hours than those laid down, without claiming overtime. The payment for overtime has not generally been applied to the field support staff: to have done so would have stifled keenness and the team spirit, and over-burdened the administrative machinery. Overtime is paid when field staff have been engaged on specific organisational operations and assignments, such as for Review Missions and Orientation Seminars. It is noteworthy that cases of indicipline amongst our field staff, despite the comparative harshness

of their existence, are rare. It would be difficult to find in this country a comparable organisation to this one for zeal and hard work.

A particular feature of the terms of service under which the field support staff work and which has produced such good results is the gratuity. A field support staff member is eligible for a gratuity of 25 per cent of his earnings, at the discretion of the Co-ordinator, on the completion of each yearly contract of service. In only two cases has gratuity been withheld. In most cases the employee's contract ends simultaneously with his annual leave of 30 working days per annum, the majority, who are from nomadic families, rush off to buy goats and sheep, a few cattle, and still fewer camels. They come back to a new contract in a happy frame of mind over this "added insurance for their future". Working for IPAL has made an earlier marriage possible for some, enabling them to meet the dowry requirements which otherwise were no more than an uncertain hope of the distant future.

As a matter of firm policy, great care is taken in the recruitment of the field support staff, particularly of the field assistant cadre, this policy has paid off to IPAL's decided benefit. Recruitment has been left almost entirely to the Administrative Officer, assisted by a professional staff member. Entries are accepted only on merit, and very few enlistments have been "through the back door." It must again be stressed here how essential it is in the long term interests of the project to make every endeavour to keep the recruitment system free from political and other pressure.

5. Recruitment of Field Support Staff.

Recruitment of field assistants has been mainly by two methods:-

(a) Advertisement of posts and interviews by a panel of three - Administrative Officer, a professional staff member, and a Senior Kenyan employee of the project - shortly after completion of the Kenya Certificate of Education Exams (form IV, equivalent to 'O' levels). More weight is placed on character and applicability than an academic brightness. As it so happens, the results of the examinations are not known at the time of the interview. Enlistments are then made,

subject to K.C.E. passes being obtained when the results come out some two months later. Our applicants are, with few exceptions, the holders of Division IV and III K.C.E. passes, as Government earmarks the potential higher grade passes for itself.

(b) Direct recruitment from the temporary field assistants who have worked for IPAL and who have passed their K.C.E. exams. This is decidedly the better method if it can be used, as it gives time to study an employee's strengths and weaknesses. As a general rule, field assistants are required to be multi-purpose - livestock and vegetation - in their abilities.

The other categories of field support staff are:-

- Professional Support Staff - mostly graduates with a degree.
- Extension Assistant - disseminating information about the project and its objectives to the local people, and doing public relations work.
- Station Supervisors - the administrative running of field stations and operating the staff canteens.
- Artisans
- Drivers
- Herdsmen - four are armed for security reasons
- Hostel attendants
- Station hands

6. Staff Canteens

Staff canteens, one at Gatab and one at Ngurunit, were established before and continued throughout this phase. These canteens, situated in localities where the local supplies of food are either non-existent or tend to run out and where we have a concentration of staff, have been indispensable to the achievement of the project's goals. They operate on their own revolving fund which is quite divorced from IPAL budgetary funds. They cater to the more simple dietary and toiletry requirements of the field support staff and temporary employees. For various reasons, these canteens have not been able to operate as co-operatives due to limited administrative manpower to cope with a co-operative, the necessity to maintain an efficient supply service, and the fluidity of postings of staff to an away from canteen served stations.

Endeavours were made to obtain supplies from towns nearer to the study area, such as Maralal and Marsabit. Regular availability of goods at these places was a major drawback, as goods are purchased in Nairobi at wholesale prices, and sold to the staff through the canteen at a small margin of profit to cover the inevitable minor losses. No transport costs are added to selling prices - a hidden but worthwhile perk to give the field support and temporary staff.

7. Temporary Employees

The number of temporary workers has varied considerably from time to time, and is dependent on the tempo of scientific and administrative activities in progress at any one time. The majority of these casual employees has been as temporary field assistants, drivers, watchmen, herdsmen and labourers. It has been policy not to use any temporary employee in a position of financial trust or command. The monthly salary emoluments for these temporary employees is near to that of the project's permanent field support staff, but lacks the additions of gratuity and leave. In this way, budgetary savings allowed us to purchase unforeseen items of equipment and contributed to the extension of Phase III by an additional year. A marked advantage to the project in the utilisation of this "temporary employee" cadre system is that it affords the best field from which to select candidates for permanent contractual posts in the project. In this way character, ability and adaptability, especially as related to work in those arid lands where conditions are regarded as "harsh", can be weighed up; this of course is not possible when making appointments from unknown applicants.

8. Health (Study Area)

The project has covered the health costs of all of its subordinate staff working in the study area through its own scheme which is written into the terms and conditions of service for the Field Support Staff. Each member's contribution of Shs.20/- per month ensures his and his immediate family's free medical attention. As a general rule, these employees obtain free medical care from their nearest Government hospital, which is in Marsabit for our study area, and rarely, Government hospitals or clinics when the need arises for medical visits to Nairobi.

As regards medical care in Nairobi, experience has shown that it is usually to the project's advantage, in terms of time and money saved, to send visiting staff to private hospitals and to pay their medical and medicants bills. Special mention is made here of the valuable service rendered to the project by the AIC Dispensaries at Gatab and Ngurunit and, to a lesser extent, by the R.C. mission dispensaries at Laisamis and Korr. The project's vehicles, and especially its plane, ensure prompt evacuation to an appropriate medical centre in emergencies; the scheme more than covers such contingencies, which have been rare.

All Field Support Staff earning more than Shs.1000/- per month contribute to the National Health Insurance Fund, as required by law.

C. Transport and Communications

1. Vehicles

The project has maintained its operations throughout Phase III on its fleet of 13 Land Rovers, 2 lorries, one small Daihatsu Van (for Nairobi) and one motor bike. Of the land Rovers, two were IPAL foundationers from 1976 and are still going strong. A decision to sell them two years back was abandoned, as it was found that every available vehicle had to be retained and kept going. One Land Rover, inherited from the Traditional Livestock Management Programme (TLMP) was in such condition that it could only be canaibalised and used for spare parts. Another worn out Land Rover was gifted to the project by the Ambassador to Kenya of the Federal Republic of Germany. Its reconditioning has not been sufficiently successful to merit keeping it in service. Unstinting efforts have been made to try and keep the old Bedford 4-4 diesel 5 ton lorry in service. Engine overheating has been chronic ailment, resulting in costly engine overhauls. Our final efforts to make it again functional will be directing to getting rid of it for as much as possible, as soon as possible.

The project has standardised on Land Rovers for the bulk of its operations. The reasons are:

- The Land Rover is still the leading, rough country medium/light capacity vehicle in this country. Spares are therefore more readily available in out of the way places, and likewise mechanical help, in the event of a breakdown.

- The back-up service for spares and more serious repairs is probably the best in Kenya for this class of vehicle.
- Land Rover spares are less expensive than for contemporary vehicles, and
- Mechanical design is probably simpler in most respects - this is important for "bush repairs."

2. Maintenance

The proper expeditious maintenance and repair of vehicles is of paramount importance to the progress of any dynamic project like IPAL. Vehicles "off the road" represent an inestimable loss in terms of time, cost and disorganisation of programmes etc., particularly when the number of Land Rovers has been too few to allow for standbys. Servicing and repairs maintained on this basis give rise to heavy expenditure because of the frequency of attention and replacement of spares before they become too worn to cause more serious damage. The point is emphasised, as a corolary to the foregoing, that no skimping in maintenance and repair funds should be practised, as a matter of policy. To achieve as high a standard of attention to project vehicles as possible, we selected a private vehicle mechanic in Nairobi who deals with little else than IPAL vehicles. In this way, vehicles from the study area are admitted for a check, repairs and service, despite the day of the week. Rarely is a vehicle not ready for the impatient scientist to return to his study 600 kms. distant. All vehicles are brought to Nairobi about once in every 5000 kms. of running to receive this specialist attention. More frequent and less specialised attention is given by an IPAL mechanic stationed at the project's headquarters in Marsabit, and still another of lesser qualification at the Ngurunit field station. Had capital funds been adequate, the ideal set up would have been for the project to establish its own fully equipped garage at its Marsabit headquarters, under an experienced and capable mechanic foreman. Practically, the entire range of repairs, excepting reboring engine cylinder blocks, would be effected there. It is emphasised that the value in having this sort of self-sufficient set up depends entirely on the calibre of the workshop manager - his experience, ability and zeal. This kind of sophisticated workshop would, of course, only be warranted where the project holds promise of a reasonable life span.

Much attention has been directed towards the controlling and improvement in the standard of driving, and instilling a sense of responsibility in the care and handling of vehicles. Progress has been made in this area, in spite of the universally encountered attitude of indifference of the well-being of property which belongs to another. The problem would be considerably reduced if there were sufficient funds and vehicles to allow for one driver to be assigned to and be responsible for one particular vehicle. As vehicles are inclined to be regarded as a status symbol, the strictest control over who is permitted to drive project vehicles has been necessary. In this context of vehicle handling responsibility, it is gratifying to state that, over these four years of operation, there have been only two serious accidents to project vehicles in which project drivers were at fault.

Special mention is made of the one project vehicle which reflects, by its appearance and condition, the devoted care its two drivers have given it. It is the Isuzu 4-4 diesel 5 ton lorry, purchased at the end of 1979. Yhis lorry works almost as new. It has done well over one hundred thousand kilometres over rough corrugated roads and Mount Kulal's precipitous tracks, and has never given a moment's trouble.

The gear boxes of about half of the project's Land Rovers have, over the past nine months, had to undergo expensive complete overhauls. This is somewhat puzzling, but the causes are probably a combination of several factors:-

- long and frequent runs over the heavily corrugated gravel road between Marsabit and Isiolo - 350 kms.
- bad driving - gear and clutch operation;
- inferior material in this age grade of Land Rovers.

3. Organisation of transfer

When project vehicles are in Marsabit or Nairobi, they are kept at all times in the depot, except when under preparation for a trip or for repair. This measure was necessary to reduce tendencies of improper and indiscriminate running, particularly after hours. Vehicle keys are held by the Nairobi depot supervisor, or in Marsabit by the Administrative Assistant in charge of the Station. In Nairobi, all vehicles are registered in and out of the depot.

From the point of view of conservation of vehicles and finance, there is the need, for a project of this magnitude, to centralise as much of its activities in its headquarters. This is especially applicable to projects having their sphere of activities remote from the country's capital. The promotion of the project's business inevitably requires visits by the Co-ordinator and his senior officers to Nairobi, 650 kms. distant, but this trafficking requires careful control.

Mention is made again of the necessity for the project Co-ordinator to be free to estimate his vehicle requirements and to obtain them from the best sources available to him. Steps in this direction had to be taken at the commencement of Phase III when scientists in charge of the various integrated programmes were on site but, without vehicles, they were unable to operate. Endeavours to conform to set practice in obtaining this equipment failed, and urgent local decisions had to be made.

D. Aeroplane

There has been a good deal of academic criticism and controversary about "this luxury piece of equipment." Suffice it so say that when the office critics have come to see the project and its modus operandi for themselves, especially those who have been subjected to the long arduous trip to and from the study area by vehicle, they have expressed unreserved approval of the plane's value to the project. There can be no question that the plane has, more than any other implement, promoted the attainment of the project's goals. To state the obvious, the plane shrinks distancies and time, and consequently effects savings in more and staff energies.

The project plane has been flown by two of the project's professional officers who hold Private Pilot's Licences. This basis of operation has worked well, and has saved the project considerable financial expenditure, obviating the employment of a professional pilot who would be using up one of the plane's few seats and be non-effective in the project's field work. Dr. Lamprey, being one of the two pilots, has flown most of the scientifically orientated trips, as well as conducting visiting V.I.P's by plane through the study area. Mr. Stephenson, the other pilot, carries out his regular monthly administrative visits to all stations of the study area. This regular contact is maintained with all scientists and their support staff in the field.

This basis of piloting the project plane is without doubt the best, as the pilot is intrinsically involved in pursuing his own particular project duty.

As the project has a plane which makes travel so much easier, there has been marked enthusiasm from many persons and organisations (both connected with and not even remotely connected with the project) for flights to the "romantic" nomadic north Kenya. This has called for diplomatic consideration in the light of costs, goodwill, value to the project, and perhaps detracting from the pilot's regular duties. It is pointed out that the more the plane is put to work, the more it reduces its own operational overhead costs. The happy medium of operation must be found after giving due consideration to the effectiveness of its tasks and the pilots' time. Commercial air charter companies aim at getting over 300 flying hours from a light aircraft in one year. Our experience has given us between 225 and 250 hours per annum, which is good productive usage.

The maintaining of the project plane in a sound and airworthy condition is of paramount importance. Aircraft engineering and servicing firms vary considerably in their efficiency and thoroughness, so it would be false economy to lookffor the cheapest firm in this respect. Maintenance and repair bills are costly, because of the high labour costs and the vary high cost of spares. However, costs can be kept down by the proper flying of the plane, by obtaining duty free spares direct from the U.S.A., and by the maximum utilisation of the plane to defray these expensive overheads.

E. Camel Transport

A project of this nature, working amongst nomadic peoples of arid environments, could make much more use of camel transport than has been the case so far. A corps of riding camels with the appropriate saddlery would provide the most suitable mode of transport for scientists and their field assistants whose work requires them to operate in remote areas. The disciplines to which this form of travel is most applicable are human ecology and extension work. The riding camel would carry the field staff worker, together with his small bivouac tent, food and water, Each such worker would have his camel-mounted assistant, whose job it would be to tend and graze the two camels.

Care would have to be taken to allow the camels adequate rest and feeding time to ensure they are maintained in a fit condition.

The other form of camel transport is by using the camel as a burden camel. Attempts made to mobilise some field staff in this manner so that they could move with the people amongst whom they were working were not very successful; failure here was due more to the lack of guidance and energetic application than to equipment problems and training of the camels. This form of transport would generally be for the larger groups of field workers with longer movement periods.

As regards the equipment, consideration should be given to obtain the Bikaner type of saddles from India (also used in the Sudan and North Africa). This type of saddle, besides containing the straddle seating portion with stirrups, has a rear portion for load carrying. For the burden camels, special mats, skins and ropes are required. The ropes, which are of three types, are now being made by the women in the Olturot locality.

F. Radio Telephone (R/T)

Up to the end of Phase II of the project, 4 stoner 150 SB R/T sets were in operation. The step up of activities in Phase III necessitated the addition of 4 more R/T sets - these are the Stoner 40 SB models. These provide a radio network of 8 sets which are positioned as follows:-

1.	"IPAL Control",	Marsabit	1 set
2.	"IPAL TWO",	Nairobi	1 set
3.	"IPAL THREE",	Gatab	1 set
4.	"IPAL FOUR",	Ngurunit	1 set
5.	"IPAL FIVE",	Olturot	1 set
6.	"IPAL SIX",	Kalacha	1 set - now withdrawn as standby.
7.	"IPAL MOBILE ONE"	Lorry	1 set
8.	"IPAL MOBILE TWO" -		1 set - mainly for the Range team, but for vehicles as and when required.

A ninth set is now being installed in the project plane in order that the pilot can also have communication with ground stations.

These radios have been absolutely indispensable to the project's operation and the attainment of its targets. They give daily communication with each of the research or mobile stations when problems can be resolved on the spot, emergencies and crises coped with, information exchanged, supplies ordered, and a host of other matters jandled. These R/T sets have given almost trouble-free service. Repairs are effected by SECURICOR, the agents for Stoner, in Nairobi. IPAL has its own allotted frequency and so communications can operate at any time without interference from other radio networks.

The Stoner R/T sets are powered by 12 volt batteries which are kept charged at stations by wind generators, except Ngurunit where two small solar panels are used. The latter type of electric charger, through more costly than the wind generator, is more efficient for the low arid lands, where ample sunshine is available throughout the year. Solar panels are gradually becoming cheaper, so careful consideration should be given to using this source of energy for battery operated radios, other battery operated equipment, and simple lighting systems.

G. Equipment

As can be appreciated, this project with its multi-disciplinary character, requires a vast assortment of equipment. Much of the equipment is costly, such as computers and sophisticated laboratory devices, so where possible, we have utilised appropriate established Government services or other agencies in order to avoid over-capitalising. The imprest of $10,000 allotted to the Administration Officer for purchase of equipment (upto $1000 under the authority of the Co-ordinator for any one item) has greatly facilitated the operation of the project, but taking into consideration the constant need for speed and flexibility of operation, this ceiling is too restrictive for a project of this size and nature. There is need here for a far greater degree of autonomy to be vested in the leader of a project, once the controlling authority is satisfied with quality of the leader of its choice. Safeguards against irrational spending are already faulty secured through UNESCO's internal audit system and periodic Review Missions. Control of high value equipment etc. can be best achieved by more precise and careful budgeting wherein such items of equipment are specifically listed. The budget would have to be approved by the appropriate controlling authority before expenditure could be made against it.

The project has lost much time and money by not having its own computer and linked word processor from near the beginning of Phase III. The volume of data poured in from all project scientists for analysis, of itself has more than warranted the project having its own computer, but the difficulties experienced over using the University computer has made it the more necessary. On the secretarial side, there has been a large number of reports and lengthy documents which have required a high standard of production. These have involved our limited secretarial staff in three and four retypes of each document, necessitating long hours of costly overtime which could have paid for one, if not two, word processors. It is planned to rectify this situation in the next phase.

An inventory of all non-expendable equipment of over Shs.200/- in value, with the current estimated value of each item, was drawn up for all stations in August 1983.

H. Development and Works

During Phases I and II of the project, operational activities, both scientific and administrative, had been centred in Gatab on Mount Kulal and Nairobi. But with the project going into its third phase, resulting from the integrated research studies of problems identified during the earlier phases, the character and structure of the project underwent considerable change. Much more money was available, field staff at all levels were increased, and requisite support services and equipment were stepped up - all resulting in a much increased operational tempo. All this, coupled with the necessity for a much closer relationship with the district administration and the people, made it apparent that the centre of gravity of the programme, and consequently the Co-ordinator's strategic point. An early Review Mission underscored this urgent requirement. This, in fact, meant not only the relocation of the field research headquarters from Gatab, but the establishment de novo of a headquarters in its entirety.

1. Project headquarters

Marsabit town was selected for the location of the project's headquarters. A plot of land of some 20 hectares was allocated in early 1981 by the Marsabit County Council to IPAL for this purpose, on the west side of the town. Development of the site commenced with the

erection of a wire fence around the land, planting of hedgerows along the boundaries, and improving the road of access. During the second half of 1981 sectional wood houses, prefabricated in Kijabe, were erected within the space of two months from the placing of the contract with the Economic Housing Group. These houses comprised an extensive administrative bl ck with conference room, a laboratory block, with separate sections for livestock and vegetation research, and a library, a three-bedroomed house for the Co-ordinator, a senior type two bedroomed house for a scientist, a minor type house for the Station Supervisor, and a house of four rooms for four subordinate services staff. Capital funds were conserved by translocating two scientists' houses from Gatab to the Marsabit site in late 1982, one forming a quarter for a scientist, and the other, the mess room, kitchen and bathroom of the much needed hostel in the new station. The three-bedroomed block of the Gatab hostel was likewise moved and re-erected in 1983 to form the sleeping accommodation of the Marsabit hostel,, now giving 12 beds in all. All senior staff houses and the hostel were furnished with water heaters, either electric or solar, and fridges. All the houses of the senior staff are fully furnished.

a) Housing

A note here is appropriate on the suitability of those comparatively cheap-type sectional wooden buildings in relation to the Marsabit climatic conditions. With the first rains experienced on the station at the end of 1981, it was found that the strong easterly winds were causing rain penetration through the wood cracks and joints in the windward walls of all buildings, as well as penetrating under the roof ridge caps. This is something which neither the experienced supplier contractors nor ourselves had foreseen. Minor damage to wall hardboards and ceiling boards resulted. Rain penetration was practically eliminated by facing all windward walls externally with a heavy black plastic sheeting. The replacement costs of damaged panelling and rendering winward walls impervious to the weather were undertaken by us, but were paid by the contractor. These buildings still have a reasonable life ahead of them of about another ten years, but a more permanent method of keeping out the rain on the windward side will have to be found within a year or two. Any further buildings erected in Marsabit must have at least their windward walls built of impervious materials such as stone or cement blocks, but preferably the entire building should be of uniform material.

Roofs should be given a suitable pitch and have adequate eaves to prevent penetration of driving rain. These pre-fab houses were all filled with glass louvre windows; this type of window is quite inadequate to prevent strong rain and wind penetration on the windward side of buildings.

b) Utilities.

Installation of utilities at the Marsabit headquarters station has been slow and frustrating. Applications were placed for water, telephone and electricity installations at the start, about mid 1981. Our own labour laid all water mains on the station, as well as installing the piping in all the houses, but no connection with the town supply was expected until early 1982. The telephone lines were installed and connected late 1982. The telephone lines were installed and connected late 1982, but it was not until late 1983 that electricity was installed.

The Marsabit headquarters station is now fully functional as regards its utilities, though a word of warning must be sounded. The water supply is precarious. The water resources of the mountain are limited, and even now an ever expanding town is at the limits of this resource. The supply springs are subject to the depredations of elephants and droughts, some piping mains supply systems, engines and pumps are antiquated and require replacing, and there is the problem of capital funds for replacements. This station will, from time to time, be facing serious water problems. One safeguard already taken is the building of pit latrines at every house. Serious consideration must now be given to:-

a) Securing the station's own alternative water supply linked to the station system, such as a hand dug well or borehole, with its own engine and pump. This is now under active investigation. Such a supply, if outside the station perimeter, will have to be secured inside a lockable pump house, and under a Right of occupancy deed. It must be recognised that in times of dire water shortages in the town, considerable pressures will be imposed on the project from political and administrative services for sharing water.

b) The installation of underground cisterns which will be supplied with water from the roofs of buildings. This method must be regarded as supplementary and a standby water supply, in the case of real need. The rainfall is more than adequate to feel large tanks, and the ground is sufficiently ready to keep the building costs relatively low.

c) The provision of a large water bowser truck, depending on the suitability of the alternative water supply detailed in (a). The bowser truck would have its own water pump and filter for drawing from springs or pools.

A further note of warning is directed towards the electricity supply. The incumbent engines are becoming overloaded, because of expanding consimption. They are subject to breakdowns and frequently deliver current at an unacceptable fluctuation level for delicate electronic equipment such as a computer and the project's Mettler electronic balance. An efficient current stabiliser could be installed for the operation of some electronic equipment, but not for the effective operation of a computer where unexpected power cuts are intolerable, and constant air-conditioning and humidity control is essential. The computer would have to be located in Nairobi,which would of course be somewhat inconvenient to the scientists concerned.

2. Development of outer Stations.

The considerable increase in the project's field support staff members necessitated a commensurate increase in housing at all field stations. The same type of sectional wood houses used in Marsabit were erected at sub-stations during the latter half of 1980. These were:-

a) Gatab - additional rooms added to provide for two married quarters.

b) Olturot - one house of 3 rooms, one of 2 rooms, and a rondavel type of two rooms translocated from Balessa Kulal.

c) Kargi - One house of 2 rooms. There was already in existence one rondavel of 2 rooms.

d) Kalacha - one house of one room to provide a best camp for visiting professional staff.

e) Korr - two houses of 2 rooms each.

f) Ngurunit - one house of 3 rooms.

These prefabricated sectional houses have proved suitable for the hot dry areas, but for added comfort, reed matting should be laid over the corrugated iron sheeting of all the houses.

The commencement of Phase III saw us trying to handle all the supplies for the study area from the single office room of the Administrative Officer, 6 floors up in Bruce House in Nairobi. This chaotic situation resulted in IPAL taking a lease over a modest residential quarter in the Westlands area, which served as a store/ office for supply operations, and visiting vehicles storage. To get the best advantage from the buildings, the living quarters were fitted out as a quarter where visiting scientists could be accommodated on a self-providing basis as regards food, thus reducing their high subsistence allowance rates for Nairobi. With two of the project's married experts leaving, this service was of no further real value, and so was abandoned.

This depot is a very busy place. It comes under the control of a Depot Supervisor. A Stores Clerk handles the receipt of all goods into his store, all goods despatches and the keeping of stores records. There are two night watchmen. All project vehicles are lodged in the depot and are checked in and out for all movements. The Nairobi Radio/Telephone set is operated from this depot, taking up daily about an hour of one person's time throughout the week. The radio is frequently in operation on Saturdays and Sundays, mainly to monitor the project plane and long distance vehicle movements.

I. Financial

The project's financial operations have gone through various phases I and II, all IPAL's expenditure above Shs.200/- were paid by cheque by ROSTA, and lower charges were paid from a petty cash imprest held by IPAL. Even before the introduction of Phase III, the work load this imposed on ROSTA was excessive, and so brought about a degree of financial decentralisation by IPAL running its own finances entirely from its own bank imprest. The imprest ceiling was set at $100,000 during Phase III. With the high level of expenditure required by the project, this ceiling was found to be inadequate on a monthly basis of accounts submission to Paris, the reduction of this period to half monthly has proved satisfactory.

Casting a critical eye on the financial performance of the administrative section of the project throughout Phase III, it is observed with satisfaction that the control on spending in all its varied and multitudinous aspects, and the control on stores accounting and custody, has been brought to a reasonably efficient level. However, it is recognised that the administration's machinery has not been adequate to give the full attention which each administrative facet requires. As the financial responsibilities take up a great deal of the administration's time, it would be to the better interests of projects and the controlling agency (ROSTA) to lift some of the burden of routine financial work from the shoulders of administrations by having a central accountancy section established to provide the accountancy services to each and all the departments and projects concerned. Department and project administrations would continue to control their own budgets, by maintaining records of expenditure which they had approved and passed to the central accountant for payment. This idea is currently under consideration by Paris.

Project hostels operated on their own revolving fund from monies collected in accommodation fees, up to the end of 1982. These funds were external to the project budget. On the Chief Accountant of UNESCO's recommendation, financial provision for the operation of the hostels has now been embodied in the budget.

The project renders a much needed service to livestock owners in the form of veterinary treatment to their animals during the monthly mobile veterinary clinics of the two project veterinarians. The service is given free to the people, but the drugs have to be paid for. Considerable sums of money are involved which has called for special rules governing the accounting of the funds and drug stocks involved.

J. Miscellaneous

The periodic Orientation Seminars which have been conducted by IPAL have proved to be of great interest and value to the participants. During these events, practically all administrative and scientific effort is directed towards achieving the maximum success of the seminars. From our experience, there are a number of ways in which these seminars can be improved upon.

As so much time and effort is put into these seminars, it is essential that the planned number of participants be filled as closely as possible. Also, the degree of impact of the seminar on participants, and consequently on countries, is largely related to the relevancy of the participants' own work discipline. The work of finding suitable participants and making their travel arrangements can best be handled by the project. Final nominations should be done from Paris. The final stage in getting everything together, meeting participants in Nairobi etc., as well as during the seminar and the closing off stage, calls for additional help in the shape of a locally engaged consultant. Seminars which are conducted in French call for the help of a consultant, probably from abroad.

The last Orientation Seminar held in November 1983 spent a larger proportion of its time camped in the arid country than was the case heretofore. Although camping and feeding arrangements call for a good deal of extra organisation, the advantages of fulfilling the objectives of the seminar are unquestionably much greater.

The two visits paid the project by UNESCO headquarters staff - one by the Chief Accountant and representatives of the Bureau of Personnel in October 1982, and one by representatives of the Internal Audit shortly after - were of considerable advantage to us and, as we have learned from them. Project circumstances too often do not fit well into the regulations, and no amount of explanation adequately deals with some problems. But a personal experience of the project gives the best basis for sound judgement, and therefore money spent on getting our Paris compatriots over here for this purpose is, in our view, money well spent in the furtherance of the project's objectives.

Much appreciation is due to all the IPAL staff, to ROSTA staff involved, and to the UNESCO staff concerned in Paris, for all their co-operation and help in maintaining our effective administrative service.

III. HUMAN ECOLOGY

Michael O'Leary

The full-time human ecologist joined the IPAL team in September 1981. His six monthly reports outline the methodology he uses in his work and hence there is no need here to go into any great detail in describing how data have been obtained. The human ecology work can be divided into six different phases. These are as follows:

1. Collecting data at the pastoralccamps and on the range.
2. Writing up this data on to data sheets away from the view of the pastoralists at Kargi and Kalacha outstations.
3. Transplating the quantitative data on to master sheets. This work is done at IPAL headquarters, Marsabit.
4. Competerising the data. The computer used is an Apple II Europlus and belongs to the human ecologist, Dr. Damm (Department of Physics, Kenyatta University College, Nairobi) has been employed on a part-time basis to make out the programmes best suited to handle the human ecology data. The arrangement started in mid-November 1983 and is working out successfully.
5. Analysing the data
6. Writing technical reports.

At present the human ecology programme employs four research assistants to work in Rendille country. These are as follows:- Mr. Peter Gaikuku (assistant in charge), Mr. John Regano, Mr. Augustine Nyayaba and Mr. Leiti Galboran. All speak English, Rendille and Swahili. The assistants who work amongst the Gabra are Mr. Paul Wata Guyo (assistant in-charge), Mr. Dominic Dabasso and Mr. Denge Dokata. All are fluent in English, Gabra and Swahili. The assistants have been trained to conduct phases 1-3 of the Research under the supervision of the human ecologist. The human ecologist directly manages phases 4-6 of the research.

The different phases are at different stages of compilation. Phases 1 and 2 are 90% completed, phase 3 40% completed phases 4 and 6 are 20% completed once the computerisation of the data has been completed the analysis and writing of reports will follow quickly.

In this report I outline in a nut-shell the main bones of the research findings. For those who are interested in more details they can look forward to the final technical reports which will be published in the coming months.

The Rendille occupy mainly arid lands with an average annual rainfall between 200-300 m.m. They obtain their livelihood principally from keeping camels, sheep and goats, and in recent years cattle. The Rendille one-humped camel is smaller and more robust than the Somali 'dromedary (Mukasa-Mugerwa 1981,8). Their sheep are of the Somali fat-rumped breed and their goat is the small East African goat. Borana and Zebu breeds constitute their cattle herds. In 1919 the population of all the Rendille people was 5.474. According to the national population census of 1979 their population was 21,749. This gives an annual increase of 2.3% between 1919-1979. Due to droughts in the late 1960s and early 1970s the Rendille lost large numbers of livestock of all species either through forced slaughter for meat, forage shortage from depleted rangelands or animal disease frequently caused by inadequate feeding. Famine relief programmes helped to provide sustenance for the human population. The net result was an overall drop in the ratio of animals to people. Livestock numbers have not kept in pace with even a modest population increase.

The Rendille have access to over 15,000 sq.km of range which according to IPAL range and livestock scientists is able to provide adequately for the present Rendille herd. For a variety of re sons explained below Rendille stock over-graze 25% of the range and rarely or never use 15% of it (remarks of Dr. Lamprey at the re-orientation seminar December 1983). This imbalance in the use of the range is paralleled by a similar use of the range for building material for camp and livestock enclosures, and for firewood. The IPAL woodland ecologist emphasizes that at the macro-level there is sufficient wood to supply the Rendille population with at least adequate supplies of fueld for the near future. Alternative sources of building materials will have to be sought and this problem may be further acerbated if in the near future sedentarised Rendille decide to build permanent homes.

The uneven use of the range is related to two main factors. Firstly, The Rendille follow the line of least struggle or effort when seeking out suitable grazing sites. They tend to opt for sites which are close to either springs (viz. Korole), relatively shallow waterholes (viz. Bagazi) or waterholes in or close to settlements (viz.Korr). This strategy makes the task of watering all the more easy. For example at Korole no labour is involved in watering beyond the supervision of animal traffic to the springs. At Bagazi shallow waterholes lighten the work load of the herders and livestock owners. In settlements such as Korr livestock owners who normally reside there and are not themselves herders add their labour to that of the herders in establishing waterholes and in watering livestock from them. Herders only move their livestock to areas where waterholes are deep and where they themselves must contribute most of the necessary labour when their stock have used up the forage at grazing sites of easy water.

A main concern of livestock owners and herders is providing security for themselves and their animals. In this they also opt for the easier way. They continue to remain in areas that are least likely to be attacked by raiders and will only move to areas more vulnerable to attack when either the water or forage supplies of the former areas become inadequate.

Pre-occupation with how best to provide water and security is heightened in households who for one reason or other rely mainly on girl or women herders. In many instances labour migration and schools have taken boys and young men away from herding to be replaced by girls and young unmarried women.

The emergence of permanent settlements is another factor which has contributed to the uneven use of the range. The celebration of family rituals such as the sorio and almadho are important events for the Rendille. Usually it involves bringing back to the settlements most of the livestock for periods of one to four weeks. At other times where possible livestock owners like to keep milk animals near at home in the settlement. These two practices lead to the over-use of the range surrounding the settlements. The damage to the range is all the move devastating when the settlement is also a major water source for livestock. This in part explains why the range surrounding Korr is more extensively denuded than that which encircles Kargi.

The uneven use of the range for fuel and building materials are caused for similar reasons. Herders always use trees and large shrubs which are near to their stock enclosures for fencing. Consequently areas which they frequently graze lose more rapidly their tree and shrub cover. Similarly residents of permanent settlements use trees and shrubs nearest at hand and this depletes the tree and large shrub layer in ever increasing circles from the settlement.

In Rendille country there are four major permanent settlements, namely, Kargi, Korr, Loglogo and Laisamis. Minor settlements exist at Ngurunit and Ilaut. These settlements are here to stay and can be construed as mixed blessings. On the one hand they provide their inhabitants with easy water which lightens the task of women who are primarily responsible for drawing water for domestic use, shops in a time where reliance on shop bought food is increasing, schools and dispensaries (or health centres). In addition major settlements are important centres for government and church administration and this provides "town" residents with secrrity from attack and a promise of food in drought years. The latter consideration is highly important to destitute and poor households who have few stock and are unable to live solely off their drought depleted herds.

The statement of the problem so far is double-edged. On the one hand those who view affairs mainly from a resource management perspective can quickly point to how the truncated use of the range is devastating the vegetational cover of over-used areas particularly those which surround settlements (permanent or semi-permanent) and/or permanent water points. In this perspective the Rendille pastoralist can be easily viewed as a villain and his actions towards his natural resources as irrational. On the other hand one can attempt to view matters through the eyes of the Rendille and assess how rational his choices and actions are from his point of view. This may be referred to as the anthropological approach. It has nothing to do with paternalism (kind or unkind) and does not in any way question the concerns of those committed to the proper management of natural resources. Rather it casts a different light on these concerns. Outside of the question of sedentarisation the main problem is to ascertain the rationality (or irrationality) of the herding strategy to pursue "the line of least struggle." Since this brings up issues relating the nature of the Rendille pastoral economy and its links with the wider economy as well as the impact of national policy on pastoral societies, these must be dealt with first.

It is mystifying to refer to the Rendille pastoral economy as a subsistence economy. It begs the question and releases the researcher all too easily from the task and responsibility of examining the conditions which maintain he Rendille at subsistence level(or at a low standard of living). It is more illuminating to view their economy as a peasant economy. A peasant economy has the following characteristics: a heavy reliance on household labour in production, production for home consumption as well as the market, variation in household land and livestock holdings and hence a variation in household wealth. Peasant economies are not isolated entities but are linked with national economies and polities which normally dominate them.

The day when the Rendille could totally and directly depend on livestock production for their livelihood has long past. The decline in the livestock/human population ratio first moved them to an indirect reliance on their stock. In other words livestock were sold on the open market in order to purchase cereals. This shift in their economy took place around the 1940s. Nevertheless they continued to rely totally or indirectly on livestock and its products. However this indirect mode of reliance proved inadequate in the late 1960s and early 1970s when the livestock/human population ratio further declined. Supplementary sources of livelihood were sought in labour migration, cultivation, the sale of milk and firewood particularly to the residents of Marsabit Town, the district headquarters.

Since the Rendille depend greatly on the wider economy (both district and national) for their livelihood it is necessary to examine the nature of their links to it. Lack of education tie the majority of Rendille job seekers to low paid jobs. Poor market facilities condemn them to sellin, livestock at prices such lower than the down-country consumer pays for meat. To cover their risks local livestock traders monopolise the market and thereby keep prices at a low ceiling. While some Rendille households have benefited from engaging in agriculture the majority still rely on shop bought cereals as well as sugar and tea. They have to pay for foodstuffs at price levels similar to that pertaining down country, while at the same time they are forced to sell their own products at price levels much lower than that existing down country. In other words terms of trade with the wider economy are unfavourable to the Rendille. Under such circumstances they refrain from placing their livestock on the wider market except as a last resort and in times of great need when cash is required for necessities. This reluctance

to sell is primarily caused by the state of the market and not by cultural considerations. Those who say that pastoralists are reluctant to sell because their needs are few are putting the cart before the horse. In a situation where the market is uncertain and prices low the pastoralist learns to aim only for a subsistence standard of living, otherwide he would risk the very livelihood of his household. Sufficient evidence exists to indicate that once pastoralists are guaranteed a stable market and good prices they do not hesitate to sell (cf. J.G.Galaty and alia 1981:219-220) and indeed improved marketing can cause major changes in the life style, social organisation, herd management practices and economy of the pastoralists (cf. Barfield 1981).

The tendency for pastoralists to maximise their herds is motivated mainly by the desire to reap gains in good years as a buffer to losses in drought years. This strategy also reflects the lack of alternative investment opportunities. Where rich pastoralists can invest in agricultural land, trade, permanent property etc. they do so (cf. Dahl 1977, Barth 1971). Already there are signs that the Gabra and Rendille are investing in land on Marsabit Mountain. This gives them an opportunity of investing other than on the "hoof". However as long as livestock prices remain low this tendency will be under constraints.

It is unnecessary here to examine colonial policies towards pastoral groups in Northern Kenya. Between 1963-67 the new independent Kenya Government was pre-occupied mainly with quelling guerilla activities after 1967 when the Dar-es-Salaam agreement brought the conflict to a formal end. Somali and Maasai pastoralists have benefitted to some extent from the First Livestock Development Project (1968-1973) and the Second Livestock Development Project (1974-1982). However the main focus in these national projects was on ranching and cattle production. The development needs of the pastoral economies of the Rendille and Gabra were not considered. The only role envisaged for them in the national plan was to contribute immature cattle to the ranching community and even this operation was conducted on an irregular basis and sometimes even in an haphazard fashion (cf.Njiru 1983). Little cognisance was taken of the fact that the Rendille kept mainly camels and small stock, animals which are most suited to their arid lands. The exclusion of the Rendille from the main thrust of the livestock projects means that they still lack adequate veterinary services and a suitable network of waterpoints, and markets for their livestock have yet to be developed.

The discourse on the pastoral economy of the Rendille and its linkages with the wider economy and polity sets the context for understanding their herding strategy of pursuing a line of least struggle. As already mentioned the Rendille pastoralist limits livestock sales mainly because the market is unstable and unfair. He also lacks the resources to invest substantially in non-pastoral enterprises. This leaves him mainly with the choice of increasing the number of his livestock.

Increasing livestock numbers rather than maximising in terms of meat and milk production of individual animals or of the whole herd is his primary goal. No doubt he is concerned with the condition of his animals but he knows that it is subject to seasonal fluctuations. As long as the lactating animals' supply of milk is close to average and is adequate to sustain their young leaving some milk for home consumption he finds it unnecessary to move to better grazing sites which involve an increased watering work-load and greater risks of losing animals to raiders. In his view the law of diminishing returns applies. Under present marketing conditions the marginal improvement to the condition of his animals does not justify the increased work load or the greater risks involved. This formula applies mainly to the Rendille who herd most of their stock in large groupings. These are exceptions amongst young ambitious Gabra men who control their own herds.

In conclusion, poor market facilities and low prices have stunted growth in the Rendille pastoral economy and prevented any take-off above subsistence level. As a result the economy is poorly monetised and little specialisation occurs. There are no inbuilt incentives to maximise production through investing extra labour in opening up new waterpoints and grazing sites, and in investing in veterinary services other than in a limited way. Their economy is unable to afford specialists in non-herding occupations such as tradesmen to build cement lined and permanent wells, mechanics to maintain water pumps, commercial wood-cutters capable of transporting fuel and building material long distances etc. The specialists who work amongst the Rendille at present are either paid government, church or international agency staff (whose wages the Rendille can little afford), traders (many of whom are non-Rendille), or Rendille who serve communities other than their own. For example some Rendille specialise in selling firewood (cut from their own range) to residents of Marsabit Town who are able to afford it. However, most Rendille cannot afford to purchase firewood. Instead they have to depend on household labour to cut and fetch it with minimum effort.

The above arguments lay the basis for reconciling and integrating the management of natural resources view point with the anthropological approach. The adherents of both perspectives aim at a more rational use of the range. The problem is how best to achieve this goal. One solution is to forbid the Rendille from using over-grazed range and to open up alternative grazing for them by extending the present network of waterpoints. Wood harvesting could be regulated and limited to those areas with sufficient woodland, and the wood transported to major Rendille settlements. This solution would undoubtedly have a measure of success but it lays an emphasis on having an outside agency to do things for them and hence perpetuates dependency. What happens when the agency withdraws as it eventually must?

An alternative way suggests going beyond an examination of the symptoms of range mismanagement and sets the problem in a wider context. It recommends that the Rendille be provided with a functional market system which would guarantee good prices on a regular basis. This on the long run would maximise production by providing livestock owners and herders with incentives to go beyond a strategy of least effort in seeking suitable grazing sites, in extending the network of waterpoints, and in treating sick and weak animals. It would also greatly monetise their economy, improve their standard of living, and open the door for specialists such as tradesmen and commercial wood-cutters and hauliers. In such a setting the Rendille could mobilise local resources while having the wherewithal to operate according to principles of proper livestock and range management. This would enable them to relate to the wider economy not as dependents but as equal trading partners. This solution has the advantage of being self-sustaining and capable of continuing even after the external agency has left.

Other Activities

1. Published an article on 'Population, Economy and Domestic Groups - the Kitui Case', Africa 53 (i) Journal of the International African Institute, 1983.

2. Published an article on the Kitui Akamba: Economic and Social Change in Semi-Arid Kenya, Heinemann 1984.

3. "Ecological Villains or Economic Victims: The case of the Rendille of Northern Kenya".

4. "Human Ecology Component of the Integrated Project in Arid Lands (IPAL) MAB, UNESCO, Marsabit Kenya" presented at ILCA Headquarters, Addis Ababa, October, 1983.

5. Presented a paper on "Drought Management Recommendation: The Rendille Case" at the Fifth Workshop of the Apostolate to the Nomads organised by the East African Conference of Bishops (AMECEA), February, 1984.

6. Presented a paper on 'Aspects of Camel Pastoralism Amongst the Rendille' at the seminar on the "Significance and Prospects for camel Pastoralism in Kenya" organised jointly by SIDA and the Institute of Development Studies at IPAL Headquarters, Marsabit, April, 1984.

7. Presented a paper on "Famine Management and Public Policy", XIth International Congress of Anthropological and Ethnological Sciences, Quebec, August 1983.

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1. Adu-Bobie, G.J. (1983). The role of Rendille women. IPAL Technical Report F-2.

2. Ayiemba, E.H.O. (1983). Human Ecology: A study of environmental perception and modes of survival among the Samburu in Kenya. IPAL Technical Report F-2.

3. Mburugu, E.K. (1983). Human Ecology: Factors related to stock ownership and population movements and perceptions of land pressure and other environmental changes among the Rendille in Marsabit District. IPAL Technical Report F-2.

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IV. LIVESTOCK ECOLOGY

C.R. Field

INTRODUCTION

The following component studies have been carried out within Phase III of the IPAL Livestock Section.

1. Animal numbers and distributions in relation to their environment.
2. Livestock food habits and Nutrition
3. Livestock Production
4. Human requirements from livestock
5. Livestock carrying capacity and impact on the range
6. Livestock offtake
7. Discussions and conclusion.

1. Animal numbers and distributions in relation to their environment.

Introduction, aims and objectives.

It is necessary in all ecological studies to have a basic inventory of the resources including variations in their availability.

In the case of livestock and wildlife whose numbers and distributions fluctuate seasonally and from year to year, ongoing monitoring is necessary to detect these changes.

The purpose of this study was to obtain information on the existing numbers of livestock and wildlife, and their distribution and densities in relation to the heterogeneous environment in which they live. Such information would enable the calculation of stocking rates for comparison with carrying capacities to determine what parts of the range are over or understocked. Analysis of the data on livestock distribution in relation to their environment provides information on the reasons why pastoralists choose certain areas for their livestock and why other areas are avoided.

This work has been carried out jointly with the Senior Woodland Ecologist who has done much of the flying, and with eight assistants recruited from all sections of the project, who have undergone training as aerial observers.

Methods

Because of the large area involved (23,000 Km^2), the only suitable method to provide the information required is to use an aircraft as a mobile observation platform.

We use the method of Systematic Reconnaisance Flights or S.R.F's (Norton Griffiths, 1975) which has been adopted by the Kenya Rangeland Monitoring Unit and used by others in East Arrica, Ethiopia, Sudan and Somalia. We have adapted the method to suit the conditions of the area. Fifteen livestock, wildlife and human categories and fifteen environmental variables are recorded at 5 km. intervals along flight transects. This gives us a maximum of over 13,000 entries per survey.

Because of the large quantity of data generated it was necessary to carry out a thorough analysis using the computer facilties of ecosystems Ltd. of Nairobi who designed the method which we use and the analytical program. The latter includes analysis of variance of the densities of animals etc. in the different environmental components and also a mapping facility which provides distribution maps using a line printer.

The major input variable in the environment is rainfall. Since this has a bimodal pattern in most years it would be ideal to conduct four surveys each year i.e. one in each of the two wet seasons and one in each of the two dry seasons of the year.

During the course of these surveys oblique aerial photographs of woodland vegetation were taken for the studies of the Senior Woodland Ecologist.

Results.

Surveys were completed of the study area as follows:-

August	1981	Dry season
May	1982	Wet season (Rendille area only)
May	1983	Wet season
September	1983	Dry season

In addition, two surveys of the adjacent areas to the south and east of the study area comprising a total of 17,000 Km^2 were conducted in January and May 1983. At the request of the GTZ Food Security Project these included Wamba Division of Samburu District. In May 1981 a total count of cattle by means of aerial photography was also carried out on Mt. Kulal.

Results of the analyses from the first ten surveys which were conducted in phase II but analysed in phase III have been published (Field, Lamprey, Masheti and Norton Griffiths 1981). They show estimates of livestock and wildlife densities and reveal a significant increase ($p < 0.05$) in the former at the end of a prolonged drought. Reasons for this are attributed to emigration during drought, a phenomenon which appears to be unnecessary for wildlife which are better adapted to the stresses of drought.

Significant ($p < 0.05$) distributions of animals in relation to environmental characteristics are presented in ten tables. The distribution of cattle and smallstock in relation to watersheds and permanent water is highly significant and very relevant to the conservation policies and recommendations of IPAL.

Photo interpretation and preliminary analyses have been completed for all surveys conducted in phase III.

Detailed statistical analyses have been completed for the August 1981 survey. Results are summarised as follows:

Table 1. Population estimates of livestock within the IPAL study area.

	August 1981	May * 1982	May 1983	September 1983
Season	Dry	Wet	Wet	Dry
Smallstock	531,054	28,576	382,720	
Camels	66,720	4,955	27,830	
Cattle	30,595	12,667	92,690	

* Livestock in the Rendille area only.

The total photographic survey of cattle on Mt. Kulal in May 1981 yielded a figure very close to the average for the ten previous sample survey i.e. there is a resident population of 5,000 cattle. These and results of previous surveys have been used for the calculation of stocking rates and carrying capacities in the management plan (IPAL, 1983). They show that 25% of the range is overstocked while 14% is not used at all.

Table 2. Population estimates of Livestock in Wamba Division

	January 1983	May 1983
Season	Wet	Dry
Smallstock	22.,577	158,632
Camels	4,266	1,084
Cattle	166,150	64,880

Large fluctuations in livestock numbers due to seasonal movements in and out of the study area, clumping around waterholes in dry seasons and mortality due to drought make it difficult to follow population dynamics from such data. More frequent consistent surveying is desirable.

Problems faced in achieving targets.

The following prevented more frequent surveying.

- A requirement that analyses of Phase II data be completed before further surveys were initiated. This precluded four surveys in the year July 1980 - July 1981.
- Malfunctioning of the aircrafts radar altimeter which has since been rectified. This affected one survey in 1982.
- Transfer of observers to other tasks and/or termination of contract. This affected one survey in 1982.
- Failure of rains, this affected one survey in 1981.
- Pre-occupation with Management Plan and report writing. This affected three surveys in 1982/83.

Full analyses of the last three surveys has not been carried out for the following reasons.

- Financial constraints of employing Ecosystems Ltd.
- Pre-occupation of Ecosystem Ltd with analysis from Turkana.
- The need to negotiate a contract with KREMUL for the service of their statistician to carry out these analyses.

Outstanding work required.

- Full statistical treatment of the last three surveys
- Publication of results of surveys.

2. Livestock Food Habits and Nutrition.

Introduction, aims and objectives.

The livestock range nexus or interface is bridged through the feeding and nutrition of herbivores. It is a vital link between trophic levels and as such requires thorough understanding. Another justification is that the processes involved may lead to desert encroachment, a description of which is one of phase III's short term objectives.

The purpose of these studies was as follows.-

- To describe intraspecific differences in food habits under varying conditions of plant growth stage and vegetation composition and/or range type.
- To determine the chemical composition and digestibility of key food plants and use this information to reconstitute the composition of livestock diets.
- To determine forage dry matter intake which is used in the calculation of carrying capacity.
- To carry out detailed studies of cattle nutrition which hitherto had not been conducted in the area.

Materials and Methods.

Most of the observations were carried out on a sample of livestock of several animals of the required species which were owned by IPAL.

This is desirable since there were occasions when we wished to know the food habits of livestock in an area where no indigenous animals were present at the time. Furthermore intake and digestibility studies sometimes necessitated the manipulation of animals which would not have been acceptable to pastoralists.

Forage availability in each plant community where observations were made was recorded at different growth stages using point quadrats, the point centered quarter and by clipping and weighing sample areas.

Food habits were studied by direct observation which were made on a time basis usually once per month but every two weeks for some smallstock. Twelve animals were observed for ten minutes on each occasion.

After each set of feeding observations the most important plant species comprising 80% of the diet were harvested for chemical analysis. The latter included proximate analysis, energy, van Soest fibre, minerals and in vitro digestibility analysis.

Samples were analysed in laboratories at the University of Hohenheim, the University of Nairobi and the National Agricultural station at Kitale.

The chemical composition of a particular diet could then be reconstituted by weighting according to the proportion in the diet and the proportion of the chemical component in the sample analysed.

Two methods were used to determine forage intake:-

a) For goats and cattle the chromic oxide indicator method
b) For camels by total faecal collection and determination of the indigestible fraction of the diet.

In vitro digestibilities of cattle diets were estimated by using lignin in the indicator ratio method (Kayongo-Male and Field, 1981).

Summary of Results

Forage availability.

Monitoring of forage availability in relation to base line studies of sheep, goats, camels at Olturot, was completed by the end of 1980. Records at Ngurunit continued until the termination of the production experiment on goats at the end of 1982.

Results are presented in IPAL (1983) and illustrate the following points:-

a) There are large seasonal fluctuations in food availability with minimum less than one third of monthly maximum

b) Minimum are associated with long dry season from June to October.

c) At Olturot a 33% reduction in rainfall between years led to a 37% and 39% reduction in forage for goats and sheep respectively.

d) At Ngurunit the availability of forage to a traditionally managed flock involving transhumance to highland pastures in dry seasons is about 80% higher during dry months than for a sedentary flock.

ii) Food habits.

Food habits have been recorded on a monthly basis as follows:

Camels: Olturot July - December 1980
Ngurunit - Korr March 1981 - December 1982.

Cattle: Kulal - Ngurunit - Korr February 1981 to November 1982.

Goats: Olturot July 1980 to December 1980
Ngurunit July 1980 to December 1982
Korr January 1981 to December 1982

Sheep: Olturot July 1980 to December 1980
Korr January 1981 to December 1982

Results in terms of dietary percentages have been summarised in IPAL (1983). There were 28 sets of observation each for cattle and camels, 114 sets of observation for goats and six sets of observation for sheep.

Details of cattle diets are given in Kayongo-Male and Field (1981).

The proportions of the different plant categories in the diets of different livestock species are used in the calculations of range and woodland carrying capacities.

Feeding observations have also been carried out during the livestock stocking trials at Gatab (Field 1983). Data on the proportion of a given species in the diet is expressed in relation to its availability in the pasture as the Preference Index. This can then be used for key species as a rapid method to show whether or not pasture is being over-utilized.

iii) Chemical Composition.

Approximately six key species of plant are harvested at the time of each set of feeding observations. This has yielded over a thousand samples each requiring about five analyses in phase III alone.

Results of forage samples for camels, sheep and goats at Olturot were completed and received from Hohenheim during 1981. Analyses from cattle forage samples were completed at the University of Nairobi during 1982.

Analyses of samples of the preferred diets of sheep and goats at Korr and Ngurunit proceeded very slowly at the University of Nairobi and were eventually completed at the National Agricultural Laboratories at Kitale in 1983.

Summaries of the chemical composition of forage plants for camels, cattle, goats and sheep for the period under review are presented in IPAL (1983) and Tubei (1983). The following are some salient points.

1. Mean protein levels are higher in browse than in grasses. Wet season levels are up to three times higher than dry season levels.
2. The calcium content of browse is relatively high and the phosphorus in more suitable proportions than browse.
3. The ash content of halophytic shrubs is very high. This may be due to accumulated sodium salts in the leaves.
4. The gross energy content of grasses is remarkably consistent and varies by only 10% in 30 samples.

The protein composition of different forages has been used for the reconstitution of dietary crude protein for sheep and goats at Olturot during 1980, for camels from 1980 to 1982 and for cattle from 1981 to 1982 (Field, 1983 Lamprey and Field 1983, IPAL 1983).

Results may be summarised as follows:

1. Camels - The protein intake of camels remained above 8% throughout a period of three and a half years. Peaks coincided with two monthly running totals of rainfall and were between 15 and 21%.

2. Smallstock - Although protein intake by sheep was generally lower than that of goats in 1979 there was little difference in 1980. Nevertheless, within a given area there appears to be differences in protein intake from one year to the next. Over the same period of time the protein intake of goats pastured at Ngurunit a subhumid area, was higher than those pastured at Korr an arid area.

3. Cattle - In contrast to the other species the estimated protein intake of cattle fell below 7% in eight occasions between 1981 and 1982. On one of these occasions (March, 1981) approximately 20% of all cows and calves died in the area principally from undernutrition (Field, 1984).

iv) Forage intake.

A summary of results of daily dry matter intake expressed as a % of liveweight of the different livestock species is given in IPAL (1983). More detailed information from cattle of three age classes in wet and dry seasons is presented by Kayongo-Male (1983).

v) Forage digestibility.

Mean values for invitro digestibilities of thirty three plant species are given in Tubei (1983). They range from 23.8 to 56.8%. Twenty six forage grasses for cattle had a mean dry matter digestibility of 42.6 $\pm$ 9.35% (Kayongo-Male). The latter figures are considered to be rather low.

vi) Problems faced in achieving targets.

Virtually no problems were faced in reaching the targets for feeding observations. The main problems have concerned delays in the analysis of forage samples. This has been a general problem with all laboratories because our material tends not to receive priority in the absence of a continuous IPAL presence. This should not have been a problem at the University of Nairobi where the officer in charge of the Laboratory was employed as an IPAL consultant. Nevertheless at times a backlog of samples of over a year old were allowed to accumulate.

Progress with analyses at the N.A.R.S. Kitale is now running more smoothly with IPAL employees carrying out the analyses and being supervised regularly by the IPAL Nutritionist.

Other problems faced by laboratories in Kenya include

1. Delays in obtaining the necessary reagents
2. Delays in obtaining spare parts for equipment.

An element of trust was embodied in the earlier arrangements in phase II between the T.L.M.P. and the Consultant Nutritionist. Consultant agreements were not clearly time specific, but open ended (Schwartz 1981). With the amalgamation of T.L.M.P. with IPAL the time specific nature of our program was not recognised or adhered to by the consultant.

The lesson to be learned from this experience is that when engaging employees on a consultant basis very precise terms of reference should be particularly specific about time schedules, expenditure and reporting of results. A larger proportion of the fee should be withheld until the final report is submitted to the satisfaction of the Project. If necessary a penalty clause should be included if it is anticipated that targets may not be reached on schedule.

Secondly International Agencies have been a source of funds with which laboratories in Kenya are equipped and kept running. IPAL has not been regarded as an exception to this. Thus arrangements have been made on apparently favourable terms only to find that later the laboratories demand a heavy expenditure on equipment and reagents which was apparently incurred during the course of work on our behalf. Here again very precise contractual terms need to be made before entering on similar agreements in future.

Minutes have been taken of all meetings between IPAL and N.A.R.S. Kitale Senior staff and have been circulated among the participants (Field, a,b 1983). These have proved valuable for subsequent reference and proper understanding and acceptance of verbal agreements. It is recommended that in future IPAL operate its own Laboratory and analytical facilities.

3. Livestock production.

Introduction, aims and objectives

Livestock are essential to nomads since they convert poor quality forage into milk, meat and blood upon which the people subsist. Studies of livestock production form a logical sequence to forage digestibility trials which have provided a measure of the nutrients assimilated.

The aims and objectives of this section in phase III were to complete the documentation which had been initiated in phase II of the recruitment, mortality, milk yield and growth of the indigenous livestock species under their present form of management. Special emphasis would be given to cattle as the aerial surveys revealed their importance and they had not hitherto been studied in phase II.

From these studies under nutrition and disease were identified as two major constraints to production requiring special investigation and experimentation.

The effect of disease and nutrition on production was then examined by comparing the performance of a treated or supplemented group with a control group under 'traditional' management only. It was also important to know whether the benefits of treatment in term of increased yield are cost effective.

Methodology.

Where possible livestock owned by indigenous pastoralists were studied. However, this posed some problems as the owners invariably requested help for their animals in exchange for their cooperation. While IPAL was willing to provide help the provision of veterinary medicine in particular, meant that we were no longer able to monitor a typical situation as faced by the pastoralist.

Smallstock.

In the experiments which required precise control it was necessary for IPAL to purchase its own animals and manage them along 'traditional' lines. In the case of sheep and goats IPAL purchased both treatment and control animals commencing with a minimum of sixty of each with the flock structure approximating that of neighbouring indigenous flocks (i.e. approximated 50% adult females, 2% adult males, upto 18% castrates and the remainder immatures). Proportions of the different sex and age categories fluctuated seasonally.

Goats at Olturot were of the Galla breed which were purchased from Gabbra pastoralists while those at Ngurunit and Korr were small East African breed, purchased from Rendille and Samburu.

Sheep at Olturot and Korr were Black headed fat rumped Somali breed the former purchased from Gabbra and the latter from Rendille.

Camels

We hired 60 camels on a contract basis from three Ariaal Rendille pastoralists for the herd receiving veterinary input. The control herd also of 60 camels consisted of 13 from original IPAL stock of Rendille/Gabra origin, four purchased of Rendille origin and 43 purchased of Turkana origin. Although drought conditions prevailed it was not possible to purchase female camels from the Rendille. Herd structures of the two herds were as follows:-

	Treated herd (on hire)	Untreated herd (owned by IPAL)
	Figures in percentages	
Adult females	55	37
Adult males	2	7
Castrated	0	5
Immature and Young	43	52

Cattle

In September 1980, a herd of 105 indigenous small East African Zebu (Bos indicus) cattle were taken on contract from a Somali trader and ten steers purchased by IPAL added the following month. The herd composition was then 52% cows and heifers, 4% bulls, 26% steers and 18% calves. There was a 18% mortality of mostly cows and calves during the following six months when there was a drought. A further 40 cattle were subsequently taken on contract before the two herds were split in a restricted randomised manner into treatment and control groups in April 1981 as follows:

	Treated herd	Untreated herd
	Figures in percentages	
Bulls	3	3
Steers	9	7
Cows	28	30
Heifers	27	27
Bullocks	6	6
Calves	28	27

In general, routine monitoring of the disease and production of each animal in the herd or flock was carried out once per month. In the case of smallstock this was sometimes done twice per month.

The main disease records involved pack cell volumes, blood parasites, helminth and tick burdens. Other diseases were monitored as they occured or by a special survey e.g. for foot and mouth disease in cattle (Omara-Opyene 1983)

The major production parameters involved growth measurements through body weight changes over time; lactational yields and duration, fertility and mortality records.

Methods are described giving details of sample size and frequency as follows:=

- Smallstock diseases and productivity (Carles 1980)
- Cattle diseases and productivity (Field, 1981)
- Camel diseases (Rutagwenda, 1981)
- Camel productivity (Simpkin, 1981)

It should be mentioned here that routine monitoring was a substantial undertaking and the twice monthly monitoring of smallstock and monthly monitoring of cattle and camels involved a total of over 800 measurements of body weights alone per month or almost 10,000 per annum. Other parameters were of a similar order. The subsequent analysis of some of these data therefore necessitated the use of computer facilities.

The cost of all treatments was recorded and a preliminary assessement was made of the value of the products. Initially the veterinary package was given in the form of a blanket treatment to ensure almost complete elimination of parasites. Subsequently this practice was modified and drugs administered strategically as and when the results of monitoring recommended. Thus costs may be assessed at two different levels.

Benefits may also be assessed in two ways, that is the value of the product to the pastoralist or to a city dweller or even for export.

[illegible]

[illegible] livestock production systems.

Results

Indigenous livestock production systems.

i. Smallstock:

Basic production parameters of sheep and goats from the Olturot flocks monitored over a two year period are reported in Blackburn and Field (1982), Field (1982) and IPAL (1983).

Simulations have been made of body weights and milk production of female goats, and growth of their offspring produced during three different months of the year and under three different management systems. (Smith et al.1982).

These results may be summarised as follows:

At Olturot:

a) Kid and lamb growth was consistently different between years. The sex of the offspring and whether they were single or multiple births and little influence on body weight.

b) Ewe weights also showed year differences while doe weights did not, possibly because of the years was drier and goats were better able to meet their nutritional needs by having a larger vertical foraging range.

c) Lactational curves for both sheep and goats are presented from which it is possible to determine total milk production of the flock. This has been used in assessing minimum flock size for human requirements (Field, 1982).

At Ngurunit:

The nutritional advantages of a migratory system of flock husbandry are clearly demonstrated when compared with sedentary flocks. This advantage is apparent in the simulated body weights of females, milk production and growth of kids. Here the kids born in June appear to obtain particular advantage from migration while for those born in February there is no significant advantage.

Further analyses of the smallstock experiments at Ngurunit and Korr are still underway but preliminary results are available (Carles, unpublished and Carles et al 1984).

Korr:

a) Body weights. At the end of the period sheep were larger than goats and males were larger than females. Animals born up to two weeks after rain were heavier by 20 - 33% when compared with animals born when there was no rain.

b) Growth rate. The growth rate of goats was only 73% that of sheep. This suggests that for meat production at Korr sheep may be more productive at least up to one year of age.

ii) Camels.

The basic production parameters for camels at Ngurunit, Olturot and two other localities outside the study area have already been described from work conducted in phase II (Field 1979, Wilson et al 1980, Schwartz et al 1982). These describe lactation, herd dynamics and growth respectively.

Further information collected during the course of phase III experiments on camel growth, lactation and herd dynamics has been presented in Simpkin (1981), IPAL (1983), Field (1983) and Field, Rutagwenda and Simpkin (1983).

Our information on camel lactation has been integrated with data from other parts of the tropics in an article on the milk production potential of camels (Field 1983).

In brief, indigenous camels are producing well below their potential. Thus, growth rates 250% higher than indigenous camels have been obtained in IPAL camels by permitting the calves to suckle their mothers during the day time.

Calf mortality is high, at approximately 50% in the first two years of life. Fertility may be reduced to 80% in two years, the normal calving interval. Lactational yields average less than 2 litres per day over a period of about 40 weeks, compared with an overall average for the dromedary of 7 litres per day over almost 60 weeks. (Field, 1983).

Cattle.

Results of cattle production in terms of growth, lactation and herd dynamics are available from the IPAL contract herd and from household surveys. Preliminary results are reported in Field (1981) and IPAL (1983).

Data from four hundred household surveys have been entered on the University of Nairobi computer by our data processor and preliminary analyses conducted. More detailed analyses are necessary before final conclusions can be drawn.

The household surveys have yielded information from four communities and both settlements and foras on the following:

1. Herd composition
2. Weights at age
3. Lactational yield
4. Mortality

Means and standard deviations have been calculated for all data.

Summary:

1. Growth.

   This is very slow in the first 8 months ranging from 0.1 to 0.2 kg per day. Animals mature at 3.5 to 4 years. Asymptotic weights for cows are approximately 220 kg and for bulls 320 kg. Steers may reach 400 kg.

2. Lactation.

   Lactations may persist for over a year if conditions are poor and the cow fails to conceive. Lactational yield peaks about six weeks after the onset of rain. Wet season yield (1.3 - 2.4 litres per day) is at least two to three times that of dry seasons.

3. Mortality.

   During drought this may be quite high (20%) due to under nutrition in the localised and over grazed area around permanent water. Cattle are particularly vulnerable because of their dependence on watering every other day and they may only spend about one sixth of their time over a watering cycle in adequate grazing. Cows and calves are the most vulnerable categories because of their requirements to produce and

consume milk at a time when water and forage is scarce.

Constraints to production.

i. Disease.

Major diseases limiting productivity in probably order of importance are:

a) Camels: Trypanosomiasis, helminthiasis, ticks and mange. (Wilson et al, 1980; Wilson et al, 1982, Rutagwenda, 1982).

These studies confirm the importance of these diseases which have been reported elsewhere in the literature. However, their interaction with malnutrition could not be measured and was probably quite important.

b) Smallstock. Pneumonias in particular contagious caprine pleuropneumonia (c.c.p.p.), helminthiasis, brucellosis and enterotoxaemia. Foot abscess, orf and ticks may be a problem in humid areas. (Carles 1981, IPAL 1983, Crees, 1983)

c) Cattle. In desert areas very few diseases eeach pathological levels although sporadic out breaks of foot and mouth, anthrax, brucellosis and trypanosomiasis may occur. In humid areas ticks and helminthiasis are a problem. (Field, 1931; Omara-Opyene 1983, IPAL 1983).

In conclusion diseases are a problem for livestock particularly in humid areas. Malnutrition may predispose animals to disease following the onset of rains after drought.

Drug testing.

As part of the development of suitable veterinary packages trials on the efficacy of certain drugs have been carried out. They were mostly antihelminitics and acaricides. Results are reported in Crees (1983 a.b).

ii. The effect of health care on production.

Results to date of experiments on the application of veterinary packages to different livestock categories have been summarised (IPAL 1983, Field, Rutagwenda and Simpkin 1983).

These are preliminary and may be modified as further data are analysed.

Growth: An increase in both calf and immature growth rates and a higher calf birth weight with veterinary input.

Lactation: Veterinary input increases milk production significantly (66% over 38 weeks).

Reproductive Potential: Veterinary input reduces abortions from 20% to 5% of the breeding herd. The number of calves born is almost doubled.

Mortality: Calf mortality is reduced from about 46% in Rendille herds to 10% with veterinary input and total mortality was more than halved.

Smallstock.

Significantly increased rates of growth and milk yields have been observed in treated smallstock when compared with untreated animals. In goats the differences are greater in animals kept under humid conditions where diseases challenge is higher when compared with those kept in desert regions (Carles, unpublished data, IPAL 1983).

Cattle.

Since disease challenge is low in the desert areas where the cattle experiment was conducted veterinary input was also minimal. The growth of calves and weights of adults indicates little or no difference between treated and untreated animals. Significant differences were obtained in the growth rates of calves born in different years. This is attributed to nutritional differences between years. (IPAL 1983, Field et al, 1983).

iii) The cost efficiency of health care.

Since production data are in some cases still undergoing analysis only preliminary indications of the cost efficiency of the veterinary packages can be given. These have been assessed in terms of total veterinary input costs and the value of the increased yield at local market prices. (Njiru, unpublished data).

Camels the net benefit is equivalent to Kshs.500 per camel treated per annum.

Smallstock.

For goats treated in humid areas the increase in milk yield alone is likely to pay for the veterinary costs.

Cattle.

In the desert areas veterinary input is unlikely to be cost effective unless it is very strategically applied. It may prove beneficial in humid areas. (IPAL, 1983)

iv. Nutrition.

Experiments were conducted on cattle only since it was felt that they would benefit most from feed supplementation. The results showed a mean increase in growth rate of calves of almost 40 gm per day for 60 days when supplemented with 500 gm Acacia tortilis pods daily (IPAL, 1983).

v. Problems faced in achieving targets.

Problems may be divided into those related to the implementation of the experiments and those related to the subsequent treatment of the data. It would be to say that no problems were faced. In the event frequent minor problems arose which required on-the-spot decisions, particularly since we were sometimes operating under critical conditions of forage and water supply. However, it is appropriate here to stress that these experiments were successful in so far as they were completed according to schedule. Much credit is here due to the support staff of Field Assistants and Herdsmen. For example it became routine for Project staff to rise at 0430hrs. and depart from the Field Station by 0500 hr. in order to be at one of the more remote livestock camps at dawn (0600hrs). This was essential during drought in order to complete our monitoring activities by 0800 hr. to give all livestock and cattle in particular, adequate grazing time before the heat of the day (1100hrs).

Our staff also became very efficient at handling animals. For example two teams were able to bleed 120 camels in 120 minutes. This not only involved the collection of blood, but catching, hobbling and ligaturing them before bleeding. Such swiftness of operation is probably unequalled and deserves submission for inclusion in the Guiness Book of Records!

Large male camels and cattle may also be dangerous and it is remarkable and also a fitting tribute to our herdsman that nobody was seriously injured during the course of more than two years of intensive livestock handling.

The main experimental problems were as follows:

1. Obtaining adequate water and forage for livestock which was simultaneously accessible to regular monitoring.
2. The necessity to be quite mobile especially in the case of cattle and smallstock in the arid area.
3. The failure to be sufficiently mobile with camels
4. Lack of full control over the treatment herd of camels which was contracted from private owners owing to the large capital outlay which would have been required and the non-availability of camels for sale.
5. A trend towards sedentarization of the contract camel herd owners as a result of the benefits available from IPAL.
6. Neglect of the IPAL camel herd by the contractors who were responsible for their husbandry. This was because their own animals remained healthy as a result of the veterinary input despite their sedentary state and they did not see the need for following all the traditional camel husbandry practices (e.g. regular watering at saline wells etc.).
7. Unacceptable delays were experienced in receiving results of serology and post mortem material submitted to laboratories in Nairobi.
8. The signed contractual arrangement with the cattle owner worked well and we are most grateful for his continuing cooperation. We only experienced problems once which arose as a result of his absence.
9. The design of the smallstock experiment at Korr which involved providing daily access to water proved impracticable and a traditional system of watering every third or fourth day was adopted.
10. It would have been ideal to continue these experiments for longer, in particular in the case of cattle and camels which reproduce slowly. This was particularly desirable regarding the small sample of lactating camels and monitoring of the full lactation period in

camels; also the survival to maturity of cattle and camels. Such data should be incorporated in a full cost efficiency analysis.

11. The original contract for the smallstock appeared to be open ended and characteristic of a monitoring exercise. Later when limitations of time and funds were imposed hhis was not adequately catered for in the original design.

The main analytical problems have resulted from a failure to meet deadlines due to:

1. Non-specific contractual terms in the case of smallstock.
2. The longer period of data collection necessary for camels.
3. Inefficiency of the Nairobi University Computer
4. Insufficient time for the analysis of cattle data and the failure to find a replacement for our data processor who left for further Education overseas.

vi) Recommendations.

a) Mobility. Before embarking on any future study or management implementation in desert areas all staff involved should be both aware of the need and capable of being highly mobile. Indeed IPAL's field stations should only be resorted to for replenishment of supplies. The f fora situation should become the norm not the exception.

b) Ownership of Experimental Stock.

It will be desirable in future for the project itself to own all the experimental stock which it uses.

c) Analysis of material. Proper contractual agreements should be drawn up for these services.

d) Time schedule. Future work should not be initiated until sufficient time is allocated for completion of data collection and analysis.

e) Data analysis. The project should have as a matter of urgency, its own data processor and computer facilities.

vii). Oustanding work to achieve targets.

The completion of the following analyses is necessary:

1. Smallstock. Final report of consultant on growth, lactation, fertility, worm burdens and mortality.

2. Camels. Masters thesis of student on camel production
3. Cattle. Full statistical analysis of household data completion of analysis of disease and production data.
4. Food supplementation. An experiment using Acacia tortilis pods as a food supplement, should be conducted with IPAL kids and lambs.

4. Human requirements from livestock

Introduction, aims and objectives.

The final step in the production chain is the use of livestock products by man. Thus the aims and objectives are as follows:-

a) To evaluate the present use to which livestock are put by their owners and to determine their effectiveness in meeting the needs of society.

b) To recommend appropriate adjustments to fulfill shortages. Some data have already been collected and published during Phase II.

Methodology.

The main method used to investigate livestock and human interactions has been the household survey. Data have been stored on computer. In addition to questions asked, measurements are taken on site of livestock numbers, their weights, milk production and occasionally blood. Special emphasis has been made on filling gaps in knowledge of cattle pastoralists. Fifteen households and ten 'foras' have been surveyed during the four seasons of a year in four separate settlements. This gave a total of 400 surveys and 20,000 questions asked of cattle owners.

Some additional surveys have been made on camel owning households.

In order to determine the efficiency of cattle in meeting the nutritional needs of the society a series of child health and nutrition surveys were carried out in 1981 and repeated in 1983. These involved about 250 children in three localities. Methods used are described in Mubia (1981).

Household surveys.

1. Cattle.

Preliminary results from the first set of surveys are present in Field (1981) and further data have been used in IPAL (1983). Results from

400 surveys have been summarised in terms of means and standard deviations for each group of 25 surveys. All data are stored on University of Nairobi computer floppy discs and await cross analyses i.e. between households and foras; between seasons by area and between areas by season.

These results are stored at Gatab in the form of 93 handwritten pages of tables (Muiruri, 1983). It is impossible to do adequate justice to this information in the short space of the report. It must suffice here to outline the kind of information summarised for each survey set.

a) Herd characteristics including percentage composition by sex and age category. (Fifteen entries)
b) Reproduction and lactational data. (twelve entries
c) Weights by sex and age category. (Fifteen entries)
dà Herd size per household.
e) Recent transactions. (Thirty entries)
f) Sex, weight, price and destination of cattle sold. (Fifteen entries).
g) Health inputs to cattle. (Three entries
h) Sex and cause of mortality. (Fifteen entries)
i) Priorities for choosing an area. (Sixteen entries)
j) Areas utilised over past year on a grid reference basis.
k) Numbers of other livestock present. (Two entries)
l) Current sources of food from livestock. (Ten entries)
m) Other sources of food. (Ten entries)
n) Household expenses. 9Seven entries)
o) Human composition of household. (Twenty two entries)

Over one hundred and seventy entries are made per survey yielding in the order of 70,000 data entries for the entire set of surveys.

ii) Smallstock.

It was intended that a Graduate Fellow carry out a similar survey of smallstock flocks to fill this gap in our information. In the event the fellowship was relinguished and much of this information will depend on data presently being collected by the Human Ecologist and his assistants. Preliminary data were collected in phase II (Field, Ac 1978) and these and data collected incidental to the cattle household surveys and surveys conducted by Mburugu (1982) at Korr and Kargi have been used for the determination of human requirements of smallstock (Field, 1982, IPAL 1983).

iii) Camels.

Data were collected from 60 households in phase II and have been used together with information from the literature for the determination of human requirements (IPAL, 1983). Fourty five additional surveys have being conducted at Kargi, Laisamis and Korr in order to relate experimentally generated data to the existing Rendille system. It is expected that these data will be presented as part of a thesis on camel productivity (Simpkin, personal communication).

Results of Child health and nutrition surveys.

According to daily attendance records from two hospitals the following diseases are common in the area.

1. Anaemia during pregnancy
2. Eye infections
3. Brucellosis
4. Upper respiratory infections
5. Gastro enteritis
6. Wounds and skin infections
7. Malaria
8. Tuberculosis
19. Gonorrhoea
10. Parasitic infections

Regarding the nutritional status of children under five years it appears from the first surveys that the Ngurunit children were the most healthy and the Marsabit children the least with Gatab children intermediate (Mubia 1981). This is interesting as it is in inverse proportion of the availability of medical facilities. It is suggested that possibly greater opportunities for the sale of livestock products in particular milk exist at Marsabit and parents then use the revenue for the purchase of goods which are of little value for child nutrition and health.

The number of children surveyed in each population was however, rather few and it will be interesting to known whether the second survey (Teasdale, in preparation) reaches similar conclusions. If so it may be anticipated that sedentarization will be detrimental to the health of children unless the value of cows milk to the child, in particular those undergoing weaning, be demonstrated through adequate extension.

iv). Problems faced.

Secondary school students were employed for much of the data collection and in general they carried out their tasks well. This was partly because they are respected members of the community and also because they were recruited from the area and IPAL employees are accepted by the people.

It was however difficult to supervise surveys being conducted in several places at once and as a result we were obliged to reject some of the surveys from Marsabit as being unreliable.

The analysis of the surveys took much longer than expected. This was largely because the Data Processor and assistant experienced problems with the University of Nairobi Computer. The entry of data which was in hands of University of Nairobi employees contained numerous errors and had to be double checked by hand which too a great deal of time. Then before the full statistical analysis could be carried out the Data Processor was called prematurely for further training in the U.S.A. This was almost six months ago and no replacement has been found. Thus the work is stagnating at present. Since it represents a grett deal of time and effort in data collection and preliminary analysis it would be a pity if these data are not subject to a full analysis.

v). Outstanding work necessary.

The most important outstanding work is the full statistical analysis of the 300 household surveys of cattle owning pastoralists. This requires the employment of a statician with a full working knowledge of the University of Nairobi computer.

It is intended that the results of these analyses be incorporated in a final IPAL Technical Report on Cattle. We already have papers on cattle disease (Omara-Opyene) 1983 and nutrition (Kayongo-Male, 1983) awaiting publication and it may be necessary to use data from the preliminary household analyses to prevent further delaying the presentation of this work.

Smallstock surveys: Once the data being collected by the Human Ecology section are available we will be in a position to review whether any additional data collection will be necessary.

Camel Surveys: It is not anticipated that more surveys will be required in the near future except perhaps of camel 'foras' which tend to be under represented.

In all the above surveys long term monitoring at strategic intervals is desirable to determine how livestock and human interrelations are changing.

5. Livestock Carrying Capacity and Impact on the range.

Introduction, aims and objectives.

The process of desert encroachment is usually due to the combination of excessive use of the range by man and his livestock with a period of reduced rainfall. The immediate effect of livestock on the range is primarily due to grazing and browsing coupled with transping as they search for food and travel to water.

Attempts to assess range use by livestock in terms of forage intake alone neglect the important role of trampling. Another approach involves monitoring overgrazing around settlements, but there are difficulties in assessing the relative importance of different livestock species in contributing to the problem.

The aim of this section is to carry out integrated livestock, range, woodland and hydrological studies to measure the effect on the range of different species of livestock at similar and at varying stocking rates. By repeating these experiments over a long period of time it is hoped to be able to determine the carrying capacity of the range type involved. The contribution of different livestock categories to water loss and erosion from the soil surface is also important. Indeed it was the observation from the aerial surveys that cattle and smallstock are significantly associated with watershed areas and the possibility that this might contribute to serious erosion, which prompted the experiments described here.

These trials were initiated in phase II in the Acacia tortilis - Indigofera spinosa riverine shrub at the Balesa Kulal. The first trial was designed to monitor the impact of camels and smallstock on the grass - herb and dwarf shrub layer while the second which was initiated in phase III also measured their browsing effect on perennial woody vegetation and has included cattle. This latter experiment is of particular interest to the woodland ecologist.

Methodology.

The approach involves grazing cattle and smallstock in separate enclosures at known stocking rates and measuring the effect they have on the vegetation. This is achieved by comparing forage available before the trial with forage remaining after the trial. Any changes in forage availability during the trial due to growth or senescene are monitored by use of control areas where there is no grazing.

There are two sets of four enclosures each one hectare in area. One set is built on a steep slope at Lelerong and the other on fairly level ground near the airstrip.

In each set cattle are stocked at two rates one referred to as heaving being twice the rate of the other which is termed light. Sheep and goats at a similar combined weight to that of the heavily stocked cattle enclosure were in a third enclosure while the fourth was left ungrazed and acted as a control.

The livestock graze their respective enclosures daily until the combined weight of one of the treatment groups decreases by more than 5% when compared with their weight at the start of the trial. At this stage it is assumed that the vegetation in the enclosure used by that group has been depleted and the experiment is terminated for all treatments. Stocking rates are then standardised for comparison in terms of Tropical Livestock Units (equivalent to a 250 kg cow) per km^2 per year.

The vegetation in each enclosure is analysed as follows before and after grazing:

a) Grass/herblayer: 300 point quadrats for cover
30 x m^2 clipped quadrats for biomass
3 x fixed permanent transects each 100m

b) Dwarf shrubs: 3 x Leithead transects for cover, volume and density
30 x plants of the main species are measured, clipped and weighed to enable a regression for determination of weight from volume.

c) Large Shrubs and Trees: Stereoscopic aerial photography.

In general enclosures are grazed twice a year in the period of dormancy between growing (rainy) seasons.

Feeding observations.

Feeding observations to determine the food preferences of livestock are conducted at the beginning and end of each trial. This shows the change in dietary habits as the food supply diminishes and offers the possibility of identifying species as indicators of overgrazing.

Water catchment and erosion.

Water running from the surface of a known area of range is caught in a trap and measured. The catchment area is delineated by wooden boards. The actual rain falling is measured in gauges nearby.

Erosion is measured in two ways. Firstly thirty metal rods are placed in the ground along transects in each enclosure. Then exposure above the soil surface is measured between trials. Second 3x30 ml water samples are taken from each trap after rain. The water is thoroughly mixed before sampling and then allowed to settle. The volume of the sediment is measured and the water decanted. The sediment is then dried and weighed. This sample is then related to the total volume of water in the trap.

Results.

Three sets of trials have been conducted at Gatab, Mount Kulal as follows:

Trial 1. Airstrip enclosures (level ground)May to July 1982.
Lelerong enclosures (steepsslope) September to October 1982.

Trial 2. Airstrip and Lelerong enclosures January to February 1983.

Trial 3. Airstrip and Lelerong enclosures September to October 1983.

Trial 1 ran sequentially in the two sets of enclosures because there was insufficient livestock for them to run simultaneously.

Results of Trial 1 in terms of mean stocking rates, food habits, preference indices, changes in grass herb cover and phytomass and density of dwarf shrubs are given in Field (1983).

Results from Trials 2 and 3 are being analysed. Data analyses have been completed for grass/herb cover, dwarf shrub volumes and densities, food habits and preference indices. Grass/herb and dwarf shrub dry matter determinations have been completed for Trial 3, but not Trial 2.

From the above it can be seen that more than 60% of the analyses are complete. Results from the water catchment and soil erosion are still being analysed in Marsabit.

Results from Trail 1 and the incomplete data from Trials 2 and 3 suggest the following:-

Stocking rates.

Initially (Trial 1) stocking rates were very high i.e. 110 to 120 Tropical Livestock Units (TLU) per Km^2 per year as the paddocks aad been rested for a year. Subsequently 46-60 TLU per Km^2 per year were achieved depending on the rainfall.

Animals increase in weight by up to 10% at the beginning of trials and then lose weight quite quickly as forage is eliminated. However, cattle at the light stocking rate maintain their increased weight as the forage is not depleted.

The carrying capacity of the steep slopes is likely to be substantially lower taan that of the level ground.

Food habits.

Food habits differ according to the following factors.

a) Species of animal

b) Available forage.

The latter varies between paddocks and during the course of the trials, as more palatable plants are eliminated. The preference index of certain grasees such as Bothriochloa insculpta and Themeda triandra may pass from a negative figure to a positive figure as the trial proceeds.

Grass/herb layer.

The cover of the grass/herb layer decreases by 10-40% after heavy grazing. Some of the vegetation is converted into litter however, which together with faeces help to protect the soil.

Dry matter changes are still being analysed.

Dwarf shrubs.

A clear picture has not yet emerged regarding dwarf shrub changes. At the airstrip paddocks Aspilia is utilized heavily by smallstock but they select leaves and do not greatly reduce the crown area of this shrub. Neither cattle nor smallstock use Solanum which appears to follow an independant pattern of growth and senescence. At the Lelerong paddocks Tephrosia is used by smallstock and not by cattle. A clear browsing level as indicated by a browse line is apparent on the larger shrubs such as Rhus natalensis.

Problems faced.

Conduct of the pre-trial vegetation analysis and the grazing experiment has been straight forward and has not posed serious problems although the vegetation analyses are laborious and have necessitated the recruitment of several vacation students. Post trial vegetation analysis occasionally cannot be completed before rain initiates new growth which masks the effect of grazing. Drying of samples is laborious.

Timing of the experiments is therefore important and any delays can prevent the achievement of targets. On-the-spot supervision of the experiment is desirable but has not always been possible.

More supervision of the water catchment system and data analysis is necessary.

Outstanding work required

Since this is a long term monitoring exercise these experiments should be repeated twice per year. For the rapid analysis of vegetation particularly after the trial in experienced botanical team of six assistants is required.

Most of the outstanding analyses will be completed by the end of this phase.

More attention needs to be paid to the water catchment and erosion aspects of the trials.

6. Livestock offtake.

Introduction, aims and objectives.

A major concern of the project is that at present livestock offtake is minimal and requires stimulation. This is necessary for the following reasons.

a) Localized overgrazing.
b) The accumulation of wealth on the hoof through lack of suitable outlets.
c) The possibility of an increasing population as constraints to production are lifted through health care.

A considerable amount of information has already been collected and is referred to underchousehold surveys. This concerns mainly the present ways in which cattle are utilized, but includes slaughter for home consumption as well as the sale of cattle both within and outside the home area.

A thorough study of trade in the District which is based on livestock as the main resource, was initiated in phase II by a Graduate fellow of IPAL (1983) and presented in other IPAL publications (Njiru, 1981, 1982, 1983). It is not intended to repeat this work here. However, in the normal course of the livestock research a surplus of animals was obtained through natural recruitment and good animal husbandry. Some of these animals, mostly castrated male and cull female sheep and goats were surplus to the projects requirements. It was therefore decided to market them through different outlets to determine the most suitable channels for future Rendille marketing operations and some of the constraints which exist.

Materials and methods.

Smallstock.

IPAL has purchase about 400 head of sheep and goats for its research since the Project began. By January 1983 the number of these animals had more than doubled. One flock purchased in 1976/1977 and kept at Olturot had increased to more than four times its original size. It was decided to reduce the flocks by about 50% but on examination only 250 animals here considered suitable either because they were castrates or culls.

The plan was to market the animals in groups of 40 each consisting of 10 castrate and 10 cull sheep and goats. Ideally animals would be presented for sale at four market outlets, namely Marsabit, Maralal, Isiolo and Nairobi one group during a dry period and one group during the rains. A full cost benefit analysis was to be made of each exercise.

Cattle.

On two occasions it has been necessary to sell cattle because of drought or otherwise risk their death through starvation. On the first of these we pooled six of our steers with 87 belonging to Somali traders. They were taken to Isiolo and a ful cost benefit analysis made.

Summary of Results.

Smallstock.

Results of the smallstock marketing are reported in detail (Njiru 1983 a.b). No animals were sold at Isiolo because of quarantine and rather few were sold at Maralal. This appeared to be because of lack of cash at certain times of the month. The main sales were at Marsabit and Nairobi. Better prices were obtained at the latter outlet and should have justified the extra cost of transport (normally 30/- per animal), but we had some animals which could not be sold in Maralal and this brough the average price to an unrealistically low level.

The second marketing exercise at Marsabit faced some problems due to boycotting by local traders and some animals were eventually sold to IPAL staff at rather inflated prices.

Cattle.

The initial sale of steers has been documented in detail (Field, 1981). A number of problems were faced including drought, disease, quarantine and mortality, nevertheless a net gain of more than 30% on the original investment w was realized.

It is hoped that the second sale of 6-12 steers will be completed before the end of phase III.

Problems faced in achieving targets.

Many of the problems faced could not have been foreseen which was one of the purposes of the exercise i.e. to determine the existing constraints to offtake. These include the following:

Smallstock:

1. Poor timing in relation to seasonal fluctuation in market demand.
2. Poor timing in relation to monthly availability of cash.
3. Lack of interest in cull animals and unfinished animals.
4. Our requirement to sell on a per capita basis in order to maximize information gained. This lead to the poorest animals remaining and being sold for very little.
5. Market competition from traders. e.g. boycotting by middlement at Marsabitand competition from Somalis with better stock in Nairobi.
6. Quarantine for F.M.D. at Isiolo preventing any sales of stock there.
7. Sales of livestock on a per capita basis are very labour intensive.

Cattle:

1. Drought conditions created a surplus of cattle and poor prices.
2. Loss of weight on trek to market.
3. Quarantine at Isiolc due to F.M.D. entailed holding animals for five months during which some animals died.

Outstanding work necessary.

Further marketing exercises.

1. Of smallstock at Isiolo
2. Of smallstock in wet seasons
3. Of cattle to Nairobi.

Presentation of results.

This will form part of the IPAL Economists PhD thesis. It is recommended that IPAL seriously consider using its transport to stimulate livestock offtake and trade. During the course of nearly 8 years our truck

has made approximately 144 journeys from the study area to Nairobi at half capacity (mostly empty drums). Thus some 5,750 smallstock could have been transported. At an average fee of Ksh.25 per beast this would have yielded 144,000.00 Kshs.

Alternatively the project could purchase animals and net the full price differential itself. By so doing the Project would achieve the following:-

a) assist in destocking
b) stimulate cash flow
c) partly pay for the running costs of the truck
d) supply reasonably cheap meat to Nairobi where there is a high demand.

Numbers and yield could be greatly increased with a second story fitted to the truck. This would enable 120 smallstock to be transported per journey or 17,280 over the past 8 years yielding Kshs.432,000.00.

If cattle were carried the yield could be even higher i.e. 2 tons or 5 large steers per journey coasting 4/- per kg in Marsabit district and marketing at 6/50 per Kg in Nairobi. This would yield Kshs.5,000 per journey or kshs.720,000.00 over 8 years and would have removed 720 steers from the district.

7. Discussion, conclusions and recommendations

1: Time schedule.

It may be apparent from reading this report that it has not always been possible to achieve the targets of phase III as smoothly as desired. A major reason for this is that we have been required to run experiments with little assurance that contracts would be granted and funds available for their completion. Thus during the 42 months of phase III our contracts have been renewed 5 times, an average of little more than 8 months per contract. This is a slight improvement on the overall average since the inception of IPAL which is less than 7 months per contract or 14 contracts in 8 years.

The population dynamics of livestock may be quite slow (e.g. the generation time of camels is about 14 years) and hence experiments should be long term to provide adequate data. Furthermore rainfall is erratic and it is a matter of luck whether experiments sample representative climatic situations.

In the event we were fortunate that climatic extremes were experienced (Field, 1984). Nevertheless an element of trust was essential for the initiation and completion of experiments. Had we designed work to fit the contract schedules virtually none of the experiments described would have been under taken.

Future management procedures will be even more long term involving eventual take over by pastoralists themselves. It is highly desirable therefore that those persons participating in phase IV be offered adequate contracts.

2. Terms.

One important aspect of the livestock work in this phase has been contractual arrangements with consultants. With certain exceptions these have fallen short of our expectations in so far as consultants have not kept pace with the demands of the project.

This has partly been the fault of the project itself in so far as the earlier consultant agreements were open-ended and precise details of contracts were not clear.

It will be essential for future Consultants and Fixed Fee contractors for their terms of reference to be clearly spelled out and agreed upon before starting. A larger proportion of the Consultants fees should be retained until receipt of the final report and if necessary a penalty clause written into the contract. It should be agreed by the contractor that all data generated during the course of work for the Project should be stored in the Projects data storage facilities.

3. Analysis of material and data.

The analysis of material and data being the final steps in the conduct of an experiment, naturally tend to lag behind the rest and persons who have witnessed or participated in work are understandably anxious for the results. We have faced problems with the analysis of forage and veterinary materials due to the following:

1. Lack of priority given to IPAL work
2. Lack of funds for equipment at Government laboratories due to recent austerity measures.

With regard to data analysis we were unfortunate to lose our Data Processor prematurely and to stop using the service of Ecosystems Ltd before an adequate replacement organization had been confirmed. Furthermore a number of problems have been faced with using the University of Nairobi computer some of which have been described by Skiles (1983).

It is strongly recommended in future that the project has the following services under its sole control.

1. Data storage and analysis with a statistician/data processor familiar with computers.
2. A forage analytical laboratory with a Senior Laboratory Technician.
3. A veterinary laboratory adequately equipped to carry out basic pathological tests e.g. Bacterial culture;
   Mouse inoculation and culture.
   Microscopic histological techniques.

Two Senior technicians would be required for this.

It is recommended that the project facilities eventually become available to the whole of the arid zone of Kenya, since the services at present in this area are quite inadequate.

8. Published and unpublished reports on livestock

1. Blackburn, H.D. and Field C.R. (1982). The Performance of Somali blackhead sheep and Galla goats in northern Kenya. *Int. Goat and Sheep Res.*

2. Carles, A.B. (1980). Productivity levels of the goat herd at Ngurunit. pp. 62-73 in *IPAL Technical Report A3 Nairobi.*

3. Carles, A.B. (1983). Unpublished reports No. 1-5 on Goat and Sheep studies. *pp. Typewritten ms. Nairobi.*

4. Carles, A.B. Schwartz H.J. and Field, C.R. (1983 in press).

5. Crees, H.J.S. (1982). Report on the Veterinary/Livestock Consultancy from 15 April to 15 July 1982. *pp. Typewritten ms. IPAL Nairobi.*

6. Crees, H.J.D. (1983). Final report on the Veterinary/Livestock Consultancy from 15 July to 14 January 1983. *9 pp. Typewritten ms. IPAL Nairobi.*

7. Crees, H.J.S. (1983). Product trials on 'Vermisol' and 'Douvimisole' and Tick counts on camels and cattle treated with acaricides. *33 pp. Typewritten ms. IPAL Nairobi.*

8. Field, A.C. (1978). ODM-IPAL Sheep and Goat Project Preliminary Report on the Impact of Sheep and Goats on the vegetation in the arid zone of Northern Kenya.

9. Field, C.R. (1979). Camel growth and milk production in Marsabit District, Northern Kenya.

10. Field, C.R. (1980). A proposal to investigate the role of cattle as agents of desert encroachment in Arid lands production systems with recommendations for their management. *20 pp. Mimeo Nairobi.*

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16. Field, C.R. (1983a). The Nutritional Status of some Livestock in the IPAL study area. IPAL Progress Report.

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18. Field, C.R. (1983c). The Potential for Camel Milk Production in the Tropics 5 pp. Typewritten ms. for Longmans I.T.A.S. on *'Milk Production in the Tropics, London (in press).*

19. Field, C.R. (1983d). Livestock impact trials at Mt. Kulal Progress Report. 11 pp. *Typewritten ms. IPAL, Nairobi.*

20. Field, C.R. (1983e). Long term studies of Livestock in the Arid Lands of Northern Kenya. 6 pp. Typewritten ms. for *Second International Rangeland Congress, Adelaide, Australia (in press).*

21. Field, C.R. (1983f). Livestock Management for the Conservation and Sustained Productivity of Rangeland in the Marsabit District of Kenya 5 pp. Typewritten ms. for *Second International Rangeland Congress, Adelaide, Australia (in press).*

22. Field, C.R., Rutagwenda, T. and Simpkin P. (1983). The UNESCO-IPAL Livestock Programme. Presented to the IPAL Orientation Seminar November 1983. *20 pp. Mimeo IPAL Nairobi.*

23. IPAL (1980). Project Document. Project for funds in-trust financing by the Federal Republic of Germany. *14 pp. Mimeo IPAL, Nairobi.*

24. IPAL (1983). Draft Resource Management Plan for the Rendille area of Northern Kenya 555 pp. Mimeo. *IPAL, Nairobi.*

25. Kayango-Male, H. and Field, C.R. (1981). Feed quality and utilization by cattle grazing natural pasture in the range areas of northern Kenya pp. 230-245 in *IPAL Technical Report A.5. Nairobi.*

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28. Mubia, E.W. (1981). Preliminary report on a Nutrition and Health Survey of the Pastoralists in the IPAL study area. pp. 41-55 in *IPAL Technical Report A. 5 Nairobi.*

29. Muiruri, K. (1983). Summaries of Household Surveys of Cattle owning Pastoralists. 93 pp. of handwritten tables. *IPAL, Gatab.*

30. Njiru, G.K. (1980). Economics of Rangeland Development among the Rendille. pp. 132-142 in *IPAL Technical Report A.3 Nairobi.*

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36. Rutagwenda, T. (1982). An attempt to introduce a Comprehensive disease - control package on specific diseases of camels and evaluation of the control on camel productivity in Ngurunit, Marsabit District, Northern Kenya. *MSc Thesis University of Nairobi.*

37. Rutagwenda, T. (1983). Ticks and Trypanosomiasis of Camels in the Ngurunit area of Northern Kenya. *The Kenya Veterinarian 7:3 (in press).*

38. Rutagwenda, T. (1983). Veterinary Clinics as part of Education and Public Relations Programme of IPAL. Presented to the IPAL Orientation Seminar November 1983. *IPAL, Nairobi.*

39. Schwartz, H.J. (1980). Draft Final Report on the Implementation of the UNESCO - FRG Traditional Livestock Management Project. TLMP 114 pp. Mimeo *IPAL Nairobi.*

40. Schwartz, H.J. (1980). An introduction to the livestock ecology programme within IPAL. 9 pp. Typewritten ms. *IPAL, Nairobi.*

41. Schwartz, H.J., Wilson A.J. Dolan, R., Evans; J.O. and Fairhall, J (1982). Productivity of Camels in selected areas of Kenya *Der Praktische Tierarzt* 11: 964-968.

42. Simpkin, S.P. (1981). Preliminary report on camel production. pp. 126-135 in *IPAL Technical Report A. 5 Nairobi.*

43. Simpkin, S.P. (1982). IPAL Camel Experiment - Productivity and relevant Management Strategies. 5 pp. Mimeo Presented to the IPAL Orientation Seminar, November 1982. *IPAL, Nairobi.*

44. Smith, G., Carles, A., Schwartz J., Blackburn, H., Ruvuna, F. and Cartwright, T. (1982). Analysis and Synthesis of Small Ruminant Production Systems PP 41-54 in *Proceedings of the Small Ruminant CRSP Workshop, Nairobi.*

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V. THE VETERINARY COMPONENT

T: Rutagwenda.

GENERAL AND FIELD ORIENTATION

The writer who is a veterinarian joined the project in August 1980, just at the beginning of phase 3, as a student fellow. He spent the first two months (mid August to October 1980) in the study area at Ngurunit in order to get used to the field conditions, see the facilities available and be able to formulate a study within the project's framework. At this time he was able to meet many IPAL scientists and consultants who were very busy with their field work during the peak of the the experimentation phase.

During this period he assisted in the veterinary programme of the camels, sheep and goats, and it is at this time that he met Dr. Alan Wilson, who later became his supervisor at the University. More specifically he assisted in the bi-monthly camel and smallstock disease sampling and also in the camel work and it is at this time that he encountered many conditions especially in camels goats and cattle which are associated with drought. He received tremendous assistance from field assistants at Ngurunit specially with Samburu language and this later helped him in dealing with the pastoralists at Ngurunit.

He then applied for admission for an M.Sc. course at the University and this application was accepted and he was called to start course work in October 1980. The writer acknowledges the assistance he received from project staff who introduced him to the field programme.

Course work

At the beginning of October 1980, the veterinarian left the atudy area for Nairobi to start course work where he took the following courses; Histopathology, Virology, Immunology, Parasitology, bacteriology and Statistics. During the coursework period, he accompanied Dr. Wilson on his bi-monthly visits to the study area for camel sampling and back at the University, he participated in the analysis of camel samples from Galana, Olmaisor, Ngurunit, and Kulal. This was of additional help in that he became more familiar with camel parasites and at the same time getting more experience on handling alot of samples. This brought him much closer to camels and their problems in Arid Lands.

During the period he was doing course work, he wrote a research proposal which was in line with objective 3 of the camel programme which was on the use of a veterinary package on nomadic camel herds.

The writer wishes to thank Dr. Wilson for his interest, guidance and untiring efforts to have initiated a programme which the writer continued under his supervision and which he continued to supervise even when he left the country. One important thing here in such an arid land is to study under somebody who is willing to act as a supervisor. Dr. Wilson was such a man. This is because an on the spot supervision may not always be possible. After successfully completing course work, the research proposal had been accepted both by IPAL and the Faculty of Vet. Medicine University of Nairobi and the writer moved to the study area to start a research work on camel diseases. His University supervisors paid a visit to Ngurunit to start him off and two months later one of them came to see how far he had progressed.

Research work.

The research work went on until June 1982 when the writer moved back to the University to write his thesis.

According to the experience gathered, it is recommended that student fellows with IPAL should first of all make a visit to the study area to appreciate problems of desertification and see facilities available and then formulate research proposals in line with IPAL's research priorities and University requirements, also bearing in mind the facilities available. It is also recommended that University staff supervising such students should visit the area before, during and after the candidate has done his work in the field.

During the research period, most research materials were to be analysed in laboratories in Nairobi and because of the long distance it was sometimes difficult to get results in time. In future, attempts should be made to bridge this gap in communication. The libraries are very far and the library at Marsabit should be enriched with research materials so that scholars do not have to rely for their work from Nairobi. During the research period the writer visited Nairobi University once every 4 months periods ranging between four to ten days for consultation with his supervisor, making photocopies with the library etc. In August 1981, Rutagwenda attended an IPAL (internal scientific seminar) where he presented his progress report.

Write Up

In June 1982, Rutagwenda went back to the University to write his thesis. he had anticipated to finish writing by the end of September 1982 which was the end of the fellowship but due to the University's closure in August 1982 this was not possible. However, he received an extension of the fellowship upto the end of December which facilitated him finish the work. He wishes to thank, most sincerely the Project Co-ordinator, Dr. W.J. Lusigi for extending his fellowship, without which he would have had problems to complete in time. He also wishes to thank his first supervisor, Dr. W. Munyua who read and corrected the thesis during the period when the University was closed and made it possible for him to submit the thesis in mid December 1982. Rutagwenda also attended a seminar in June 1982 in Nairobi on Ticks and Trypanosomias. In December1982, Rutagwenda submitted a thesis to the University entitled "An attempt to introduce a comprehensive disease control package on specific diseases of camels and evaluation of the control on camel productivity in Ngurunit, Marsabit District, Northern Kenya."

Towards the end of the year the veterinarian attended a meeting in Marsabit where he participated in the writing up of the livestock section of the management plan. The findings of his work were incorporated in this section of the management plan.

After submitting the thesis, as part of the University requirements, he wrote two scientific papers from the thesis with his supervisor which have been published in "The Bulletin of Animal Health and production in Africa." Rutagwenda T., and Munyua W.K. (1983), The effects of Panacur (Fenbendazole) on nematode parasites of camels under nomadic conditions in northern Kenya. Rutagwenda, T., and Munyua W.K. (1983), Prevalence of camels ticks in the Ngurunit area of Marsabit District, Northern Kenya.

Defence of Thesis

In June 1983, Rutagwenda successfully defended his thesis and on December 7, 1983 he was awarded a masters degree in Veterinary Medicine. He wishes to take this opportunity once again to thank UNESCO/IPAL for the fellowship which enable him carry out the study leading to an M.Sc. degree. Most sincerely, he thanks Dr. W.J. Lusigi, Project Co-ordinator for

organising the fellowship and extension during the writing up period.

IPAL Veterinarian

From Mid June 1983, Rutagwenda joined the project as a veterinarian and he was charged, among other duties, to carry out IPAL Veterinary clinical work as part of extension of the project, continue monitoring of Health status of IPAL livestock with special emphasis on camel diseases. From then onwards, Rutagwenda has organised monthly veterinary clinics in Korr, Loglogo, Kargi, Olturot and Gatab. These clinics take about 1/2 of his time as he has to be in those stations from periods ranging from 10-14 days in a month. The veterinarian has also been involved in care of the IPAL Fistulated camels used for Nutrition studies (Tubei in this report) and this has involved re-suturing and post operative care of the Oesophageal fistulated goat which had problems with its fistula. In mid June, the Veterinarian attended a seminar on Education and Training in IPAL Marsabit. In mid August 1983, the veterinarian carried out a Trypanosomiasis prevalence survey on IPAL camel herds where 20% of the camels were positive. The animals which were positive were subsequently treated with Naganol. The Trypanosomes isolated from positive camels were innoculated in mice and sent to KETRI where they have been stabilised and will be used in future studies on camel trypanosomiasis.

From October 10th-11th, Rutagwenda represented the project at a Nairobi Cluster's Scientific Seminar where he presented a paper entitled "Ticks and Trypanosomiasis of Camels in Ngurunit Area of Marsabit District Northern Kenya." The paper will be published in the seminar proceedings in the next Kenya Veterinary Association Journal "The Kenya Veterinarian." IPAL is one of the 12 institutes forming the Cluster which deals with studies on Tickborne diseases and Trypanosomiasis and their vectors. From November 1-11th the Veterinarian attended an IPAL Orientation Seminar where he presented a paper entitled "Veterinary clinics as part of Education and Public Relations Programme of IPAL." He also presented a section on camel diseases in a paper he co-authored with Field and Simpkin entitled "The UNESCO/IPAL Livestock programme."

Rutagwenda has published or has been involved in writing the following publications.

1. Rutagwenda, T. (1982). An attempt to introduce a comprehensive disease control package on specific disease of camels and Evaluation of the control on camel productivity in Ngurunit, Marsabit District Northern Kenya. M.Sc. Thesis University of Nairobi.

2. Rutagwenda, T. & Munyua, W.K. (1983). Prevalence of Camel Ticks in the Ngurunit area of Marsabit District, Northern Kenya (Published in Bull, Anin Hlth & Pro Afric).

3. Rutagwenda, T. and Munyua, W.K. (1983). The effect of Panacur (Fenbendazole) on nematode parasites of camels under nomadic conditions in Northern Kenya. (Published in Bull Anin Hlth & Prod. Afric).

4. Rutagwenda, T. (1983). A study of Important camel diseases in Northern Kenya with special emphasis on their control. Submitted for publication in a Newsletter of the Arab centre for the studies of Arid zones and dry lands Damascus Syria. This was one of the two papers contributed by IPAL for the newsletter.

5. Rutagwenda, T. (1983). Veterinary clinics as part of Education and Public Relations Programme of IPAL. Presented at IPAL Orientation Seminar Marsabit 1-11 November 1983.

6. Rutagwenda, T. (1983). Ticks and Trypanosomiasis of camels in Ngurunit area of Marsabit District Northern Kenya. Presented at Nairobi Cluster (10-11 October 1981). Published in Kenya Veterinarian. This was IPAL's contribution to the seminar.

7. The UNESCO/IPAL Livestock programme by Field, Rutagwenda and Simpkin. Paper presented at IPAL Orientation Seminar Marsabit 1-11 November 1983.

8. Rutagwenda is at the moment preparing a paper from his thesis to be published in UNESCO-IPAL technical report series on his camel disease findings.

VI. LIVESTOCK/RANGE NUTRITION

S.K. Tubei

GENERAL

The task of the Livestock/Range Nutrition Consultant, who was engaged in the last year of the Phase III of the project, was to take charge of nutrition experiments in the IPAL, Ngurunit area. These experiments were:-

i) Caring of IPAL fistulation (rumen and oesophageal) animals;
ii) Carrying out the feed intake studies with sheep and camels;
iii) Carrying out diet preference studies with oesophageal fistulated camels, cattle, sheep and goats in different range units.
iv) Carrying out studies on the nutrient content of the diets for livestock in different range units;
v) Carrying out in vitro and nylon-bag digestibility of the forages and livestock diets.

Some of these experiments had either been done before or were ongoing but they required fillers and refining in order to be able to design the resource management plan of land use in the study area with the objective of arresting and reversing the trends of land degradation and establish sustained production in the pastoral economy. Also during the period the consultant contributed to the day to day running of Ngurunit station in the capacity of the Scientist-in charge.

Chemical analysis and forage preference by livestock

Before, studies on key food plants for livestock using "feeding seconds" and "feeding minutes" method had been done. These methods, however, could only estimate upto 80% of the composition of the diet and each individual plant species making 80% had to be hand-clipped. Not always was the same plant or plant part bitten by the animal hand-clipped for chemical analysis. This alsomeant that large numbers of samples were sent for analysis at Kitale laboratories at a time when there was a backlog in analysis and the project was experiencing long delays in reporting of results from Kitale. Problems of equipment breakdown and chemicals supply contributed to these delays.

Even after receiving the results of each individual sample, the catch was how to determine the nutritive value of the animal's diet. This was particularly so with the digestibility whereby, although digestibility of each plant species was reported, the digestibility of 80% of the diet would not be calculated with accuracy because of the associative effect of plant species ingested. A weighted digestibility average of plant species (taking into account percentage eaten) again was not realistic. However, the in vitro digestibility of each plant species and not of diet was then reported. But for crude protein, the dietary composition (80% of diet) was calculated by Dr. Field using the ration formulation method.

Oesophageal fistulated animals were therefore introduced and initially they required daily washing and disinfecting. It took them about 3 months to heal, after which they were used for collecting fistula samples. Oesophageal fistulated animals have been used in range studies elsewhere to obtain the closest representative of a grazing animal's diet from which the botanical composition and nutritive value can be determined. From the face of it, it may have looked expensive. But considering the fact that after healing they were maintained as the rest of the herd and the resultant benefits, then it was a worth while move. The benefits from the use of oesophageal fistulated animals are:-

i) The samples sent for chemical analysis and digestibility were whole diets and the results show the animal's diet quality at a given period. Calculations were therefore faster and precision of diet quality determination improved.

ii) Number of samples sent for analysis were greatly reduced because one sample could contain 10 or more forage species. This resulted in increased turn-over of analysis results from Kitale.

iii) Because of fewer samples, costs of chemical analysis were tremendously reduced for given raw data required to make sound conclusions.

iv) What actually happens in the use of oesophageal fistula sample collection is that the fistulated animal is clipping for the experimenter. It selects different plant species and plant parts as the rest of the herd in a way that cannot be repeated accurately by hand-clipping. On that basis, the influence of forage quality on animal performance, assuming other factors like

disease being negligible; can be shown explicitly. This relationship will be reported in the final technical report of this work.

v) This benefit is linked together with (iv) and that is, the preference index (PI) for each plant species, can be calculated. The PI values for forage species are very valuable in livestock management especially where plant community distribution have been described like in the study area and available labour for herding is limited. In other words, the diet preference information is required for optimal forage allocation to different livestock species and other wild ruminants compatible with grazing resource. The PI values of plant species, can be used as an indicator of those plant species which are threatened with depletion.

The results of diet preference and diet quality of livestock namely, camels, cattle, sheep and goats in range units 20, 13, 3 and 23 were completed during the reporting period. Also the nutrient content (CP, NDF, ADF, ADL and minerals), and digestibility of the preferred species has been compiled similarly, the relationship between these nutrient components; and between nutrient and animal performance are being analysed statistically. This is in accordance with recommendation of the Tripatrite Review Mission of IPAL 1983; that estimates of the seasonal nutritional characteristics of livestock diets be obtained. However, the conventional seasonal classification in the study area, did not distinctly come out in the period of experimentation because of the unreliable and sporadic nature of the rainfall. For example, in April which was expected to be wet was dry almost throughout the study area. Also, there could be rain in one range unit and not in others which made it more difficult to classify the period as wet or dry.

To circumvent this problem, the author carried out experiments on each range unit after there had been some rain or when the vegetation was still green and continued until the dry spell started to set in. The rainfall received in each range unit was recorded. Plant preferences is best determined when there is vigorous growth of each plant species. The Rendille nomads normally move to an area which has just received rain and remains there for as long as the forage is green and then move to another area. The design of the grazing plan will be kind of similar to this pattern except that more time should be allowed for the plants to grow after rain in a locality before moving in the animals, and during drought when reserves will be utilized.

Digestibility

Although rumen fistulated animals lend themselves for use in other studies, they were used mainly to determine the digestibility of milled individual forage species and whole diets of livestock by suspending in nylon-bags in the rumen. Their use was necessitated by the fact that at Kitale, the in vitro digestibility trials are run using rumen fluid from sheep; which perhaps has low microbial digestion on the forages from study area as they were new to them. The animals in study area, particularly the camel, may be having different microbial population and hence different microbial digestion capacity compared with the sheep maintained on high quality hay.

So far the results from nylon-bag digestibility are higher than in the in vitro digestibility values. However, the extent of variation is being refined with more results being obtained and a regression equation will be developed so that in future the nylon-bag technique will be used solely in the study area.

Dry matter intake

Daily dry matter (DM) intake for sheep and camels were monitored using the total faecal collection method within the 4 range units mentioned above throughout the year. DM intake values calculated from the percent body weight of the animals have been used in carrying capacity estimates of the study area for the resource management plan and the results of these monitoring will be used to refine these estimates. These dry matter estimates of sheep and camels will be documented in a technical report.

On the whole, there has been more achievements on the scientific endeavours mainly due to well co-ordinated administrative back-up. The use of radio communication network with all the stations immensely perfected the co-ordination of the daily activities to the extent it was like all the operation were in one building.

Also the supply of basic requirement by the project through canteens in out stations, was very desirable as all the efforts of the support staff were then directed wholy to scientific work.

Although there was a library, there was need to enlarge and update it with more and a variety of periodicals and journals for quick referencing by the scientists; or arrangements are made for access to library services elsewhere. This was very essential especially for choice of methodology to use for particular experiment since methods are continuously being improved.

VII. RANGE ECOLOGY

E.R. Nkurunziza

1. INTRODUCTION

Following the change in the project priorities requiring immediate production of the management plans by the end of 1982, the range ecology section had to modify its programme to meet this need. The main task therefore was to plan and carry out intensive systematic range surveys, in order to provide a complete inventory of the range resources, the classification of the vegetation into major range types and their mapping, an assessment of the range condition and productivity of the vegetation, and a computation of the resulting livestock carrying capacities. These activities were further aimed at understanding the dynamics of vegetation change following mechanical bush control, grazing and fire. The project Co-ordinator Dr. Lusigi undertook the Overall supervision of the range work, whilst the author was responsible for the field work and investigations. By the time the resource management plans were due, only one range survey had been possible. Information obtained from that survey which was undertaken during the long rainy season of 1982.

2. RANGE SURVEYS

Wet season survey - 1982.

The general activities involved in planning the initial range survey have been discussed in detail in a previous progress report (Lusigi, W.J. et al, 1982) and are therefore only briefly reviewed here. The period of January to April, 1982 was devoted to the planning and general organisation of the range survey which had to take place following the rainy season. This included a literature review to select the most appropriate methodology applicable to the vegetation of the study area, the training and selection of the initial range teams which were to carry out the surveys, the screening of the selected methods so as to ensure their suitability, the compilation and purchase of the necessary field data forms and equipment such as dippers, paper bag etc., and finally, consultation with other scientists in other fields such as climatology, geomorphology, soils, livestock feeding habits and food preferences, populations and movement patterns etc.

During the same period, aerial photographs taken in 1972 (the only ones available) were being interpreted in preparation for actual field work. The aerial photo-interpretation at a scale of 1:50,000 was later used together with photo-mosaic base maps at a scale of 1:100,000 for ground-truth checks. Since time was a major constraint, these ground-truth checks had to be done at the same time as the actual range type sampling. The ground-truth checks consisted of physically visiting individual range types as established on the aerial photographs, and determining whether the mapped boundaries coincided with the actual observable vegetation boundaries. Where such boundaries did not coincide it was observed that in the majority of cases, this was due to changes that had taken place in the 10 year interval between the photographs and the survey. The necessary adjustments were made accordingly. The observed differences were largely due to varying degrees of range utilization by the nomads. In order to properly follow the sequence of vegetation changes during that 10 year period, other aerial photographs between 1972 and the present should be studied and compared. If this is studied in relation to the livestock population, positions and movements during the same period, it should give very reliable information with which to predict future trends in vegetation change under various degrees of range utilization. Areas or range types more prone to degradation could be identified, and proper steps taken in deciding their future use.

As already mentioned, two teams, one southern and the other northern, were selected for the first range survey. These teams whose bases were Ngurunit and Olturot were led by E.R. Nkurunziza and S. Masheti and had variable composition of 10 and 14 field assistants and casuals for the respective teams. The field activities of the two teams consisted of:

- ground checking the aerial photographs and making the necessary adjustments for each individual range type.
- determination of the most representative sites for the location of the transects.
- determination of observable gradients of vegetation change across which the transects had to be established.
- range analysis by the paced transect method using the "loop" to determine the amount of ground cover of the various plant communities

- plant community analysis by the "concentric circle" method
- estimation of productivity by obtaining the standing crop biomass of above-ground plant parts in pre-determined clipped plots;
- carry out an inventory of the tree and large shrub resources using the Leithead (or zig-zag) transect method (see woodland section for details).
- compile a comprehensive species checklist, including observations on the phenological changes of individual plant species.
- determine the operative abiotic factors in each community, such as climatic factors, topographic characteritics, soils properties and current erosion status and hazards in conjuction with the abiotic scientists, and finally;
- to visually determine the impact of utilization by man and livestock on the range condition.

Details of methodologies used in the above investigations have been published in previous progress reports for this phase, as well as the papers presented to the Orientation Seminars held in November 1982 and 1983, and the "Management Plans" produced in December 1982.

The fisst survey which was carried out in generally unfamiliar areas took both teams approximately $2\frac{1}{2}$ months to complete, and sample weighing data analysis and community write-ups took a similar amount of time. The results of this survey have been incorporated in the "Management Plans" and will not be discussed in detail here. Further detailed results on this work will, however, appear as a separate technical report. The format adopted for the presentation of the survey of each range type consisted of the followingginformation.

- a range unit characterization using the dominat species
- an aerial photograph of the representative vegetation
- a description of the physical attributes - Soils, climate, temp. aspect, hydrology
- a complete write-up of the vegetation attributes including estimates of productivity
- an assessment of the impact of man and livestock on the vegetation
- a table summarizing the cover, composition and biomass with desirability and availability vegetation for individual livestock species

- a range condition rating, and
- the calculated carrying capacity using information supplied by the livestock ecologist on the daily dry matter intake by an average livestock species.

Wet season survey - 1983

The second survey was carried out following the long rainy season of 1983 in June to July. It followed exactly the same pattern as the previous one with the exception that in this case I had only one team, comprised of two Senior Field Assistants, four Field assistant and seven casuals. This survey took only 6 weeks to complete. A reduction in time atrributable to the fact that no nore ground checking and transect establishment was necessary. That we also knew the exact layout of the transects, allowed us a more carefully planned operation where emphasis was laid on aaving time. A few transects with very difficult access and representing small range types, as well as those outside the "Management Plan Area" eere not re-sampled, but these represented less than 10% of the original 144 types. The results of this survey were in time, in late July, 1983 for the scientists meetings for the up-dating of the management plans according to the recommendations of the Review Mission.

A comparison of the results of the two wet season range surveys showed various differences which are explainable mainly by the rainfall distribution both in time and space, as well as the impact of livestock use. A decision had therefore to be taken on what figures reflected the most realistic situation since figures from only two surveys were available. A very clear but unfortunate example of this was Range Unit 21. This unit which in 1982, was judged to be in excellent condition had been destroyed by accidental fires prior to the 1983 survey. Therefore only the 1982 data could be used. Upto the time of writing this report, this unit is still in the very early recovery stage, and it would be of much interest to see how long it will take to return to the original condition. This proved particularly frustrating since this range unit had been recommended for the dry season grazing of 2500 Rendille cattle. It also provides us with a warning that planned livestock movements should be viewed with caution as they are likely to be disrupted by natural or man-made disasters.

Dry season surveys - 1983.

Two dry season range surveys had been originally planned as part of the activities of the range ecology section. The first dry season survey which had been planned for March 1983 could not take place due to unusual sporadic rains in the study area which resulted in uneven plant growth which, it was felt, would have given non-representative data. The long dry season survey was however, successfully carried out in a record 3 weeks from late September to early October 1983. This survey exactly covered those range types covered in the previous rainy season survey. The woodland (zig-zag) transects were not examined in this survey. This made it possible to re-split the team into two working groups. More efficient planning also allowed the two teams to share transportion and yet function individually on the transects. It is still felt however, that the provision of a third landrover on the day of moving camps would have saved even more time since on such occasions we were normally forced to make an extra trip, since all the staff and equipment cannot fit into two vehicles. Alot of time was also saved by the complete absence of vegetation in some range types, this being the height of the dry seasons. Some annual grasslands which had also been grazed were found to be absolutely bare. It would be unrealistic to attempt to cover the study area in similar period of time following rains.

A comparison of the carrying capacities of the various range units during the three surveys is given in Table 1.

General observations.

During the last two years of IPAL Phase III, three out of four possible range surveys were accomplished with increasing efficiency. This was mainly due to a better knowledge of the study area which, together with the fact that the assistants became more and more familiar with the methodology, allowed for better planning. Although an enormous amount of data has been collected so far, and this will appear in separate Technical Reports, the rainfall has been so erratic that no firm conclusions can be drawn as yet. There is urgent need to plan for more surveys to cover the seasons over a longer period of time. This is specially important since, for example, some areas have been observed to have received no rain for the last two years and hence results at hand do not represent the actual potential of those areas if they obtain rain. The systematically programmed movement plans aimed at better utilization of time and money, have, on several occasions landed the team in certain range types at the wrong times. For instance the best time to clip an annual grassland for wet season standing crop biomass, would be at the time when the majority of the grasses have set seed (approx. 2 weeks), but before they have started drying out, but in our case this timing was difficult to achieve. The timing is also not easy as it would require very close monitoring of rain in the entire study area, as well as a stand-by survey team ready to move out at all times. The Rendille livestock, furthermore, moved into many areas after rains long before the range team could be mobilized to go in, so that by the time the team arrived, most of the young flush of growth had been completely eaten out. This practice also enhances range degradation since the plants are not allowed time to set seed and hence there is no build up of a seed pool for further regeneration.

In addition to more full scale seasonal range surveys recommended above, future plans should include impromptu or on-the-spot surveys in range types where rain will have fallen. This will provide additional information which will act as a firm basis for future large scale controlled livestock movement, contrary to the present haphazard system exemplified above.

3. PRODUCTIVITY

Fallowing the realisation that vital rangeland productivity data that existed on the project was inadequate, it was decided during this phase that experiments be set up to provide this information. Ideally, productivity experiments should have been set up in all major range units.

As previously observed however, these experiments can only be carried out in protected exclosures (see previous progress reports), and IPAL experience has been that this protection is not always easy to achieve in the study area. For example nomads were discovered to put their "kids" and lambs into the Kargi exclosures at night, when the grazing was inadequate elsewhere. The fact also that the scientific meaning and objectives of the IPAL experiments is alien to the local people has accounted for the loss of pegs and poles in our experimental plots. Establishment of the productivity studies in each range unit would have required more man-power and time than was available to the project. With these constraints in mind, it was decided that these studies be carried out in the existing IPAL exclosures at Ngurunit, Kargi and Balesa, representing productivity in a Duosperma dwarf shrubland, an Indigofera dwarf shrubland and a riverine woodland respectively. Plans to include an annual grassland in the Kargi-Kurkum area have so far been delayed by non-availability of the required cedar poles.

In each of the three sites mentioned above, 144 sample plots, each $1m^2$, were laid out in May 1983. The experimental design was a completely randomized block with the plots being one metre apart. Since their establishment, 12 replicate plots have been clipped in each site at regular monthly intervals. Prior to clipping however, the plant cover of each plot was estimated using the ten point frame method. This data will be used in the statistical analysis of the clipped data as a covariant. The initial stage of the productivity experiments will continue till April 1984 when preliminary data analysis will be carried out.

It is hoped that these investigations will be carried out for a long period of time since one year's data cannot provide adequate data on monthly fluctuations. Furthermore, climatic data, for this year which should be correlated with productivity has not yet been analysed so we cannot tell whether it has been average. It is also hoped that the said investigations will be expanded to cover more range types. The need to establish more productivity plots, even in areas presently being studied, may be illustrated by the history of the vegetation in the exclosures. At Kargi for example, the vegetation inside the exclosure is dominated by Indigofera cliffordiana, whilst the surrounding areas are dominated by Indigofera spinosa which is regularly heavily grazed. In the Balesa exclosure, the vegetation is different on each of the two outer ridges from that in the central depression, a situation not representative of the surrounding areas.

It is quite evident that much more information could be obtained by comparing turnover inside and outside the exclosure. The problem is that in pegs used to demarcate plots outside the exclosures, are immediately knocked down by livestock, or just simply picked by the herders. This makes it very difficult to retrrn to the previously demarcated areas. This can be circumvented by the use of incospicuous markers such as stones or old bones hammered in the ground, an idea we are experimenting with in Kargi, or by the use of a very large number of replicate plots placed at random which would require a similar increase in man-hours. The former is vulnerable and not 100% fool-proof, whilst the latter is a policy decision. Future plans should compare the reliability of the two.

4. MONITORING VEGETATION CHANGE

In addition to the marked transects used in range surveys, it has been decided early 1983 that in the future, subtle floristic changes will be recorded along permanent transects. For this reason, permanent transects have been established in all enclosures at Mt. Kulal and Balesa where the stocking trials are carried out. At Mt. Kulal where the paddocks are 1 ha each, at least three transects each 100 m have been established and these are examined before and after each trial. At Balesa where the paddocks are much larger (5 ha), only one long transect crossing each paddock has been established. Others are being put in. The permanent transects consist of marked straight lines along which a measuring tape is stretched and readings are made at every metre interval. If the tape is placed in the same position, then the readings will be made at the same points each time. The readings or 'hits' are taken within a 2 cm (3/4") loop in the same manner as has been described for range surveys in previous reports.

5. RANGE IMPROVEMENT

During the third phase of the IPAL Project, there has been a steadily growing feeling that the large expanses of Duosperma which is of little use as forage should be improved by bush control methods. There are a number of range improvement techniques known today and most have been critically analysed and found to be limited by constraints of time, man-power and finance. For those relatively easy to apply, such as burning, there might arise unexpected ethical problems as such applications might be regarded by the local population as an encouragement to do the same indiscriminately (Nkurunziza, E.R. 1981).

We have therefore adopted a policy of monitoring vegetational succession in areas where such controls have occurred by accidential means.

Three such areas have been found in the study area, and are being monitored both by permanent transects and photographic records. One Duosperma dwarf shrubland which was stripped of all vegetation in the construction of an airstrip near South Horr $2\frac{1}{2}$ years ago, is being monitored by 6 transects, 3 of them being in the graded and 3 in the ungraded areas. Present observations indicate that this area has changed into a pure annual grassland dominated by Leptothrium senegalense, and is presently being heavily utilized by cattle. Both the graded and ungraded areas are photographed on a regular basis. Similarly about $\frac{1}{2}$ ha of thick Duosperma at Korr-Laisamis-Ngurunit-Illim road juction which was burnt down to ash in September 1983 by unknown people, are being monitored in the same way. Observations in the Duosperma burnt paddock at Ngurunit shows that almost the same vegetational state maybe reached within 2 years, but the successional trend depends on the prevailing climate, the time of burn and the subsequent utilization.

At Karare on Marsabit mountain and the largest portion of Range unit 21, vegetation was completely destroyed by fire early 1983. Due to man-power and time constraints, vegetational succession is being recorded by photography alone. The same is being done for a burnt area in Range Unit 1.

Since these areas are being burnt by local people at different times during the dry seasons which we record, it is hoped to find out the burning period which will produce the most favourable results. We shall also learn individual plant species response to fire as well as the rate of recovery.

Range improvement techniques should be expanded in the next phase to include the search for suitable local grass seeds and re-seeding denuded area. Controlled experiments should also be carried out in the three above mentioned techniques.

5. STOCKING TRIALS

Investigations aimed at finding out the effects of grazing and trampling on the vegetation by various livestock species, have been carried out by the woodland and livestock ecologist for sometime. The detailed report on the vegetational aspects of these studies are reported in the relevant sections. however, since the beginning of 1983, it has become apparent that these studies are multi-disciplinary and should involve the livestock, woodland, abiotic and range scientists. For this purpose, the said scientists have held several meetings where views have been exchanged on how each scientist should participate. The range ecology section is mainly interested in the long-term effect on vegetation and these are being monitored along permanent transects at Mt. Kulal and Balesa. During the period under review, the range ecology section has made arrangements to set up similar investigations in an annual grassland near Kargi. This will also be used for demonstrations purposes as has been recommended by the 1983 Review Mission.

It is suggested that within these studies, all the concerned scientists soould participate equally in the timing, data collection, data analysis and interpretation, as well as result write-ups.

6. OTHER ACTIVITIES

During the last two years of phase III, the author has actively participated in activities aimed at increasing awareness of desertification in general, and the work of IPAL in particular. The main ones are listed below:-

a) Cooperated with an IPAL consultant in developing an ordination computor programme for the analysis of IPAL vegetation data. This programme still needs refining in order to ease the load due to manual analysis.

b) Attended an Orientation Seminar in 1982 for the African French speaking countries in arid areas, and presented a paper on the "Range Ecology Programme." Proceedings have already been published in French and the English version is still awaited.

c) Partcipated fully in the meetings, discussions and writing up of the "Management Plans" between November and December 1982, and also their revision in July 1983.

d) Attended meetings in Korr and Kargi aimed at enlightning the elders on the findings and recommendations contained in the Management Plans.

e) Made presentations of the objectives and activities of the IPAL range ecology section to the UNSO mission, at Marsabit.

f) Gave field demonstrations of range ecology techniques to the 1982 Steering Committee, the Mini-Orientation Seminar scientists from North Africa (1983), USAID team (1983) and the two main orientation committees, and others.

g) Attended an Extension Seminar in mid-June 1983.

h) Participated in an aerial survey conducted by a consultant from ILCA which resulted in a co-authored paper on "Water Development in the Hedad".

i) Co-authored a paper on Livestock Fooduptreference which was been a accepted for publication in the Journal of Range Management.

j) Participated fully in the 1983 Orientation Seminar for English speaking arid countries in Africa, Middle East and Asia and presented a paper.

k) Corraborated with the Woodland Ecologist/Pilot and Animal Nutritionist (Recorder) in taking black and white aerial photographs of various range units for the "Management Plans."

l) Continuously made a photographic record of various vegetation types as well as other activities valuable to IPAL Project including records of plant phenologyaand plant species collection.

m) Participated in the IPAL exhibition and presented to the public a slide show on some of IPAL activities, and this exercise earned IPAL an award during Kenya's 20th Independence Anniversary Celebrations and,

n) Continuously advised other IPAL scientists on range matters whenever requested.

The following 10 papers have been written or co-authored during the last two years:

1. 4 progress reports of the Range Ecology Programme of which one was co-authored.
2. Lusigi, W.J., E.R. Nkurunziza and S.M. Masheti. Forage preferences of the major Livestock Species in the Arid Lands of Northern Kenya. (accepted for publication in the Journal of Range Management).
3. Nkurunziza, E.R. (1983). Range Ecology Programme (to be published in the proceedings of the UNESCO/IPAL Orientation Seminar 1983).
4. Lusigi, W.J., E.R. Nkurunziza and Awere-Gyekye (1982). Range Ecology Studies. Paper presented to the UNESCO/IPAL Orientation Seminar 1982. (already published in French).
5. UNESCO/IPAL. (1982). Resource Management Plan for the Rendille Area of Northern Kenya Part I, II, III and IV.
6. King, J.M., G. Bako and E.R. Nkurunziza (1982). Water Development of the Hedad Plains in the Rendille Grazing Area. (mimeo).
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   N.B. I was an active participant.
8. Range Map for the entire IPAL Study area.

VIII: WOODLAND ECOLOGY

H. Lamprey

1. INTRODUCTION

The objectives of the Woodland Ecology programme of IPAL, the research methods used and preliminary results were described in IPAL Technical Reports A-4 and A-5. These have been brought up to date in the recent half-yearly reports and summarised in the first volume of the IPAL draft management plan (1983). The second volume of the plan includes recommendations for the conservation, rehabilitation and sustained production of the tree and large shrub communities in the IPAL study area. One technical report in preparation describes the detailed results of the woodland programme, providing, in particular, tree and large shrub population parameters and specific management recommendations for each of the 147 range types identified in the study area. A second technical report in preparation describes the methods and results to date of the stocking trials carried out in the riverine woodland community.

A re-organization of the Project's vegetation research programme was planned at the end of 1980. Previously, D.J. Herlocker, designated Woodland Ecologist, had carried out studies which included mapping and describing the vegetation of South Western Marsabit District (IPAL Technical Report D-1, 1979) and measuring the production of the dwarf shrub layer which constitutes the main food source of livestock in the region. In company with D. Walther he had also investigated the wood requirements of Rendille pastoralists and vegetation indicators of environmental degradation. Descriptions of these and other work carried out by Dr. Herlocker prior to 1981 are included in IPAL Technical reports A-3, A-4 and A.5

Early in 1981 the emphasis of the vegetation research was changed to an intensive study of rangeland condition in which the woodlands and the shrublands were to be investigated in parallel with the range assessment programme. Since the ecological study of trees and large shrubs in the arid zone has received little attention in the past, a somewhat new approach was needed and it was deemed advisable to operate the woodland research programme separately, adopting a methodology which was to some extent experimental. The revised woodland

programme was to be designed and implemented by H.F. Lamprey, appointed Senior Woodland Ecologist, while D.J. Herlocker was to become Range Ecologist.

This report is not intended to repeat the accounts of the woodland ecology programme which have already appeared in IPAL Technical reports and in the draft management plan, but is intended to provide a summary of the results obtained during the last three years, with a critical commentary on the methodology, on the practical value of the results and on the general conduct and progress of the programme. It also summarises the management recommendations resulting from the research programme.

It should be noted that the woodland programme has been carried out as an integral component of the IPAL project, with strong interactions with the range assessment programme on the one hand and with the livestock ecology programme on the other. It has further significance in its direct links with the ecology of human subsistence owing to the importance of trees and shrubs as sources of fuel, building materials, rope, food, medicine and shade. There is also the possibility of promoting a local industry to diversify the economy, based upon the product of Acacia senegal, gum arabic.

In the arid rangelands of northern Kenya subsistence pastoralism the only current land use, is as dependent on trees and large shrubs as upon the herb and dwarf shrub layers. For the camels and goats which constitute 59 percent of the region's livestock biomass, the foliage and fruit of trees and large shrubs, amounting to approximately 8 percent of the available forage, form 29-35% of their diets. The wood of the dominant Acacia species is extensively used for constructing temporary night enclosures and for fuel and the living trees and shrubs provide essential shade for cattle and smallstock.

The following short passage is quoted from the summarized account of the Woodland Ecology Programme in IPAL Technical Report no.A-5.

> "As a brief background to the woodland research programme it can be said that desert encroachment in Marsabit District, the eventual control of which is the primary long-term objective of IPAL, consists of two main processes. Firstly the herb layer is being progressively depleted by overgrazing and trampling by livestock and in some localities has been reduced to a remant of its former state. Secondly, the trees and shrubs are being reduced, through felling and lopping,

for fuel and for building and fencing materials; the latter use being the most important cause of woodland destruction in the region (Synnott, 1979; Lamprey, 1981). Simultaneously, the regeneration of young trees is greatly retarded by heavy browsing by livestock. Tree destruction, like overgrazing, takes place predominantly near settlements, but is spreading out into the surrounding woodlands and shrublands as the people are obliged to go further to obtain the materials needed for the construction of their livestock night enclosures (bomas). If the present trends continue it is evident that large areas of Marsabit District will degenerate towards desert conditions in the coming decades and that the region will become less capable of supporting the growing human population and the livestock upon which it very largely depends."

2. The approach to the applied woodland research programme.

In view of the processes of degradation in the tree and large shrub communities, briefly described above, a research programme was required that would provide answers to the most urgent questions relating to the deleterious trends and to the possibilities for remedial management. These answers were urgently needed for inclusion in the IPAL draft management plans for Western Marsabit District, which were scheduled for the end of 1982. Thus the woodland programme, had to achieve useful and applicable conclusions in a period of two years. Relevant research results were available from the work of D.J. Herlocker in the previous phase of the project and some aspects of the woodland programme described in this report were continuations of the earlier research programme of Herlocker.

The questions to which answers were needed can be summarized as follows:

a) What are the wood and browse requirements of the Rendille people and their livestock and how are these likely to change in the future?

b) What are the distributions, biomass densities and production levels of the important tree and large shrub communities?

c) In what condition are the tree and shrub communities and what is their viability under present and foreseeable levels of exploitation?

d) What stocking rates and levels of wood offtake can be sustained by the woodlands and the shrublands in the various management units of the region?

e) What management measures are needed to meet the requirements of the Rendille people and to ensure sustained or improved wood and browse production and the rehabilitation of degraded tree and shrub communities?

f) How can the woodlands and shrublands contribute more fully to the economy of the region through the rational use of wood, fodder and industrial products?

Preliminary answers to the first question a) were already available (Hunting Technical Services, 1977; Synnott, 1979 b; walther and Herlocker, 1981; Field, 1979). These data have been summarized in the Woodland Ecology section of the IPAL Management Plan and the main results are given below.

In partial answer to the second question (b), Herlocker's vegetation map (1979) shows the distribution of 72 vegetation communities in the IPAL study area and his accompanying report (IPAL D-1, 1979) gives brief qualitative descriptions. In the next phase (1982-83) the estimation of biomass densities and production levels representative of the different tree and large shrub communities necessitated the use of three sampling method: (i) destructive sampling of the important species to obtain biomass-dimension relationships;

(ii) growth measurements of the important species to obtain production rates and

(iii) transect sampling of all the important tree and large shrub communities to obtain basic population parameters (species compositions, plant densities, canopy areas, biomass densities, production levels and size class structures).

It was recognized that tree and large shrub community characteristics vary with distance from settlements and permanent water supplies, along gradients of exploitation intensity. In order to measure variations along these gradients, as well as variations between vegetation communities, it was planned to site the transects so that they radiated outwards from the main settlements. After a total of 15 km of transect records had been obtained in the Hedad shrublands in the vicinities of Kargi and Olturot, the system of transect siting was changed to bring it into line with the newly introduced range assessment transects in early 1982. The aim of this change was to provide relatively detailed tree and large shrub data to accompany the herb and dwarf shrub layer data collected at each range assessment site.

The method of woodland and shrubland sampling adopted was the so-called zig-zag transect described by Leithead (1979), which is similar to the P.C.Q. method but quicker under the conditions encountered in the woodlands and shrublands of the IPAL study area.

Answers to the third question (c) on the viability of the woodlands and the shrublands have been obtained by observing their size and age class structures to determine recruitment rates at each growth stage.

The fourth question on sustainable stocking rates (d) has been answered provisionally in two ways. Firstly by comparing known fodder requirements for each livestock species with available forage production in the tree and large shrub canopies. The second method is the controlled stocking of experimental fenced plots of mixed woodland and shrubland at known livestock densities to simulate predetermined annual stocking rates accompanied by measurements of production and offtake. However, the stocking rates calculated on the basis of observed offtake and known production levels have been modified by reference to the age class structure of the of the tree population in question. Poor recruitment to the older age classes, commonly due to the excessive browsing of young trees, has necessitated low recommended stocking rates for goats and, to a lesser extent, for camels, in many woodland and shrubland communities, and total protection in some.

The sustainable wood offtake if any in each woodland and shrubland type has been derived from the estimated wood production rates and the proportion of mature trees in each type.

The fifth question (e) on the management measures required is considered above. The control of stocking rates and of tree felling and lopping should be achieved either through ensuring low livestock densities and limited wood cutting or, in the case of urgent rehabilitation, through total protection for periods of several years. Management measures are discussed further in section below.

Answers to the sixth question are being obtained through experiments in the controlled harvesting and use of woodland and shrubland products. The experiments are necessarily long term and will continue into the next phase of the project, but considerable progress has been achieved in the experimental collection of gum arabic from naturally occurring Acacia senegal shrublands, in tree "tapping" and in the assessment of the locally produced product for Kenyan industry and for export.

In seeking answers to these questions it was recognised that the amount of certain categories of data that could be collected in a period as short as two years might be insufficient as the basis for firm management decisions but might be used cautiously until larger data records could be built up over the year. The woodlands and large shrublands are in a constant state of successional change which is influenced by the variable climate and by human and animal use. Year to year climate variability results in fluctuating foliage production, with many trees failing to come into leaf in particularly dry seasons. Under these circumstances, as witnessed by the narrow stem growth rings produced in drought years, wood production is greatly reduced in most of the small tree species which rely mainly on rainfall rather than ground water. The extent of the variability in foliage production has not been measured critically and more observations are required covering a range of wet and dry years. The same can be said for the series of observations on potential optimum stocking levels which are being carried out in the [illegible] stocking trial control plots. It is necessary to recognise the dynamic nature of the woodlands and shrublands and to prepare for flexible management based upon upon a programme of continued monitoring. Nevertheless, it should also be recognised that much can be learned about relatively long term trends and processes from observations on current plant community structures and the spatial variation occuring along gradients of land use intensity.

A further instance of the limited use of observations based upon small samples is evident from the results of some transects carried out over the standard 500 m distance in tree and shrub communities of low density, which give unacceptably high variance. Under such circusstances the temporary expedient of grouping data on the rarer species can be employed until larger samples can be built up by further transects in the same communities. Similarly, series of tree destructive sampling measurements calls for samples of at least twenty trees per species and well spaced within the size range of each species. This has been achieved in the case of some species while in others, preliminary regressions have been obtained with as few as seven trees, which nevertheless give provisional results. Such small samples must be extended as the opportunity permits while the range of tree and large shrub species included in the destructive sampling programme must also be increased to cover such groups as the Commiphora species and more of the Capparid species.

Over the three year period (1981-1983) several separate series of quantitative observations on woodlands and large shrublands were undertaken either simultaneously or sequentially, their timing depending mainly upon the seasons and upon actual rainfall, but also upon the overall programme of the project, the availability of staff and experimental livestock and on the occurrence of other project activities (e.g. seminars, meetings, evaluations, range assessments, survey flights etc.). In parallel with the field observations, the preliminary analysis of data has progressed steadily to provide a continuous feedback on the outcome of the observations and the experiments. Final analysis is being undertaken in the closing months of this phase for the completion of technical reports on the woodland programme.

Programmes in which the Woodland Ecology Unit have been involved were as follows:

1. Transects along land-use gradients: one series; 1981
2. Transects to measure community biomass, production, structure etc. in 143 range types; 1982 and 1983.
3. Destructive sampling of trees and large shrubs: 12 species, between 7 and 21 trees per species to date. 1981 - 1983.
4. Growth measurements of c. 350 trees at several sites over three years. 1981 - 1983.
5. Interpretation of growth rings in two Acacia species. 1982.
6. Stocking rate trials to assess carrying capacity of the riverine woodland community. 1981 - 1983.
7. Aerial survey of livestock numbers and distribution in relation to environmental factors. 1981.
8. Aerial photography of woodland and shrubland communities for assessing change in structure, canopy and for tree growth
9. Testing of experimental fencing made of bamboo bundles, to replace felled and lopped thorn trees in the construction of livestock enclosures. 1981 -1983
10. Experimental tapping of Acacia senegal trees and collection of gum arabic for commerce.

4. Summary of research findings.

Wood requirements of the Rendille people.

The rendille, like other pastoral people in north eastern Africa, require wood for two main purposes: for fuel in cooking and for the construction of their livestock night enclosures (bomas). Estimates of Rendille wood requirements have been made by several IPAL research workers, including Lewis (1977), Hussein Yusuf, quoted by Synnott (1979) and Walther and Herlocker (1981). There is general agreement between the findings of these authors, which are based upon observations of the quantities of wood actually used by certain Gabra and Rendille families in the construction of their manyattas and for their cooking fires.

Wood for fuel.

Synnott(1979) estimated that the present annual requirement for fuel wood by the Rendille and Gabra people is between 75 and 150 kg per person. For the Rendille people as a whole, 12,900 in number, this would give a total fuel wood requirement of between 967 and 1,935 tonnes annually. Walther and Herlocker (1981), in estimating the total wood requirements of the Rendille, distinguished between the more traditional nomadic families and the relatively settled households which normally move only within a 5 km radius of the main villages of Korr and Kargi. Among the latter, of which 350 sedentary households have been counted in the vicinity of Korr village, the fuel wood consumption was estimated at 2.26 kg per household per day (825 kg per year). With an average household calculated at 3.8 people, the annual requirement per person amounts to 217 kg which is somewhat higher than the upper estimate of Synnott (1979) at 150 kg.

Among the more traditional nomadic families, Walther and Herlocker found that the average fuel wood consumption is 3.6 kg per day (1314 kg per year) which, with an average of 3.2 persons per household, gives a consumption per person of 411 kg annually. This quantity is 2.7 times the higher estimate of Synnott and possibly reflects not only the greater availability of wood to the families who live away from the degraded areas but also an increasing trend towards the consumption of grain food, mainly maize meal, between the two series of observations. Among the sedentary households, Walther and Herlocker found that only 10% of the fuel wood used is actually

cut, the remainder being collected from abandoned manyatta sites where it has already served as fencing material. Among the nomadic households they observed that only 5% of the fuel wood is cut, the rest being picked up as dead wood. Taking a total of 350 sedentary households and 2086 traditional households, these authors estimated that the former use 288,750 kg annually and the latter 2,741,000 kg annually, with a total annual fuel consumption of 3,029,750 kg dry weight, which is 36% higher than Synnott's estimate. However, it should be noted that, these authors estimate that only 165,925 kg of this total is actually cut annually for fuel wood.

If we accept the findings of Walther and Herlocker that some 3,000 tonnes of fuel wood are required annually by the Rendille, giving a daily requirement of some 3.2 tonnes, it is necessary to examine the means by which this quantity can be obtained without further degradation of the tree and large shrub populations around the settlements. The management measures necessary to meet this requirement, including the use of camel transport to bring fuel wood from the productive woodlands and shrublands to the settlements, are discussed in the management section of this report.

Wood for livestock bomas

Lamprey (1981) described the general problem of the excessive exploitation of trees and large shrubs for the construction of livestock night enclosures. Lewis (1977) estimated that each pastoralist family cuts six trees on average for boma construction each time it moves. Synnott (1979) suggested that, following certain assumptions this might amount to 1 m^3 of solid wood, equivalent to 0.2 m^3 per head. Hussein Yusuf (quoted by Synnott, 1979) collected data on the trees and branches cut for the construction of a Gabra manyatta. Taking this data, Synnott estimated that the wood required was equivalent to 0.4 m^3 head/move and, assuming 6 - 8 moves per year, suggested a total use of 1.5 - 3.0 m^3/ head/year. He also quoted Yusuf's observation that two Gabra manyattas of 17 houses each weighed a total of 15,700 kg, giving an average manyatta weight of 7850 kg and 462 kg per household.

Walther and Herlocker (1981) estimated the dry weight biomass of wood in five traditional Rendille manyattas ranging in size from 16 to 76 households, with an average of 47.4. The average biomass of dry wood per manyatta was 7885 kg and the dry weight of wood per household average

166 kg. The one sedentary manyatta weighed had a slightly lower consumption rate with 144 kg of wood per household. These authors have calculated the total quantity of wood used annually for fence construction, by the Rendille people as 294,632 kg, assuming three moves of the manyatta per year. Although three moves per year may be normal for some sedentary households, this appears to be a low estimate for the number of moves made by traditional Rendille nomads. Enquiries made by the Woodland Ecology Unit have generally confirmed the estimate of six to eight moves quoted by Synnott (1979) as the annual average for most Rendille families. If we assume that seven moves are made on the average, and taking Walther and Herlocker's wood biomass figures for Rendille manyattas, the total amount of wood used annually for this purpose by the Rendille would be approximately 687,475 kg. This amount is considerably lower than the estimates of Synnott and the estimated total which would be obtained by expanding the small sample of two Gabra manyattas obtained by Yusuf. It should also be noted that Walther and Herlocker converted all their weights to oven dry equivalents, which is approximately 93% of air dry weight and a lower proportion again of the incompletely dry samples obtained by Yusuf. A further factor in estimating the total amount used for manyatta building is the difficulty of including all the small twigs lost in the collection and building processes, as Synnott pointed out.

Total wood consumption by the Rendille.

Taking the estimated sum of wood biomass used for fuel and fence construction by the Rendille people as approximately 4,000 tonnes annually (and as much as four times this amount if Synnott's estimates are accepted), an objective of the woodland programme has been to examine the biomass and production of the tree and shrub communities in the IPAL area with a view to meeting these requirements while ensuring that the tree and large shrub communities across the region are further depleted by over exploitation. Later sections of this report deal with the research programme which has been investigatinng wood and shrub production and the management proposals for ensuring that the tree and shrub populations can be rehabilitated and maintained at the optimum rate of production in future.

Future trends in wood consumption.

At present the consumption of wood by the Rendille people is relatively low, although the extremely localised nature of their wood cutting has resulted in the denudation of formerly wooded areas. It has been anticipated that the rapdily changing living standards and patterns of the Rendille people as well as their increasing populttion, will result in increasing needs for wood for various purposes, but particularly for fire wood for cooking. As the diet of the Rendille changes from milk, meat and blood to include increasing amounts of maize meal, so their need for fuel will increase. Walther and Herlocker (1981) examined the fuel requirements of other nomadic societies as described by several authors. These varied from 1460 kg/year in West Africa (Le Houerou, 1975) to 4088 kg/year in Afghanistan (Casimir et al.1980) for each household. In agricultural areas 1200-1600 kg/year per household is considered a normal rate of consumption, and it appears likely that Rendille fuel wood requirements will steadily rise towards this level unless severe shortages of food restrict their use of wood. The present evidence of the Rendille propensity for gathering virtually all the available wood from as close as possible to settlements, suggests that they would continue to follow this course (unless prevented or dissuaded), thereby denuding increasing areas around the villages, despite the steadily increasing distances that they must travel each year to obtain their wood. Walther and Herlocker (1981) point out that although the annual overall wood requirements of the Rendille within their home range are about 287 kg per km^2, owing to the concentration of 14.4% of the manyattas into 0.5% of the total area, 10.4% of all wood consumption is restricted to this small area. This amounts to a consumption of 5604 kg/km^2 per year, as compared with 258 kg/km^2 for the rest of the home range area. The former rate of consumpption exceeds the annual production of most woodland and shrubland communities in the already degraded areas near settlements and results in the steady depletion of the standing crop of woody plants. By comparison the latter rate of consumption is small proportion of the annual production of the average woodland and large shrubland communities and has little or no effect on their viability. By contrast, the impact of browsing animals on the areas which are relatively remote from the settlements is very great.

The present level and pattern of wood consumption by the Rendille people is damaging the tree and large shrub communities, especially near to settlements, and necessitates urgent and far reaching management measures. However, the predictable increases in the requirement for wood due to the incfeasing population and to changing diets will call for even more stringent management proceedures in the coming years. The proposed guidelines for rational wood harvesting are described later in the management section of this report.

Livestock browse requirements.

This subject is discussed at greater length under the heading of animal husbandry but since it relates directly to the condition and viability of the tree and large shrub vegetation of the region, it is summarised here to provide a background for the account of the woodland programme.

Camels and goats, the browsing livestock species, which consistitute 58% of the livestock biomass, obtain between 29 and 35% of their forage from trees and large shrubs, while sheep obtain 9% of their diet from this source. The combined requirement of all livestock in the region for browse from trees and large shrubs is over 16% of all forage consumed, although tree and shrub foliage amounts to only 8% of the total forage and somewhat less than 8% if accessibility is taken into account. Thus, tree and large shrub foliage production is apparently more limiting to the livestock populations than is the production of the herb and dwarf shrub layers.

From the known average intake of forage (dry matter) of each of the livestock species as a percentage of live weight (daily values: camels, 1.6%; goats, 3.4% sheep, 3.2% and cattle 2.7%, the total forage intake per animal, for the total population, and also per km^2 and per hectare, has been estimated. Taking the known proportion of browse material in the diets of each species, the daily and annual intake of tree and shrub foliage for each has been calculated for the total populations and per unit area in the region. Thus, camels consume annually, 840 kg/km^2, goats 521 kg/km^2, sheep 99 kg/km^2 and cattle 35 kg/km^2 (dry matter) as tree and large shrub browse, giving a total of 1495 kg/km^2.

This level of consumption by the livestock populations can be compared with the estimated average browse production of c.3800 km/km^2. On the assumption that trees and large shrubs can tolerate the removal of up to half of their annual foliage and new growth production each year without endangering their chances of survival, it appears that this offtake by browsing livestock could be sustained provided that it is evenly distributed across the woodland and shrubland communities. In the present situation, the browsing pressure is very unevenly distributed, with certain areas over-exploited, especially those near to settlements, and other areas being virtually unused. Provisions of the manaeement plan are intended to rectify this poorly distributed use of the woody vegetation by livestock, so that the degraded areas can be rehabilitated and other areas which are threatened by degradation can be conserved through proper management.

Tree and large shrub biomass density and production

Mapping and description of woodlands and shrublands.

The tree and large shrub populations of the region occur as a mosaic of different communities with greatly carying areas, species compositions, age class structures, and plant densities. These characteristics are determined by a number of environmental factors, including soils and drainage, altitude, rainfall, and past animal and human impact. The mapping and basic description of these communities was undertaken by D.J. Herlocker (IPAL Technical Report D.1, 1979). In 1981 the IPAL proposed management area was mapped again for the purpose of assessing the status or condition of the vegetation, with a view to defining management units for the future. Across the study area 143 vegetation "photo-types" were identified and mapped by the photo=interpretation unit, each photo-type being defined as a block of relatively homogeneous vegetation pattern as observed on the aerial photography of 1972. Each vegetation block had sited in it at least one transect line intended to define a sample of the range vegetation, (described in the report under range assessment).

Woodland and large shrubland transect sampling.

At each site a closely parallel transect of at least 500 m was marked and a set of observations taken according to the zig-zag method described by Leithead (1979). This method has proved to be especially

convenient for this purpose in the extensive woodlands and shrublands of the study area. In each of the range types observed the following characteristics of the tree and large shrub community were recorded: species composition and relative frequency; plant density; percentage canopy cover and size calss distribution.

The transects have been carried out by the Woodland Unit, the working team normally consisting of three field assistants. The basic measurements taken are plant height, crown diameter (the mean of two measurements taken at 90° to each other), and the distance between the stem bases of the successive recorded. The transect is directed towards a distant aiming point (or follows a compass bearing where no convenient aiming point is visible), and moves successively to the nearest tree or large shrub species (whatever its growth stage) lying within the 90° angle which is bisected by the line to the aiming point or the compass bearing. In this manner a zig-zag line is followed until the total inter-plant distances amount to at least 500 m for the transect. Estimates of relative frequency of species and size classes an and of canopy areas are derived from absolute plant densities which are obtained by the expression:

$$\text{Density} = \frac{10{,}000}{\left(\frac{i}{n-1}\right)^2} \quad \text{plants ha}^{-1}$$

where i = the interplant interval

and n = the number of plants in the sample.

Two series of tree and large shrub transects have been carried out, one in 1982 and another in 1983, both in conjunction with range assessment transects the same sites. In most cases it was ascertained that the second transect line at each site followed closely, but not exactly, the line of the first transect, so that the second transect could be regarded as an extension or replication of the first. In some cases the exact line of the first transect could not be located and it could only be shown that the two transects were sited within the same range type.

The comparison of the two transects at each site has provided a preliminary measure of the variance resulting from the sampling rates. The variances had depended very much on the absolute density of trees and shrubs and, as would be expected, the highest variances are obtained in the sites with the lowest plant density. For this purpose, the tree and large shrub densities have been divided into four density classes: I, 1 ha^{-1};

II, 10 ha^{-1}; III, 100 ha^{-1}; IV, 100 ha^{-1}. At the low densities of class I and class II, variances have been of the order of $\pm$ 4 - 6 times the density estimates so that it is necessary to carry out further replications to increase the sampling rate at all these sites. At the higher density sites varances have generally been between 0.5 and 2.0 times the density estimates and although further replications would be advantageous, repeat sampling at these sites is not so important and will be carried out if time and staff availability permit.

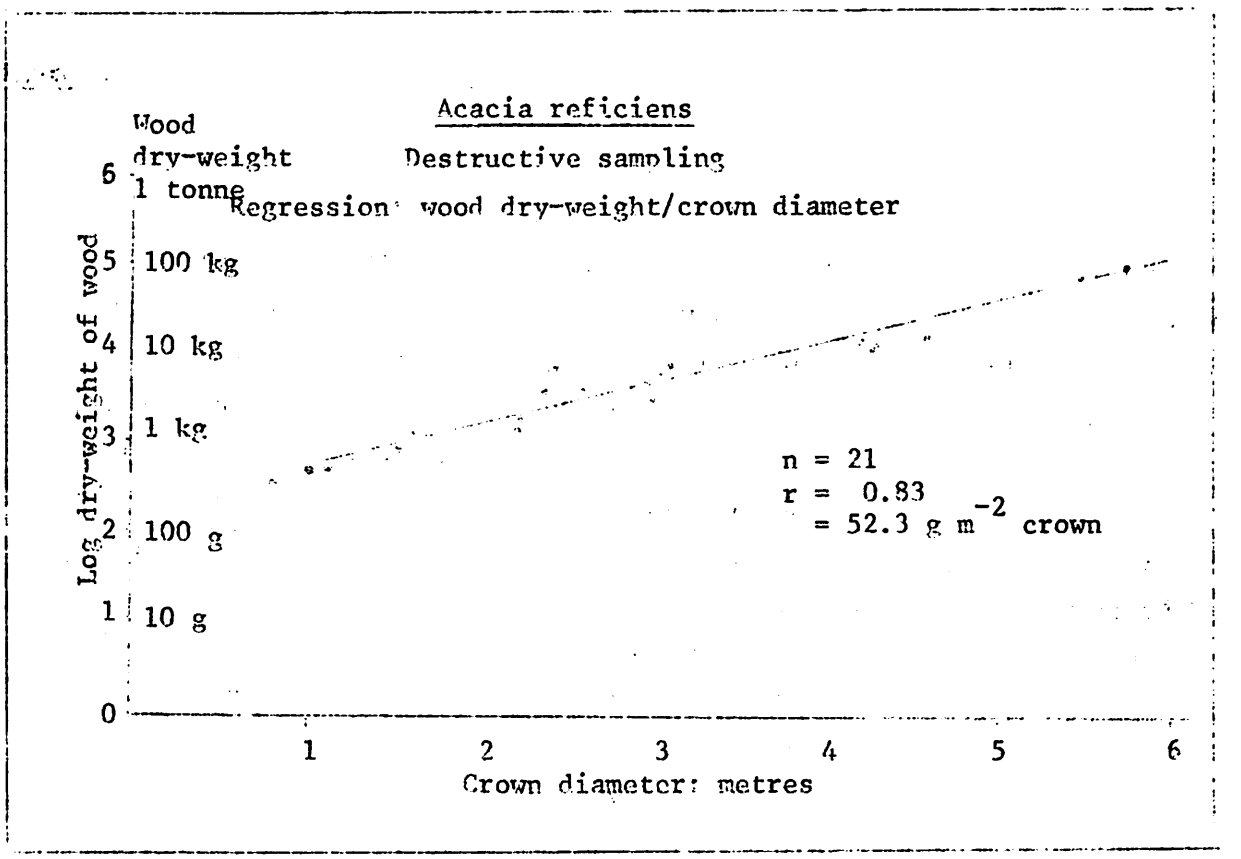
The results of the transect sampling have been given in summarised form in the first volume of the management plan and will be given in detail in the relevant technical report which is in preparation. A general account of these results is given below.

Tree and shrub destructive sampling: biomass estimates.

In order to obtain biomass and production estimates from the transect records of each range type, the relationship between tree and large shrub dimensions and their dry-matter weights has been calculated of the 12 commonest species, which together make up approximately 90% of the biomass of the woodlands and shrublands.

Weighing samples of trees has been carried out by the woodland unit team, which for this purpose, consists of at least three field assistants and three additional labourers. For each of the common species at least ten, normally twenty, trees over a full range of sizes, have been cut up into the their component aerial parts (trunk, branches, twigs, foliage and new growth), with the foliage divided into categories according to its height above the ground. After air drying the woody material, the foliage and new growth are weighed and the data used to construct regressions of dry weight (for each component) against the plant's dimensions, expressed primarily as grown diameter (example figure 1), but also as crown area and volume. The height categories relate to livestock feeding heights, goats normally feeding up to 1m above the ground and camels from 1 to 2.5 m. By measuring the availability of forage at different feeding heights, the proportions have been of the forage accessible to the two browsing livestock species estimated.

Figure 1.



The absolute quantities and the proportional availability of browse fooder have been used in the estimation of carrying capacities and stocking rates quoted in the first volume of the management plan. REgression of wood dry-weight against crown diameter obtained from a sample of 21 Acacia reficiens trees, to illustrate how relationships between dimensions and weight have been calculated for the important tree and large shrub species.

Growth and production in trees and large shrubs.

Annual productions of wood and forage are the most important quantities to be determined for the estimation of fuel and building material availability and for estimating the carrying capacity of the woody vegetation for browsing livestock. A working theory has been adopted that offtake can be sustained at a level which is approximately equal to production without the risk of damage to the community, provided that the offtake is evenly distributed across the range of age classes or concentrated more on the older trees and shrubs. However, it is probable that an offtake which slightly exceeds existing production levels would be possible in unexploited communities under ecological climax conditions since such offtake would be likely to stimulate production. In degraded communities in which rehabilitation is necessary, the offtake should be considerably less than the production and, where the age structure is poor, offtake should be reduced to a minimum. This topic is discussed further under the heading of

management.

The measurement of growth and production has been carried out by the Woodland Unit using four methods. Firstly, over three hundred trees have been measured repeatedly for five or six years, in order to obtain rates of growth of stems at ground level (and in the case of large Acacia tortilis at breast height), and of crown diameters and heights. Simultaneously, the same trees have been recorded on large scale aerial photography on which crown dimensions can be measured at intervals and a large number of other trees also recorded in this way. A third method has been the marking and measurement of series of individual twigs on trees and large shrubs in protected and unprotected sites. In general, growth measurements are made on trees in fenced enclosures to provide control against browsing animals. However, two open plots are under continuous observations near the Balesa Kulal water course where the Acacia shrubland is subject to moderate use by livestock and wild ungulates.

The fourth method employed to measure growth rates in trees has been the measurement of growth rings which can be interpreted in the light of the known growth rates obtain from the six years of observations in the growth plots. Cross sections of two tree species, A. tortilis and A. reficiens, have been cut and polished. although growth rings are indistinct in some years, probably owing to occasional prolonged rainy seasons and some drought periods. Nevertheless, clear rings appear to have been laid down in most years in the two species examined. Acacia reficiens the annual stem radius increments observed for years of normal or heavy rain were 3.5 to 4.5 mm and 2.3 to 2.6 mm in drought years, with a mean annual increment over 27 years of 2.869 mm (s.d. 0.712 mm). Acacia reficiens, the dominant tree species across very large areas of north eastern Africa, is deciduous after each rainy season, being largely dependent upon rainfall for its water requirements. Acacia tortilis is partly dependent upon ground water and, where this is abundant, grows into a large tree. It shade its leaves over a period of several months and in some years is leafless for approximately a month, during which it lays down a distinct, very thin, white ring. In this species, the stem radius increment is relatively constant from year to year after the roots have reached the water table and in the large tree examined average 2.25 mm annually over 127 years.

Using the stem diameter increment data (from growth measurements and growth ring interpretation) in combination with the data from the destructive sampling, the successive annual weight increments of an average tree of each important species have been calculated. The pattern of wood biomass production of the dominant species Acacia reficiens is illustrated by a regression shown in IPAL Technical Report A-5, in which the Log_{10} dry weight of wood is plotted against stem diameter and age in years.

Date from the growth studies and estimates of annual stem-diameter increments, combined with wood-biomass/tree-dimension regressions, have provided estimates of wood annual production in the 143 shrubland and woodland communities samples by transects. These data were prepared for publication in the first volume of the management plan, together with data on other aspects of the tree and shrub communities, but were found to be too lengthy for inclusion in their complete form. They were summarised and presented as averaged data for each of the 21 range management units. The full data are presented in a technical report which is now in preparation. For each of the 143 range types the wood biomass and production estimates of the trees and large shrubs have been used to deduce wood collection recommendations.

Wood biomass estimates for the region vary from less than 30 kg ha^{-1} in bare annual grasslands to 11 t ha^{-1} in dense shrubland, with an annual wood production of c. 900 kg ha^{-1}.

Tree and large shrub foliage production in each of 143 range types has been estimated from the results of the destructive sampling and from the leaf litter collection under a small number of tree and shrub species. Most of the destructive sampling was carried out in 1981 and timed to collect foliage and new twig growth before the leaves fell after the rains. Data from 15 common tree and large shrub species provide leaf and new growth dry weights in relation to tree dimensions and wood dry weights. The most useful of these relationships is that of foliage dry weight per m^2 of tree canopy, a value that permits the estimation of foliage biomass from the results of transect counting from large scale aerial photography. Preliminary results for five species

are given in Technical Report A-5 and full results for the 15 species sampled are given in a technical report in preparation.

In the deciduous tree and large shrub species (e.g. the small Acacia species) the annual production of foliage is normally twice the standing crop biomass since one crop of leaves is produced during each of the two rainy seasons in a year. In the evergreen species such as Salvadora persica the annual foliage production is approximately the same as the standing crop. This has been shown by the close similarity of the results of the destructive sampling of 9 trees and the collection of a year's leaf fall under 10 other trees of this species. The fact that both samples gave a mean dry weight of 233.9 g m^{-2} is coincidental as the standard deviations (destructive sampling 117.0 and leaf collection 117.5).

Woodland and shrubland community structures

The species and age-class structures of the 143 communities which have been sampled by the zig-zag transect method have been presented as a series of histograms, which were prepared for inclusion in the first volume of the Management Guidelines. Unfortunately, this material proved to be too bulky for inclusion so the method and the results obtained were summarised in that volume by a small series of histograms representing the woodland and shrubland structures along one 10 km transect from Kargi settlement westwards, illustrating the effects of human and livestock impact upon the communities. The main effects shown were a general reduction in species diversity from the relatively unexploited communities 50 km west of the settlement 12-14 tree and large shrub species) to the heavily exploited communities in the immediate vicinity of the settlement (4 species). The size-class structures along the same gradient furthest from the settlement showed the characteristic balanced age-class curve with a gradation from the very numerous young plants. Through the less numerous plants in the middle sizes to the few in the largest classes. Near to the settlement the age-class structures showed an almost total lack of trees and shrubs in the small and medium age-classes, indicating that these communities are likely to be virtually eliminated within on or two decades unless control is exercised over their exploitation. Among the 143 range types sampled throughout the management area, a high proportion showed similar

poorly balanced age-structures, indicating a serious depletion of the small and middle-size classes which is mainly due to their over-exploitation by goats and, to a lesser degree, by camels. Figure 2 shows shows size-class and species structures at three sites in Range Unit 9 as an example of the structure descriptions given in Technical Report D-5 (in preparation).

These community structure results have figured prominently in the design of the woodland and large shrubland management measures proposed in the second volume of the Management Guidelines, discussed briefly below.

Large scale aerial photography of woodlands and shrublands

Vertical aerial photography of sample areas of woodland and shrubland has been carried out, giving scales on the enlarged photographs of between 1:500 and 1:1500. The photographs have been used to analyse the canopy structures of the different layers in the vegetation using the dot-grid method, mainly as a check against the results obtained by the transect method, but also to augment the transect data with information on the grass, herb and dwarf shrub layers in representative communities. Examples of canopy structures are given in Technical Report A-5 and will be further illustrated in Report D-5. Large scale aerial photography of woodland and shrubland communities has been used as a means to provide base-line measurements from which the growth of individual tree crowns, and other changes in tree and shrub community structures can be monitored over the medium (e.g. 10 years) and the long term (e.g. 20-40 years). Similarly, a series of low level oblique colour transparency photographs has been taken in each 10 x 10 km grid squares to provide a record of the vegetation status in 1982 and also to check the density and canopy data obtained in the same areas by ground transects. The collection of base-line data of this type demonstrates the possibilities for monitoring ecological changes in vegetation and the value of such monitoring in detecting desertification or recovery resulting from successful management measures.

Woodland and shrubland parameters estimated on survey flights

On each survey flight estimates were made of foliage production levels of the tree and large shrub vegetation, as well as the grass and dwarf vegetation, in each of the 10 x 5 km half grid squares in the

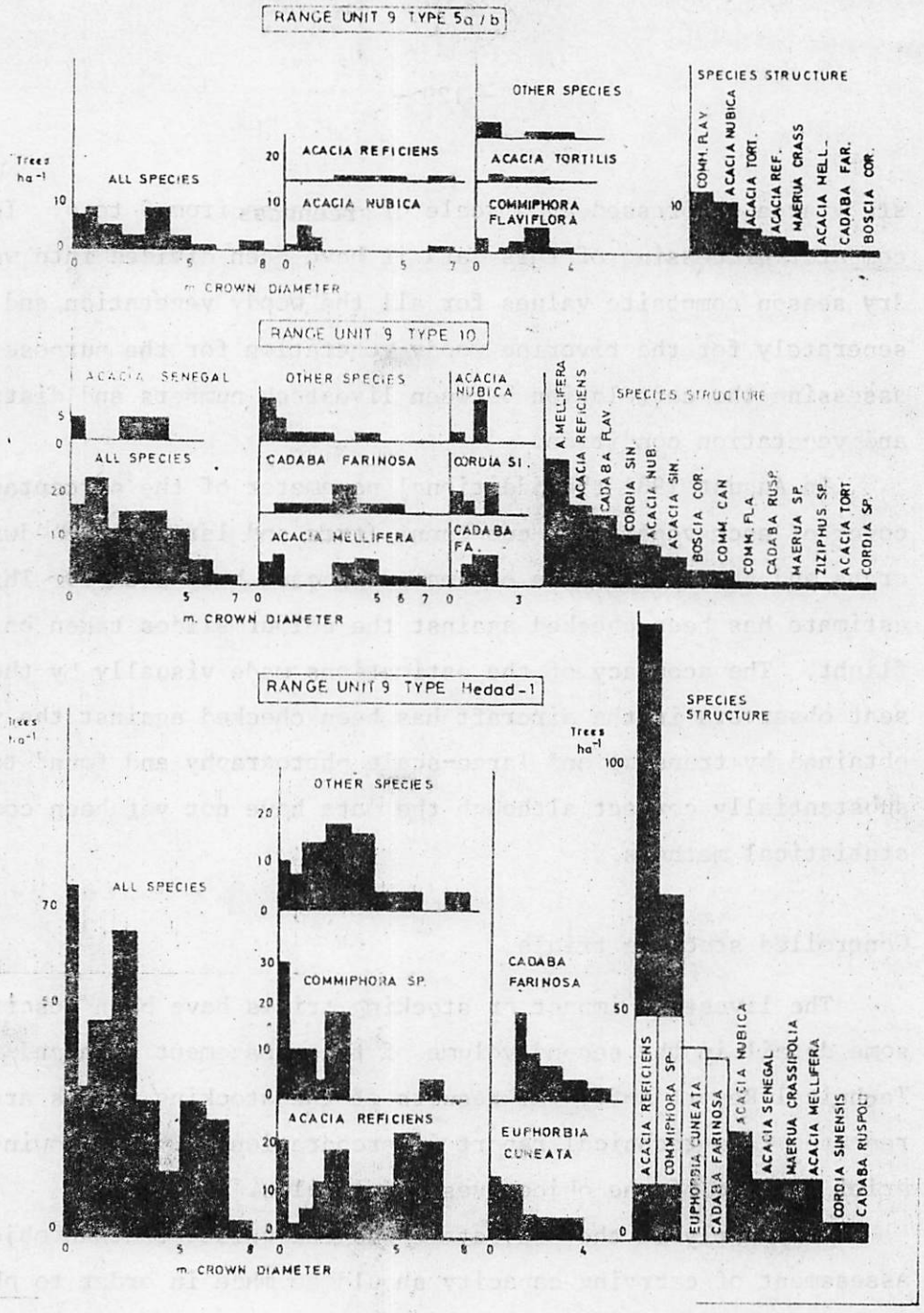


Figure 2

Size-class and species composition histograms of three out of 143 range sites sampled by ground transects, illustrating poor to moderate age - class distributions in shrubland communities which are threatened by excessive goat browsing which prevents the growth of young trees.

study area, expressed as a scale of greenness from 0 to 4. In the computer processing of this data it have been divided into wet and dry season composite values for all the woody vegetation and seperately for the riverine woody vegetation for the purpose of assessing the correlation between livestock numbers and distribution and vegetation condition.

In August 1981 the additional parameter of the percentage canopy cover of each vegetation component (tree and large shrub; dwarf shrub; grass and herb layer) was estimated in each half-square. This estimate has been checked against the colour slides taken on the same flight. The accuracy of the estimations made visually by the front seat observers in the aircraft has been checked against the values obtained by transect and large-scale photography and found to be substantially correct although the data have not yet been compared by statistical methods.

Controlled stocking trials

The livestock impact or stocking trials have been described in some detail in the second volume of the management plan and in Technical Report A-5. The results of the stocking trials are more fully reported in a technical report in preparation. The following is a brief outline of the objectives and results.

Very early in the project it was recognised that an objective assessment of carrying capacity should be made in order to obtain a positive confirmation of the applicability of the theoretical values published in the literature to the grazing and browsing ecosystems of the IPAL area. In particular it was intended to measure quantitatively the actual offtake of vegetation by livestock at predetermined stocking rates in an area of known biomass and productivity. In 1976 the first stocking trial plots were fenced in the riverines vegetation beside the Balessa Kulal water course, enclosing a total area of 40 ha and divided into smaller plots to test the effects of light, medium and heavy stocking by camels and sheep and goats and to provide a control against which the changes in the exploitation plots could be compared. After initial trials it was found that the differences between the results of the different stocking rates could not be demonstrated statistically and that the medium and light stocking regimes were producing slight and insignificant effects that would not be measurable or conclusive within the expected life of the project.

In 1980 the Balessa trial plots and the stocking methods were modified in order to observe the effects of deliberate overstocking by cattle, camels, sheep and goats at a stocking rate of 18 TLU $km^{-2}y^{-1}$ intended to simulate the densities of livestock normally observed within 20 km of settlements in the region. However, during each of the three years in which the trials have been run under the modified system, it has not been possible to achieve the rate of 18 TLU $km^{-2}y^{-1}$ owing to the almost complete exhaustion of the available fodder in the plots and the rapid loss of weight of the animals before the experiment was complete. In effect the highest rate achieved has been 14 TLU $km^{-2}y^{-1}$ in the sheep and goat trial plot, 9 TLU $km^{-2}y^{-1}$ in the cattle plot and 16 TLU $km^{-2}y^{-1}$ in the camel plot. The fact that these stocking rates were achieved with the almost total consumption of the available forage, indicates that the "correct" stocking rates in this vegetation under the prevailing climatic conditions were approximately half of these achieved, i.e. rates which would have resulted in leaving approximately half of the available plant production intact, and would provide the basis for full recovery of the vegetation with the following rains.

Several observations can be made on the general efficacy of the stocking trials carried out at the Balessa Kulal station.

(a) Initially, the Balessa Kulal trial was intended to be one of several similar experiments to be carried out in each of the major vegetation communities in the region since it was recognised that carrying capacity would vary from one community to another. The Balessa trial was selected to represent the relatively small but nevertheless important riverine habitat which is used by livestock mainly during the dry seasons when other habitats have low forage reserves. It was also recognised that the riverine vegetation, having the benefit of a greater soil moisture content than the surrounding rain-fed communities, would have a relatively high productivity and could not be taken to represent the carrying capacity of the country as a whole. Unfortunately the limited funding of the project precluded additional stocking trials in other habitats until C.R. Field was able to start similar trials in the sub-humid grasslands on Mt. Kulal in 1982. The need for further trials in the rain-fed shrublands and annual grasslands which cover the greater part of the region is urgent but depends on additional funding and man-power.

Despite the limited applicability of the results of the Balessa stocking trials to the study area as a whole, they have demonstrated that the general level of stocking achievable in the long term in the region approximates the published estimates for the climate regime in question but, since the Balessa conditions are relatively favourable, suggest that the published estimates may be too high for the area as a whole.

(b) The Balessa stocking trial has demonstrated many practical difficulties inherent in the conduct of experiments of this kind, only a few of which can be mentioned here. Perhaps the most important problem lies in the actual selection of a trial plot which can be said to represent a wider area of the habitat in question. The experimental conditions achievable with the limited staff and funding available, including the lack of replication, the subjectivity of the selection of the site, the inevitable lack of homogeneity of the experimental plots themselves make this a far from satisfactory scientific enquiry. Ideally, the stocking trial concept is a good one but one which should merit the expenditure of a great deal more effort and funding than has been possible within the framework of IPAL during the past seven years. It appears that the very preliminary approach to the stocking trial concept which the Project has been able to make has produced some unexpectedly useful results. It has also indicated that a well supported programme carried out over a longer period, probably covering one climatic fluctuation of approximately fifteen years, would be an important adjunct to any management-orientated research and monitoring programme in the arid rangelands. Furthermore, it is clear that a valid assessment of long-term carrying capacities in the different habitat types in the region would benefit greatly from continuous or repeated observations of several experimental fenced plots under controlled treatment, maintained (as far as possible) indefinitely. It is to be hoped that the IPAL monitoring programme of the future will include the maintenance of system of long term observation plots which can be continued by the Government department concerned.

(c) In the experience of IPAL in the past seven years, there has been difficulty in reconsiling the frequently conflicting needs of different components of the project for the limited man-power and resources available, including the livestock needed for the stocking trials. Nevertheless by accepting compromise solutions, such as the omission of the cattle component of the experiment in some years, it has been possible to continue without a serious breakdown in the series of observations.

It should be noted that although useful short-term results have been obtained from the stocking trial plots in assessing offtake and short-term carrying capacity (i.e. from year to year), the long term carrying capacity of the riverine vegetation can only be assessed by observation of the cumulative impact of several years of heavy stocking. The main value of the stocking trials depends on their continuity over at least twenty years.

The application of alternative woodland industries

Firewood collection

It was pointed out in section 4 above that the collection of firewood is an important factor in the observed ecological degradation which is expanding outwards from the settlements. Although much of the wood collected for this purpose is dead or has already been used in boma construction, a sufficient quantity of wood is already being cut from live trees to be a serious cause of deplation in the woodlands and shrublands and, since the trend towards the use of grain foods is increasing, this exploitation of the tree and large populations for firewood will increase unless an alternative sources is provided.

The best source of firewood is the large quantity of dead Acacia tortilis and Acacia reficiens wood available at scattered localities throughout the region which is available for collection if suitable transport can be mobilized. The woodland Unit has demostrated the cutting up of dead Acacia tortilis trees into suitable camel loads for transportation to settlements and the recommendation has

been made that camel transport of firewood should become a regular industry in the future, depending entirely upon the turn-over of mature Acacia tortilis and A. reficiens woodlands.

Gum Arabic

The natural occurrence of Acacia senegal, the source of commercial gum arabic, throughout western Marsabit District, should be exploited as an additional industry in order to provide some diversification of the cattle-based economy in the region. During the reporting period, an experiment in the tapping and harvesting of gum arabic trees has been carried out by the Woodland Unit. Approximately one tonne of this commodity has been collected from prepared trees by two employees engaged for this purpose and, after suitable maturing, is now available for sale to local industry and for export on a trial basis.

Initial enquiries have been made through the Ministry of Commerce in Nairobi and through potential importers in Europe and Australia and it is hoped to initiate a trade in gum arabic which can be continued by the Rendille cooperative committees in the future.

Fence construction

As an alternative to the construction of livestock night enclosures from felled thorn trees (mainly of the species Acacia reficiens) with the resultant serious degradation of the woodlands and shrublands, experiments were carried out in the construction of fences from bamboo brought into the area from Mount Kenya and the Aberdare Mountains. The bamboo was used successfully in making standard portable fence units of 2 x 1.5 m which have been tested both by the project's livestock units and by local herdsmen and one trader over a period of four years to enclose camels and cattle.

It has been concluded that the bamboo fencing system is a practically useful means of fencing livestock but that it is too expensive for most Rendille pastoralists to afford. A livestock boma consisting of 30 bamboo hurdles costs approximately $300, the greater

part of the cost being for transport of the bamboo raw material to the area. Its main value lies in its relative durability since, in lasting four years, a bamboo boma has about ten times the life of a thorn tree boma and can be transported short distances to new sites when the manyatta moves, so that a new fence of felled trees is not required.

The provision of "artificial" fences has been proposed in the Management Plan as a service of a subsidized commodity for the Rendille people, and will require an initial capital outlay. An additional advantages of a fence construction industry would be the employment of additional labour and eventually the provision of a source of income for the Rendille Co-operative Committees

Other Activities

1. Attended International Conference on Landscape [illegible] Planning, Nairobi. Made brief statement on the work of IPAL and the unlikelihood of adopting sophisticated landscape architecture in Marsabit District in the foreseeable future. Proper planning of settlements was discussed.
2. Participated in evaluation of KREMU with Dr. Tener and Dr. Brink.
3. Gave lecture to Nairobi University Department of Geography on the work of IPAL and the problems of desertification in Kenya.
4. Meeting with Dr W. Payne to discuss possible UNSO involvement with IPAL.
5. Gave lecture and audio-visual show to UNESCO National Commissions.
6. Participated in U.N. Intragency Mission to Ethiopia for DROUGHT and disaster planning at request of U.N. Headquarters.
7. Gave lecture at Egerton College on IPAL and desertification problems of Kenya

8. Demostrated systematic survey flight to the FRC Food Efficiency Project, Wamba Division.

9. Participated in International Seminar on Action to Control Desert Envroachment in Africa and present the approach and results of the IPAL programme.

10. Attended the 20th Anniversary of the College of African Wildlife Management, Mweka, Tanzania.

11. Participated in Workshop on the Rational Development of the Dhofar Province in Oman, at Muscat and Salalah.

12. Assisted with organisation of student course in range and livestock management for IPAL Field Assistants.

13. Participated in the 2nd International Rangeland Congress in Adelaide, Australia.

14. Acting as External Examiner for the Egerton College Diploma course in Wildlife and Range Management.

Conclusions and Recommendations

The programme of research on woodland ecology carried out during the last three years has had its main conclusion in the results and recommendations given in the Management Plan. The recommendations can be summarised as follows:

(a) Live wood should be collected only where the dry biomass exceeds 2.5 t ha^{-1} and production 150 kg $ha^{-1}y^{-1}$ from mature only.

(b) To prevent further depletion of trees in the settlement areas, firewood should be transported by camel from harvestable woodlands and shrublands; for the 12,900 Rendille people, 5.3 t d^{-1} are needed, to be transported by 53 camels daily.

(c) Both for fuel and fencing materials, tree and shrub felling should be permitted up to the limits of annual wood production in the management units concerned but where the production is low, may be prohibited except for the collection of dead wood.

(d) Pastoralists occupying protected woodland areas should be provided with substitute fencing materials (wire netting and bamboo hurdles) permanent dry stone walls in rocky areas.

(e) With the exception of dead trees Acacia tortilis should be completely protected from felling. Lopping to provide emergency forage should be under close supervision and limited to avoid serious damage to the trees.

(f) A rotational system of resting important woodland areas from browsing for periods of 4 - 5 years where the size class structures indicate insufficient recruitment to the middle and large size-classes, to give shrubs the opportunity to grow above the goat vulnerable height. Riverine woodlands to be protected in alternating 1 km lengths marked by painted trees.

In concluding this report, it appears worthwhile to mention the main constraints that have served to limit the general output and implicability of the woodland research programme. The most important constraint has been the lack of any firm committment to continuity, so that a programme that correctly should have been established for the purpose of monitoring the relatively long term processes of woodland succession and the variability due to climatic fluctuation over a normal "cycle" has inevitably been inadequately concluded owing to the exigencies of a short-term project framework. The realities of project planning and funding are recognised, including the feelings of insecurity they engender in the scientific and assistant staff. Nevertheless it should be clearly understood that the knowledge upon which rational land management in the long term must be based should itself be gathered systematically on a continuing basis rather than relying on the short, and possibly atypical, period covered by the life of a project. Conclusions drawn from such a short period of observation must be interpreted with great caution and should be flexible so that they can be modified in the light of the continuing input of new information over the years and decades.

While the above comment probably applies as much to the project as a whole as to the woodland programme alone, the woodland component has been affected perhaps more than other components by the competing demands of other project activities in which the supervising scientists has been involved. A situation in which the supervising scientist is able to concentrate upon the scientific programme, both the field work and the analysis and write up, is clearly preferable to one in which he is very frequently diverted to carry out more general duties for the project. However, while this is not a critical conservation, and is made in the full knowledge that this is the nature of a project in which everybody has a share of general duties, it is perhaps worth mentioning as a factor affecting the efficiency of the project component itself.

Publications.

Woodland Ecologist 1982 to 1984

Lamprey, H.F. (1982). Pastoralism and problem of overgrazing. Ch. 31 in book: *The Tropical Savannas*, ed. F. Bourliers. (Vol. 13 in Ecosystems of the World, ed. D.W. Goodall).

_____ (1983). IPAL woodland ecology programme: summarized account. In *IPAL Technical Report A-5. Proceedings of the IPAL Scientific Seminar, 1-2 December 1981.*

_____ and Field, C.R. (1983). Estimated Carrying Capacities and protein intake by small ruminants in relation to browse resources in arid rangelands of Marsabit District. 184-201. In *Proceedings of the Second Small Ruminant CRSP Kenya Workshop*, Nairobi, Kenya.

_____ (1983). UNESCO's Integrated Project on Arid Lands (IPAL): a silvicultural approach. Paper II in *Plant Research and Agroforestry* ed. P.A. Huxley. ICRAF, Nairobi, Kenya.

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IX. THE PHYSICAL ENVIRONMENT

Gernot Bake

INTRODUCTION

This report does not cover the scientific results in this field. These and the methodologies have been published or will be published in the IPAL Technical Report series. It is the aim of this final report to state the value of this scientific input within the objectives of IPAL in both ways-say which mistakes have been done, which objectives were achieved and perhaps the most important, which work has still to be done in the next phase of IPAL

The term "abiotic components" is misleading. In sciences it has never been well defined and is almost not used. From the terms of references for the cunsultant they can be defined as the sciences of Climatology, hydrology, geomorphology and pedology. It is common to include geology, geophysics and other geosciences as well. A clear definition right from the beginning would have been helpful for everybody e.g. for people outside of IPAL.

This report cannot be objective. It is written by a geoscientist. Like almost every other scientists geoscientists tend to emphasize the value of their work and try to prove this with the best arguments. But as long as an argument cannot be quantified it can be subjective as well. And to be quite open even quantitative results can be interpreted as long as they cannot be traced down to a simple binary amount. '0' for no and ' 'I' for yes or vice versa. The outlines in the following chapters should be seen in this light. It is also possible that emotional aspects will infiltrate into work. An attempt was made to keep them out as much as possible. The author hopes that he succeeded in doing this if not completely, then as much as possible.

The last chapter is confidential and should be read only by the project co-ordinator and any person authorized by him!

2. WORK ACCOMPLISHED UPTO THE END OF 1981

From the 18th of January IPAL employed a full time consultant responsible for climatology, hydrology and geomorphology. Previous work in these fields had been done as follows:-

1) Borgerson, R.H. 1981. A preliminary analysis of groundwater data from the Marsabit District of Northern Kenya.
2) Ongweny, G.S. 1981. A preliminary account of erosion, sediment transport and surface water resources of parts of Marsabit district.
3) Edward, K.A. et al 1979. A preliminary analysis of climatological data from the Marsabit District of northern Kenya.
4) Sinda, P.M. 1981. Provisional geomorphological map of South Western (Marsabit District, northern Kenya (no report).

These three reports, all of which are now published in the IPAL report series, were written by short term consultants of UNESCO/IPAL.

Fortunately there was a soil scientist working on a detailed soils map on the project since 1981. Thet work is now completed and will be published soon. Another Associate Expert also carried out some work on geomorphology but no report of his results is available. A German geomorphologist carried out some work in 1981 as a visiting scientist but none of his results has been published so far or even was handed over to IPAL.

In the pre-IPAL time only very little work on the abiotic environment had been done in Marsabit district. There are publications of early travellers like Gavendish, H.S.H. (1898), Donaldson Smith(?), Archer,G.F (1913), Toula, F.(1891) and von Hohnel, L.(1894) just to mention a few but their reports are today of limited scientific value. 1930/31 and 1935 Fuchs, V.E. lead an expedition to Lake Turkana with special emphasis on the geology.

Only in two small parts of the IPAL area, South Horr and Laisamis was a proper geological survey made in 1963 (Dodson, R.G.) and 1970 (Randel, R.P.). Dixey in 1948 published "geology of northern Kenya", a study on which the early water development of the area was based. 1971 FAO published a report on range resources with some few remarks on climate, water, etc. In a certain way Marsabit District could therefore be called a white spot on the map. This includes also the availability of accurate maps. Only two over view maps in the scale of 1:100,000 and 250,000 have

sheets with contours. The others are only shaded reproduction of the 1972 aerial photographs. Contours are only drawn in very rare cases and larger scales are not available.

3. WORK DONE SINCE 1982

It was the first task for the fulltime consultant to work out a minimum program for the abiotic components except in pedology where the Associate Expert continued to work with IPAL till May 1983. The goal was to put together as much informations on the physical environment as possible. All the information was to contribute to a Range Management Plan.

In the following pages the work being done by the consultant will be reviewed and discussed, including recommendations for further work.

Climatology.

In the beginning of IPAL a network of number of rain gauges, two automatic weather stations (Gatab then shifted to North Horr and then to Korr, and at Olturot) and a Stevenson screen were built up because it was felt that the existing net work at various police posts and missions was inadequate. The only longterm stations for rainfall in the area were Marsabit and North Horr. The data base for a climatological analysis was therefore fairly poor especially in the reconnaissance of drought periods. It should be understood quite clearly that the map of mean annual rainfall (1976-1982) now produced, is still quite tentative if one considers the high mean variabilities of monthly and annual rainfall from similar longterm stations outside the area a mean annual variability of about 100% was determined. It was not possible to draw probability maps for the whole area but probability analysis could be done for Marsabitaand an attempt for the lowlands by iividing the figures from Marsabit by 3. Also the goal to come up with a drought prediction model could not be achieved. So far no one in the world has succeeded in that.

As there is only one banograph at Marsabit Meteorological Station (Kenya Government) no attempt was made to analyse the rain generating system, so that short term forecasts would have been possible. Here references were made to the available literature on the climate of East Africa.

For an area of 23,000 Km^2 the network of rain gauges e.g. daily read gauges is still quite wide. It was also discovered that the monthly storage gauges used are not very reliable. For management purposes correction factors could be found, so that the data are comparable with the daily gauges. Other meteorological parameters other than daily or monthly rainfall are only measured in the few IPAL stations. Temperature data is still not available from all stations. The rainfall intensity should also be measured in more than 4 stations (Marsabit Met. Station is included here).

Parameters measured by the automatic stations are listed in the various reports. As already mentioned, a longer period data base is needed for several purposes and reading of the existing gauges has to continue. With the opening of the central Hedad, the rain gauge net work should be increased as there will be more tracks available. Also a new automatic weather station should be built in the central Hedad because in thes area almost no data is available. It should have also sensors for soil moisture and soil temperatures. The IPAL stations of Ngurunit, Kalacha and Kargi should be equipped with recording rain gauges so that further information on rainfall intensity can be obtained. In different areas attempts have been made to detect rainfall from satellite images partly with good results. For this purpose either NOAA or LANDSAT images could be used. They could also give valuable information for the range sector as it indicates also the status of vegetation. But this would require the services of a fulltime climatologist, a post which is not foreseen for the next phase of IPAL.

A strong gap still lies in the field of bio climatology but due to time constraints no correlation between annual rainfall and vegetation type has been done. In this regard collaboration with the Range and Woodland sector is absolutely necessary. The first results of a classification in arid and humid months could be of great help. Also the range production figures should be correlated with climatological data. So far most of the analysis has been done with pocket computers (partly by Mr. Muiruri who has left the project meanwhile). It would be of great help to store the available data on computer discs so that there is an easy access. This would decrease the time spent on data processing. IPAL's own computer would be of great advatage for this purposes. With the end of Phase 3 of IPAL there will be no trained climatologist in the Project. It is feared therefore that most of the gathered data will just be stored and be

almost useless for climatological and especially the other scientists. As it is most likely impossible to change the plans for Phase 4, it is recommended to negotiate with the Meteorological Department if they could second somebody to Marsabit Met. Station who would collaborate with IPAL and give certain advice. That this is necessary has been shown in various reports where the climatic side is covered in adequately. It is not possible for a data analysist who will or might operate the IPAL computer to do this work which needs University level training.

Hydrology

This section has to be divided in surface and sub surface hydrology. Water is, beside the vegetation, the major base for nomadic livestock husbandary. Therefore it is not understandable that in an area where almost nothing is known of the water resources no fulltime hydrologist was employed from the beginning.

Surface water

In surface hydrology Ongweny established in 1981 a network of various staff gauges and made the first necessary measurements (cross-sections, flow speeds) which finally allowed him to calculate preliminary discharge rating curves. Except at the IPAL station in Ngurunit, continous measurements of the runoff have not been done because some of the gauges are in remote and difficult accessible areas so that reading them in case of any run off are imposiible. Surface water was also recorded during the aerial surveys for the livestock counting but it is not absolutely clear how accurate the obtained data are. It is sure that the 6% technique used for livestock counting cannot be used for the distribution of surface water. That is why only runoff curves are available for the Ngurunit river. Due to time constraints it was not possible to build water catchment trials before the 2nd wet season 1983. These will give results on the amount of runoff infiltration, influences of different vegetation (also in various states of degradation) and of the grazing factor. Dr. Field built catchments earlier at Gatab, while the consultant chose Olturot as a site. This one is more representative than Gatab for the drier part of the IPAL area. More catchment trials are necessary in various vegetation types.

To overcome the problem of not knowing the runoff in the major lagas recording gauges for height of runoff and also suspension load are necessary. Financial constraints hindered so far the purchase. Recommended sites for the installation should be Ngurunit (replace the staff gauge), Balesa Kulal, Loglogo and eventually one laga on the lower slopes of Marsabit. The well known problems (pollution, sedimention) with open water storage prevented detailed research direction. Baur identified a few sites with a limited capacity but also recommends subsurface storage. Further research is here necessary but also the equipment has to be purchased before. So far no plan has been developed to improve the conditions for watering animals at the springs along the Marsabit Hurri Hills lava escarpment. The recommendations given therefore can be transferred to the Falan dam site to prevent rapid silting.

Ground water

Two consultancies (Borgeson, Ndombi) provided first results on the ground water resources. Much more electric resistivity soundings have to be done in the future. The conclusions and the plan for water management drawn from the consultant are still too tentative. Therefore research has to concentrate in the near future on more resistivity soundings, eventually in some areas seismic profiles and also close monitoring of the existing wells. As there are more complicated formulas for data analysis, a powerful computer is necessary which would facilitate data processing and allow also the necessary modelling. Programs for the last item are already available. IPAL or the bilateral project will have to buy their own resistivity logging equipment as soon as possible. Also a small transportable drilling equipment would be usefull to drill groundwater control boreholes for the monitoring of the local shallow water table.

Building the proposed 26 new shallow wells has to start as soon as possible. A gap lies still in the knowledge of the water quality. Very few analysis have been done so far. The results show sometimes that the standard procedures in handling the samples were not followed so that the results have a limited value only. Quality analysis should be carried out continously so that changes can be detected. A first analysis of the age of groundwaters were done which showed that all tested boreholes tap already fossil water. New conclusions from these results have to be drawn for water management. More analysis e.g. ^{14}C-determination are necessary as the ^{3}H-analysis has already showed its time limit.

Geomorphology

A map of the major landforms was drawn by Sinda in 1981 but without any explanatory notes. Also in the soil map landscape information are available. The consultant drew a map of the actual processes and the erosion hazard in a larger scale (1:250,000). Attempt were made to quantify the amount of eroded and also accumulated materials. Vandalism and theft of the equipment did not allow any results. That is why the already described water catchment trials will be used for geomorphological purposes as well.. Some areas with high erosion hazard have to be monitored closely in the future. This can be done by aerial photographs taken by the IPAL plane. A full time geomorphologist is therefore not necessary. This task should be included in the terms of references of the full time hydrologist. This should include also experiments with rainfall simulators. Soil erosion control is necessary in some areas as well. Collaboration with the existing government agencies at Marsabit can facilitate work here.

Range Management Plan

A considerable amount of time of the consultant was spent in the preparation and revising of the Range Management Plan for the south western Marsabit District area (namely the Rendille country). It should not be overlooked that the first draft was submitted after less than one year of research. In the field of the abiotic components. It is strongly felt that the result and recommendations have to be updated continuously when more data will be gathered.

Further activities

The consultant participated in two orientation seminars where he gave speeches on the results in his scientific fields. He also attended the seminar on extension but played no active role. Considerable time was spent for administrative matters. Consultations were done with various Government agencies and other institutions. Namely the Ministries of Agriculture, Water development, Environment and Natural Resources were directly contacted. Visits were paid also to members of the German

Agricultural team, the Kiboko Range Research Station and the Food Security Programme at Wamba. Various members of the University of Nairobi and the Kenyatta University College were also contacted for discussions. The remoteness of the duty station does not allow discussions with scientists of the same background as it would be normal. The consultant did not attend any external seminar or conference.

4. GENERAL

The working conditions are adequate. Office space was made available. A landrover was allocated for the whole period. The use of the plane was limited and restricted. The library facilities at IPAL are inadequate. Purchase of more books in all scientific fields and also of periodicals and should be no question for a project like IPAL. It is necessary that IPAL obtain its own computer with a high capacity. This has been already put in the budget of the next phase.

The consultant worked 22 months for IPAL being responsible for three important sciences. This means that the time had to be shared. Help was given by two sub consultancies which gave a lot of useful information. To say it frankly by his terms of references the consultant had to be fulfilled within 22 months (that is 23% of the time IPAL Project duration) a job which would have normally employed three scientists for a longer period. Nevertheless the consultant liked to work with IPAL, giving him the opportunity to do basic research in an area where almost nothing was known before his arrival.

This report should also be seen as the final assignment report as required in the contract.

5. Reports and Papers Produced

1. Borgerson, R.H. (1981). A preliminary analysis of groundwater data from the Marsabit District of Northern Kenya.

2. Ongweny, G.S. (1981). A preliminary account of erosion, sediment transport and surface water resources of parts of Marsabit District.

3. Edward, K.A. *et al* (1979). A preliminary analysis of climatological data from the Marsabit District of Northern Kenya.

4. Sinda, P.M. (1981). Provisional geomorphological map of South Western (Marsabit District, Northern Kenya (no report).

5. Baur, P. (1983). Surface water hydrology of West Marsabit.

6. Ndombi, J. (1983). District climatology of West Marsabit District.

7. Bake, G. (1983). Climatology of West Marsabit District.

8. Bake, G. (1984). Hydrology of West Marsabit District.

9. Bake, G. (1984). Preliminary Geomorphology of the West Marsabit District.

10. Van Kekem, A. (1984). A preliminary Soil Survey of West Marsabit District of Northern Kenya.

X. SOILS

Arie van Kekem

INTRODUCTION

The main task of the associate expert with Unesco is the characterization of soils in biosphere reserves and other important Man and the Biosphere (MAB) study sites. The soil research in MAB projects, which is carried out under guidance of the international Soil Museum Wageningen, The Netherlands) was started because of the following reasons:

- the soil characteristics of many biosphere reserves and other sites of MAB field projects are inadequately known;
- where available, this knowledge is usually not integrated with data in other disciplines;
- there is a lack of standardized forms of characterization which would enable comparison of soil characteristics to be made from project to project and from region to region.

As IPAL is one of the projects of the MAB programme, and the need was felt for more information on the soils of the study area. It was agreed that the associate expert would spend part of his time carrying out a soil survey in the study area.

An agreement with the Kenya Soil Survey (Ministry of Agriculture) was made to carry out a soil survey in the Kulal-Marsabit area by the associate expert in cooperation with the Kenya Soil Survey and using their methodology.

Soil samples are analysed at the National Agricultural laboratories in Nairobi. Assistance is being given by the drawing room of the K.S.S. in drawing maps and text figures.

Objectives

a) To provide basic information on the soils as stanl place and a nutrient holding and releasing medium for the vegetation.

b) To determine and describe those processes in or at the surface of the soil which are relevant for the process of desertification.

c) Try to find ways and means to prevent (further) degradation of the soils and to recover the badly degraded soils.

Methodologies.

To reach objective (a):

Carry out a regular soil surveys at a scale of 1:250,000 in the main part of the study area. This part is situated between 37° and 38°E and 2° and 3°N. The Mt. Kulal Biosphere Reserve will be included. This soil survey includes the compilation of a soil map with an accompanying report. The legend of the soil map will be built up as follows: At the first level the physiography e.g. (landforms) at the second level the geology (mainly lithology) and the third level the soils in a descriptive way and arranged according to the FAO/UNESCO legend of the soil map of the world. Physical, chemical and morphological characterization of the soil units will be given. Attention will be given to the soil fertility and erosional processes as well.

The preparation of a soil map involves the interpretation of satellite images and aerial photographs. Satellite images are available at scale 1:100.000 as false colour positives and can be enlarged by projecting them on a wall to a scale 1:100.000. This facilitates the interpretation and the information can be directly carried over to the topographical base maps of the same scale. Aerial photographs are available at a scale of 1.50 1:50,000 and are studied with a stereoscope.

The different units, delinected with the images interpretation are sampled in the field with a soil auger. Borings are made to a depth of 1.50 a 2.00 m. At representative sites a soil pit is dug and a precise soil profile description is made and soil samples for physical and chemical analysis are taken from the different horizons.

To reach objective (b):

A more detailed study at selected sites has to be carried out in close cooperation with experts on vegetation and landuse. The study has to be done in and around soil pits to find out the physical and chemical processes that are involved in soil degradation. These sites have to be chosen in such a way that they represent areas with increasing destruction and, if possible, areas which are in different stages of recovering.

To reach objective (c):

Carry out a land evaluation study in close cooperation with experts on climatology, vegetation and land use. Make a capability map, or at least a map showing the limitations, for rangeland management or any other relevant type of land use.

Accomplishments

In the past one and half years about four months have been spent in the field of which more than 20% was needed for travelling toand from the study area. About 150 augerhole observations were made and 40 soil pits were dug, fully described and sampled. Two small cross-sections were done to a depth of about four meters.

The following reports have been produced.

1. Soils section in the IPAL Manangement Plan for West Marsabit.
2. A preliminary soils survey of West Marsabit.
3. A reconnaisance soils map of the IPAL study area.

XI. ECONOMICS AND MARKETING STUDIES

G. Njiru.

1. OBJECTIVES

Studies into economics and marketing started in January 1980 as a 4 year Phd. programme to broadly study:

a) how the economic functions of production and distribution of goods and services are performed in a pastoral society;
b) constraints to raising the sales of livestock and livestock products in order to ease grazing pressure and to raise the earnings of the Rendille;
c) cost - benefit analysis of proposed management improvements to see whether it would be in the pastoralists interest to adopt them;
d) monetary flows through the society and evaluation of the extent to which money has been accepted as an exchange media.

All these efforts were to culminate in:

e) the designing of management guidelines on what to do in order to improve the flow of goods and services in and out of this economy.

2. ACTIVITIES CARRIED OUT.

To fulfil these objectives the following activities have been carried out:

a) Participant observation.
The first year in the field was spent observing the peoples' lifestyle and getting to know and participate in data collection by other scientists whose data was to be a valuable input into the economics study. Over the period and throughout the study many days were spent observing the people while herding and watering their animals and in their daily activities in the Manyattas.

Visits were also made to all trading centres within Rendille land to watch how trade was conducted and the relationship between traders and their people. On several occasions traders were accompanied on their trips to purchase supplies and on one occasion an assistant accompanied traders on a two week trek to take livestock for sale in Isiolo, a major market outside Marsabit district.

b) Formal and Informal Interviews.

During these visits, informal interviews soliciting explanations for observed behaviour were held as opportunity arose. People interviewed in this manner included groups of elders, warriors, women, traders, government officials, tax collectors at livestock markets, transporters, missionaries, chiefs, politicians and other researchers met in the field. On a more formal level the District Commissioner, District Range, Veterinary, Livestock Marketing, Hides and Skins, and Trade Development Officers were interviewed.

c) Questionnaires.

In addition, structured questionnaires were administered to

i) about 90% of all traders in the area covering the 1979 - 80 and 1980 - 81 periods' trading activities.

ii) 119 pastoralist households from all over the study area to get an idea of their income sources, cash needs, attitudes to the sale of livestock and involvement in market transactions.

iii) to Rendille IPAL employees on a monthly basis to study their income and expenditure habits and involvement in the traditional Rendille economy.

d) Visits to LMD Auctions and Other Markets.

All the LMD Auctions held between January 1980 and April 1983 have been attended. At the same time livestock markets to which animals are taken by traders viz Marsabit town, Isiolo, Maralal, Baragoi and Nairobi have been visited and data on prices, main customers and organisation of markets collected. In Marsabit, Maralal, Baragoi and Nairobi information was re-inforced by actually selling surplus IPAL smallstock in these markets in March and May 1983.

3. Reports and Seminar Papers

In the course of this research the following reports and Seminar Papers have been produced:

pp. 132-193

1. Njiru, G.K. (1980). 'Economics of Rangeland Development Among the Rendille', in *Proceedings of a Scientific Seminar, Nairobi 24-27 November 1980*, IPAL Technical Report Number A-3.
2. 1981, 'Studies in Pastoral Economics', a section contributed to Lusigi, W.J. *Combatting Desertification and Rehabilitating Degraded Production Systems in Northern Kenya*. An IPAL Case Study and Summary so far. UNESCO/ICSU Conference on Eco-ogy in Practice, Paris, 22-29 September 1981. (produced as IPAL Technical Report A-4).
3. 1981, 'Trade Among the Rendille of Laisamis Division, Marsabit District', in *Proceedings of a Scientific Seminar, Nairobi, 1-2 December 1981*, IPAL Technical Report A-5.
4. 1982, 'The Rendille Economy - Some Preliminary Findings on Trading Activities', Working paper No. 389, Institute for Development Studies, University of Nairobi.
5. 1982, 'Monetary Flows Through a Pastoral Economy: Some Prliminary Observations on Income and Expenditure patters of Rendille Pastoralists'. Progress report submitted to the Co-ordinator IPAL.
6. 1982, 'Studies into Pastoral Economics', Paper presented to the UNESCO-IPAL Orientation Seminar for French Speaking Scientists, 1-12 November 1982.
7. 1983, Chapter V, 'Marketing and Infrasctructure' and Section A (Forestry) and B (Agriculture) of Chapter VI 'Other Land Uses' in Integrated Resource Assessment and Management Plan, for Western Marsabit District Northern Kenya.

pp. 377-424

8. 1983, 'Economics and Marketing Studies', Paper presented to the UNESCO-IPAL Orientation Seminar for english Speaking Scientists 1-12 November 1983.
9. 1984, (Forthcoming), (a) 'Trade in Pastoral Societies: A Study of Constraints to Greater Participation in Livestock Marketing by the Rendille - Camel Nomads of Northern Kenya', Ph.d Thesis University of Nairobi.

   (b) About three papers summarising the most important findings of the above Thesis.

Thus the major findings of the Economics and Marketing Studies Component of IPAL have been, or are about, to be published as scientific papers and in the management plan in a form useful to administrators and planners.

4. COMMENT ON SUPPORT SERVICES:

In the carrying out of the above studies, project personnel and equipment have been extensively used. The present structure of the IPAL general and scientific administration is well attuned to facilitating these kinds of studies and the same structure should be carried forward in subsequent phases.

A major shortcoming has been the fact that the Economics and Marketing Studies Component did not have any vehicles or assistant specifically assigned to it.

It had to use any assistants or transport that was free from other duties and this caused many delays. More important the constant changes of assistants necessitating retraining and familiarisation with required data collection procedures wasted valuable time and removed the element of continuity from the various investigations.

On the other hand, the economist himself was only available to carry out these studies because he needed the data for a graduate degree at the University of Nairobi. He is not a full time employee of the project.

Promotion of sales of livestock is an important objective of any project seeking to increase the productivity of pastoral livestock production systems without leading to overstocking and degradation of the environment. More resources should therefore be allocated to this component including permanent staff at the scientific and support staff levels.

The cost benefit analysis component depended very much on productivity and veterinary input data from other scientists. While the veterinary data has been forthcoming, data on productivity differences between treated and untreated animals has only been available in bits and pieces especially for smallstock and cattle despite the experiments having got finished sometimes back. Preliminary calculations for camels however, do indicate substantial benefits from the veterinary package.

XII EDUCATION, TRAINING AND EXTENSION

INTRODUCTION

The Problem

"One of the biggest problems in a developing country like Kenya is that research information does not reach the people who really need it. It tends to be concentrated among the educated and urbanized communities in relation to the modern sector of the economy. While this is desirable, the great majority of people living in the rural areas receive little because knowledge is not adequately translated and transferred in a form that can be used by them. This in fact remains one of the biggest challenges to scientific work". (Mungai, 1978).

This is a challenge facing IPAL, for in order that its research into desertification and arid land ecology have long term value, it must help promote the development of the people among whom it is applied, the nomadic pastoralists, and others.

Cognizant of this fact, IPAL has studied traditional practices with a view to integrating them with scientific research findings. Project scientists have worked closely with the people with whom they come in contact in the study area, and with other institutions in Kenya.

The work of the consultancies in education and training represented a step in facilitating a constant flow of information about the environment from the scientists to the people and vice versa. This can be called "environmental education".

IPAL educational objectives

The specific IPAL objectives are outlined in the project document. While the Project has been and still is primarily a scientific investigation, the present phase is more action oriented, with emphasis on human ecology and on education and training. Some of the revised long term objectives for this phase which have educational implications are:

- To elucidate the mechanisms of recovery of soils, vegetation, and animal life in arid and semi-arid regions, to evolve guideline for the rehabilitation of, and the restoration of the sustained productivity of arid areas; to study the interaction of the vegetation with all forms of animal life, specially domestic livestock; to provide simple demonstrations of the results of ecologically oriented management of arid zone ecosystems.
- To carry out training and orientation in arid zone ecology and management at the professional and technical levels.
- To provide education at several levels in arid zone ecology and management.
- To provide the programme basis for the establishment of an institution in Marsabit District for continued research, monitoring, and training relevant to the management of resources in the arid zone.

Among the short term objectives of Phase III which have educational implications are:

- To support and encourage the training of experts in arid zone research, resource management and rehabilitation specially in developing countries, and to help in the development of local expertise.
- Support extension officers in the district by providing them with some of the information they need for their extension programmes, and to assist in the organization of orientation seminars in arid zone ecology at all levels.

IPAL Phase III education and training programme started with the commissioning of two consultancies whose basic aim was to lay down the foundation for a co-ordinated education effort within IPAL.

Aims of the consultancy in education and training

Consultancy I.

The aims of the consultancy, as defined in the terms of reference were:

(a) To investigate how Project results can be incorporation into the present educational curricula in Kenya.

(b) To evaluate the effectiveness of present communication media to determine the most effective means of reaching the pastoral nomads of northern Kenya.

(c) In order to investigate the most effective way of disseminating Project results to the largely illiterate local population, and using the Project as a test case, to design a radio programme of 15 minutes to be transmitted twice a week on the Voice of Kenya in the Rendille language, and later evaluate the success of such an experiment.

(d) To make a brochure on the project's objectives, functioning and expected results.

(e) To start to design material for the proposed seminars at different levels.

Consultancy II.

(a) To study Kenya's education curricula and to design a comprehensive programme of training and education so that IPAL can complement existing Governmental activities for semi-arid regions of the country.

(b) To suggest modes of presentation of IPAL material, e.g., in illustrative graphics or other suitable format, for all levels of education.

(c) To study IPAL's results and documentation and to determine their relevance to the different educational levels of the project audiences including pastoralist communities.

Methods of study

Different methods of study were used to achieve the various tasks of the consultancy.

1. IPAL resource utilization

The IPAL Technical reports were reviewed to provide a picture of the study area and of the various investigations. Consultation were held with each of the project specialists regarding their investigations, and findings, their interactions with the pastoralists, and specifically on the educational implications of their work.

2. Review of the literature

There is still relatively little information on education and communication in the study area. The literature reviewed could be classed under the following categories:

(a) studies of the people and conditions in the area by social anthropologists and biologists.
(b) Kenya development and education policies and plans through government publications e.g. Annual Reports, and circulars.
(c) environmental education, particularly in Africa and Kenya.
(d) communication policies and methods particularly in Kenya.
(e) catalogues and syllabi of educational institutions in Kenya.

3. Discussions with local people and government officials

Informal discussions were held with pastoralists, IPAL employees, teachers and headmasters, missionaries, chiefs and councillors in the study area, and with government officials at Marsabit and Nairobi.

4. Interviews

In order to evaluate the radio programmes designed to assess the effectiveness of radio as a means of communication with the pastoralists, an interview schedule was designed, tested and used to carry out structured interviews with Rendille people in the study area, both before and after the radio programmes.

5. Observation

Visits to schools in the study area were made, and observation made on teacher-pupil interaction and school activities.

6. Visits to study area

Visits were made to the study area for the following purposes:

(a) obtain general orientation on the area and project:
(b) carry out survey of communication and education facilities in the area, and consultation with project scientists:

(c) test the interview schedule, conduct interviews, train assistants, determine and locations for placement of radios in manyattas, and record interviews and sound effects to be used in the radio programmes.

(d) monitor the programmes, brief field assistants and conduct post-radio programmes interviews for summative evaluation.

Activities and Results

Work accomplished and results from this component can be divided into six broad areas:

- group training
- on the job training
- formal education
- non-formal education
- production of communication materials
- research.

Towards the end of the two consultancies, IPAL got the services of a young local graduate Mr. Oba Gufu to look after the activities of this component.

a. Group Training

1. The project organised several educational tours for various groups through the study area. In March 1982 the project organised a two week familiarisation visit of the first year students in Range Management at the University of Nairobi.

   In May 1982 an eight man team from the Kenya Soil Conservation Unit in the Ministry of Agriculture visited IPAL

2. IPAL organised four local seminars for leaders in the Marsabit District and three orientation seminars for scientists from all over the world.

3. IPAL introduced 15 minute radio programmes on the Voice of Kenya which were broadcasted twice a week for one full year in Rendille and Borana languages. These broadcasts were intended

to familiarize the local population with the various problems of environmental degradation which IPAL was studying and also to investigate the most efficient way of communicating with the pastoral nomads. These were very well received and plans are under way for their continuation by the national government.

b. On the Job Training

IPAL undertook on the job training of 40 field assistants in all aspects of the project activities. These were young pastoralists from the area who had completed their high school but had not passed their exams well enough to be admitted into other institutions of higher learning. After long negotiations, the Kenya Polytechnic accepted to give these young men a four months course in Nairobi which would enable them to get a certificate so that they can be absorbed into government service, at the end of the project - 30 of these field assistants completed the course.

c. Formal Education

Eight graduate students completed their studies in the study area as follows:

1.	R. Okello	- MSc.	-	Acridid Ecology.
2.	K. Sogomo	- MSc	-	Geomorphology of the Korr area.
3.	R. Bagine	- MSc.	-	Termite Ecology
4.	T. Rutagwenda	- MSc.	-	Camel Diseases
5.	E. Okilla	MSc.	-	Animal Production
6.	B. Migongo	- PhD.	-	Range Ecology
7.	Gufu Oba	- MSc.	-	Range Ecology
8.	P. Simpkin	- MSc.	-	Camel Production

The field work for all the above was accomplished in the IPAL Study area with full or partial IPAL support.

d. Non-formal Education

1. Mention has already been made of the radio programmes which also appropriately fall under this heading.

2. A reader for adult learners in arid and semi arid areas was prepared by Gufu Oba.

3. In April 1982 two specialists in education, Messrs B. Eddy and T. Gilbert from the Environmental Concerns International Inc. visited IPAL study area in order to try their video and also find the possible use of video as a means of education in remote areas.

4. Vegetation exclosures and the veterinary clinics.

Reports and Publications

1. I.A. Allen (1981). Report of a Consultancy in Education and Training.
2. F.N. Ibrahim (1981). Training and Education within the Integrated Project on Arid Lands in Northern Kenya.
3. Gufu Oba (1982). Problems of Arid Lands Rehabilitation and Management: Proceedings of a Leaders Seminar held in Marsabit 15-26 June 1982.
4. Gufu Oba (1982). A Proposal for Extension Programmes on Land Management for Pastoral Communities in Northern Kenya.
5. Gufu Oba (1982). Environmental Education for Nomadic Pastoralists - Important input for the Management of the Arid Areas of Northern Kenya.
6. Gufu Oba and Sokotey Seyee (1983). A Preliminary report on Traditional Organization as a base in Extension Planning among Pastoral Nomads of Northern Kenya - A Case Study of Rendille Traditional Administrative in Decision Making and its Implications in the implementation programme of IPAL Management Plan.
7. Gufu Oba (1983). Proceedings of the IPAL Seminar for Extension Workers in Pastoral Communities in Kenya.

Constraints in the Implementation of this Component

The Tripartite Review Meeting of November 1981 recommended that no further activities in education training be undertaken in the project period. Activities listed above will therefore undertake to sustain what had been started without which it would have been demoralizing to the local people. No new initiatives were undertaken following that recommendation.

XIII. SEMINARS, MEETINGS AND CONFERENCES

One of the most significan outcomes of the IPAL work in Phase III was the organisation and also participation at various seminars both nationally and internationally. IPAL Scientists received invitations to participate and give papers at several conferences and meetings. Most of these invitations were made to them in their individual capacity where all the expenses for participation were met by the organisers. Most of these have been listed but the major ones may be listed as follows:

Seminar organised by IPAL

1. 12-15 August 1980 IPAL Programming Seminar was held in Nairobi attended, among others, Dr. Colin Lendon and Dr. Gisbert Glaser from Paris. All scientific programmes of IPAL were reviewed and recommendations made for their updating.
2. 21-27 November 1980 IPAL Scientific Seminar was held in Nairobi and attended by participants from Government and other research and education institutions in Kenya.
3. August 1981 First Internal Scientific Seminar for the project took place in Nairobi attended by IPAL Scientists, Consultants, Fee Contractors, Graduate Students and Assistants'.
4. November 1981 IPAL Scientific seminar attended by participants from National Institutions and International Organisations in Nairobi.
5. 1-12 November 1982 IPAL hosted an International Orientation Seminar primarily for field scientists from French Speaking Countries in Africa. The following countries were represented, Cameroon, Chile Gambia, W. Germany, Upper Volta, Mali, Morocco, Mexico, Niger, Senegal, Chad, Tunisia, Switzerland and France.

6. 22-23 June 1982, and 22-26 June 1982 Leaders Seminars held in Marsabit on the IPAL Project. These seminars were attended by all Leaders, Chiefs, MP's, Councillors and Elders from Marsabit district.

7. 22-23 June 1983 IPAL Seminar for Extension Workers in Kenyan Pastoral Communities. This seminar which was held in Marsabit brought together Government and non-Governmental officials from all over the country who had never met before.

8. 25 June to 3rd July 1983 Orientation Seminar in Marsabit for specialists from the French zone who failed to attend the 1982 Seminar with participants from, Senegal, France, Algeria, Nigeria and U.S.A.

9. 31 October to 12 November 1983 Orientation Seminar in Marsabit for Scientists and specialists from English Speaking Countries. The following countries were represented at the seminar: India, Ethiopia, Zambia, Sudan, Iraq, Egypt, Tanzania, Libya, Zimbabwe, Uganda, Malawi, Botswana, Pakistan, Syria and Somalia.

Seminar in which IPAL Scientists participated

1. 9-22 January 1981 Dr. Lusigi attended in India the International Workshop on the "Socio-Economic Constraints to Forest Management" where he read a paper on "Social-economic effects and Constraints in Forest Management in Kenya". The invitation was made by the International Federation of Institutes of Advanced Studies

2. October 1980 Dr. Lusigi attended a seminar on Desertification Problems in Khartoum, Sudan, organised by the German Foundation for International Development.

3. 25-27 March 1981 Dr. Lusigi at the invitation of the National Christian Council of Kenya attended a seminar in Limuru, Kenya on "Irrigation and Agricultural Development in the Arid Lands of Kenya". He presented a paper on "The Integrated Ecosystem Approach to Land Use in the Arid Lands of Northern Kenya".

4 In August 1981 A seminar of technical significance to IPAL took place in Nairobi. This was the "International Workshop of Strategies for Developing Resources of the arid and semi arid areas of Kenya" organised by the Department of Geography of the University of Nairobi in collaboration with the Canadian International Development Aid and the National Council for Science and Technology. Dr. Lusigi chaired one session and IPAL Scientists presented 4 papers.

5. 23-28 August 1982 Dr. Lamprey attended an International Seminar on Progress in Combatting Desertification convened by E.T.M.A. in Khartoum, Sudan.

6. 22 February 1983 Dr. Lusigi and Dr. Field represented the Project at Annual Seminar of the Small Ruminant Collaborative Research Support Programme (SC-CRSP) in Naivasha. Dr. Field presented a paper entitled "Estimated carrying capacities and protein intake by small ruminants in relation to browse resources in Arid Rangelands of Marsabit District".

7. March 1983 Dr. Field represented the Project at the Seminar for Somali Refugees Aid Organisation hosted by the Mennonite Central Church Committee at Rumuruti, Kenya.

8. 24 June 1983 Dr. Field also represented the Project in the District Co-operative Seminar on Integrated Approach to Rural Development held in Marsabit.

9. June 1983 Mr. Njiru the Economist represented the Project at a seminar organized by the District Trade Office in Marsabit. He gave a lecture on "The role of wholesalers in Development"

10. 10-21 October 1983 Dr. O'Leary attended a seminar on ILCA training Course Tropical Rangeland Management and Methodology hel in Addis Ababa, Ethiopia.

Conferences and Meetings

1. In November 1980 Mr. J.G. Stephenson visited Paris to finalize IPAL's new budget.

2. Two meetings were held with the D.C. Marsabit, in Olturot and D.C. Samburu in Ngurunit respectively. Both meetings were attended by several other District heads.

3. The Co-ordinator held meetings with the following co-operating institutions: Ministry of Livestock Development - Livestock Research Section, Ministry of Education - Kenya Institute of Education, University of Nairobi, Kenya Agricultural Research Institute and Texas A&M University.

4. 31 March 1981 Dr. Lusigi attended the Ford Foundation meeting on studies on the pastoral nomads of northern Kenya in Nairobi.

5. 9-13 April 1981 Dr. Lusigi attended in Mombasa a meeting of Board of Kenya Trypanosomiasis Research Institute of which he has been a member since 1979. KETRI collaborates with IPAL on livestock diseases research.

6. 20 May 1981 Dr. Lusigi helds meetings on IPAL in Bonn.

7. 23-28 May 1981 Dr. Lusigi attended meeting of the Expert Group on Conservation Theory and Practice in Paris.

8. 22-29 September 1981 Dr. Lusigi represented IPAL at the UNESCO-MAB Conference/Exhibit "Ecology in Practice" "Establishing a scientific basis for land management which took place in Paris". At this time MAB celebrated its 10th anniversary and IPAL was selected as one of the case studies to be presented under Project 3 - Impact of Human Activities and Land Use Practices on Grazing Lands. Another significant contribution which IPAL made to the MAB Conference/Exhibit was its participation in the Conference Exhibit by presentation of the IPAL audio visual documentary on the field activities of IPAL.

9. In November 1981 the IPAL Phase III mid-term review mission took place. The purpose of this mission was to look at the progress made in the implementation of Phase III activities in accordance with the set revised objectives and to make suggestions and recommendations for ways to effectively implement the activities in order to meet the project objectives.

10. In May 1982 the Project participated in the UNESCO-MAB "Ecology in Action" exhibit at the 10th Anniversary of UNEP in Nairobi. There were over 60 shows of the IPAL Audio-Visual documentary at this exhibit.

11. In April 1982 the Project Co-ordinator, Dr. Lusigi attended Preparatory Committee Meeting for the Biosphere Reserves Congress in Moscow and also gave a lecture to the UNEP Rangeland Productivity Course in Ashkhabad, USSR.

12. In May 1982 Dr. Lusigi and Dr. Lamprey participated as part of the UNESCO delegation to the UNEP Governing Council and Session of special character.

13. In May 1982, Dr. Lusigi went to Soviet Union where he gave a lecture on "Problems and Prospects for the dual utilization of Rangelands and Domestic and Wild Herbivores" to the UNEP/USSR Course on Rangeland Productivity.

14. In March 1982 the Project had its General Staff Meeting in its new Project Headquarters in Marsabit.

15. In June 1982, the Project Steering Committee had its meeting at the Project's headquarters in Marsabit.

16. 28 September to 1 October 1982 Dr. Lusigi took part in an Evaluation Meeting in connection with UNEP/USSR Projects entitled "Desertification Control Training Course" and "Sand Dune Fixation Course". The meeting was held at Ashkhabad in USSR. Dr. Lusigi presented a paper which was accepted for publication in the Journal "Problems of Desertification published by the Centre of International Projects of the USSR State Committee for Science and Technology.

17. 11-22 October 1982 Dr. Lusigi attended the Third World National Parks Congress held in Bali, Indonesia, where he presented a key-note paper entitled "Future Directions for the Afrotropical Realm".

18. In October 1982 Dr. Lamprey gave a lecture to students of Egerton Agriculture College on Desertification and the work of IPAL.

19. Dr. Field returned from Home leave on 27 August 1982, and while on leave he attended the Third International Theriological (mammal) Congress at Helsinki, Finland where he presented a paper on behalf of Dr. Lamprey entitled 'MAB IPAL Studies of Interactions between Domestic Ungulates and the Vegetation in the Arid Zone of Kenya'.

20. In January 29 to February 12 the final Evaluation Mission of the projects' activities in its third phase by a Tripartite Review Mission took place.

21. The UNSO - UNDP - Government of Kenya Mission, under the chairmanship of Dr. William Payne of UNSO reviewed several development projects in the arid and semi-arid regions of Kenya with a view of providing financial support where this was found justified. The mission spent three days in the IPAL Project, Marsabit, under the guidance of the Woodland Ecologist. As a result of their discussions, the project was requested to prepare a supplement to the existing project documents for KALRI and RIDP (1984-86) as a first move towards extending the project to cover the Gabra lands as well as those of Rendille, since it was the view of the mission that the project should not appear to favour one tribe in the district. The UNSO mission was accompanied by the UNDP Deputy Resident Representative, Mr. Peter Metcalf and by six officers representing Government Ministries.

22. In May 1983 Dr. Lusigi represented the project at the Co-ordination meeting of Range Research in Kenya. This meeting was organised by the Research Division of the Ministry of Livestock Development and was sponsored by the International Livestock Centre for Africa and USAID.

23. 26 September to 2 October 1983 Dr. Lusigi attended the 1st International Biosphere Reserve Congress, held in Minsk (Byelorussion SSR/USSR). He also presented a paper entitled "Mt. Kulal Biosphere Reserve: Conservation with local human population needs". He also served as the Chairman for workshop session C-II. "Local Participation in the Management Biosphere Reserves".

24. 19-21 September 1983 Dr. Lusigi attended a Working Party on Wildlife Management and National Parks of the FAO African Forestry Commission, Arusha, Tanzania. He attended this meeting on his personal capacity and took part in the discussions as a Consultant.

25. 17-30 November 1983 Dr. Lusigi attended a meeting on "Pilot Project of Survey and Monitoring of Sahelian Ecosystem" (Senegal) and visited the Institute of Sahel, Bamako, Mali.

26. 6-7 February 1984 Dr. Lusigi participated in discussion on IUCN's Environmental Education Programme needs and how the Education Commission can be restructured to serve them at IUCN meeting in Gland, Switzerland.

27. 5-7 April 1984 Dr. Lusigi attended the CFP/United Nations University Workshop in Montreal Canada.

28. 13-18 May 1984 Dr. Lusigi, Dr. Lamprey and Dr. Field participated in the 2nd International Rangeland Congress, Adelaide, South Australia. Dr. Lusigi gave a lunch time address on International Aid to 3rd World Countries. Dr. Lusigi presented three papers at this congress, entitled:
    1. "International Aid to the Third World Countries", (lunchtime lecture)
    2. "Integrated Project on Arid Lands (IPAL Kenya)" and
    3. "Forage Preferences".

29. Dr. Field presented a paper entitled, "Long Term Studies of Livestock in Arid Lands of Northern Kenya" and Dr. Lamprey presented a paper entitled, "The MAB IPAL Woodland Ecology Programme in Northern Kenya".

A full list of participants of all IPAL seminars is given in Annex under Appendix I.

XIV. REPORTS AND PUBLICATIONS

Various reports which have been produced by the individual project components have already been given under each component report. A complete list of all the report produced by the project scientific staff in this phase of the project is given in Appendix II A major strength of IPAL in this phase has been the synthesis of its data and producing preliminary reports on various project findings and results. There have been four types of reports produced by the Project.

First have been reports of project scientists and consultants on specific aspect of IPAL research on completion of a specific item of study. These reports have had conclusive results that could be preliminarily used by various implementors or other researchers. They have therefore been published in the project official Technical Report series.

The second type of reports have been reports written for seminars both internal and international. These have been published by the project as proceedings of the seminars in its Technical reports series or have been published in the proceedings of various seminars outside the project. These are all included in the list of project reports.

The third type of reports have been the six monthly progress reports produced by all the project components, which describe the status of the research in each specific period. An important part of the progress reports has been a reflection on the planned activities of each specific period. This has made the job of co-ordination relatively easier as the individual plans were tied down up to the month.

Many of the project scientists have been distinguished individuals in their various field of expertise and were invited in their capacity to contribute to various other scientific forums. Their contributions of lectures and papers in these other forums are also

listed since they were done in the project period under review.

From the list of reports produced, it goes without saying that the project output has been tremendous and simply hard to believe. This amount of report writing went on at the same time as the active implementation of field activities and analysis of the results. The ability of the IPAL Scientists to balance all these efforts has been in my opinion highly commendable.

XV. VISITORS TO THE PROJECT

A full list of all visitors to the project in its Phase III is given in Appendix III. As it will be apparent from this list, the number of visitors who came to see the project and indeed the number of requests received for such visits, far exceeded the capacility of the project Scientists to cope while at the same time accomplish the already mentioned results. We have to carefully strike a balance between the inputs and outputs from the projects from each visit before committing project time. It is nevertheless important to mention here that the project really benefited from the exchange of experiences gained from these visits. Most of the visitors as it will be apparent from the list [illegible] were top world authorities in their areas of expertise and the project really learned a lot from them. All these experiences were usually incorporated whenever possible in the ongoing research work and this is the biggest strength of the IPAL Project. The resource management guidelines which have been produced for the area, for example, have been subject to debate and scrutiny from a wide variety of specialists from all over the world and hence our believe that they are the best and unique that could be produced under the circumstances and for such an area.

XVI. ACHIEVEMENT OF IMMEDIATE OBJECTIVES

Objective I: Discribe the process of Environmental degradation and their causes

Based on its eight years of research, IPAL has been able to put together one of the most comprehensive physical and natural resource inventory of this arid zone of northern Kenya. This describes in detail most aspects of the experimental environmental management of the region, concentrating upon "human ecology" of the nomadic pastoralists in a dynamic interrelationship with the animals, plants and other resources of a drought-prone, uncertain environment. The processes of environmental degradation and their causes, have been identified and are described in over 50 publications and reports produced by the project in this Phase.

Objective 2: Predict the ecological and socio-economic consequences for the pastoralists of continuing degradation.

The intensive human ecology investigations which have been carried out, have already shown the interrelationship of the pastoralist with his environment. An appraisal and evaluation of cultural, political, ecological and socio-economic factors has been accomplished and an attempt made to balance resources against local human needs in both the short and long term. This has out of necessity taken into account the history of the area - human activities, habitat changes, fauna density, and [illegible] diversity changes for without historical facts as a background to present ecological setting, there is a risk of making serious mistakes in both management and research because the factors determing the prevailing situation are not understood. All these have been described in detail in the project publications in human ecology and history.

Objective 3: In the light of the above findings, contribute to the design of management activities directed towards achieving a sustainable balance between production and consumption, taking into account the requirements of the growing and increasingly sedentarized population

During the last four years the results of IPAL research have synthesized to produced resource management guidelines for the area. These are contained in two volumes and four parts. The first contains the resource inventory and assessment the second contained the resource management policy, specific resource management objectives and lastly plans to fulfil these objectives. These resource management guidelines which have been the subject of scrutiny and discussion by numerous specialists who have visited the project and also the local people and their leaders are believed to be unique or the first of their kind for a pastoral system inhabited by nomads. These guidelines and plans are going to be the basis for pilot development programmes in the area.

Objective 4: Use the project findings in education and training for the dissemination of information on rational Management.

The project in its third phase organised seven local training seminars at all levels and three international orientation seminars. The local seminar included one seminar for extension workers, two seminars for local leaders and elders and four scientific seminars. The International orientation seminar were attended by a total of 40 specialists from 33 countries.

Project results were also used far on the job of training of 30 field assistants who completed their training with a four months resident course at the Kenya Polytechnic.

The project gave fellowships to some eight graduate students who completed their higher degrees - 7 masters level and 1 at PhD level - on some aspect of project work. All their field work was undertaken in the project area under the supervision of the project professional staff.

Project findings were the basis of a fifteen minutes radio programme on the voice of Kenya, broadcast twice a week for one year in the Rendille and Boran languages. Public demand for these broadcasts after they had been stopped testifies the success of the programme.

IPAL technical reports have been disseminated to a wide range of inviduals, institutions and organisations both locally and internationally. The increasing demand for these publications have ended in most of them going out of print.

Objective 5: Provide the programme basis for the establishment of am institution in Marsabit District for continued research, monitoring and training relevant to the management of resources in the arid zone

Field work of the IPAL now takes place in the arid zone of northern Kenya in a working area of 22,500 km^2 situated between Lake Turkana and Marsabit Mountain. The project operates five field stations at Mount Kulal, Olturot, Kargi, Korr and Ngurunit, with the project headquarters in Marsabit which is the administrative centre of the District. The project also has a small administrative unit at the Unesco Regional Office in Nairobi. Marsabit Station has one Laboratory block with two labs and offices for scientists; and an administrative block with a conference room and the office of Project Co-ordinator and the Administrative Officer. The laboratory block also contains a herbarium, a small library and photo production unit.

The station has houses for the Project Co-ordinator and two scientists and a hostel with twelve beds. Ngurunit and Mt. Kulal have houses for one scientist and lab and office spaces. Kargi, Olturot and Korr have working and sleeping rooms for one scientist. All stations have housing for subordinate staff.

This infrastructure is seen to be the basis of a long term research, monitoring and training activity in Marsabit and with a few additions and improvements should handle all the necessary research and family needs foreseen in this objective.

Objective 6 Recommend the infra-structural basis for the required management

The Resource Management Guidelines and plans clearly recommend the infrastructure which will be needed to bring about the needed results. First, the organisation outlined and how the recommended activities will fit within the present government machinery and other organisations in the area and the country. Secondly a physical infrastructure is recommended. This includes the roads, water, market centres, auction grounds, schools, health centers and stock routes. Alternative industries to supplement the present livestock economy have been suggested. These include encouragement of small traders, rural handicrafts, firewood collection, bee keeping, fishing, abattoirs, gum arabic collection, cheese and yoghurt making, tourism, etc.

XVII. UTILIZATION OF PROJECT RESULTS

Although the project from its objectives in this case was never intended to be an implimentations programme there are already a few observable results from its various recommendations and activities.

1. The project has slowly gained the acceptance of the local people and leaders as a source of advice on various resource management and social problems. The project is continually being asked for advice on issues like annimal health, livestock marketing etc.

2. The missionaries who have been key implementors of various development programmes accept the necessity for sound information base before the implementation of various activities e.g. boreholes, schools etc. The project is being approached by them for advice and they no longer undertake development activities without discussing it with the project.

3. Through its participation as a member of the District Development Committee, the project has been able to influence various dicisions on the priorities for development in the area.

4. The district development plans now produced by the national development plan have been largely based on the IPAL resource management plans and guidelines. The Provincial Planning Officer spent considerable time with the project in Marsabit during their writing.

5. Through various recommendations of the project, by presidential order, a bank has now been built in Marsabit - the first one in the biggest district in Kenya. The Agricultural Finance Company has also opened an office in Marsabit.

6. Through the projects veterinary clinics and demonstrations increasing number of pastoralists are administering their non-prescription drug.

7. Through its work and co-operation with national institutions the project is being increasingly called upon to contribute to research forums, lectures to students and seminars.

8. Through its both radio and publications programme the programme has increased national awareness at all levels about the problems of the arid areas and the plight of the pastoral nomads who live there.

9. By IPAL scientists living and working in Marsabit has started changing the tendency of Civil Servants who get posted in Marsabit to feel that they are on punishment

10. Through the distribution of project results in publications and also participation of IPAL scientists in international seminars, IPAL type projects are being conteplated in various parts of the world and requests have been made to advice for setting up such projects in countries like Venequela and the Soviet Union.

11. Through visits from numerous scientists, administrators and decision makers and participants in orientation seminar, IPAL is no long an anonymous work in arid land resource management. Its contribution lies in having demonstrated the working of human based on integrated research programme.

XVIII. CONCLUSIONS AND RECOMMENDATIONS

Performance and results of IPAL III were evaluated twice by tripartite review missions. The first one took place in November/ December 1981 and the second one in February 1983. Both missions commended the progress made towards achieving the project goals, following the reorientation, change of objectives and reorganization of IPAL agreed upon for Phase III in 1980. The 1981 IPAL review mission recommended that the immediate project objectives should be enlarged and that as an action-oriented output of its research work an integrated resource management plan should be prepared. On this basis the project submitted a draft management plan to the 1983 IPAL review mission. The missions report states "...a well-prepared and comprehensive Management Plan has been elaborated covering almost every aspect of development in the area. The Mission commends the efforts that were put into this".

Acknowledging the very valid results of IPAL, the 1983 mission recommended supporting the great interests expressed by the Government of Kenya with a view (i) to starting development action in the Marsabit District based on the resource management plan prepared by IPAL, and (ii) to establishing a permanent institution for promoting integrated management of arid and semi-arid lands in Kenya.

The main recommendations of the mission were textually:

1. That two closely interlinked projects should succeed the current phase of IPAL.
2. Both projects would be executed by the Ministry of Livestock Development.
3. The draft project documents would be amendments to the earlier draft proposals presented to the Federal Republic of Germany during the November 1982 inter-governmental discussions.
4. To ensure close integration of the two projects, the mission strongly recommends that the inter-ministerial Steering Committee now ably overseeing IPAL should continue.

5. It was crucial that the Committee is broadened to include all Ministries relevant to the work of the project.
6. The research and monitoring component would be called 'The Kenya Arid Lands Research Station' (KALRS). This would be established in association with Unesco.
7. The other project would be called 'Rendille Integrated Development Project" (RIDP), and would be executed as a pre-extension programme of the Station.
8. The Mission is hopeful that the Steering Committee, especially the Chairman, would give both of these Projects the strongest possible backing and accord them high priority ranking among the projects being submitted to the Federal Republic of Germany.
9. The Mission noted that IPAL has progressed substantially towards the achievement of Project goals and there now exists a sufficient body of data on which a viable development project can be based.

Specific considerations

The successful implementation of IPAL has generated a number of specific assets which, in the view of the 1983 tripartite review mission, should also be preserved by all means and further developed for the benefit of the country. The best way to do this seems to be the establishment of the Kenya Arid Lands Research Station (KALRS):

1. The facilities established by IPAL in Marsabit District including the main station at Marsabit and six sub-stations of varying sizes elsewhere in the District, which are supporting the current research and monitoring programmes, can adequately serve as the facilities for the proposed Institute (with some improvement and extension). At the anticipated termination of IPAL Phase III a considerable quantity of equipment will be available for the Station, including materials and apparatus for training, an excellent ecological monitoring laboratory and an assemblage of research and monitoring equipment.

2. IPAL has assembled a highly qualified group of experts used to working as an interdisciplinary team and following integrated approaches. The team, however, consists mainly of expatriates. It is felt that over a period not exceeding three years a specific effort should be made to train high-level Kenyan experts who would then provide continuity to the operation of KALRS and increase in general the number of Kenyan specialists on arid zones.
3. The project has also trained a considerable number of local support staff for its operation. KALRS will further develop this middle level expertise for the benefit of the country and in particular its arid and semi-arid lands.
4. The base line data and the results of seven years of resource monitoring obtained by IPAL will be available both as the foundation for future monitoring and as excellent material for instruction purposes.
5. The second sequel to IPAL Phase III, which is the proposed Western Marsabit Integrated Development Project, will gain immeasurably in value by having its implementation guided from a scientific basis and the results of practical livestock and range management monitored critically to enable reorientation and modifications if necessary.
6. Cooperation between the two projects in the fields of training and research would be equally profitable since the development projec project would provide excellent teaching subject matter and the possibility of much data for research on livestock, range vegetation and soils under managed conditions.
7. Part of the problem of the development of range areas has been that of gaining acceptance of the chosen development strategies and activities by the local population of the range areas. Many plans have been ill suited to their way of life, and therefore rejected. Planning of development projects in the range areas must be based on an appraisal and evaluation of culture, political,

ecological and socio-economic factors, and resources must be balanced against local human needs in both the short and the long term. Above all, the strategies adopted must be acceptable to the local population. The realization of this fact has formed the central thrust of the MAB programme and, indeed, of that of IPAL. Studies on human ecology and the evaluation of human needs have formed the central core of IPAL's investigations in Phase III. KALRS focus on human needs and human acceptance will be a natural continuation of the MAB/IPAL approach.

8. KALRS links to Unesco's international Programme on man and the Biosphere (MAB) will be an asset. In particular, it will facilitate making available to the station the international body of knowledge on arid and semi-arid lands and sharing experience with other countries. Relevant Unesco documentation and publications will be made available to the institute free of charge. In this respect it is obvious that KALRS's activities will be relevant not only for Northern Kenya but for the Sahelian Zone in Africa south of the Sahara as a whole and to some extent for arid and semi-arid zones worldwide. At a later stage the station may consider having a deliberate regional dimension, in particular, as regards training and seminar activities.

XVIX. CONCLUSION

At the time of completing this final report of this phase of the project, there is a drought in Northern Kenya. Most pastoralists have lost most of their livestock and they are still dying. It is anticipated that by the end of the drought most families will have lost their total herds and will be fully dependent on famine relief.

At the Catholic Mission in NorthernHorr there are already 300 families who have come in after losing all their livestock. The number will keep increasing as the drought advances. Such is the reality of the situation with which IPAL Scientists have had to work everyday in this environment. The problem is real and the solution urgently needed. It is our belief on IPAL that we have contributed towards that solution by providing the knowledge base for decision makers. What lies ahead for the pastoralists of Northern Kenya depends wholly on what decisions will be made. If the correct decisions are urgently made, it is not too late to alleviate the problems, but if wrong or no decisions are made, then the picture is grim. We believe part of the solution lies in deciding on the appropriate follow up actions that will implement the recommendations already made by the project in this phase.

APPENDIX I

PARTICIPANTS AT IPAL SEMINARS

I. IPAL PROGRAMMING AND SCIENTIFIC SEMINAR
24-27 NOVEMBER 1980

1. Dr. Irma Allen
   IPAL Consultant

2. Dr. A.B. Carles
   University of Nairobi

3. Mr. Jim Crees
   Ministry of Livestock Development
   Kenya

4. Mr. D.A.F. Dobbelaere
   International Laboratory for Research
   on Animal Diseases (ILRAD, Kenya)

5. Dr. R. Dolan
   University of Nairobi

6. Dr. Francesco di Castri
   UNESCO, Paris

7. Mr. Ali El Hili
   Comite National du MAB
   Tunis

8. Dr. C.R. Field
   IPAL

9. Dr. Dennis Herlocker
   IPAL

10. Mr. D. Kinyanjui
    National Environment Secretariat (NES)
    Nairobi, Kenya

11. Dr. H.F. Lamprey
    IPAL

12. Dr. Colin Lendon
    UNESCO, Paris

13. Dr. W.J. Lusigi
    IPAL

14. Mr. J. Lundquist
    Groukullanagen, Sweden.

15. Mr. Timothy O. Matolo
Kenya Institute of Management
Nairobi, Kenya

16. Mr. M.B. Musoke
Uganda National MAB Committee

17. Mr David Mbuvi
Wildlife Conservation & Management
Nairobi, Kenya.

18. Mr. R.M. Mewson
International Centre for Insect Physiology and Ecology
Nairobi, Kenya.

19. Mr. G.K. Njiru
University of Nairobi

20. Mr. Panoikov
University of Nairobi

21. Aca. V. Sokolov
Institute of Evolutionary Morphology & Animal Ecology
Moscow, U.S.S.R.

22. Mr. V. Smirnov
USSR National Commission for UNESCO

23. Mr. J.G. Stephenson
IPAL

34. Dr. A.N. Said
University of Nairobi

35. Miss Rita Sharma
Nairobi

36. E. Exc. Prof. R. Slatyer
Permanent Delegate of Australia to UNESCO
France

37. Dr. E.J. Schwartz
University of Nairobi

38. Mr. Dierk Walther
IPAL Consultant

39. Dr. A. Wilson
University of Nairobi

40. Dr. S. Waghela
Government Veterinary Research Laboratories
Nairobi, Kenya.

II. IPAL PROGRAMMING AND SCIENTIFIC SEMINAR

AUGUST 1980

1. Dr. Colin Lendon
   UNESCO, Paris

2. Dr. Gisbert Glaser
   UNESCO, Paris

3. Dr. W.J. Lusigi
   UNESCO - IPAL

4. Dr. C.R. Field
   UNESCO - IPAL

5. Mr J.G. Stephenson
   UNESCO - IPAL

7. Dr. Jurgen Schwartz
   UNESCO - IPAL

8. Dr. Hugh F. Lamprey
   UNESCO - IPAL

9. Mr. Lierk Walther
   UNESCO - IPAL

10. Mr. Dennis Herlocker
    UNESCO - IPAL

III. IPAL SCIENTIFIC SEMINAR

1-2 DECEMBER 1981

1. Dr. Irma Allen
   IPAL Consultant

2. Mr. Elias H.O. Ayiemba
   University of Nairobi

3. Mr. Richard K.N. Bagine
   University of Nairobi

4. Mr. Harvey Blackburn
   University of A & M

5. Dr. A.B. Carles
   IPAL Consultant

6. Dr. S. Chema
   Ministry of Livestock Development

7. Dr. C.R. Field
   UNESCO - IPAL

8. Prof. Dr. Gall
   Institut fur Tierzucht und Veerbungsforschung
   West Germany

9. Dr. Gisbert Glaser
   UNESCO, Paris

10. Mr. P. Gufu Oba
    UNESCO - IPAL

11. Dr. Dennis Herlocker
    IPAL Consultant

12. Prof. Dr. R.R. Hofmann
    Institut fur Veterinar-Anatomie
    West Germany

13. Dr. Kayongo-Male
    IPAL Consultant

14. Dr. H.F. Lamprey
    UNESCO - IPAL

15. Dr. W.J. Lusigi
    UNESCO - IPAL

16. Prof. Dr. H. Mensching
    Geographical Institute
    West Germany

17. Mr. Mohling
    Bundesministerium fur Wirtschaffliche Zusammenarbeit (BMZ)
    West Germany

18. Dr. Eva Mubia
IPAL Consultant

19. Mr. Joseph Muiruri
UNESCO - IPAL

20. Mr. Edward K. Mburugu
University of Nairobi

21. Mr. G.K. Njiru
University of Nairobi

22. Prof. F.F. Ojany
University of Nairobi

23. Mr. Romanus Omolo Okelo
Kenyatta University College

24. Dr. M. O'Leary
UNESCO - IPAL

25. Dr. G. Ongweny
University of Nairobi

26. Dr. T. Rutagwenda
University of Nairobi

27. Dr. A.N. Said
University of Nairobi

28. Mr. Piers Simpkin
UNESCO - IPAL

29. Mr. K. Sogoma
University of Nairobi

30. Mr. J.G. Stephenson
UNESCO - IPAL

31. Mr. A.J. van Kekem
UNESCO - IPAL

IV IPAL LEADERS SEMINARS - CHIEFS AND ASSISTANT CHIEFS
15-19 JUNE 1982 AND 22-26 JUNE 1982

1. Dub Ware
   Sagante

2. Wago Gedo
   D/Fachana

3. Jattan Kotote
   Uran

4. Suleiman Bagajo
   Sololo

5 Huga Guleid
   Sololo

6. Abdi Bando
   Moyale

7. Hassan Jillo
   Bori

8. Wario Diba
   Moyale

9. Haji Farah
   Moyale

10. Adan Ali
    Godoma

11. Abdi Ibrahim
    Hallu

12. Dalacha Godana
    Dukana

13. Mamo
    North Horr

14. Hussein Roba
    Maikona

15. Katelo Wata
    North Horr

16. P. Sheramo Boru
    Maikona

17. Kotore Ali
    Babisa

18. Luwa Luk
Illeret

19. William Wario Duba
Sagante

20. Yusuf Sege
Sagante

21. Joseph Kukuton
Laisamis

22. Timando Lonyo
Loglogo

23. Solomon Alkaya
Songa

24. Jareo Ngurusi
Karare

25. Robert Roba
Kalacha

26. Gorge Ore
Kargi

27. Domnic Brantoi
Loglogo

28. Dadio Kieri
Kargi

28. Adan Ibrahim
Livestock Marketing Division, Marsabit

29. Otito
District Agricultural Officer, Marsabit

30. Mr. Matete
Forester, Marsabit

31. Dr. Kirigia
Veterinary Department, Marsabit

32. Dr. Omara-Onyene
IPAL Veterinary Officer

33. Mr. Ojiambo
District Co-operative Officer, Marsabit

V. IPAL ORIENTATION SEMINAR

1-12 NOVEMBER 1982

1. M. Augustin Tchantchet
Yogoua, Cameroun

2. F. Eugenio Caviedes
Santiago, Chile

3. Mr. Katim Touray
Banjul, Gambia

4. Mr. Heins Ellenberg
Gottingen, Germany

5. Mr. Vollmer
Bonn, Germany

6. Mr. Laurent Bado
Ouagadougau, Upper Volta

7. M. Mamadou S. Cissoko
Bamako, Mali

8. M. Brehima Diallo
Bamako, Mali

9. M. Mamadou Ouattara
Bamako, Mali

10. M. Omar Berkat
Rabat-Agdal, Morocco

11. M. Carlos Montana
Gomex Palacio, Mexico

12. M. Abdou Daoure
Niamey, Niger

13. M. Ibrahim Boubakar
Niamey, Niger

14. M. Medicke Niang
Koalack, Senegal

15. M. Boukar Bang Ning Wada
Ndjamena, Chad

16. M. Tahar Gallili
Tunis, Tunisia

17. Dr. W.J. Lusigi
UNESCO - IPAL

18. Mr. J.G. Stephenson
UNESCO - IPAL

19. Dr. Hugh Lamprey
UNESCO - IPAL

20. Dr. Chris Field
UNESCO - IPAL

21. Mr. K. Awere-Gwekyo
UNESCO - IPAL

22. Dr. G. Bake
UNESCO - IPAL

23. Mr. Jim Crees
IPAL Consultant

24. Mr. Gerard Dekker
IPAL Consultant

25. Mr. P. Gufu Oba
UNESCO - IPAL

25. Mr. A. van Kekem
UNESCO - IPAL

26. Mr. S. Masheti
UNESCO - IPAL

27. Miss Betty Migongo
UNESCO - IPAL

28. Mr. J.K. Muiruri
UNESCO - IPAL

29. Mr. George Njiru
UNESCO - IPAL

30. Mr. E. Nkurunziza
UNESCO - IPAL

31. Mr. Michael O'Leary
UNESCO - IPAL

32. Mr. A.L. Omara-Onyene
UNESCO - IPAL

33. Mr. Piers Simpkin
UNESCO - IPAL

34. Dr. Gisbert Glaser
UNESCO, Paris

35. Mr. Patrick de Rham
IPAL Consultant

VI. IPAL TRIPARTITE REVIEW MISSION AND STEERING COMMITTEE
31 JANUARY 1983 TO 11 FEBRUARY 1983

1. Prof. F.F. Ojany
   University of Nairobi

2. Dr. S. Chema
   Ministry of Livestock Development
   Nairobi, Kenya

3. Prof. Dr. H. Mensching
   University of Hamburg
   Federal Republic of Germany

4. Prof. Dr. C. Gall
   University of Hohenheim
   Federal Republic of Germany

5. Dr. K.G. Dilg
   Embassy of the Federal Republic of Germany
   Nairobi, Kenya

6. Dr. R.D. Child
   Ministry of Livestock Development
   Nairobi, Kenya.

7. Dr. Johann Helland
   Coordinator, ASAL Turkana
   Lodwar, Kenya

8. Dr. Gisbert Glaser
   UNESCO
   Paris

9. Mr. H. Agoya
   Ministry of Finance
   Nairobi, Kenya

10. Mr. G. Kirimi
    Ministry of Economic Planning and Development

11. Ms. M.I. Aoko
    National Environment Secretariat

12. Mrs. J.C. Onyango
    Ministry of Environment and Natural Resources

13. Mr. D.N. Namu
Ministry of Livestock Development

14. Mrs. C. Kabutha
National Environment Secretariat

15. Mrs. S. Bundotich
Ministry of Economic Planning and Development

16. H.E. von Vacano
Ambassador of the Embassy of the Federal
Republic of Germany, Nairobi

17. Chief Olu Ibukun
Director of the UNESCO Regional Office for
Science and Technology for Africa

18. Mr. W. Welime
Ministry of Livestock Development

19. Hon. H.M.K. Adichare
Assistant Minister for Environment and
Natural Resources, Nairobi, Kenya

20. Mr. Kaniaru
District Officer I., Marsabit

21. Mr. K. Laigwanane
Clerk of Marsabit County Council

22. Mr. Irungu
District Officer II., Marsabit

23. Mr. J. Ngera
Officer in-charge of Roads and Transport, Marsabit.

24. Mr. Muthua
Officer in-charge of Police, Marsabit.

25. Mr. Mugwe
Marsabit National Reserve

26. Mr. Kedogo
Marsabit Secondary School

27. Mr. Matimba
Inspector of School
Marsabit

VII. IPAL EXTENSION SEMINAR
22-23 JUNE 1983

1.	Dr. W.J. Lusigi		UNESCO - IPAL
2.	Dr. M. O'Leary	-	UNESCO - IPAL
3.	Mr. Mark Hinton	-	Dayster Communications
4.	Rev. Andrew Adana	-	Bubisa Development & Evangelism Project
5.	Mr. Jeffrey Lewis	-	BPSAAT, Ministry of Agriculture
6.	Mr. & Mrs. Slade	-	African Development Church
7.	Mr. & Mrs. Morgan	-	S.R.D.C., Maralal
8.	Mr. Fred Kniss	-	Mennonite Board
9.	Sokotei Seye	-	UNESCO - IPAL
10.	Dr. Chris Field	-	UNESCO - IPAL
11.	Dr. T. Rutagwenda	-	UNESCO - IPAL
12.	Dr. E. Nkurunziza	-	UNESCO - IPAL
13.	Dr. Levi Omara	-	UNESCO - IPAL
14.	Mr. S. Masheti	-	UNESCO - IPAL
15.	Dr. G. K. Njiru	-	IPAL Consultant
16.	Mr. S. Simpkin	-	UNESCO - IPAL
17.	Mr. K. Tubei	-	UNESCO - IPAL
18.	Mr. Frances Weaver Grill		Mennonite Central Committee
19.	Mr. Peter Gabauer	-	Food Security Programme, Wamba
20.	Mr. Peter Grill	-	SALTLICK, Nanyuki
21.	Dr. A.K. Njoroge	-	District Development Officer, Marsabit
22.	Mr. Anthony Wambai	-	M.O.A., Marsabit
23.	Mr. Gufu Oba	-	UNESCO - IPAL
24.	Ms. Oriel Kenny	-	Women's Group Co-ordinator, Marsabit
25.	Mr. R.W. Kaniaru	-	District Officer I., Marsabit
26.	Mr. Alex Ngoroni	-	UNESCO - IPAL
27.	Mr. Muchiri	-	Forest Department, Marsabit
28.	Fr. Leonel Gomez		Diocese of Marsabit
29.	Mr. Kimura	-	NCCK, Nairobi
30.	Mr. J.G. Stephenson	-	UNESCO - IPAL
31.	Dr. Gernot Bake	-	UNESCO - IPAL

VIII. IPAL MINI-ORIENTATION SEMINAR

25 JUNE 1983 TO 3 JULY 1983

1. Mr. Hamady Sow
   Bureau Education Parcs Nationaux
   Dakar, Senegal

2. Mr. H. Le Houerou
   Texas 1 and 2 University
   U.S.A.

3. Madame Yamna Djellouli
   Centre de Recherche Surlg
   Algeria

4. Dr. I.M.A. Toure
   UNESCO, Dakar

5. Mr. Dave Shift
   Colorado State University
   South Turkana Ecosystem Project

6. Madame Delila Nedjeraoui
   C.R.B.T.
   Algeria

Dr. L. Dangana
UNESCO/ROSTA
Nairobi

IX. IPAL ORIENTATION SEMINAR

31 OCTOBER TO 12 NOVEMBER 1983

1. Dr. S. Maudal
   Department of Environment
   India

2. Mr. Tessema Chekun
   Ethiopia National Agency for UNESCO
   Ethiopia

3. Dr. Andrew Siwela
   University of Zambia
   Lusaka

4. Mr. Mustafa M. Suliman
   UNESCO National Commission
   Khartoum

5. Dr. Laikan Al-Joboury (Mrs)
   Council for Scientific Research
   Iraq

6. Dr. Ratik El-Ghareeb
   University of Alexandaria
   Egypt

7. Mr. A.S. Hamad
   Tanzania National Scientific Research Control
   Dar-es Salaam

8. Dr. Mohammed Ammar
   UNESCO National Commission
   Tripoli

9. Mr. Stanley Manase
   Department of Rural Development
   Zimbambwe

10. Dr. Eric L. Edroma
    Kampala

11. Mr. Rodney Nkaonja
    Lilongwe

12. Mr. R.M. Kwerepe
    Ministry of Agriculture
    Gaborone

13. Dr. Zafar Uddin
Pakistan Agricultural Research Council
Islamabad

14. Mr. Ahmed Hammoud
Director, Arab Institute for Forestry and Range
Camascus

15. Mr. Mohamoud Ahmed Ayan
Ministry of Culture and Higher Education
Mogadisho

16. Dr. W.J. Lusigi
UNESCO- IPAL

17. MR. J.G. Stephenson
UNESCO - IPAL

18. MR. H.F. Lamprey
UNESCO - IPAL

19. DR. Chris Field
UNESCO - IPAL

20. Dr. G. Bake
UNESCO - IPAL

21. Mr. Sylvester Masheti
UNESCO - IPAL

22. Mr. George Njiru
IPAL Consultant

23. Mr. E. Nkurunziza
UNESCO - IPAL

24. Dr. M. O'Leary
UNESCO - IPAL

25. Mr. P. Simpkin
UNESCO - IPAL

26. Mr. T. Rutagwenda
UNESCO - IPAL

27. Mr. S. Tubei
UNESCO - IPAL

28. Mr. M.B. Musoke
IPAL Consultant

APPENDIX II

REPORTS AND PUBLICATIONS

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2. Carles, A.B. (1980). Productivity levels of the goat herd at Ngurunit. *IPAL Technical Report A-3*, Nairobi.

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10. Field, C.R. (1982a). Minutes of meetings held at the National Agricultural Research Station, Kitale. (mimeo), IPAL Nairobi.

11. Field, C.R. (1982b). The smallstock programme of the UNESCO Integrated Project in Arid Lands. A summary of work carried out between 1976 and 1982 in *Proceedings of the Small Ruminant CRSP Workshop*, Nairobi.

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13. Field, C.R. (1983b). An Introduction to reseach on camels by the UNESCO, Integrated Project in Arid Lands in Northern Kenya.

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15. Field, C.R. (1983d). Livestock impact trials at Mt. Kulal progress Report. IPAL, Nairobi.

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APPENDIX III

VISITORS TO THE PROJECT

1.	Dr. D. Andere	- Director, KREMU
2.	Dr. G. Arkhurst	- MAB, Abdjan
3.	Mr. B. Asimila and Others	- Voice of Kenya Television Team
4.	Lieut. Col. J. Blashford	- Operation Drake, U.K.
5.	Mr. Bruce	- Canadian High Commission Kenya
6.	Prof. J. Goodman and student party	- Anderson College, Indiana, U.S.A.
7.	Dr. J. Grimadell	- ILCA Nairobi
8.	Dr. G. Martin	- Kenyatta University College
9.	Mr. P. Robinson and student party	- St. Lawrence University, New York
10.	Mr. R. Svenson	- Ministry of Water Dev., Kenya
11.	Mr. P. Thatcher	- Deputy Director, UNEP
12.	Mrs. Chellanor	- UNESCO Liasion Office Washington DC
13.	Dr. M. Conertz	- USAID Remote Sensing Unit
14.	D.A. Liebers	- St. Lawrence University, New York
15.	Mr. B.T. Ngoma	- Marsabit
16.	Mr. H. Chige	- Marsabit
17.	Dr. P. Kuchar	- KREMU, Nairobi
18.	Dr. A.L. Alusa	- Meteorological Dept. Nairobi
19.	Mr. A. Sheikh	- District Commissioner, Marsabit
20.	Dr. Manua	- University of Nairobi
22.	Mr. G. Mukindia	- Marsabit
23.	Mr. J. Severson	- St. Lawrence University
24	Mr. I.P.S. Abdallah	- Marsabit
25.	Prof. R. Maeckel	- University Freibourg, FRG
26.	Dr. Reiner	- Federal Republic of Germany
27.	Mr. C. Dewhurst	- D.L.C.O., Nairobi
28.	Prof. Dr. G. Kaule	- Stullgart, FRG
29.	Mr. J. Kabina	- Nairobi
30.	Mr. F. Mellay	- Nairobi

Visitors Continued

31.	Mr. R. Allen	- FAO Quelea Project
32.	Dr. M.A. Khan	- University of Nairobi
33.	Dr. R. Newsome	- KIPE, Nairobi
34.	Dr. G. Martin	- Kenyatta University College
35.	Dr. Mac Guire	- University Leicester, U.K.
36.	Dr. Gatuta	- KETRI, Muguga
37.	Dr. Olahu	- KETRI, Muguga
38.	Dr. Gibson	- KETRI, Muguga
39.	Mr. M. Woodward	- Australia
40.	Mr. J. Murphy	- Australia
41.	Prof. E. Decker	- Colorado State University
42.	Dr. D. Rottcher	- Veterinary Lab. Kabete
43.	Mr. W. Schulthess	- Nairobi
44.	Mr. Ngarengi	- Adult District Office, Marsabit
45.	Brigadier Lengess	- Kenya Army, Nanyuki
46.	Mr. Kalama	- District Water Office, Marsabit
47.	Mr. N. Dyson	- University of Nairobi
48.	Mr. W. Penchhorn	- University of Nairobi
49.	Dr. R.N. Mero	- Mpwapwa, Tanzania
50.	Dr. W. Schultka	- University of Giessen, W. Germany
51.	Hon. Loitityo Lekoikum	- Ministry of Transport, Nairobi
52.	Miss Bolgn	- Office of the President, Nairobi
53.	Mr. N.M. Collins	- ICEPE, Kajiado
54.	Dr. D. Pomeroy	- University of Nairobi
55.	Dr. J. Norris	- Ministry of Livestock Dev., Nairobi
56.	Dr. D. Child	- Range Ecologist, Kiboko
57.	Dr. Theuri & Njoka	- University of Nairobi
58.	17 students (1st year BSc. Range Management Dept)	- University of Nairobi
59.	Mr. P. Njoroge	- Ministry of Agriculture, Nairobi
60.	Mr. L. Hedtors	- Ministry of Agriculture, Nairobi
61.	Mr I. Sjostrand	- Ministry of Agriculture, Naiorbi
62.	Mr. L. Herikon	- Ministry of Agriculture, Nairobi
63.	Mr. S.N. Kagiri	- Ministry of Agriculture, Naiorbi

Visitors Continued

64.	Mr. Josaphat F.N. Waweru	- P.D.A., Garissa
65.	Mr. de Vreede	- Paris
66	German Camera Team	- W. Germany
67.	American Video Team	- U.S.A.
68.	Mr. J.G. Nyambwa	- District Officer, Marsabit
69.	Mr. E. Mugo	- Marsabit
70.	Ms. Maud-Anne	- American Cultural student
71.	Mr. J.M. Italakua	- Ministry of Env. & Natural Resources
72.	Dr. H. Epp	- KREMU
73.	Mr. Simon Trevor	- Filming team
74.	Mr. Damian Bell	- Filming team
75.	Mr. P.B.C. Muthee	- Kenya Rainfall Inspector
76.	Mr. D.J. Gatimba	- Marsabit
77.	Mr. I. Shambal	- North Horr, Marsabit
78.	Mr. J. Kimani	- KETRI, Nairobi
78.	Mr. Aggray	- KETRI, Nairobi
79.	Mr. H. Karanja	- KETRI, Nairobi
80.	Mr. F. Haman	- Marsabit
81.	Mr. R. Kadenge	- Marsabit
82.	Mr. A. Tego	- Marsabit
83.	Mr. H.N. Wako	- Marsabit
84.	Mr. R.M. Ngatia	- Marsabit
85.	Mr. Gathui	- Marsabit
86.	Mr. J.K. Nganga	- Marsabit
87.	Dr. E.N. Ngarari	- Marsabit
88.	M.A. Jama	- Marsabit
89.	Mr. A. Frost	- Project Trust, Nairobi
90.	Mr. A. Shedden	- Project Trust, Nairobi
91.	Mr. D. Pim	- Nairobi
92.	Mr. Justus Murebu	- Marsabit
93.	Mr. C. Leleapana	- Marsabit
94.	Mr. Kwamba Katabwa	- Marsabit
95.	Mr. S. Shiralui	- Marsabit
96.	Mr. de Mdede	- Marsabit
97.	J.A. Abduba	- Marsabit
98.	Mr. M. Kocha	- Australia
99.	Mr. M. Neumayer	- Australia
		-

Visitors Continued

100.	Prof. J.G. Wandera	- University of Nairobi
101.	Dr. D.E. Kapule	- University of Nairobi
102.	DR. D.M. Chibek	- Livestock Management
103.	Mr. Morique Arends	- The Hoque
104.	Mr. F. Weldschlet	- The Hoque the Nothos
105.	Mr. H.A. Isaac	- National Museum
106.	G. Jean Paul F. Jesse	- EEC Delegate, Nairobi
107.	Mr. Goes Charles	- EEC Delegate, Nairobi
108.	Mr. D.W. Charaggu	- Ministry of Economic Planning, Nairobi
109.	Mr. Steven Wiggns	- Embu
110.	Mr. Davis Lewis	- Nairobi
111.	Ms. Julie Ezeokoli	- Nigerian National Commission
112.	Mr. A.O. Ajibasis	- Nigerian National Commission for UNESCO
113.	Dr. V. Schnelder	- Coordinator, Wamba Samburu Project
114.	Dr. K.K. Fenilbih	- Wamba Samburu Project
115.	Dr. Peter Gebauer	- Wamba Samburu Project
116.	Mr. R.J. Onyango	- Chairman KETRI Team Board
117.	Prof. G. Kinoti	- University of Nairobi
118.	Mr. Thomas Malinda	- KETRI Team
119.	Mr. I.E. Murithi	- KETRI Team
120.	Mr. Ruchiami	- KETRI Team
121.	Mr. L.B. Kion	- KETRI Team
122.	Ms. Jane R. Mbaya	- KETRI Team
123.	Mr. Francis Ogutu	- KETRI Team
124.	Dr. Decker	- Hydrologist Expert
125.	Mr. Eilef J. Gard	- Marsabit
126.	Mr. Camp Bill	- UNESCO, Paris
127.	Mr. Biigitee Guillouk	- UNESCO, Paris
128.	Mr. D.C. Daly	- UNESCO, Paris
129.	Mr. J.K. Etemesi	- Embu
130.	Mr. S.K. Kaith	- Embu
131.	Mr. M.O. Onyango	- Isiolo
132.	Mr. D.M. Chibeu	- Livestock, Marsabit
133.	Ms. M. Arends	- The Hague, Netherlands
134.	Mr. F. Wildschut	- The Hague, Netherlands
135.	Mr. J. Melchert	- Munich, West Germany

Visitors continued

136.	Mr. Mr. H. Ohliger	- Munich, West Germany
137.	Ms. D. Chinn	- Cambridge University, U.K.
138.	Mr. J. Morphew	- London University, U.K.
139.	Capt. Newton Kirera	- Kenya Air Force
140.	Mr. D. Newton	- Journalist, N. Carolina
141.	Dr. U. Vollmer	- Bonn, W. Germany
142.	Dr. M. Niang	- I.S.R.A., Kaolack, Senegal
143.	Prof. Richard M. Hansen	- Biologist
144.	Mr. Sybill Campbell	- Chief Staff Training
145.	Mr. Ken Maclean	- External Auditor
146.	Mr. Anollw Caddils	- External Auditor
147.	Mr. C.P.E. Metcalf	- UNDP, Nairobi
148.	Mr. E.C. Goss	- Anti-Poaching Unit, Nairobi
149.	Mr. F.N. Pertet	- Wildlife Department, Nairobi
150.	Mr. P. H.	- Wildlife Department, Nairobi
151.	Mr. W.J.A. Payne	- UNSO Consultant
152.	Mr. Z.G. Gathuka	- Ministry of Livestock Dev.
153.	Mr. L.J. Ayuko	- Nairobi
154.	Mr. J.M. Mwangi	- Veterinary Lavoratories, Kabete
155.	Mr. H.C.K. Kinyanjui	- Kenya Soil Survey
156.	Mr. J.M. Kibe	- Kenya Soil Survey
157.	Mr. D.N. Mungai	- Kenya Soil Survey
158.	Mr. R.L. Kiome	- Kenya Soil Survey
159.	Mr. H.M. Bram	- Kenya Soil Survey
160.	Mr. V. can Engelen	- Kenya Soil Survey
161.	Mr. J.R. Rachilo	- Kenya Soil Survey
162.	Mr. W.N. Wamicha	- Kenya Soil Survey
163.	Mr. M.M. Gatahi	- Kenya Soil Survey
164.	Mr. F.N. Muchena	- Kenya Soil Survey
165.	Mr. S. Baraza	- E.A. Power & Lighting, Marsabit
166.	Mr. H.A. Ochieng	- Nairobi
167.	Mr. R. Gitahi	- Department of Culture, Nairobi
168.	Mr. H.J. Kinuthia	- Meteorological Dept., Nairobi
169.	Mr. Stephenson Ocharo	- Mariakani

Visitors continued

170.	Mr. Mohamed	- Chief, Kikumewi
171.	Mr. P.H.K. Kinyanjui	- Urban & Regional Planner, Embu
172.	Mr. K. Njui	- Ministry of Water Dev., Nairobi
173.	Mr. C.R. Kirrinya	- K.A.R.I., Kikuyu
174.	Prof. Muriuki	- University of Nairobi
175.	Dr. Kipkorir	- Institute of African Studies, Nairobi
176.	Mrs. Allison B. Herrick	- Director, USAID, Nairobi
177.	Mr. Gary E. Lewis	- Deputy Director, USAID, Nairobi
178.	Mrs. B. Mowoe	- Secretary-General, Nigerian National Commission for UNESCO
179.	Dr. Hans Bibelriecther	- West Germany.
180.	Mr. Moslah Mekki	- Institut Regions Arides Medenine, Tunisia
181.	Mr. Bert Demmers	- UNEP, Nairobi
182.	Ms. Susan Beeds	- Nairobi
183.	Ms. Rowena Richter	- Friends World College, Nairobi
184.	Mr. Gabauer	- Ministry of Economic Cooperation, Bonn
185.	Prof. C. Nyamweru	- Kenyatta University College
186.	Mr. Francois de Donnea	- Belgian Minister for Dev. Co-operation
187.	Mr. C. de Saint Hubert	- Belgiam Ambassador to Kenya
188.	Mr. Joahim von Mengden	- German television team
189.	Mr. Dieter Hoase	- German television team
190.	Mr. K.A. Tuffuor	- UNESCO/ROSTA, Dakar
191.	15 International Journalists	
192.	Mr. H.N. Le Hoverod	- University Kingsville, Texas
193.	Mr. Francis Rume,	- CRSP
194.	Dr. John Galanty	- Department of Anthropology, Montreal
194.	Mr. Louise Sperling	- University of Nairobi
195.	Mrs. Bibelriecther Gertie	- W. Germany
196.	Mr. E.G. Avedi	- Ministry of Higher Education, Nairobi
197.	Mr. J.M. Kiarie	- Embu
198.	Mr. J.A.A. Mwinamo	- Embu
199.	Mr. Tawkare	- British High Commission, Nairobi
200.	Mr. Kiichiro Harano	- Nairobi
201.	Isukasa Yokoyamd	- Nairobi

Visitors continued

202.	Mr. James Peipert	- Associated Press
203.	Mr. Andrew Hill	- Nairobi
204.	Mr. Benard Estrade	- Nairobi
205.	Mrs. Maragete Bgehler	- Newsweek, Nairobi
206.	Mr. Von Lan Germann	- UNEP, Nairobi
207.	Dr. Odegi Awuondo	- University of Nairobi
208.	Miss Louis Sperling	-
209.	Dr. Anders Bjort	- Stockholm University, Sweden
210.	Mr. S.O. Amoko	- Machakos
211.	Mr. K. Vogt	- Meru
212.	Ms. Arne Delfelt	- Norway
213.	Mr. Muchiri E.M.	- Marsabit

APPENDIX IV

MAJOR ITEMS OF PROPERTY AND EQUIPMENT

WITH IPAL ON 30 JUNE 1984

A. BUILDINGS

1. Marsabit

1	Office block	- Sectional wood
1	Laboratory and Library block	- Sectional wood
1	3 roomed store	- Sectional wood
1	Hostel	- Sectional wood
1	3 bedroom house (Co-ordinator)	- Sectional wood
2	2 bedroom houses (Scientists)	- Sectional wood
1	1 bedroom house (Junior service)	- Sectional wood
1	dwelling block, 3 rooms (Support Staff)	- Sectional wood

2. Gatab

1	2 roomed store	- Sectional wood
1	Laboratory/Office block (3)	- Sectional wood
1	1 bedroom house (Scientist)	- Sectional wood
2	dwelling block 11 rooms (Support Staff) (7 single, 2 double)	- Sectional wood.

3. Olturot

1	roundoval house of 2 rooms (1 dwelling, 1 store)	- Sectional wood
1	dwelling block, 3 rooms, (Support Staff)	- Sectional wood
1	drying shed - vegetation samples	- Sectional wood
1	2 roomed Rest house (1 room visiting scientist, 1 office)	- Sectional wood.

4. Karge

1	2 room dwelling block (Support Staff)	- Sectional wood
1	dwelling rondavall (1 Senior officer rest camp, 1 Support Staff)	- Sectional wood.

5. Ngurunit

1	1 room rondavall (office)	- Sectional wood
1	1 room rondavall (hostel kitchen and mess room)	- Sectional wood
1	3 room block (Support Staff)	- Sectional wood
1	3 room block (Support Staff)	- Sectional wood
1	2 room block (Support Staff)	- Sectional wood

Ngurunit ...continued

1 2 room block (store and canteen) - Sectional wood
1 1 room shack (mechanical store) - Sectional wood
1 1 bedroom house (Scientist) - Sectional wood
2 shower rooms
2 kitchens

6. Korr

1 2 rooms block (office and store) - Sectional wood
1 2 room block (Support Staff) - Sectional wood

7. Kalacha

1 1 room house (rest camp for Scientist) - Sectional wood

B. INSTALLATIONS

1. Marsabit

1 water tower (4,000 gallons)
Electricity from town supply
piped water from town supply
fencing around station plot (10 hectors)
7 pit latrine accommodation
2 solor pannel heater
2 water heaters - electric
3 street lights with metal posts

2. Gatab

2 wind generators
1 cattle paddock
4 fenced trial exclosures
2 erosion monitoring tanks
1 goat dip
fencing around station plot
piped water supply from mission
2 pit latrine accommodation
3 solor pannel heaters

3. Olturot

1 well and hand pump
2 wind generators
4 fenced trial exclosures (vegetation and livestock impact
fencing around station plot (20 hectors)
1 airfield
3 pit latrine accommodation.

4. Kargi

2 fenced trial exclosures
1 wind generator
1 airfield
1 pit latrine accommodation.

5. Ngurunit

2 fenced trial exclosures
fencing around station plot
1 airfield
piped water supply from stream
1 pit latrine accommodation.

6. Korr

1 well
fencing around station plot
1 fenced trial exclosure
pit latrine accommodation.

7. Kalacha

1 well
1 pit latrine accommodation.

C. ADMINISTRATIVE EQUIPMENT

1. Vehicles

		Remarks
a.	1 x 5 ton 4 x 4 diesel truck - Isuzu	
b.	1 x 5 ton 4 x 4 truck - Bedford	old
c.	1 x Wide cab small van - Daihatsu	
d.	1 x 250 cc motor cycle suzuki	
e.	2 x water carrying trailers	
f.	1 x haulage trailer for Land Rover	
g.	3 x Pick up long wheel base Land Rover	
h.	1 x Station wagon long wheel base Land Rover	
i.	1 x Hard top special long wheel base Land Rover	
j.	1 x Hard top special short wheel base Land Rover	
k.	1 x Station wagon long wheel base Land Rover	

Note: All vehicles under (a) - (d) and (g) to (j) all fully equiped with spanners and safari tools, jacks etc.

2. Aeroplane 5Y-KRY-Cessna 185

3. Camping equipment — Remarks

tentage:

7 Ngong — 2 for write off

4 Marsabit — 1 for write off

15 Karen

3 Manyara

Other: chairs, tables, lampes.etc.
Value Kshs. 40,000/=.

4. Fridgidaires

5 electric

4 gas

2 small safari gas — 1 for write off

5. Deep freeze 1

6. Cookers

4 electric

3 gas

3 gas small 2 burner

7. Radio (Radio/Telephone) Stoner sets 4 x 100 watts
5 x 40 watts

8. Typewriters

3 I.B.M. electric

1 Olympia manual

1 portable

9. Fire extinguishes 22

10. Honda generators 2 x 2,500 walts
1 x 300 walts

11. Watches for Field Assistants 8

12. Camel saddles (Bicaner type)

2 complete

4 frames only

13. Trickle chargers 3

14. Cement mixer with engine 1

15. Duplicator, Gestetner 1

16. Photo copying machine, Nashua 1

17. Sets taps and dies
    pipe 1
    machine 1

18. Radar altimeter (in plane) 1

19. Carpenter/mason Tools and Equipment
    value Kshs. 10,000/=.

20. Steel cabinets - offices 12

21. Adding machine 1 1

22. Filing cabinets 10

23. House and office furniture and equipment
    value Kshs. 190,000/=.

24. Garage tools
    value Kshs. 60,000/=

25. Miscellaneous equipment - Administration
    value Kshs. 30,000/=.

D. SCIENTIFIC EQUIPMENT

1. Livestock

Camels	82
Camels fistulated	3
Cattle	11
Cattle fistulated	3
Sheep/Goats	632
Sheep/Goats fistulated	8
Donkeys	3

2. Microscopes

Standard disecting	2
stereo high powered	1

3. Cameras

Canon F1. with 1 standard lens
1 zoom lens
2 adapters
1 motor drive back
1 grip

Bronica with 8 lens
3 additional film chambers
Nikon with 1 standard lens
Mamia EF. with 1 standard lens

4. Slide projector
   1 small Russian make
   1 new Australian make

5. Audio visual equipment
   Kodak with 2 projectors with drums
   2 speakers
   2 cassettes.

6. Film developer 1.

7. Tape recorders
   2 old Phillips for write off
   4 Sony
   1 National Panasonic.

8. Binoculers - Canon 1

9. Stereoscope mapping 1

10. Altimeters (hand) 2

11. Map drawing table with lights 1

12. Calculators - pocket 18

13. Capacitance vegetational meter 1

14. Precision balances
    melther electronic 1
    Beam 5
    salter spring x 100 kg 1
    salter spring x 500 kg
    with triped 1
    tripple beam 3
    standard trading seales 2

15. Hydraulic weighing platform 1

16. Drying oven electric 240 v. 1

17. Wood power saw 1

18. Post hole driller 1

19. Centrifringe

porta hand, battery	1
mechanical	1

20. Prismatic Compass

1 large with trypod	1
1 hand	1

21. CRC. Dry Ice Machine (Co_2)	1
22. Voltage stabiliser	1
23. Weighing crates (sheep/goats)	2
24. Automatic weather station	2
25. Weather station (standard)	1
26. Calorimeter	1

27. Veterinary equipment value Kshs 30,000/=

28. Miscellaneous scientific equipment (other than 27 above) value Kshs,30,000/=

29. Library books value Kshs. 20,000/=