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## Final Report

### Kiboko Range Research Expansion Project

21 June 1979 - 30 June 1986



Submitted to:

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## EXECUTIVE SUMMARY

### Background

Close to 80% of Kenya's land is classified as rangeland. It supports about a third of Kenya's domestic grazing animals and sustains a great many people, primarily pastoralists and crop-livestock farmers. As the country's human population continues to increase, so does the need for livestock and livestock products. But rangeland serves more than people who make their livings from it. It is watershed that ensures water supplies for Kenya's rural and urban people. It is also home for the wildlife that are central to tourism, the country's number one foreign exchange earner.

Land use in Kenya is changing -- putting pressure on the land and its ability to produce. Semiarid rangelands attract people from high-population areas. Land traditionally managed by pastoralists is being subdivided -- split in some cases among family members and in some cases to provide a place for the people moving in from other areas. Families find themselves with smaller shares of the rangeland and are forced to change their traditional methods of working the land.

As these pressures mount, Kenya needs a strong research capability, aimed at helping solve the resulting problems and to secure a hopeful existence for future generations. To be effective, this capability must come largely from within Kenya with Kenyans working to find solutions for Kenya's problems.

In June 1979 the Government of Kenya signed a contract with Winrock International Livestock Research and Training Center to assist the Government of Kenya as it expands its range research capability. Funding was from the Government of Kenya and the United States Agency for International Development. The projects main focus centered at the Kiboko National Range Research Station and the Bachuma sub-station.

### Project Objectives

The project had three principal objectives as follows:

- Develop an institutional base and program staff to support a sustained research program.
- Establish a research program to develop improved management systems that will conserve and improve rangelands, increase the supply of usable forage, and support the increased production of animal and other products from rangeland.
- Test and transfer improved technologies to pastoralist and farmers using both station and on-farm research.

### Major Accomplishments

The most notable accomplishment of the project was the training of 21 Kenyan research officers (2 PhD, 16 MSc and 3 BSc degrees). At the close of the project all those trained were working within their chosen discipline in Kenya and all but four were stationed at the Kiboko or Bachuma research stations. The research officers are making good progress at determining appropriate research priorities for Kenya and enhancing its range research program. The range research conference held at Egerton College in April 1986 illustrates the depth and breadth of the Kenyan researchers now available in Kenya.

During the course of the project major acquisitions of equipment were made to support research and station operation and technicians were trained in its use and maintenance. In December of 1985 the station was connected to the Kenya Power and Light system thus providing full electricity to the station.

Research priorities were established at the beginning of the project and reviewed during and at the end of the project by teams composed of Kenyan researchers and officials and outside technical advisors. The workshop held at Egerton College in April 1986 was the most recent review of research priorities. This workshop was planned and conducted primarily by Kenyans and demonstrates the relative strength of Kenya's range research program.

Extension activities began toward the end of the project as the Kenyan research officers returned from training and determined appropriate approaches and areas of focus.

#### Future Needs

The Kiboko Range Expansion project was successful in meeting the the short-term objectives set for it. The true test of the projects effects will be in how successful the Kenyan research officers are in future selection of research priorities and the determination of rangeland management strategies to meet the needs of the people of Kenya.

Though much was accomplished through the project, there is more to be done. The transition from graduate student to research officer does not occur when the diploma is received. It is rather a process that requires time, and can seldom be done in a professional vacuum. In most countries, new researchers have the opportunity of working alongside experienced people as they make this transition. But the Kiboko research officers were trained and returned home toward the end of the project, just when the technical advisors were leaving and the project was ending. Follow-up is needed to ensure these researchers' professional growth.

These newly trained research officers need two kinds of support if they are to make the transition and become productive research officers: 1) continued contact with experienced researchers and 2) financial support for both the recurrent research station costs and research implementation costs.



## CONTRACT AND INCEPTION

A contract was signed on 21 June 1979 by the Permanent Secretary of the Ministry of Agriculture, Office of the Vice President and Ministry of Finance for the Government of Kenya and by Dr. Ned S. Raun, Director of Production Programs for Winrock International Livestock Research and Training Center. The agreement was to initiate a major expansion of range research in Kenya with funding from the Government of Kenya (GOK) and United States Agency for International Development (USAID). The headquarters for the program was to be at the Kiboko Range Research Station.

Under the terms of the contract, Dr. Jonathan J. Norris became Chief of Party and Dr. Donald N. Hyder was appointed Deputy Chief of Party. Dr. Norris served as Range Lands Specialist and Chief of Party until the end of December 1982. Dr. Hyder served as Range Management Specialist and Deputy Chief of Party for 2.5 months before resigning and returning to the United States.

At the start of the program Mr. D. M. Thairu served as Director of Research for the Ministry of Agriculture and Mr. Benson M. Woie as Officer in Charge of the Kiboko Range Research Station.

The research proposal submitted to the Government of Kenya by Winrock International listed Winrock International Livestock Research and Training Center as the Contractor and Texas A&M University as the subcontractor (for training). The Contractor was to work directly for the Division of Scientific Research in the Ministry of Agriculture and provide long term and short term technical assistance in the enhancement of research programs to develop improved range and livestock management systems which could be implemented by indigenous pastoralists, to develop a research utilization

plan and to provide participant and on-the-job training for a cadre of Kenyan range and livestock scientists to staff the range research program in Kenya.

The purposes of the Kiboko Range Research Expansion Project were to substantially increase the supplies of useable forage for support of livestock, and to develop improved range and livestock management systems.

The contract agreement was for the proposed project to function until 30 June 1985. The work plan was to include a preparation phase, initiation phase, full operation phase, and a completion phase. Firm work plans were to be presented for each ensuing work year and tentative projections for each succeeding year. Annual work plan revisions and annual budget revisions were to be submitted annually. There have been seven amendments to the contract and the program's completion date was extended to 30 June 1986.

Six three-bedroom houses were to be constructed by the GOK at the Kiboko Range Research Station for Winrock's resident staff.

The contract called for the Government of Kenya to provide #2,006,363 which was to include direct contract support and overall project support for the first 5 years. The total USAID budget for the initial project period (June 1979 through June 1985) was \$5,141,419. The GOK also agreed in the initial contract to provide many other services, personnel, facilities, equipment, and logistical support to the Kiboko Range Research Expansion Project

## FIRST YEAR

The Kiboko Range Research Expansion Project underwent a change in GOK direction and leadership during the first year. The project was placed in a new Ministry of Livestock Development. This transition from the Division of Scientific Research, Ministry of Agriculture to the Research Division of the Ministry of Livestock Development was gradual.

The Kiboko Range Research Station was elevated to the National Range Research Station and Mr. B. M. Woie's title was changed from Officer in Charge to Director. Dr. S. Chema, Deputy Director for Research, Ministry of Livestock Development, became the overall director of project activities. Dr. Charles T. Hash was the Program Officer for the USAID Mission in Nairobi.

Project vehicles (7 Land Rovers, 2 Leyland Lorries) and two diesel powered generators were purchased and arrived in Mombasa. Household appliances and furniture for the expatriots were stored at warehouses in Nairobi since the houses being built for expatriots at the National Range Research Station were still under construction.

A training plan was developed. Four officers (S. Anyona, J. I. Kinyamario, J. N. Ndegwa, R. N. Kinuthia and D. K. Musembi) went to Texas A&M University to begin Master of Science degrees in January 1980. There was some concern about finding other qualified trainees who would meet the minimum graduate school requirements at Texas A&M University. An agreement was made for Kenyan officers who have Egerton College diplomas to complete a Bachelor of Science degree followed by a Master of Science degree at Texas A&M. An agreement was made for project's Technical Assistants (expatriots)

to assist the new Department of Range Management, University of Nairobi, as lecturers and in other ways.

The previous and active research programs at the National Range Research Station were reviewed and this information proved valuable for planning new research projects. Professors F. E. Smeins and S. L. Hatch who served as major professors for Kenyans at Texas A&M visited the National Range Research Station and prepared useful guidelines for assisting the station's personnel in doing their work accurately and efficiently.

#### SECOND YEAR

Highly qualified and experienced personnel were employed by Winrock International after they were approved by the GOK. These technical experts were selected from a long list of applicants. Dr. Donald F. Burzlaff, Range Management Specialist and Deputy Chief of Party, arrived in Kenya on 4 October 1980. Dr. R. Dennis Child, Rangeland Ecologist, arrived in Kenya 15 November 1980. Dr. M. Joe Trlica, Plant Materials Specialist, arrived in Kenya on 15 November 1980. Dr. Rodney G. Ward, Range Livestock Specialist, arrived 5 January 1981. Dr. Norris and the 4 expatriot staff members listed above served as advisors for the Kenyan officers who went to Texas A&M for training and the Winrock employees were made Visiting Professors of the Graduate School and were more or less coadvisors with the Major Professors at Texas A&M.

Even though the houses were not yet finished at the National Range Research Station all the expatriot staff occupied the houses in February 1981. Each family spent many hours finishing the houses to suit their individual desires. Much of the credit toward getting the expatriot houses

ready for occupancy was due to Dr. Chema and Mr. Woie. Their dedication and interest in developing the National Range Research Station was commendable.

Four research officers, Ali R. Ali, S. K. Cheruiyot, P. M. Kamau and P. F. Kibet were selected to go to Texas A&M for training for a Bachelor of Science degree and a Master of Science degree. Their programs included returning to the National Range Research Station to conduct thesis research after the Bachelor degree. Additional courses, data analysis and thesis writing would be done at Texas A&M when they returned to Texas. They departed from Kenya on 2 January 1981.

All the initially necessary research equipment was at the National Range Research Station in early 1981. Many scientific books, science periodicals and technology references had been purchased and added to the library. Many Experiment Station bulletins, USDA Bulletins, Journal articles, reprints, FAO reports and other technical reports were donated to the library as gifts from the expatriots and their friends. Books and references were regularly purchased and added to the library until the end of the project.

A Range Research Planning Workshop was held in mid January 1981. All Winrock employees, the Director, and all senior research officers at the National Range Research Station were joined by Dr. Ned S. Raun, Winrock's Vice President for Programs and four Range Science Department faculty members from Texas A&M who were major professors for research officers in training at Texas A&M. The professors from Texas A&M were Dr. Joseph L. Schuster who heads the Range Science faculty, Dr. Fred E. Smeins, Dr. Jerry W. Stuth, and Dr. Wilbert H. Blackburn. This workshop developed guidelines, understanding and cooperation between the Texas A&M major professors and the

Winrock advisors toward the training programs of Kenyan research officers.

The January workshop provided much information and laid the groundwork for a station paper, "A Plan for Action 1980-1985." All the staff assisted in its preparation. This paper served as a synthesis of information and ideas to guide development, research planning and implementation of studies at the National Range Research Station. A number of tentative research projects were outlined for testing for their feasibility for continuance.

Dr. Robert L. Blackwell, who served as a consultant, examined all the available breeding records and consulted all staff who could provide information about the livestock programs at Buchuma and Kiboko. Dr. Blackwell, Animal Geneticist at Montana State University, made suggestions and recommendations for livestock management.

During 1981 a strong effort was made to recruit personnel to fill vacant positions at the National Range Research Station and Buchuma Range Research Station. Of greatest need were a trained librarian, drivers, mechanics, technicians (both laboratory and field) and persons holding a Bachelor of Science degree (to be sent off for training to Texas A&M) as well as other specialists. Employees with concern toward proper care of livestock were requested. Personnel to fill these empty slots were needed in order to perform the demanding procedures at a research station.

On-the-job instruction and training was a common activity of all the Winrock staff. The Kenyan staff were instructed daily about responsibility toward care of equipment and reasonable work ethics. A control and check out system for vehicles was initiated. A great deal of time was spent concerning honesty in carrying out work and in collecting research data.

Much effort was expended by the Winrock staff working with the Kenyans to minimize problems with supplies and purchases for the station and for research projects.

Weekly seminars were begun in the library. Initially these sessions were attended by senior members of the research staff and Winrock Technical Advisors. The schedule began with seminars concerned with presentations on goals, policies and available resources and later on they included technical subjects and research proposals.

The course in Range Ecology was taught at the University of Nairobi by Drs. Trlica and Child during the second term. Dr. Burzlaff was the External Examiner of the Range Management Department at the University of Nairobi and Dr. Norris was the External Examiner for the Range Management Department at Egerton College. These arrangements continued through December 1982.

### THIRD YEAR

Mr. Benson Woie departed 22 August 1981 to begin coursework at Texas A&M University toward a Ph.D. degree. Departing in January 1982 for Texas A&M to pursue Bachelor of Science degrees to be followed by Master of Science degrees were Mr. W. N. Mnene and Mr. D. S. Mbakaya. Mr. S. Anyona failed to make satisfactory progress toward a Master of Science degree and left the program.

Mr. N. R. K. Musimba was appointed Acting Director of the National Range Research Station. Mr. S. K. Sunyai, Wildlife Research Officer was transferred to the Buchuma Range Research Station where he was appointed Officer in Charge.

Ali R. Ali, S. K. Cheruiyot, P. M. Kamau and P. F. Kibet completed their Bachelor of Science degrees at Texas A&M in May 1982. They returned to Kenya to begin field data collecting for their Master of Science theses. Mr. J. I. Ndemwa and Mr. D. Kingaro departed on 24 May to participate for 9 weeks in a range management short course at New Mexico State University. Mr. M. Ojowi left on 10 June to attend a six weeks short course in small ruminant production at California State Polytechnic University, Pomona.

Dr. Fred E. Smeins became Texas A&M University's campus coordinator for technical training of the Kenyan research officers. He was at the National Range Research Station in December 1981 advising Mr. J. I. Kinyamario and assisting in his thesis data collection. Dr. Smeins also helped obtain critical data needed by Mr. J. N. Ndegwa and Mr. D. K. Musembi. Dr. John Griffiths was in Kenya during July 1981 and he also assisted in obtaining thesis data to be used by Mr. Musembi.

Several technical assistants, technical officers, and research officers were employed and assigned to work at the National Range Research Station and Buchuma Range Research Station. The newly appointed personnel were taught field techniques and procedures needed to collect, record and process research data. Weekly seminars, staff meetings and tutorial instruction programs were organized on a scheduled basis.

On-the-job instruction and hands-on training became routine and intensified, and continued throughout the life of the Kiboko Range Research Expansion Project. Misuse and irresponsibility in the utilization of equipment (especially vehicles) were pointed out and proper use was highlighted. The difference between official and unofficial errands was discussed. Also emphasized was the difference between authorized and

unauthorized travel. Proper responsibility and honesty in work assignments were also subjects frequently covered. The need to maintain a schedule was a very difficult concept to be accepted and/or understood by the majority. The expatriates were involved in all phases of on-the-job training. Leadership responsibility in specific areas was divided among the Winrock staff.

Graduate Training Program - Norris  
Laboratories - Trlica, Child, Ward, Norris  
Livestock - Ward, Burzlaff  
Equipment Management - Burzlaff  
Library - Trlica, Child, Norris  
Seminars and Meetings - Trlica, Child  
Land Use Planning - entire Winrock staff  
Personnel Management - entire Winrock staff  
Schools, Social, Welfare - entire Winrock staff  
Off Station Activities - entire Winrock staff

The Kiboko Range Research Expansion Project was examined and reviewed by a team of consultants selected by USAID during the third year. Mr. N. K. R. Musimba compiled a listing of the range livestock research projects and range ecology projects for the review team. His report contained essential information concerning all of the past efforts, current ongoing projects and research proposals. The Winrock staff also provided the team with reports and records concerning the project. The team's report was judged unfavorable by the Winrock staff.

A major setback in planning occurred when the GOK let it be known that construction of new offices, new laboratories and many other buildings approved at the onset of the Kiboko Range Research Expansion Project had

been postponed indefinitely. Therefore, major amendments in development of the station's research program and funding priorities were undertaken.

A major crisis developed during the latter part of the third year. Ministry of Livestock Development money allocations had been exhausted and all of the operational funds were "frozen" by the GOK. Therefore, even though the contract stated the GOK would provide operational funds for the Kiboko Range Research Expansion Project, the shortage of funds made the agreement impossible to continue. Therefore, USAID funds from the project were used regularly to help the GOK purchase petrol and diesel (and other supplies) until the USAID funds for these purposes were exhausted in 1985.

The two previously mentioned setbacks made it necessary to alter goals and objectives and to amend the budgets. Many of the services, supplies and facilities promised at the start of the project could not be expected.

Dr. Ned S. Raun, Program Officer from Winrock Headquarters, worked with the staff from 29 January to 25 February 1982 concerning the status and changes anticipated because of the discontinuance of construction of new buildings at Kiboko. A site inspection was held in early May which included the Director of the USAID and the Director of Research for the Ministry of Livestock Development. The progress, research programs and anticipated amendments were reviewed.

The construction on the new roads at headquarters was finished. Six houses for senior staff were completed except for a means for sewage disposal. Some temporary septic tanks were built so that junior staff could occupy houses which were finished but could not previously be occupied because the sewage system remained under construction. Numerous requests

were made to increase the speed of construction of projects underway to meet the needs of the increased staff numbers. Many of the station's employees were required to live off station and commute to work daily. This situation continued to the project's end, 30 June 1986.

Construction was completed for the pre-fabricated units so 14 new offices could be occupied. The large extension being built onto the stores was finished. A request was made to finish the water tank at Boma 2, noting that nothing had been done since 1980 when the foundation was completed. The urgency for suitable water to meet the needs of the increased number of employees was stated as a very high priority. The tank at Boma 2 was constructed by the station's workers and was in use before the third year ended.

A curriculum for training students in range management at the station was developed. This curriculum was for university and institute students who regularly came to the National Range Research Station to receive training about range plants and range animals. At first the teachers were the Winrock Staff and as the Kenyan research officers became experienced and trained, they became the instructors. This program has been continued.

Some animals were surgically altered so that researchers could conduct studies using both rumen and esophageal fistulates. Stalls and holding pens (clinic) were constructed to house the experimental animals and to allow proper handling and protection from predators at night. Four Kenyans were trained to aid in surgery and to care for fistulated animals. On-the-spot instructions and training of the 4 assistants to collect dietary samples in the field and to do rumen digestion testing were carried out. Other animal nutrition procedures and techniques were started. After a thorough study of

past and present livestock records at the stations, procedures were begun for marking animals, taking inventory and storing records in a uniform and consistent manner.

The library resources were completely inventoried and procedures started for a card catalog system. A request was made for the trained librarian promised in the contract.

Many research programs were started during the third year and those already started for the officer's theses were continued. A tentative style and format was developed for reporting progress of research projects. Detailed progress reports were written for all of the ongoing studies at the National Range Research Station and the Buchuma Range Research Station. The majority of the research projects underway were to support the academic training programs of research officers who were obtaining Master of Science or Doctor of Philosophy degrees. The direct link between pastoralist problems and thesis or dissertation requirements at Texas A&M was not possible until later on.

An agreement was made with the Kenya Rangeland Ecological Monitoring Unit to conduct aerial surveys of the National Range Research Station at regular intervals. These counts of livestock and big game were necessary in order to estimate the extent of trespassing by livestock and carrying capacity for wildlife.

#### FOURTH YEAR

Seven research officers began their training in the United States during the fourth year. Those going to Texas A&M University were: Mr. S.

N. Onchoke who departed in July 1982 to begin a Bachelor of Science degree to be followed by a Master of Science degree. Departing in September 1982 to pursue a Master of Science degree were Mr. E. K. Maranga, Mr. S. B. Shaabani and Mr. D. K. Too and in January 1983 Mr. M. K. Mbui also departed to Texas to begin his Master's degree. Mr. N. K. R. Musimba departed in January 1983 to begin a Doctor of Philosophy degree at New Mexico State University, Las Cruces. Dr. Tariq Qureshi, the station veterinarian, was offered a scholarship by the Welder Wildlife Foundation, Sinton, Texas, to pursue a Master of Science degree and he departed in January 1983 for Texas A&I University, Kingsville.

Dr. Larry L. Tieszen was a consultant for the Kiboko Range Research Expansion Project in June 1982. His expertise was utilized working with the research officers in the ecology section and with Winrock scientists. In addition he transported samples to the USA for chemical and isotopic analysis in his laboratory. He filed an authoritative report at the National Range Research Station on, "Distribution of stable carbon isotopes in plant and soil compartments of an East African grassland-woodland complex." He speculated that in the past the National Range Research Station was formerly less heavily wooded than it is today.

Dr. M. J. Trlica departed from Kenya on 31 August 1982. His 2 year contract was ending. Dr. J. J. Norris and Dr. R. Ward both finished their tours of duty in December 1982. Dr. Norris completed 3.5 years of service to the Kiboko Range Research Expansion Project and Dr. Ward completed 2 years. Dr. D. F. Burzlaff became Chief of Party after Dr. Norris left and Dr. R. D. Child became Deputy Chief of Party. Dr. Gary E. Lewis became the Program Officer for the USAID Mission in Nairobi.

Mr. J. I. Kinyamario was Acting Director of the National Range Research Station for a brief period between the time when Mr. Musimba departed and when Mr. J. M. Wanyama became Acting Director in late January 1983.

Winrock hired three highly qualified and experienced personnel after they were approved by the Government of Kenya. They were selected to replace the vacancies of Drs. Norris, Trlica and Ward. Mr. Jon M. Skovlin, Range Water and Vegetation Specialist arrived in Kenya 14 December 1982. Dr. David L. Whittington, Range Livestock Specialist arrived on 13 January and Dr. Richard M. Hansen, Range Management Specialist arrived 14 January 1983. Drs. Blackburn and Stuth, Major Professors for some officers in Graduate School at Texas A&M University, were at the National Range Research Station advising thesis research in August 1982. Dr. J. L. Schuster was at the station assisting Mr. Woie with his data collecting during late February and early March 1983.

Dr. D. Lynn Drawe, Rob and Bessie Wildlife Foundation, Sinton, Texas was contracted as a consultant to evaluate the wildlife resources at the National Range Research Station. He spent August and September 1982 surveying wild ungulates and game birds at the station. He submitted an excellent report on, "Status, Proposed Research, and Management Plan for Wildlife on the National Range Research Station, Kiboko." His efforts laid the basis for wildlife studies which have continued.

Dr. R. H. Bernsten (sociologist) and Dr. A. H. Jacobs (development anthropologist) were contracted as consultants for the Kiboko Range Research Expansion Project. From May to August 1983 they worked at the National Range Research Station and other parts of Kenya attempting to develop a pre-extension program. Their report summarized the importance for recognizing

environmental, social, cultural and economic elements. They wrote an extensive report on, "Socio-economic aspects of range research in Kenya: a plan for reaching the ultimate target groups." Their report made it possible to develop a socioeconomics program within the Kiboko Range Research Expansion Project. In order to develop practical solutions to the problems of quantifying the amount of biomass available to grazing animals a consultancy was awarded to Dr. Charles D. Bonham. His report, "A Methodology to Determine the Vertical Distribution of Forage Biomass on Rangelands of Kenya: Principles and Practices" was based on data he and research personnel collected at the station in June and July 1983. Before coming to Kenya, Dr. Bonham had thoroughly reviewed the literature.

Vehicle and motor maintenance deteriorated in spite of daily suggestions to the station employees by the Winrock Technical Advisors. Many drivers were not responsive to suggestions or authority. The non maintenance of mechanical equipment had become a limiting factor. In February 1983 USAID entered into a personal service contract with Mr. Zahoor Malik, a Master Mechanic. Mr. Malik was assigned to the station on 1 April 1983 to initiate a program of training for updating mechanical skills and to develop a preventative maintenance program among drivers and other equipment users. USAID also provided funds for spare parts at no cost to the project. Mr. Malik was hired as Maintenance Engineer for the Kiboko Range Research Expansion Project after his previous contract with USAID ended. His presence was absolutely necessary and invaluable for servicing generators, water pump engines, tractors, lorries, landrovers and other electrical and mechanical equipment. He successfully kept the equipment operating until the project's funds for spare parts was exhausted in 1986. His work tremendously enhanced the development of the station.

An intensive evaluation of livestock management at the National Range Research Station was conducted in early 1983 by Winrocks's Technical Staff. The report and recommendations by Dr. Blackwell made during the first year and those by Dr. Ward done during the third and fourth years were examined. The recommended livestock management procedures prescribed had not been followed by the employees assigned to conduct the work. Therefore, Mr. Robin Long, who had many years of experience in ranch and livestock management in Kenya, was contracted in February 1983 to spend two days each month advising station personnel and developing a livestock management plan for the research station.

A contract was made between the GOK and East African Power and Lighting Company Limited to construct a stepdown transformer substation along the major powerline near Kiboko. This substation would permit the National Range Research Station, Kiboko, Simba and Makindu to eventually have a continuous flow of electricity. The station's headquarters received electricity from the substation on a 24-hour basis on 30 December 1985.

A water pipeline had been installed from the Kiboko Spring near Hunter's Lodge to Mwaitu Hill by June 1983. The contractor was also constructing a pumping station at Kiboko Spring and a 100,000 gallon water storage tank on Mwaitu Hill. However, the water from Kiboko Spring was first pumped to the storage tank using diesel power in March 1986.

The oxidating ponds, for the sewer system whose construction started in 1979, were finished during the fourth year. By the end of June 1986 the sewer system and the oxidation ponds had never been tested or used. All the houses at the headquarters have temporary septic tanks and drain lines.

A workshop was held in May 1983 concerning continuation of the research at the National Range Research Station after the Kiboko Range Research Expansion Project ended. The workshop was attended by officials from USAID, National Range Research Station and Ministry of Livestock Development. A report was written which outlined the essential needs of a follow up program. Drs. Child and Burzlaff submitted to the Ministry of Agriculture and Livestock Development a proposal for a follow-on project (PRE-PID FOR A RANGELAND DEVELOPMENT PROJECT). A workshop was held in June 1983 whose purpose was to develop stronger linkages between all the departments and agencies who are concerned with rangelands and arid land farming in Kenya. Representatives who participated were from International Livestock Centre for Africa, Kenya Rangeland Ecological Monitoring Unit, International Program for Arid Lands, National Dryland Farming Research Station, Range Management Division and National Range Research Station. Everyone present agreed that research and extension linkages needed to be improved.

Amendments to the contract were made which extended the length of the Project until 30 June 1986. Changes were made so money could be used more effectively to assist the National Range Research Station. Changes also were made in technical assistance and to facilitate completion of training for research officers who normally needed more time to complete the requirements for a degree than that planned for in the budget.

There were 43 research projects underway or in the final planning stages by the end of June 1983. The full operation phase for research continued into the sixth year. Data collecting and field work subsided and manuscript writing and research planning then increased. A procedures manual was prepared which presented guidelines for proposals, reviews, and maintaining permanent files of original research data.

Dr. R. Dennis Child finished his tour of duty and returned to the United States in June 1983. The position of Range Ecologist which Dr. Child had held was no longer deemed necessary so that position was not continued. Dr. Child became the Program Officer for the project at Winrock's headquarters in Arkansas. He kept this assignment until the Kiboko Range Research Expansion Project ended. Soon after returning to the United States Dr. Child prepared a paper on "Research and Training Needs for the Rangelands of Kenya and East Africa." This important paper has been consistently consulted by donor agencies. Dr. Richard M. Hansen became Deputy Chief of Party of the Kiboko Range Research Expansion Project on 1 July 1983. He also served as External Examiner for the Range Management Department at University of Nairobi.

Additional training had been approved for three research officers to obtain Bachelor of Science degrees. In January 1984, Mr. F. K. Asambo and Mr. A. A. Tifow departed for Utah State University and Mr. M. O. Ojowi departed for California State Polytechnic University, Pomona.

#### FIFTH YEAR

Two significant events caused serious setbacks during the fifth year of the Kiboko Range Research Expansion Project. First, Kenya experienced a drought which began soon after the long rains of 1983. Rainfall remained about 50% below normal for over 18 months. During this drought above normal expenditures were necessary at the National Range Research Station and the shortfall in money from the GOK made it essential to use project funds, budgeted for research projects, for station operation. The drought ended in October 1984 when the short rains were about 60% over normal.

The second event concerned the reassignment of GOK administrators who were responsible for the National Range Research Station. During the fifth year the Ministry of Agriculture and the Ministry of Livestock Development were combined in a single Ministry of Agriculture and Livestock Development. The organizational restructuring was extremely slow. For several months there was uncertainty concerning the GOK officials who could be contacted for support or advice concerning operational procedures during the drought of 1983-84. Dr. W. W. Wapakala was appointed Director of Research for the Ministry of Agriculture and Livestock Development and thus he became the overall head of the Kiboko Range Research Expansion Project.

The completion date for ending the Kiboko Range Research Expansion Project was extended to 30 June 1986 by the sixth amendment to the contract. Operating expenses of the station in the drought, especially May, June and July 1984, were paid from project funds because the GOK was unable to meet the station's needs. This shortfall of GOK funds made it necessary to request another amendment to increase funding to the project from USAID. (See Appendix 5).

Dr. Curtis R. Nissly became USAID's Program Officer for the project during the fifth year. The Nairobi USAID Mission appointed a team of consultants to review the Kiboko Range Research Expansion Project in March 1984.

In early August 1983 Professors Blackburn, Smeins and Stuth returned to the National Range Research Station to advise and assist Mr. Mbakaya, Mr. Mnene, Mr. Shaabani, and Mr. Too who had also returned to the station to collect thesis research data. Mr. Musimba had returned also to complete

research for his Ph.D. thesis. He was assisted and advised by Dr. Whittington. The socioeconomics effort began by Drs. Bernsten and Jacobs during the fourth year was expanded during the fifth year. They were in Kenya for about six weeks during the first half of the fifth year collecting social and economic data and preparing reports. The socioeconomic effort was greatly enhanced in October 1983 when Dr. Adrian W. Mukhebi was employed by Winrock International on a half-time basis to head the socioeconomic effort of the Kiboko Range Research Expansion Project. His other half-time employment with Winrock was at Maseno for the Small Ruminant Cooperative Research Support Project. Dr. Mukhebi also served as the external examiner for the Agricultural Economics Department at Egerton College and the University of Nairobi.

Livestock handling facilities and renovation of bomas were begun under the direction of Mr. Long and Dr. Whittington during the fourth year. These improvements were nearly completed at the end of the fifth year. Maasai from the Kiboko Group Ranch were given a contract to herd the cattle, sheep and goats used for one of the grazing management studies. The GOK civil servants who had been assigned to this task had failed to provide satisfactory animal care. They had lost many animals and were unable to find the correct pastures much of the time and on-the-job instructions were not followed. Initially, there was no absenteeism among the Maasai and the animals were grazed on the correct pastures from 7:00 a.m. until 6:00 p.m. each day. No livestock was "lost in the bush" and the animals gained weight and there were no deaths due to disease. The contract with the Maasai lasted about one year. However, toward the end of the contract the Maasai herders had become lax and the quality of their work seemed to have deteriorated.

During the fifth year and extending into the sixth year the research station was used extensively by herds of cattle owned by pastoralists and local farmers. Early in the drought their livestock had depleted the forage where they mornally grazed. The National Range Research Station had been stocked properly and grazed correctly by livestock and there was an abundance of forage. The grazing experiments may have been affected more by the drought than by the trespassing animals. The station's livestock were unaffected by the drought and death losses were extremely low.

Mukhebi's study was the only investigation on the drought. He reported that the Kajiado district lost 76% of its cattle herd, 59% of its sheep flock and 50% of its goat flock. In economic terms, this loss is worth about US \$40 million. The southern part of Machakos district lost 61% of its cattle herd, 61% of its sheep flock and 61% of its goat flock. For the whole of Machakos district, the economic loss for cattle amounted to about US \$14 million. The economic loss of livestock per capita for all of Kenya was estimated to have been about KSh 322 (US \$1 = KSh 16, Nov. 84).

#### SIXTH YEAR

The research arm of the National Range Research Station was divided into sections by Acting Director Wanyama. (see Appendix 4). He established: Accounts Section, Purchasing on Supplies Section, Farm Management Section (which included a Transport Section), Animal Range Nutrition Section, Cattle Management Section, Sheep and Goat Management Section, Wildlife Management Section, Range Plant Ecology Section, Soil and Watershed Management Section, Agrometeorology Section, Socioeconomics Section and Research Support Services. Mr. Wanyama appointed Kenya civil servants to be in charge of the

various sections and subdivisions. This was a major step toward developing an organized system at the National Range Research Station. The major responsibilities were delegated to the senior research officers. Mr. Wanyama also started the publication of Technical Reports.

Nine research officers completed graduate degrees and returned to the National Range Research Station during the sixth year of the project. Texas A&M University awarded a Ph.D. degree to B. M. Woie and Master of Science degrees to P. M. Kamau, P. F. Kibet, D. S. Mbakaya, M. K. Mbui, W. M. Mnene, S. B. Shaabani and D. K. Too. T. Qureshi completed his Master of Science degree at Texas A&I University, Kingsville, Texas where he had been funded to study by the Welder Wildlife Foundation.

Word processing and computer analysis of research data became possible at the station early in the sixth year. An IBM-PC XT computer and a printer were purchased by the project to enhance the research and professional capabilities of the National Range Research Station. Initial responsibilities for management of the computer were shared by Drs. Jacobs and Whittington and Mr. Musembi was selected to head the computer services for the station. Dr. R. Dennis Child provided essential on-the-job training for users of the IBM-PC XT during November and December when he was at the station. The demand for use of the IBM-PC XT was so great that two more IBM computers and another printer were purchased by the project. Dr. Alan H. Jacobs completed his consulting for the socioeconomics section in August 1985. Dr. Richard N. Connor of Texas A&M, who became Mr. Onchoke's major professor, was at the National Research Station advising and assisting in Onchoke's thesis research on ranching systems in the Kajiado district. Mr. Onchoke's research was in part a study of pastoral economics.

Dr. James G. Teer, Director of the Welder Wildlife Foundation, Sinton, Texas, was a consultant for about six weeks early in the sixth year. Dr. Teer reported on the feasibility of an East African conference on the role of wildlife in the management of natural resources and he prioritized problems in research programs for wildlife. His two visits culminated in a highly successful workshop on "Livestock/Wildlife Interfaces." The proceedings of this workshop held at Taita Hills Lodge 22-25 April 1985 resulted in a 300 page book which was published in June 1986. The proceedings were published as a special publication in the "Bulletin of Animal Health and Production in Africa" which is sponsored by the Inter-African Bureau for Animal Resources of the Organization of African Unity, Nairobi. Copies were distributed to about 1000 subscribers and libraries on the "Bulletin's" mailing list and to the participants of the workshop.

A seventh amendment was prepared and submitted to the Ministry of Agriculture and Livestock Development on 9 October 1984. The amendment requested \$197,827 in additional funds which USAID officials suggested was available to the Kiboko Range Research Expansion Project to cover the shortfall in GOK funding during the drought. The amendment was signed and sent to the Ministry of Agriculture and Livestock Development for GOK approval. By July 1985 the available USAID funds was reduced to \$120,000 because GOK had not approved the amendment and a search revealed the amendment was "lost." Another amendment request was made in July 1985 which was lost. Another amendment request was initiated in December 1985. This amendment was approved by the Ministry of Agriculture and Livestock Development and was sent to Treasury for approval. Drs. Hansen and Woie spent much time and made frequent visits attempting to speed up the procedure. The Ministry of Treasury approved amendment seven on 13 June

1986. Dr. David L. Whittington resigned his position as animal scientist effective 31 October 1984. Funds available in the project's budget were so depleted by the drought that his position was not filled. Mr. Robin Long terminated his position at the end of April 1985. His input had resulted in functional handling facilities and an inventory method for livestock. Mr. Long was concerned about the apparent reluctance of station herders and boma foremen to be responsible for caring for animals and keeping accurate records.

Mr. Justin M. Wanyama was transferred to the Dairy Training School, Naivasha, as Principal of the school on 15 October 1984. Dr. David M. Chimwani, Station Veterinarian, became Acting Director for a short period until Director Woie returned to assume the Directorship in early 1985.

#### SEVENTH YEAR

Dr. R. M. Hansen became Chief of Party effective 1 July 1985. He and Mr. Zahoor Malik, Maintenance Engineer, and Dr. Adrian W. Mukhebi, Agricultural Economist (half-time for the project) were the Winrock International employees who remained during the phase out of the Kiboko Range Research Expansion Project which ended on 30 June 1985. Mr. Jon M. Skovlin's contract ended on 30 June and he departed on 12 July 1985. Dr. Donald F. Burzlaff, former Chief of Party, departed for the United States on 3 August 1985.

Mr. Francis K. Asambo and Mr. Ally A. Tifow obtained Bachelor of Science degrees at Utah State University and returned to the station. Mr. Meshak O. Ojowi obtained a Bachelor of Science degree at California State Polytechnic University, Pomona, and also returned. Nashon K. Musimba

completed a Ph.D. degree at New Mexico State University and Mr. Sospeter N. Onchoke obtained a Master of Science degree at Texas A&M University but neither had returned to work at the station when this final report was written.

In July 1985, a request was submitted to the Ministry of Agriculture and Livestock Development to permit Mr. D. T. ole Kimongo to attend a special six months course at the College of African Wildlife Management in Tanzania. Clearance was started in October. Although the necessary papers and documents were misplaced and lost twice at headquarters in Nairobi, Mr. Kimongo departed for training in mid January (two weeks late). Mr. Kimongo had not returned to his work at the station when this final report was written.

Mr. Robert D. Havener, President, and Dr. Ned S. Raun, Vice President of Winrock International were in Kenya in late July and visited the National Range Research Station on 26 July 1985.

The two main Caterpillar generators remained functional until electric power from the main line was obtained on 30 December 1985. They were the backbone of the station in supplying power to the houses, offices, laboratories and computers. Most of the time these diesel powered generators have run twelve hours per day (6:00 a.m. to 9:00 a.m., 12 noon to 3:00 p.m., and 5:00 p.m. to 11:00 p.m.). The small diesel generator provided electricity during the daytime hours (when needed) while the big generators were not operating. The small generator provided power to the laboratories, repair shops and the building housing the computers and photocopy machine.

There were frequent holdups in energizing the station. The Kenya Power and Lighting substation, near the main transmission line, was ready to be energized on 5 October 1985. Some of the old houses, station headquarters and other defectively-wired sites had to be rewired and new ground cables installed. Various other small repairs or replacements had to be accomplished. The process took longer than anticipated. No GOK funds were available when Kenya Power and Lighting completed the substation. The Director had to get supplementary funds to implement the remaining work. More than a dozen trips to Nairobi and Machakos were required. The repair work had to be tendered to a private contractor who was registered with the Ministry of Works, Housing and Physical Planning and was acceptable to Kenya Power and Lighting Company as a competent contractor. The contractor completed his contract on 22 November 1985. The process entailed issuing a work completion certificate. The inspectors found additional defects on 23 and 24 December 1985 which were corrected before a certificate was issued. Between 2:00 and 3:00 p.m. on Monday, 30 December 1985 the electric system was tested and Kenya Power and Lighting Company switched on the electricity.

The 100,000 gallon water storage tank on the north side of Mwaitu Hill was finished during the sixth year and the pumphouse was finished by September 1985. Electric lines had been installed to the pumphouse from the electric transformer substation so that water could be pumped to the station's headquarters with electricity. A standby diesel powered generator in the pumphouse was used to test the pipeline and tank. The connection of electricity from the pumphouse to the electric lines had not occurred at the time of writing this report. Still wanting was adequate electrical wiring, a meter and a meter box.

A highly successful workshop was held at Egerton College Agricultural Resources Centre, Njoro, Kenya, 1 to 5 April 1986 (see Appendix 1). Much time and effort was devoted to this workshop from September 1985 to April 1986. Tentative plans for this conference were developed at the conclusion of the Taita Hills workshop on Wildlife/Livestock Interfaces held in April 1985. Steering Committee meetings were held at the Kenya Rangeland Ecological Monitoring Unit Headquarters in Nairobi. Dr. Woie, Director of the National Range Research Station was Chairman of the Steering Committee as well as overall Chairman of the conference. All major sectors of range management in Kenya were represented on the Steering Committee. There were over 70 persons attended the workshop and there were 46 papers presented. Papers were presented by each of the senior research officers who were at the National Range Research Station at the time of the meetings. There are about 700 pages of double spaced manuscript. Tentative plans are to publish the papers as a book as soon as possible.

Dr. Harold F. Heady gave the keynote address at the workshop on Range Development and Research at Egerton College. The recorders and reviewers for the workshop sessions were Drs. Blackburn, Stuth, Trlica, Child, Schuster and Smeins. They had been closely associated with the Kiboko Range Research Expansion Project and the officers at the National Range Research Station. During the week following the workshop at Egerton the above named expatriots traveled to the National Range Research Station. They advised and gave on-the-spot suggestions to the research staff. They also reviewed manuscripts and research proposals for the station's officers. They provided support and encouragement to the station's personnel and renewed old friendships.

The research officers who had returned to the National Range Research Station were busy preparing papers for publication (see Appendix 2) and were busy planning new research and writing research proposals during the seventh year. In addition, some research projects which had been started earlier (but not needed for a thesis) were being phased out.

During the latter half of the seventh year Dr. Woie and the senior research officers prepared research proposals and budgets for the National Agriculture Research Project Proposal. GOK has proposed that the National Range Research Station will have national responsibility for all range research. The research program will focus on the management, utilization and improvement of range for increased animal productivity. Areas of emphasis will include livestock production systems in the pastoral regions, studies on animal production constraints and the design, development and testing of technologies for ensuring the sustainability of livestock production in the range areas. Specific attention will be paid to the development of drought and range management strategies as bases for the overall development of rangelands in Kenya.

The National Range Research Station will have sub-centres at Buchuma and Marsabit and will cooperate with the Naivasha Research Center in cattle and small ruminant breeding, Garissa Research Center in range management and with Muguga Research Center in animal nutrition and physiology, especially the physiology of stress on reproduction and productivity.

The Range Pastoral Systems Program will focus on the investigation of the dynamics of livestock production systems in the pastoral districts. Emphasis will be on the collection and collation of data on fertility, growth, mortality, diseases and parasites, breeding of livestock and

pastoral management practices and rangeland ecology as the bases for the development of medium and long term strategies for rangeland management for increased livestock productivity. Such strategies, technologies and interventions will be tested for acceptability and impact on rangeland production. A group of range ecologists, livestock scientists, agro-climatologist, socioeconomist, range scientists and veterinarians will operate as an integrated team on this program.

The Range Animal Production Constraints Program will focus on studies on the constraints in the productivity of range livestock. Emphasis will be on the effects of stress, trekking, feed and water shortage, grazing regimes and livestock/wildlife interactions etc. A team of range scientists, socioeconomists, nutritionist, physiologist, animal health scientist, ecologist and wildlife scientist will formulate inter-disciplinary projects which will lead to the development of range management strategies for the amelioration of identified constraints in both ranching and pastoral communities.

The Range Management Technologies Program will be on the design, development and testing of range management technologies drawing on existing knowledge. Special emphasis will be on the development of technologies for group, cooperative and other ranching systems, and on rangeland productivity studies. A multi-disciplinary team similar in composition to those of other programs will be strengthened in the area of range improvement to operate this program.

The Research Support Services Program will comprise an agro-climatologist, biometrician and an agricultural chemist who will provide services in data collection, collation and analysis.

The National Veterinary Laboratories Kabete will have responsibility for aspects of veterinary research and research-related services to be done in cooperation with the National Range Research Station. Research work will focus on acaricide use and evaluation for tick control, studies on tick resistance to acaricides, studies on mineral deficiency diseases in all classes of priority livestock, and studies of diseases of wildlife.

Several research planning workshops were held with personnel from the International Livestock Centre for Africa and from the National Dryland Farming Station at Katumani. These three research agencies have planned and prepared proposals which link them together in cooperative integrated farming systems research. Since there is a trend toward establishing mixed farming in traditional pastoral areas steps were taken to link the three research entities together.

Attempts to get short term funding from USAID to carry over the researchers at the National Range Research Station until new monies are made available from donors or GOK were not successful at the time the final report was written.

The socioeconomics team wrote papers which describe the effects of the 1983-84 drought in Kenya (see references in Appendix 2) on livestock in the Kajiado Districts and southern Machakos District.

Copies of the theses (see Appendix 3) of the research officers were deposited at all the major science libraries in Kenya.

National Range Research Station

Kabete Veterinary Laboratories

USAID-Nairobi Headquarters

University of Nairobi

Moi University

Kenyatta University

Egerton College

Agriculture Documentation Centre-Kilimo

Agriculture Information Centre

## APPENDIX 1

### RANGE DEVELOPMENT AND RESEARCH IN KENYA

The Kiboko Range Research Expansion Project and Winrock International sponsored a workshop held at the Agricultural Resources Centre, Egerton College, Njoro, Kenya, on 1 to 5 April 1986.

Winrock International was the contractor for the Kiboko Range Research Expansion Project headquartered at the National Range Research Station. The project was supported by the Government of Kenya and USAID (United States Agency for International Development). The project began 21 June 1979 and will end 30 June 1986. There will be 16 Kenyans who will have earned Master's degrees and 2 who will have earned Ph.D. degrees while serving as research officers for the project. Some of them presented papers at the conference.

The speakers at the workshop were selected by the Steering Committee. Each speaker was requested to prepare an abstract to be made available for participants at the start of the workshop and to write a paper to be published in a book. Any opinions, findings, and conclusions or recommendations expressed at the workshop or in the publications are those of the author(s) and do not necessarily reflect the views of the Government of Kenya, USAID or Winrock International.

#### Steering Committee

B. M. Woie, Chairman National Range Research Station P.O. Box 12 Makindu	Mrs. Susan Mbugua Kenya Rangeland Ecol. Monitoring Unit P.O. Box 47146 Nairobi
R. M. Hansen, Secretary/Treasurer Winrock International P.O. Box 12 Makindu	H. A. Mwendwa Kenya Rangeland Ecol. Monitoring Unit P.O. Box 47146 Nairobi
A. A. Aboud Range Management Department Egerton College Njoro	T. J. Njoka Range Management Department P.O. Box 29053 Nairobi
R. K. Langat Range Management Division P.O. Box 68228 Nairobi	M. O. Olang Tani & Athi Rivers Develop. Authority P.O. Box 47309 Nairobi
E. K. Maranga National Range Research Station P.O. Box 12 Makindu	

## Coordinators For Presentations

### Production Systems

Chairman of Session 1

A. M. Chege  
Range Management Division  
P.O. Box 68228  
Nairobi

Recorder/Reviewer of Session 1

W. H. Blackburn  
Range Science Department  
Texas A&M University  
College Station, TX 77843 U.S.A.

### Ranch/Livestock Management

Chairman of Session 2

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P.O. Box 29053  
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### Ecology/Environment

Chairman of Session 3

H. F. Heady  
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Recorder/Reviewer of Session 3

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Range Science Department  
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Fort Collins, CO 80523 U.S.A.

### Socioeconomics/Marketing

Chairman of Session 4

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International Livestock Centre  
for Africa  
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Recorder/Reviewer of Session 4

R. D. Child  
Winrock International  
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### Training/Education/Extension

Chairman of Session 5

P. K. Kusewa  
Katumani Research Station  
P.O. Box 340  
Machakos

Recorder/Reviewer of Session 5

J. L. Schuster  
Range Science Department  
Texas A&M University  
College Station, TX 77843 U.S.A.

## Range Inventory

Chairman of Session 6

J. W. Kufwafwa  
Kenya Rangeland Ecological  
Monitoring Unit  
P.O. Box 47146  
Nairobi

Recorder Reviewer of Session 6

F. E. Smeins  
Range Science Department  
Texas A&M University  
College Station, TX 77843 U.S.A.

### PROGRAMME AND SPEAKERS

Tuesday, April 1

- 1:00 to 5:00 - Egerton College bus will meet participants opposite Police Headquarters in front of the Kenyatta Conference Center for transport to Njoro. The bus must depart at 2:00 p.m. in order to arrive at Egerton College by 5:00 p.m.  
5:00-6:30 - Registration at Agriculture Resources Centre.  
8:30-10:00 - Film show in Conference Room.

Wednesday, April 2

- 8:00-8:40 - Opening Remarks - Wilson Nguyo, Registrar (Academic) of Egerton College.  
8:40-9:20 - Opportunities for Rangeland Development, Keynote address - H. F. Heady, Professor Emeritus, University of California, Berkeley, U.S.A.

Session 1: Production Systems

Chairman: A. M. Chege

Recorder/Reviewer: W. H. Blackburn

- 9:20-9:40 - Group Ranches in Kenya - P. L. K. ole Sadera  
9:40-10:00 - Grazing Block Development in Kenya - R. M. M. Muriuki  
10:00-10:30 - History of Range Management in Kenya - J. H. N. Mwangata  
10:30-10:50 - Commercial Ranches in Kenya - R. K. Langat  
10:50-11:10 - Ranch Planning in Kenya - Z. J. Mwangi  
11:10-11:30 - Multiple Uses of Rangelands in Kenya - W. K. Ottichilo and H. A. Mwerwa  
11:30-11:50 - Land Use Planning in Kenya - M. O. Olang & E. K. Maritim  
11:50-12:10 - Discussion for Production Systems

Session 2: Ranch/Livestock Management

Chairman: C. N. Karue

Recorder/Reviewer: J. W. Stuth

- 12:10-12:30 - Chemical Composition and Nutritive Value of Natural Pasture Herbage of Semiarid Areas - S. Tessema
- 12:30-12:50 - Botanical Composition and Selection of Diets by Range Cattle - P. F. K. Kibet
- 1:00-2:00 - Lunch Break
- 2:00-2:20 - Effects of Available Forage on Goat Dietary Selection and Nutrition - P. N. Kamau
- 2:20-2:40 - Environmental Factors Influencing Productivity of Sahiwal Cattle at Naivasha - B. A. J. Mwandotto
- 2:40-3:00 - Effect of Burning on Soil and Plant Water Relations in a Bushed Grassland in Kenya - A. R. Ali, F. E. Smeins and M. J. Trlica
- 3:00-3:20 - Effects of Prescribed Burning on Cattle and Goat Diets - M. K. Mbui
- 3:20-3:40 - Diet Quality and Intake of Steers Under Range Conditions - W. N. Mnene and J. W. Stuth
- 3:40-4:00 - Use of Fecal Nitrogen Indices to Predict Cattle Diet Quality - S. B. Shaabani and J. W. Stuth
- 4:00-4:20 - Digestive Capabilities of Sheep, Goats, Cattle and Camels - W. E. Migongo-Bake, D. L. Whittington, and R. D. Child
- 4:20-6:00 - Coffee/Tea Break and Discussion for Ranch/Livestock Management

Thursday, April 3

Session 3: Ecology/Environment

Chairman: H. F. Heady

Recorder/Reviewer: M. J. Trlica

- 8:00-8:20 - The Seasonal Climate of Rangelands - D. K. Musembi
- 8:20-8:40 - Effects of *Panicum maximum* and *Digitaria macroblephara* on Water Infiltration - S. K. Cheruiyot
- 8:40-9:00 - Infiltration and Soil Loss as Influenced by Vegetation Cover Types - D. S. Mbakaya
- 9:00-9:20 - The Role of Rodents in the Rangeland Ecosystems of Kenya - G. H. G. Martin
- 9:20-9:40 - Diets of Rodents in a Dry Sub-humid Kenyan Grassland - N. O. Oguge
- 9:40-10:00 - Discussion of Climate, Soils, Water, Rodents
- 10:00-10:30 - Coffee/Tea Break
- 10:30-10:50 - Foraging Preference of the African Armyworm - J. I. Kinyamario & F. M. Muthuri
- 10:50-11:10 - An Ecological Perspective of the Phytosociology of Woody Acacia-Herbaceous Understory Complex - E. K. Mwangi
- 11:10-11:30 - Effects of Defoliation Frequency and Intensity on Production of Grassland Communities - D. K. Too, F. E. Smeins, and R. D. Child
- 11:30-11:50 - Effects of Defoliation on Range Grasses - B. M. Woie
- 11:50-12:10 - Range Research at Chemeron - F. W. Lusenaka
- 12:10-12:30 - Kenya Arid Lands Research Station - W. J. Lusigi
- 12:30-12:50 - Discussion for Ecology/Environment
- 1:00-2:00 - Lunch Break

Session 4: Socioeconomics/Marketing

Chairman: F. Chabari

Recorder Reviewer: R. D. Child

- 2:00-2:20 - Evolution of Individuation of Group Ranches in Maasailand - I. K. ole Pasha
- 2:20-2:40 - Economic Justification for Range Research in Kenya - A. W. Mukhebi
- 2:40-3:00 - Marketing of Range Cattle in Kenya - E. Mweya
- 3:00-3:20 - Case Study of Livestock Marketing Among the Rendille of Marsabit - G. K. Njiru
- 3:20-3:40 - Livestock Marketing in Eastern Kajiado, Kenya - S. Bekure & F. N. Chabari
- 3:40-4:00 - Range Development Constraints and Research in Kenya - A. Aboud
- 4:00-4:20 - Ranch Credit Facility and Administration - R. E. M. Kachula
- 4:20-5:00 - Coffee/Tea Break and Discussion for Socioeconomics/Marketing
- 8:30-10:00 - Annual Meeting of East African Society of Range Management

Friday, April 4

Session 5: Training/Education/Extension

Chairman: P. K. Kusewa

Recorder/Reviewer: J. L. Schuster

- 8:00-8:20 - Diploma and Certificate Range Management Education in Kenya - I. K. Kemei
- 8:20-8:40 - University Range Education - T. J. Njoka
- 8:40-9:00 - Range Management Personnel & Deployment - J. M. Muteti
- 9:00-9:20 - Range Extension in Kenya - N. C. Towett
- 9:20-10:00 - Discussion for Training/Education/Extension
- 10:00-10:30 - Coffee/Tea Break

Session 6: Range Inventory

Chairman: J. W. Kufwafwa

Recorder/Reviewer: F. E. Smeins

- 10:30-10:50 - Monitoring Livestock and Wildlife in Kenya - Mrs. Susan W. Mbugua
- 10:50-11:10 - Comparisons of Aerial and Ground Counts of Big Game at Kiboko Range Research Station - T. Qureshi & F. K. Waweru
- 11:10-11:30 - The Use of NOAA AVHRR Imagery for Rangeland Monitoring - R. H. Lamprey and P. N. de Leeuw
- 11:30-11:50 - Application of Remote Sensing to Rangeland Resources, Management and Monitoring - L. A. Isavwa
- 11:50-12:10 - Implications of Range Condition and Trends in Resource Management - J. C. Ngethe
- 12:10-12:50 - Discussion for Range Inventory
- 1:00-2:00 - Lunch Break
- 2:00-3:00 - Closing Remarks - B. M. Woie, Director of National Range Research Station
- 3:00-6:00 - Writing of Summaries and Recommendations
- Saturday, April 5
- 8:30-11:30 - Egerton College bus returns participants to Nairobi

## APPENDIX 2

### ACCUMULATIVE LIST OF PUBLICATIONS AND PRESENTED PAPERS

- Ali, Ali R. 1984. The effects of burning on the plant water status of two shrubs and two grasses on a semiarid bushed grassland ecosystem in Kenya. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 110 p.
- Briske, D. D. and B. M. Woie. 1984. Plant response to defoliation. morphological considerations and allocation priorities. Proc. 2nd International Rangeland Congress. Adelaide, Australia.
- Burzlauff, D. F. and R. D. Child. 1984. The nature of tiller and stolon development of *Digitaria macroblephara*. Proc. 2nd Int. Rangeland Congress, Adelaide, Australia.
- Cheruiyot, S. K., W. H. Blackburn and R. D. Child. Water infiltration rate of soil dominated by *Digitaria macroblephara*. Journal of Range Management, January 1985 (submitted).
- Cheruiyot, S. K. and W. H. Blackburn. Water infiltration of soils under different plant species. Journal of Range Management, (to be submitted)
- Cheruiyot, Simeon K. 1984. Infiltration rates and sediment production of a Kenya bushed grassland as influenced by vegetation and prescribed burning. Master of Science Thesis in Range Science, Texas A&M Univ. College Station, Texas. 89 p.
- Cheruiyot, S. K., W. H. Blackburn, and R. D. Child. 1984. Infiltration rates and sediment production of a bush grassland as influenced by vegetation and/or prescribed burning. Proceedings of the 1984 Annual Meeting Society for Range Management. Rapid City, SD, U.S.A.
- Child, R. D., N. K. R. Musimba and M. J. Trlica. 1984. Grazing preference for native grasses and an introduced fodder shrub (*Leucaena leucocephala*) by sheep and goats in Kenya. Proc. 1984 Annual Meeting Soc. Range Manage. Rapid City, SD, U.S.A.
- Child, R. D., J. N. Njuki, R. M. Hansen and D. L. Whittington. 1986. Digestibility and protein content of *Leucaena leucocephala*. East Afr. J. Agric. & For. (in press).
- Hansen, R. M. 1984. How to write a scientific paper. KREMU Workshop on Scientific Report Writing, Nairobi, Kenya.
- Hansen, R. M., S. B. Shaabani and D. L. Whittington. 1984. Penetrable fraction of feces from sheep, goats, and cattle at NRRS-Kiboko. Third Small Ruminant Collaborative Research Support Program Workshop, Ministry of Agriculture and Livestock Production, Kabete, Kenya. 5 p.

- Hansen, R. M., D. L. Whittington, R. D. Child and J. M. Wanyama. 1984. Ruminant digestion consistency of zebu cattle. *J. Range Manage.* 37(3):283-284.
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#### Addendum

Papers presented and manuscripts prepared for publication at the Egerton College Workshop on Range Development and Research in Kenya by research officers at the National Range Research Station are listed in Appendix I.

### APPENDIX 3

#### UNIVERSITY EDUCATION PROGRAMS

The training program was extremely successful. Three research officers were awarded Bachelor of Science degrees, seven research officers obtained both Bachelor of Science and Master of Science degrees, nine research officers were awarded Master of Science degrees, and two research officers completed Doctor of Philosophy degrees. One officer failed in attempting to pursue a MS degree. In addition, four research officers participated in certificate training (three in United States, one in Tanzania) which enhanced their knowledge and skills for their assignments at the National Range Research Station.

Listed below are the names of the research officers sponsored by the Kiboko Range Research Expansion Project, the degrees they earned, and their specialized areas of training.

Trainee	Degrees	Specializations
Ali R. Ali	BS + MS	Range Ecology (fire)
Francis K. Asambo	BS	Range Management (economics)
Simeon K. Cheruiyot	BS + MS	Range Ecology (soil and water)
P. M. Kamau	BS + MS	Range Science (small ruminants)
P. F. K. Kibet	BS + MS	Range Science (large ruminants)
E. K. N. Kinuthia	MS	Range Science (large ruminants)
J. I. Kinyamario	MS	Range Ecology (fire)
Elias K. Maranga	MS	Range Ecology (fire)
David S. Mbakaya	BS + MS	Range Science (grazing systems)
Moses K. Mbui	MS	Range Science (livestock)
William J. Mnene	BS + MS	Range Science (livestock)

Trainee	Degrees	Specializations
D. K. Musembi	MS	Range Science (meteorology)
N. K. R. Musimba	Ph.D	Range Science (livestock)
Wa. N. Ndegwa	MS	Range Ecology (plant taxonomy)
Meshak O. Ojowi	BS	Animal Science (small ruminants)
Sospeter N. Onchoke	BS + MS	Range Management (economics)
Tariq Quereshi	MS	Wildlife Management (parasites)
Salim B. Shaabani	MS	Range Science (livestock)
Ally A. Tifow	BS	Range Management (soil & water) Daniel
K. Too	MS	Range Ecology (plant growth)
Benson M. Woie	Ph.D	Range Ecology (plant growth)

Presently, five research officers who were sponsored by the Kiboko Range Research Expansion Project have transferred from the National Range Research Station.

S. K. Cheruiyot to Egerton College, Njoro

E. K. Kinuthia to University of Nairobi, Nairobi

J. I. Kinyamario to University of Nairobi, Nairobi

W. J. Mnene, in charge of Buchuma Range Research Station

W. N. Ndegwa to the National Herbarium, Nairobi

Although the above named research officers have departed from the National Range Research Station they have continued to maintain close contact and research linkages with the station.

## ABSTRACTS OF RECENT THESES AND DISSERTATIONS

Aboud, A. A. 1982. Range management extension services on pastoral societies of Kenya. Master of Science Thesis in Agricultural Economics and Rural Sociology, Ohio State University, Columbus, Ohio. 173 p.

ABSTRACT: A major criticism of many pastoral extension programs is that the diffusion process assumes a top to bottom bureaucratic nature of implementation. Development planners and administrators identify target group problems, design development programs to solve the problems and implement development for the target groups, with little or no involvement of clientele in planning and decision making. The validity of this criticism in Kenya's range management extension programs for pastoral societies was evaluated.

A survey was conducted to evaluate a working hypothesis that involvement of pastoralists in program design and planning is directly related to program effectiveness, and to describe the range management extension organization and functions. Crosstabulations and nonparametric statistical coefficients support the working hypothesis. The range management extension organization and functions were described using frequency and percentile data.

Evidence produced in this thesis suggests that a low degree of involvement of pastoralists in the initial designing and planning of range development programs, has inhibited the effective implementation of these programs. It has also been shown that only the ranch committee members and ordinary members who joined the ranching schemes during their inception were consulted in planning.

Ali, Ali R. 1984. The effects of burning on the plant water status of two shrubs and two grasses on a semiarid bushed grassland ecosystem in Kenya. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 110 p.

ABSTRACT: A study to determine the effect of burning on xylem tension, transpiration rate and diffusive resistance of the *Acacia mellifera*, *Commiphora riparia*, *Digitaria macroblephara* and *Chloris roxburghiana* was conducted at the National Range Research Station, Kiboko from November 1982 to March 1983. Two study sites about 8 km apart having similar vegetation type and soil conditions were selected. Atmospheric parameters and soil water potentials were also determined. Four dates of seasonal and 18 dates of diurnal evaluations of the soil and plant parameters, covering one wet and one dry periods were selected. Root biomass and distribution data of the plants under the study were collected outside one of the experimental sites.

Results indicated that burning significantly influenced the xylem tension, transpiration rate and diffusive resistance (0.05 level) of the four plant species at some of the dates in a season. Most significant differences were numerically small and felt not to be biologically meaningful. Few large significant differences occurred on some dates but

the cause of their differences was not known. Some plant variables which were not measured such as stomatal density, leaf area and grass and shrub production are important in determining the influence of burning on water relations in the future studies.

Transpiration rates of plant species were predominantly influenced by atmospheric variables. Seasonal variation of xylem tension of the plants were predominately influenced by the seasonality of soil water potential. However, *Commiphora riparia* maintained low negative and relatively constant xylem tension values (-0.5 Kpa to -1.1 Kpa) throughout a wet and a dry period.

Root biomass and distribution data revealed that the four plant species exhibited different root morphology patterns. This suggested that the plants survived under similar environment by partitioning the water resource. Although the plants differed significantly (0.05 level) in water status measurements, it appeared that they had survived the water stress conditions through different drought avoidance mechanisms. *Commiphora riparia* shed its leaves during the drought period to reduce the transpiring surfaces. *Acacia mellifera* had numerous leaves but their sizes were small. The small leaf sizes reduced their amount of water loss to the atmosphere.

This information should be helpful in future studies in the field relating to soil and plant water relations in response to fire. It should also provide useful information pertaining to prescribed burning and grazing management decisions.

Cheruiyot, Simeon K. 1984. Infiltration rates and sediment production of a Kenya bushed grassland as influenced by vegetation and prescribed burning. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 89 p.

ABSTRACT: A drip-type rainfall simulator was used to assess the effect of prescribed burning and vegetation on infiltration rates and sediment production near Kiboko, Kenya. Two burning treatments were studied: February burn and October burn. Three vegetation types and no vegetation were also studied: bare ground (unvegetated), *Digitaria macroblephara*, *Hermannia alhiensis* and *Sporobolus fimbriatus*. The objectives of the study were to determine: (1) the influence of prescribed burns on infiltration rates, sediment production, plant standing crop and cover, soil bulk density, organic carbon and aggregates, (2) the factors that influence infiltration rates and sediment production, (3) the influence of *H. alhiensis*, *D. macroblephara*, *S. fimbriatus* and unvegetated areas on infiltration rates, sediment production, soil surface bulk density, organic carbon and aggregates and (4) interrelationships of vegetation and soil with infiltration rates and sediment production.

Forward stepwise multiple regression identified variables associated with vegetation (vegetation foliar cover, litter cover, standing crop and litter accumulation) and aggregate stability as being the most important in influencing infiltration rates and sediment production.

Infiltration rates were less and sediment production greater from the February burn which was applied prior to a long dry period than from

unburned areas. Gazelles and zebras grazed on regrowth of grasses. However, infiltration rates were greater and sediment production lower from the October burns which were applied prior to "short" rains as compared to unburned plots. Grazing pressure by wild animals in October burned plots was less than that in February burned plots because comparatively a large area was burned in October. Grasses in the October burned plots tended to have more leaves than stems whereas grasses in unburned plots had more stems than leaves. Infiltration rates were similar in areas with *S. fimbriatus* and *D. macroblephara* and greater than in bare ground or *H. alhiensis* areas. Sediment production was similar from *S. fimbriatus* and *D. macroblephara* areas and less than from bare ground or *H. alhiensis* areas. *H. alhiensis* had less sediment production than bare ground areas.

Gakahu, Christopher G. 1982. Feeding strategies of the plains zebra *Equis quagga boehmi* in the Amboseli ecosystem. Ph.D. Thesis in Wildlife Science. Univ. Nairobi. 179 p.

**ABSTRACT:** This thesis consists of two parts, one establishing the efficiency of plains zebra and a similar sized ruminant in digesting various components of forage and comprising the efficiencies of the two ungulates; the second part concentrates on zebra and looks at how the established digestive characteristics affect the species use of phagic resources, and specifically how these characteristics influence and constrain the feeding strategies, behaviour and group dynamics of zebra. In Part I results indicated that zebra is as efficient as the ruminant in the digestion of high quality forage, but as the quality of forage drops the ruminant is better off in digesting all forage components, except protein. The capacity of zebra to digest protein as well as the ruminant was apparent. Nitrogen recycling has, however, been used to explain the superiority of the ruminant to equines in protein assimilation. To date, little work has been done on this aspect on equines, and the little done indicates that equines may have the ability to recycle nitrogen. This calls for more knowledge on the physiology of equines protein digestion.

However, keeping the lack of this information aside, the larger intake of forage together with the rapid rate of passage of ingesta through a zebra's digestive tract, can allow the species to extract nutrients from forage at an equivalent or higher rate than the ruminant, thus compensating for the observed lower digestion efficiencies.

In Part II the availability of forage (quantity and quality) during different seasons and in different habitats is presented. These resources were found to be spatially and temporary variable. With this information an attempt was made to establish how the plains zebra adjust feeding strategies to cope with the fluctuating resources by looking at activity regimes, feeding behaviour, group size/composition and the distribution and movement of the species.

The principal hypotheses used to investigate these aspects were; that zebra will maximise benefits through maximising digestible intake per unit time and inter-individual distance, and that animal movement will follow the digestibility gradient in the habitat; that non-optimal foraging patterns can be explained by constraints such as predators, lack of utilizable standing water, etc.; that the efficiency of energy harvesting influences

reproductive success by making reproductive adjustments to optimize energy harvesting and finally that zebra increase harvesting at the expense of socialness.

Quantitative data on how zebra distribute time among various activities are presented. Grazing, moving and standing are the main activities. Interseasonal differences among age/sex categories in the proportions of time allocated to various activities have been drawn out from the data and their adaptive significance considered. On the whole, foraging time was a major factor governing the zebra's time budgets and zebra make "decisions" about how much time to allocate to foraging, so as to maximise or get the required intake of forage.

The adaptive responses in group dynamics to maintain optimal utilization of resources were established with data on seasonal changes in number of individuals in a group together with changes in composition of the group. Changes in group size were mainly due to the birth of foals. Most births occurred during the wet season when food resources were abundant.

Data on spacing of individuals and rates of progression while foraging together with temporal and spatial distribution of zebra were collected with a view to establishing how resources influence foraging patterns. The data and their seasonal variability have been presented. Zebra were found to progress faster and space out more when forage availability was poor. They also selected habitats with high quality and quantity. Zebra also preferred areas with grass greenness of over 50% especially during the dry season.

These observations have finally been discussed as processes for optimizing food intake. The factors which inhibit optimization were found to be availability of surface water and predator avoidance. The order of habitat preferences was found to correspond with the severity of these two factors.

The results of this study were found to be consistent with expectations based on the food selection model of optimization and support the validity of extending the model to habitat selection.

Kamau, P. M. 1985. Influence of browse availability on goat diets in an Acacia senegal savannah of south-central Kenya. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 98 p.

ABSTRACT: Seasonal effect of bush canopy on dietary selection and nutrition of goats was evaluated at Kiboko, south-central Kenya from June through November, 1982. Three mature esophageally fistulated East-African goats were used in the study on a one day graze, 28-30 day rest cycle. Treatment paddocks (2.25 ha), twice replicated were established in three bush conditions designated as light, moderate, and heavy with 13.1, 30.7 and 46.8% total canopy cover, respectively.

Dietary habits of the goats reflected a high degree of seasonal flexibility between forage classes, species and plant parts. Grass and grasslike species dominated goat diets in the early-dry period, particularly *Cenchrus ciliaris*, *Sporobolus pellucides*, *Eragrostis caespitosa*, *Digitaria macroblephara* and *Chloris roxburghiana*. *Talinum portulacifolium*, which

dominated the forb category, became an important component in the diet composition in the early wet season. Overall, browse played the most important role in the diets of goats mainly in the moderate and heavy bushed treatment paddocks from August through November. *Acacia senegal* pods were the major source of foods for goats in July and August. Grasses, forbs and woody species comprised 45%, 7% and 47% of goat diets respectively throughout the study period. Leaves, stems and fruits (seeds, pods and grass inflorescences) from all categories of vegetation were consumed by goats. However, leaves formed the greatest portion of the goat diets throughout the period of study.

*Solanum incanum*, *Grewia bicolor*, *Acacia mellifera*, *Acacia senegal*, *Cenchrus ciliaris* and *Sporobolus pellucides* were the most preferred woody and grass species during the early-dry and late-dry seasons while *Talinum portulacifolium*, *Solanum incanum*, *Acacia mellifera*, *Commiphora africana*, *Sporobolus pellucides* and *Chloris roxburghiana* were the most preferred vegetation species in the early-wet season.

Nutritional analysis of extrusa indicated that the goats were able to select diets adequate in protein to meet maintenance requirements throughout the period of study. A potential energy deficiency for maintenance was noted in moderate and heavy bushed conditions in August and heavy bushed conditions in September.

Kemei, I. K. 1982. Vegetation-environmental relationships on the Kiboko Range Research Station, Kenya. Ph.D. Dissertation in Range Science, Texas A&M Univ., College Station, Texas. 124 p.

**ABSTRACT:** Vegetation of Kiboko Range Research Station is a function of the interaction between prevailing biotic and abiotic environmental factors. To determine and explain the relationships between the vegetation and environmental factors, relevant characteristics of sample stands were taken and analyzed. Forty-four vegetation stands were sampled for vegetation foliar cover, frequency, soil, landscape and disturbance (fire and grazing) properties. Reciprocal Averaging ordination was used to describe vegetation relationships to environmental factors. Four major vegetation groups were identified. The vegetation of alluvial clayey soils was dominated by *Pennisetum mezianum*, *Bothriochloa insculpta*, *Ischaemum brachyatherum*, *Acacia drepanolobium* and *A. xanthophloea*. The vegetation of the basement complex system with sandy clay loams was dominated by *Chloris roxburghiana*, *Digitaria milanjiana* (macroblephara), *Enteropogon macrostachyus*, *Eragrostis caespitosa*, *Commiphora riparia*, *C. africana*, *Acacia tortilis*, *A. senegal*, *A. mellifera* and *Duosperma kilimandscaricum*. The vegetation of the lower volcanic area was dominated by *Sehima nervosum*, *Heteropogon contortus*, *Combretum apiculatum* and *Cordia gharaf*. The upper volcanic cone is dominated by *Chrysogon aucheri*, *Tricholeana eighingeri* and *Acacia hockii*. In specialized wet areas, *Themeda triandra*, *Andropogon distachyus* and *Combretum apiculatum* may be found. In denuded or heavily grazed areas, *Microchloa kunthii*, *Aristida keniensis* and *Eragrostis caespitosa* were the increaser or invader plants. In a seasonally waterlogged area in the basement complex system, *Echinochloa haploclada* was dominant grass species and *Acacia drepanolobium* was at the edges of the stand. The complexity of the interacting environmental factors (biotic and abiotic) make it difficult to determine the exact factors that have determined a specific vegetation

stand. However, soil properties, disturbance and landscape factors seem to be important in stand composition determination in the short-run. Climate, in addition to the above factors, determines the vegetation composition in the long-run.

Kibet, P. F. K. 1984. Influence of available browse on cattle diets in an Acacia savannah of East Africa. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 99 p.

**ABSTRACT:** A six-month study was conducted in southeastern Kenya to determine the influence of varying bush canopy cover on dietary selection and nutrition of mature esophageally fistulated heifers. Replicated moderately stocked paddocks (2.25 ha) each, were grazed one day every 28-30 days from June to November, 1982. Treatment paddocks were designated light, moderate and heavy bush conditions with 12.8, 31.5 and 49.8% total canopy cover, respectively. *Acacia senegal*, *Cordia ovalis* and *Grewia villosa* were the primary woody vegetation which created treatment effect. *Digitaria macroblephara* increased in composition with increasing canopy cover while *Chloris roxburghiana* decreased.

Heifer diets were dominated by grass and grasslikes irrespective of seasons. Animals ate more grass, less forbs and least browse across pastures and in all seasons. Animals consumed less grass and grasslike as canopy cover increased. *Digitaria macroblephara* and *Chloris roxburghiana* dominated animal diets throughout the study. Although more than 18 woody species were on offer only three species, *Acacia senegal*, *Hermania alhiensis* and *Boscia* sp. were selected by animals. These species constituted less than 1% of the animal diets. When green, animals ate *Commelina bengalensis* and *Talinum kafrum* forbs along with grasses. Diets during the long dry season were not diverse as for the wet season.

*Digitaria macroblephara*, *Chloris roxburghiana* and *Sporobolus pellucides* were the major grass selected by the heifers, whereas *Bothriochloa insculpta* was least preferred grass. Preference ratios indicated that cattle preferred grass and grasslikes, forbs and browse in that order. *Boscia* sp. was the most preferred browse while *Talinum kafrum*, *Commelina bengalensis* and *Asparagus* sp. were the most preferred forbs. Although *Acacia* sp. and *Hermania alhiensis* dominated the study site, they ranked least in diet preference order. Further ecological research is needed to determine the influence of these woody species on herbage production in order to recommend the economic advantage of these dominant species.

All the dietary nutrients met the maintenance requirements of the cattle throughout the study, except for crude protein which was deficient in August and September. There appears to be potential problem for rumen carbon:nitrogen (C:N) balance in cattle due to the relatively high DE values in relation to nitrogen content of the diets.

Kinuthia, E. K. N. 1982. An evaluation of the relationship between fecal nitrogen and digestibility, crude protein and dry matter intake of forages. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 38 p.

ABSTRACT: Fresh liveoak leaves (*Quercus* spp.) were mixed with fair quality alfalfa hay to form four rations containing 0, 25, 50, and 75% liveoak leaves on "as fed" weight basis. The rations were fed to four Spanish goats in a 4 x 4 Latin square sequence. Relationships between fecal nitrogen and the dry matter intake, total nitrogen intake, and dry matter digestibility were evaluated.

Daily feed intake, fecal output, and nitrogen balance were determined for each ration. In vivo percentage digestibilities of dry matter, organic matter and nitrogen were calculated. In vitro digestibility coefficients for ration organic matter were also determined. Feed and fecal samples were analyzed for nitrogen (N), neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent fiber nitrogen (ADFN).

Fecal nitrogen output expressed as either grams per day or percentage nitrogen, exhibited no significant ( $P > .05$ ) relationship to either percentage digestibility, dietary nitrogen, total nitrogen intake (g/d) or organic matter intake. However, percentage dietary nitrogen (PDN), total nitrogen intake (TNI), and percentage nitrogen digested (PND) decreased significantly ( $P < .05$ ) as the level of liveoak leaves in the diets increased. Urinary nitrogen (UN) in g/d varied among treatments and decreased with increase in the level of liveoak leaves ( $P < .05$ ).

Digestibility values differed among treatments; in vitro method gave higher digestibility values for rations one (0% liveoak) and two (25% liveoak) and significantly ( $P < .05$ ) lower value for ration four (75% liveoak). Treatment effects for in vivo organic matter digestibility were only significant at  $P = .3$  level. OMI was similar for rations one, two and three; however, addition of more than 50% liveoak leaves to the diets resulted in a significant ( $P < .05$ ) decrease in OMI. NDF and ADF of feed and feces were positively related to the level of liveoak leaves.

However, ADFN showed a positive relationship to OMD. This relationship suggested that by correcting total FN for bound N, then FNI technique may be used to predict digestibilities of browse-containing rations. This approach requires more data for validation.

Kinyamario, J. I. 1982. Effects of prescribed seasonal burning on a Combretum-Commiphora plant community in south central Kenya. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 60 p.

ABSTRACT: Studies of prescribed seasonal burning on a Combretum-Commiphora plant community were conducted in Kenya on the National Range Research Station, Kiboko, in 1980-81. Dry and early rainy season burns were applied in different months. Dry season burns were more effective in reducing woody plant canopy cover, height and increasing stem mortality for most species. Early rainy season burns produced greater numbers of resprouts as compared

to dry season burns. Numbers of plants for most species showed no significant change due to treatment. Composite plant canopy cover was highly significantly ( $P < .001$ ) reduced by January (dry season) burn. Some species, however, had their canopy covers greatly reduced by early rainy season burns compared to dry season burns, notably, *Combretum apiculatum*. In some species, *Combretum apiculatum*, *Lannea floccosa* and *Lantana virburnoides*, average plant heights were reduced more following early rainy season burns than after dry season burns.

Maranga, Elias K. 1984. Influence of *Acacia tortilis* trees on the distribution of *Panicum maximum* and *Digitaria macroblephara* in south central Kenya. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 94 p.

ABSTRACT: Water relations of *Panicum maximum* under *Acacia tortilis* and *Digitaria macroblephara* in the open, were studied under field conditions at the National Range Research Station, Kiboko, Kenya and under controlled environmental conditions at Texas A&M University.

Mean soil water potentials at 10 cm, 30 cm and 90 cm were significantly lower under *Panicum maximum* than *Digitaria macroblephara*. Leaf to air vapor pressure gradients and air temperatures were greater over *Digitaria macroblephara* than *Panicum maximum*. Change in temperature increases were higher for *Panicum maximum* than *Digitaria macroblephara*. Quantum flux over *Digitaria macroblephara* and *Panicum maximum* was  $1069 \text{ Em}^{-2}\text{s}^{-1}$  and  $537 \text{ Em}^{-2}\text{s}^{-1}$ , respectively.

Seasonal transpiration and leaf conductance to water vapor remained higher for *Digitaria macroblephara* than *Panicum maximum*. Leaf water potentials were generally lower for *Panicum maximum*. Increases in transpiration corresponded with increases in stomatal conductance. Transpiration for both species decreased with increase in leaf to air temperature differentials and increase in leaf to air vapor pressure gradients. *Digitaria macroblephara* had a higher leaf conductance to water vapor than *Panicum maximum* for the same leaf temperature.

Under conditions of non-limiting water supply in the growth chamber, *Panicum maximum* exhibited higher leaf temperatures and leaf to air saturation vapor pressures. Under moisture stress, *Panicum maximum* experienced lower leaf water potentials and reached wilting stage faster than *Digitaria macroblephara*. These differences may be due in part to morphological variations. As the plants became drier, diffusive resistance increased for both species with a steeper decline in *Panicum maximum* than *Digitaria macroblephara*. Leaf temperatures departed little between the species, however, a degree change in leaf temperature was associated with a greater change in leaf water potential for *Panicum maximum* than *Digitaria macroblephara*.

Based on the results of this study, it is possible to conclude that the distribution of *Panicum maximum* and *Digitaria macroblephara* reflect ecological differences arising from microclimatic modification induced by *Acacia tortilis*.

Mbakaya, David S. 1985. Grazing systems effects on infiltration rates and sediment production of a bushed grassland, Buchuma, Kenya. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 76 p.

ABSTRACT: A drip-type rainfall simulator was used to assess effects of grazing systems and vegetation on infiltration rates and sediment production at Buchuma Range Research Station, Kenya. Four livestock grazing treatments were studied: high intensity low frequency, rotation, moderate continuous and nongrazing. A combination of cattle and goats were utilized in each treatment. Two vegetation types and bare ground were also studied: *Chloris roxburghiana*, *Grewia bicolor* and bare ground (unvegetated). The study objectives were to determine (1) the influences of high intensity low frequency (HILF), rotation grazing (RG), moderate continuous grazing (MCG) and livestock exclosure (EXC) on infiltration rates and sediment production, (2) the influence of HILF and RG on vegetation, (3) the influence of *Grewia bicolor*, *Chloris roxburghiana* and bare ground on infiltration rates and sediment production, (4) interrelationships of plant standing crop and cover, soil bulk density, organic matter, soil moisture content, texture, aggregate stability and micro-relief with infiltration rates and sediment production.

Infiltration rates were consistently greater in vegetated plots than unvegetated plots. However, in the vegetated plots there was significant difference between the two vegetation types. Infiltration rates were greater under *Grewia bicolor* than in *Chloris roxburghiana*. Sediment production was greater from unvegetated plots than from vegetated plots.

The EXC had the greatest infiltration rate, although it was not significantly different from high intensity low frequency before grazing (HILFI), rotation grazing before grazing (RGI) and rotation grazing after grazing (RG2). The MCG pasture infiltration rates were less than other pastures although they were not significantly different from RG pastures. During August the greatest sediment production occurred from MCG pastures although it was not significantly greater than RG pastures. During December greatest sediment production was from RG2 pastures although it was only significantly greater than the EXC.

Stepwise multiple regression identified variables associated with vegetation: foliar cover, litter cover, standing crop and litter accumulation and soil aggregate stability as being the most important in influencing infiltration rates and sediment production.

Mbui, Moses K. 1984. Effects of burning on diet quality and associated production systems of cattle and goats on *Acacia* savannahs of Kenya. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 125 p.

ABSTRACT: A one-year study on the seasonal effects of burning on the dietary nutrition of cattle and goats was conducted at Kiboko from March 1982 to March 1983. Four esophageally fistulated heifers and two goats were utilized to collect diet samples from two adjacent burned and unburned paddocks. Pre-burn and post-burn herbaceous plant species frequency and density were evaluated in both paddocks. Post-burn shrub/woody plant

species were evaluated for density and canopy parameters. Diet samples were subjected to laboratory analysis for crude protein (CP) and organic matter digestibility (OMD). Digestible energy was calculated.

Burning did not significantly affect the frequency and density of most of the important forage species but enhanced species diversity and density of forbs and subshrubs at the expense of some desirable forage grasses. Burning enhanced the regeneration of some important browse species.

The highest diet quality values for cattle occurred during the wet seasons, while the dry seasons had the lowest values. Burning enhanced dietary CP content during the wet seasons and into the early part of the dry seasons. Also, burning had positive effects on dietary OMD during the wet seasons but for shorter durations.

The seasonal trend of dietary quality contents for goats was similar to that of cattle but the seasonal variations were not as dramatic as in cattle. Burning had detectable positive effects on dietary CP and OMD of goat diets during the wet season only.

A cattle nutritional profiles model for Sahiwal, Boran and small East African shorthorn zebu breeds with January, May and October mean calving dates was run to estimate daily CP and net energy (NE) balances at selected production levels and rainfall conditions. For above average rainfall conditions and unlimited forage availability, the heavier, higher milk-yield breeds benefited more than the lighter breeds, and the October mean calving date was more preferable. Under low rainfall conditions, there were many months of NE deficits, where the heavier Sahiwal had higher deficits than the Boran and zebu during lactation periods. No calving date was definitively better than the others because of prolonged NE deficits.

Mnene, William J. 1985. Influence of herbage/browse on nutritive intake of cattle grazing a *Commiphora* savannah in Kenya. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 97 p.

ABSTRACT: This study was conducted in a *Commiphora* savannah with two levels of bush canopy cover (68-70% vs. 30-32%) and two levels of herbage (434-499 kg/ha vs. 846-872 kg/ha) in August (dry season) and December (beginning of wet season), respectively, in 1983 on the National Range Research Station, Kiboko, Kenya. Effects of season, available herbage, and bush level on dietary composition, preference, crude protein, digestible organic matter, and intake by cattle were determined. Diets were collected via oesophageally fistulated heifers while intake was estimated by the use of the external markers erbium and ytterbium orally administered daily to steers.

*Chloris roxburghiana*, the most prevalent grass and *Sporobolus pellucidus* produced more under high bush while *Cymbopogon pospochilii* preferred open space. Availability of browse depended primarily on the shrub layer and was influenced by herbage level and precipitation.

Treatment effects were influenced most by percent tree canopy cover. Cattle selected more grasses than browse or forbs in that order, regardless

of bush level. More grass was selected in high herbage paddocks and during the dry season. Browse replaced grasses in all cases where grass consumption declined, particularly under low herbage level and during the wet season. *Chloris roxburghiana*, *Cymbopogon pospochilii* and *Digitaria macroblephara*, and *Hermania alhiensis* were the most dominant grasses and browse in the diets, respectively.

Leaf fractions were the most selected by cattle, especially in the high herbage paddocks and during the wet season. During the dry season under low herbage condition, cattle consumed recently shed dead browse leaves. Reduction of herbage mass led to selection of more dead and stemy material in the diets, and consumption of herbage relative to its availability, i.e., reduced preference. Selection of live material varied three-fold between wet season and dry season trials.

Season had a strong effect on dietary crude protein and energy intakes but had little effect on in vitro digestibility. Cattle had near or below maintenance level of crude protein and energy intake during the dry and beginning of the wet seasons, respectively. Digestibility was positively related to herbage level, the relationship being proportional. However, the influence of bush level on intake was inverse during the dry season. A drop in dietary digestibility required a similar drop in crude protein in order to effect a significant decline in intake.

Musembi, D. K. 1984. Identification of crop-growing seasons of semi-arid Kenya by analyses of soil moisture patterns. Master of Science Thesis in Meteorology, Texas A&M Univ., College Station, Texas. 133 p.

ABSTRACT: Eight stations with over 30 years of rainfall record were selected in the dry region of Kenya, east of 38°E longitude, to study the nature of the crop growing seasons during the short and the long rains (October through June).

The rainfall data were reduced to soil moisture based upon area-wide assumptions on the soil characteristics. The start, end and duration of the crop growing seasons were determined and tested for normality using a 10 mm soil moisture threshold value at each station. Mean seasonal conditions were computed and comparisons were made between the two growing seasons within each station and among all the stations. Stations were grouped according to the magnitude of the coefficient of determination between start and duration and regression equations were developed to predict season duration, from the starting dates. Equations are also derived to estimate the probable length of the growing season for various levels of crop moisture requirements. The exceptionally wet and dry years are examined.

The distributions of the start, end and duration of the seasons are not significantly skewed or significantly different from the normal distribution. The start and end times of the short rains season have a southward trend. The start of the long rains season is widespread but the end of the season shows a northward trend. Durations in both seasons have no general patterns but reflect the influence of local factors. The short rains growing season is found to last longer and to have a higher soil moisture content than the long rains season for the stations located south of the equator. The opposite is true for the stations north of the equator.

The very wet and very dry seasons are not usually widespread. The occurrence of a very wet season appears to weaken the other season and a 10-year periodicity is observed in the very wet and widespread seasons in the short rains season. Periodicity is not observed in the long rains season or for the very dry seasons.

Musimba, N. K. R. 1986. Influence of watering frequency on nutritional characteristics of cattle in southeastern Kenya. Ph.D. Dissertation in Animal and Range Science, New Mexico State Univ., Las Cruces, New Mexico. 103 p.

**ABSTRACT:** The effect of watering frequency on forage consumption, water intake and performance of Zebu-type steers was investigated under three treatments of daily watering (1/1) and two intermittent waterings -- once in two days (1/2) and once in three days (1/3). The study was carried out at a southeastern Kenyan rangeland dominated by *Commiphora* and allied shrubby genera, and perennial grasses such as *Sporobolus pelucidus*, *Digitaria macroblephara* and annual grasses, such as *Eragrostis* spp. Botanical and chemical composition of the diet selected by steers was determined from esophageal masticate samples. Forage consumption was estimated from total fecal collection and diet indigestibility. In addition, Ytterbium (Yb), a particulate phase marker dosed daily, was also used to estimate fecal output and intake for comparison with the total fecal collection. Steers were watered once in the evenings in metered 210 liter barrels. All steers were weighed approximately every two weeks. The study covered 159 days, which included four phenological stages of forage development: late maturity (March), growing stage (April), early maturity (June) and early dormancy (July).

Total herbage production showed that there was sufficient forage for the steers throughout the study. Digestible organic matter (DOM), crude protein (CP) and digestible energy (DE) intake were highest ( $P < 0.01$ ) in April when forage was growing and decreased as forage advanced in maturity. Compared to daily watering, intermittent watering reduced ( $P < 0.01$ ) dry matter, DOM, NDF, CP and DE intake of steers drinking both (1/2) and (1/3). In March and April, intermittent watering reduced ( $P < 0.01$ ) free water consumption by 47-49% for steers watering (1/2) and 57-61% for steers watering (1/3) relative to the daily watering group. Steer performance was not influenced by watering frequency. Steers showed a faster growth rate ( $P < 0.01$ ) when forage was growing in April than the rest of the sampling periods. Fecal output and forage consumption estimated by total collection method and Yb excretion procedure showed that the Yb excretion procedure overestimated forage intake.

Mwandotto, B. J. 1978. Factors affecting weaning weight of the small East African Shorthorn Zebu, Boran, Sahiwal, Boran x E.A.S.Z., Sahiwal x E.A.S.Z., Fresian x Boran and Friesian x Sahiwal cattle at Kiboko and Buchuma (Kenya). Master of Science Thesis in Animal Production, University of Nairobi. 72 p.

**ABSTRACT:** The variation of weaning weights of 1054 calves was analysed by the least squares method for fitting constants for non-orthogonal data, to

estimate the effect of genotype, sex, year of birth, season of birth, age of dam, birth weight, weaning age and some two-way interactions of the main effects on weaning weights of beef calves. The data were collected at Kiboko and Buchuma Range Research Stations from 1971 through 1976.

The corrected mean weaning weights were  $153.61 \pm 32.48$  kg. for 3 genotypes at Kiboko and Buchuma and  $139.64 \pm 34.74$  kg. for 7 genotypes at Kiboko.

Genotype, sex, year of birth, birth weight and weaning age had significant effect on weaning weights ( $P < 0.01$ ). Age of dam was also significant ( $P < 0.05$ ). For the 7 genotypes at Kiboko and 3 genotypes at Kiboko and Buchuma, these had the following estimated contributions to the total variation in weaning weights respectively:- genotype 0.24 and 0.12%, sex 0.05 and 0.12%, year of birth 0.32 and 1.22%, weaning age 8.74 and 39.73%, birth weight 47.74% and age of dam 0.02%. Station and season of birth had no significant effect on weaning weights.

Of the 14 first order interactions tested, 2 had a significant effect on weaning weights ( $P < 0.01$ ). These were year x place and year x season of birth. They contributed an estimated 0.23% and 0.44% respectively to total variation in weaning weights for the 3 genotypes at Kiboko and Buchuma and year x season contributed an estimated 0.09% to the variation in the weaning weights for the 7 genotypes at Kiboko.

Friesian X Sahiwal crosses were 9.49% heavier than pure Sahiwal and Friesian X Boran crosses 10.19% heavier than pure Boran at weaning. Sahiwal X East African Shorthorn Zebu and Boran X East African Shorthorn Zebu crosses were 3.59 and 2.65% heavier respectively at weaning than the pure East African Shorthorn Zebu.

Steers were 8.10 and 8.42 kg. (5.42% and 6.19%) heavier than heifers at weaning for the 3 genotypes at Kiboko and Buchuma and the 7 genotypes at Kiboko respectively.

1972 had the highest weaning weights and 1975-76 had the lowest weights. The difference in weights between these extreme years were 36.50 kg. (30.82%) and 41.23 kg. (32.08%) for the 7 genotypes at Kiboko and the 3 genotypes at Kiboko and Buchuma respectively.

Calves born of cows which were two and three years old had the lowest weaning weights and peak weaning weights were from calves born of cows which were six and seven years old. After this age of dam, weaning weights tended to decline.

Calves which were heavier at birth were also heavier at weaning. A linear regression coefficient of  $1.562 \pm 0.221$  was found between weaning weight and birth weight for the 7 genotypes at Kiboko.

Older calves were heavier than younger ones at weaning. Linear regression coefficients of  $0.294 \pm 0.074$  and  $0.181 \pm 0.058$  were found between weaning weights and weaning age for the 3 genotypes at Kiboko and Buchuma and the 7 genotypes at Kiboko respectively.

In 1972 and 1974 Kiboko animals were heavier at weaning than Buchuma animals but in 1971, 1973 and 1975-1976 Buchuma animals had heavier weaning weights than Kiboko animals.

Generally, animals born in dry season had heavier weaning weights than those born in wet season. This was however not the case for both Kiboko and Buchuma genotypes in 1972. For the 7 genotypes at Kiboko, animals born in wet season in 1975 and 1976 were heavier at weaning than those born in dry season.

Ndegwa, Wa. N. 1983. Vascular plant flora of Kiboko Range Research Station, Kenya. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 92 p.

ABSTRACT: The flora of the Kiboko National Range Research Station was systematically sampled and collections made in each major ecological site. Belt transects were laid through the sites to serve as reference points in collection of species over all seasons of the year.

Representative specimens were collected and identified making up the list of the flora. The relative abundance, habit and longevity of each species were recorded in the field and this has been compiled to form a checklist. The specimens represented sixty (60) families, two hundred twenty (220) genera, and three hundred seventy-three (373) species.

The most widespread families on the Research Station in order of prominence included Poaceae (Eragrostis, Digitaria, Chloris, Brachiaria, Setaria), Fabaceae (Acacia), Compositae, Burseraceae (Commiphora), Combretaceae (Combretum), Capparaceae, Euphorbiaceae, and Acanthaceae.

Nkemi a'Tchie. 1985. Prescribed burning effects on plant and animal communities on the Kiboko National Range Research Station, Kenya. Master of Science Thesis in Zoology, University of Nairobi. 134 p.

ABSTRACT: This thesis presents results of responses of plant and animal communities to a late dry season prescribed burning. Comparisons are made between a paddock burnt in March 1984 and its unburnt neighbour. Comparisons in terms of density and biomass density of large herbivores between paddocks burnt at different dates are also made.

The fire was effective in reducing the number of plant species, the total density as well as the canopy area per hectare both for the understorey and overstorey species. Thus fire is a powerful tool in reducing bush encroachment at KNRRS. The burn induced an increase of 1.65% in total density of herbaceous species while the density of forbs increased by 23%. Similarly the number of herbaceous species increased by 50% while the number of forb species increased by 275%. Fire affected perennial grasses adversely. Grass mortality ranged between 7.79% for *Botrichla insculpta* and 98.03% for *Microchloa kunthii*. The Bray and Curtis (1957) community similarity coefficient showed more dissimilarity after the burn between the two paddocks at the herbaceous, understorey and overstorey strata, as one would expect. Ellenberg (1956) index of similarity showed more dissimilarity only for the herbaceous layer.

Fire was also effective in killing tagged plants of most species, irrespective of their height. There was a general trend towards reduction of canopy area and height for most species. However the number of live stems increased in most of the tagged plants as a result of the burn.

Responses of mammals to the effect of fire were very varied even within a defined group such as large herbivores. The latter generally responded to one of the following factors: visibility, availability and/or nutrient content of food and changes in the structure of the habitat (vegetation). The immediate effect of reduction of food supply on the burnt area, particularly for grazers, was for them to leave the area. However other grazers too moved into the burnt area due to better visibility. The flush of green after the rains, attracted more animals and species which feed on broader variety of plants, thus enhancing their nutritional benefits. It was also shown that burns of over one year old attracted large herbivores, mostly browsers. This study did not show any evidence of competition between wild herbivores and livestock for food resources. Dietary overlap between them is not excluded. However any wildlife/livestock conflict may arise from predation. It is suggested that killing of large herbivores at KNRRS must be based on scientific facts established by research. This has not yet been carried out.

The species composition of small mammal populations on the unburnt paddock was not very different from that on the burnt one. Also no significant differences emerged in trap success, population size and density between the burnt and the unburnt paddock. Presumably, the small mammal populations had crashed as a result of the persistent drought which already was effective prior to the start of the study.

Finally more research is recommended. Other aspects like responses of insects, birds etc. must be included in such interdisciplinary research program if the response of the whole ecosystem to fire at KNRRS is to be known and documented.

Onchoke, Sospeter N. (In Progress). Alternative land ownership strategies in the arid and semiarid rangelands of Kenya: Impact of group, individual and cooperative ranching systems on livestock productivity in south-central Kenya. Master of Science Proposal in Agricultural Economics, Texas A&M Univ., College Station, Texas.

Qureshi, Tariq. 1985. Use of albendazole treated feed to control *Fascioloides magna* infections in captive white-tailed deer. Master of Science Thesis in Range and Wildlife Management, Texas A&I Univ., Kingsville, Texas. 72 p.

ABSTRACT: Thirty-six *Fascioloides magna* infected white-tailed deer (*Odocoileus virginianus*) were captured and randomly assigned to four groups. Each group was fed a commercial pelleted deer ration coated with albendazole for one week to deliver the drug at a dose of 0.0, 5.0, 7.5, and 15.0 mg/kg/day to each animal. Six weeks post-treatment, all animals were euthanatized and necropsied. Effects of albendazole treatment included a reduction in fluke egg counts per gram of feces, a recovery from anemia, reduction of eosinophil count, and an increase of albumin levels. At

necropsy remnants of dead and stunted flukes at the end of migratory tracts and smaller and stunted flukes were observed in the treated groups. Efficacy of the drug was in the approximate range of 60-84%. The treated feed was potent and large differences between the three dosage groups were not observed.

Shaabani, Salim B. 1985. Fecal nitrogen as an indicator of nutritional stress in steers in semi-arid rangelands of Kenya. Master of Science Thesis in Range Science, Texas A&M Univ., College Station, Texas. 99p

ABSTRACT: The study was conducted in Kenya to determine the relationship of fecal nitrogen, fecal nitrogen fractions and fecal nitrogen ratio to organic matter intake, dietary crude protein, in vivo dry matter digestibility and in vitro organic matter digestibility.

Two sites were chosen for the study based upon bush cover. One site had higher bush cover than the other, 70% and 30%, respectively. Ten hectares in each bush type were divided into two five hectare paddocks. One paddock was strategically grazed to create low forage availability level (<400 kg/ha) while the other paddock was left ungrazed (>800 kg/ha).

Sixteen steers divided into two groups of 8 steers were used to collect fecal samples from the paddocks. Four fistulated steers were used to sample the forage available to the experimental steers.

Samples were collected during the dry season and just after the rains. Fecal and diet samples were analyzed for total nitrogen and bound nitrogen (NDFN). Nitrogen fractions and ratios were calculated. Diet samples were further analyzed for in vitro and in vivo digestibility, and fecal samples were analyzed for condensed tannins and the percentages of monocot and dicot fragments.

Simple and multiple regressions were developed to test for predictive relationships between fecal and dietary parameters. Percent fecal insoluble nitrogen was the most important single variable in estimating dietary crude protein and organic matter intake. Dietary crude protein (%) was predicted with the following equation:  $y = 1.79 + 8.37 (\text{fecal insoluble nitrogen})$   $R^2 = 0.88$ . Organic matter intake (kg) was predicted with the following equation:  $y = 11.07 + 6.24 (\text{soluble/total nitrogen}) - 0.12 (\text{tannin}) - 0.05 (\text{cell wall})$   $R^2 = 0.81$ . Percent fecal soluble nitrogen was the single most important variable in estimating digestibility. Dietary in vitro organic matter digestibility and in vivo organic matter digestibility were estimated by the following equations:  $y = 53.94 + 13.09 (\text{soluble nitrogen}) + 0.06 (\text{monocot fragments})$  and  $y = 53.75 + 2.79 (\text{soluble/insoluble nitrogen}) + 1.58 (\text{monocot/dicot})$  with  $R^2$  of 0.33 and 0.53 respectively.

Too, Daniel K. 1985. Effects of defoliation frequency and intensity on production of four burned and unburned bushed grassland communities in south central Kenya. Master of Science Thesis in Range Science. Texas A&M Univ., College Station, Texas. 101 p.

ABSTRACT: Effects of defoliation frequency and intensity on production of burned and unburned plant communities were studied in Kenya on the National Range Research Station, Kiboko in 1982-1983. Study sites were located in ecological zone V which showed some contrast in topography, soils and

dominant grasses. Two replications of four plant communities, dominated by combinations of five grasses were included within eight enclosures.

Grass was clipped from two to seven times a year to estimate seasonal and cumulative biomass yield under two clipping intensities and a dry season burn. The four plant communities were not statistically different ( $p < 0.05$ ). However, community variation existed with the *Digitaria* community yielding the most phytomass and *Digitaria-Thameda* the least.

Fire had no significant effect on overall yields of grassland communities. However, significant treatment effect was noted especially on burned plots. Treatment 1, which was clipped the most (13 times) during the study period had the most phytomass compared to all other treatments. Treatment 4 which was defoliated 5 times had the lowest phytomass.

Intensity of clipping did not show any significant differences. Phytomass from the heavy defoliation intensity (5 cm) was slightly higher than the moderate (12.5 cm) intensity.

Soil physical characteristics had marked influence on species composition and had moderate influence on production. Clay loams had more biomass production than sandy soils. Soils with high organic matter content had more phytomass than those with low organic matter. Sites with longer wet periods had more production than those which dried soon after the rains.

Woie, Benson M. 1984. Influence of frequency and intensity of clipping on forage yield, crude protein content and digestibility of six Kenyan range grasses. Ph.D. Dissertation in Range Science, Texas A&M Univ., College Station, Texas. 76 p.

ABSTRACT: This investigation was conducted at two experimental sites on the National Range Research Station, Kiboko, to evaluate forage yield, leaf-to-stem ratio, crown area, tiller number, regrowth height, forage digestibility, and crude protein content of six native range grasses following defoliation at three frequencies (3, 6, and 9 weeks) with three cutting heights to leave 5-cm, 10-cm, and 15-cm stubble heights.

*Digitaria macroblephara*, *Panicum maximum*, and *Cenchrus ciliaris* produced higher forage amounts and tiller number than *Chloris roxburghiana*, *Eragrostis superba*, and *Themeda triandra*. The large number of tillers and leaf area produced by *Digitaria macroblephara*, *Panicum maximum*, and *Cenchrus ciliaris*, especially at the 6-week harvest frequency, allowed the three grasses to attain a maximum growth rate at an earlier age and recover soon after defoliation. Defoliation at the 3-week harvest frequency significantly suppressed tillering in all grasses and resulted in significant reductions in forage yield. Furthermore, plants defoliated at the 3-week interval with the 5-cm cutting height produced the lowest forage yield and tiller number.

Forage yield, tiller numbers, regrowth height, and crown area for the six grasses were highest at the 6-week harvest frequency and lowest at the 3-week harvest frequency. In contrast, leaf-to-stem ratio, crude protein content, and digestibility values were highest at the 3-week harvest

frequency and lowest at the 9-week harvest frequency. Crude protein content and digestibility values of the leaf fraction were higher than crude protein content and digestibility values of the stem fraction. Furthermore, crude protein content and digestibility showed a decline for all grasses as the interval between defoliations increased.

Recommendations for further research include studying the responses of grazing animals and native range plants to a grazing plan that utilizes a 42-day defoliation frequency leaving stubble heights of 10 cm to 15 cm, and continuing to explore the impacts of defoliation treatment at various phenological states on native range plants.

APPENDIX 4

RESIDENT TECHNICAL ASSISTANTS, WINROCK INTERNATIONAL

At the end of the Kiboko Range Research Expansion Project, 30 June 1986, the total input of resident technical staff was 23.75 man years. There were three persons who served as Chief of Party. Each resident staff participated in the training programs, station development and management and in the research and publications. During the seventh year, Dr. Hansen, was the last of the resident technical staff.

Technical assistance to the Kiboko Range Research Expansion Project by resident staff (July 1979 to June 1986).

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<u>Position</u>	<u>Name</u>	<u>Term (Yrs.)</u>	<u>Dates of Service</u>
Chief of Party	Dr. J.J. Norris	3.5	Jul 1979 to Dec 1982
	Dr. D.F. Burzlaff	2.5	Jan 1983 to Jun 1985
	Dr. R.M. Hansen	<u>1.0</u>	Jul 1985 to Jun 1986
		7.0	
Range Ecologist	Dr. D.N. Hyder	0.25	Oct 1979 to Dec 1979
	Dr. M.J. Trlica	2.0	Sep 1980 to Jun 1982
	Dr. R.D. Child	<u>3.0</u>	Sep 1980 to Aug 1983
		5.25	
Range Management	Dr. D.F. Burzlaff	2.5	Sep 1980 to Dec 1982
Specialist	Dr. R.M. Hansen	<u>2.5</u>	Jul 1985 to Aug 1985
		5.0	Jan 1983 to Jun 1985
Animal Scientist	Dr. R.G. Ward	2.0	Jan 1981 to Dec 1982
	Dr. D.L. Whittington	<u>1.8</u>	Jan 1983 to Oct 1984
Range Watershed Management	Mr. J.M. Skovlin	2.7	Nov 1982 to Jun 1985
TOTAL MAN-YEARS		23.75	

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TECHNICAL CONSULTANTS, WINROCK INTERNATIONAL

Technical consultants were essential for providing services, advice, criticism, training and expertise beyond that possessed by the resident technical staff. During the seventh and last year of the project Dr. Adrian W. Mukhebi, Agricultural Economist and Mr. Zahoor Malik, Maintenance Engineer continued their valuable and competent service to the National Range Research Station.

Technical assistance to the Kiboko Range Research Expansion Project by short-term consultants (July 1979 to June 1986).

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<u>Subject Matter</u>	<u>Name</u>	<u>Term (Months)</u>
Range Science	Dr. Joseph L. Schuster, Texas A&M Univ.	3
	Dr. Fred E. Smeins, Texas A&M Univ.	3
	Dr. Wilbert H. Blackburn, Texas A&M Univ.	2
	Dr. Stephen L. Hatch, Texas A&M Univ.	1
	Dr. Charles D. Bonham, Colorado State Univ.	4
	Dr. Larry L. Tieszen, Augustana College	<u>1</u>
		14
Animal Science	Dr. Robert L. Blackwell, Montana State Univ.	1
	Dr. Jerry W. Stuth, Texas A&M Univ.	2
	Mr. Robin Long, Nderit Estate, Naivasha	7
	Dr. David L. Whittington, So. Dakota St. Univ.	<u>2</u>
		12
Socioeconomics	Dr. Adrian W. Mukhebi, Univ. Nairobi	16.5
	Dr. Richard H. Bernstein, Winrock International	4
	Dr. Richard N. Connor, Texas A&M Univ.	1
	Dr. Alan H. Jacobs, Western Michigan Univ.	<u>6</u>
		27.5
Wildlife Management	Dr. D. Lynn Drawe, Welder Wildlife Foundation	3
	Dr. James D. Teer, Welder Wildlife Foundation	<u>3</u>
		6
Maintenance Engineer	Mr. Zahoor Malik, Toronto, Ontario	27
TOTAL MAN-MONTHS		86.5

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## PERSONNEL LIST AT NATIONAL RANGE RESEARCH STATION

After the Kiboko Range Research Expansion Project had been underway a short time the need to rapidly increase the staff and workers at Kiboko and Buchuma was recognized. A request for drivers, mechanics, technicians, certificate holders, diplomates and others was made in early 1981. The GOK responded favorably and the numbers of GOK employees was greatly increased by the end of the third year. About the same number of GOK employees was maintained at the National Range Research Station and the Buchuma Range Research Station during the last three years of the project.

Listed below are the names of the staff at the Kiboko and Buchuma Range Research Stations in December 1980, at the start of the Kiboko Range Research Expansion Project.

### Kiboko Range Research Station Personnel

Mr. B. M. Woie, Officer in Charge  
Mr. S. K. Sunyai, Range Officer  
Mr. N. K. R. Musimba, Livestock Improvement  
Mr. S. Anyona, Range Officer  
Mr. J. M. Ndegwa, Range Officer  
Mr. J. K. Kinyamario, Range Officer  
Mr. E. K. Maranga, Range Officer  
Mr. J. Bartenge, Range Economist  
Mr. A. K. A. Siele, Assistant Animal Husbandry Officer  
Mr. W. M. Mwaniki, Assistant Range Officer  
Mr. P. F. K. Kibet, Assistant Range Officer  
Mr. A. R. Ali, Assistant Range Officer  
Mr. M. O. Ojowi, Assistant Range Officer  
Mr. S. K. Cheruiyot, Assistant Range Officer  
Mr. D. S. Mbakaya, Assistant Range Officer  
Mr. I. D. M. Mwanga, Assistant Range Officer

Plus 7 Technical Assistants  
    6 Laboratory Technicians  
    3 Administration/Clerical  
    84 Subordinate Staff

### Buchuma Range Research Station Personnel

Mr. Peter M. Kamau, Acting Officer in Charge  
Mr. S. D. Kitiuo, Livestock Officer  
Mr. B. H. Amboka, Assistant Range Officer  
Mr. A. Z. Abdala, Assistant Range Officer (Garissa)

Plus 39 Subordinate Staff

To follow are the names of staff and their designated responsibilities during the seventh year of the Kiboko Range Research Expansion Project.

Staff List, Kiboko National Range Research Station

Name	P/No.	Designation	Responsibilities
<u>Personnel and Office Administration</u>			
Dr. B.M. Woie	8766	SRRO/DIRECTOR	Institute Admin.
Michael M. Mang'ao	101230	Executive Asst.	
James M. Mbaluku	101529	H.C.O.	Filing, indexing & recording. Safe custody of records.
Priscillah K. Ndulu	101590	C.O.	
Simon K. Kyenze	101523	C.O.	
Michael M. Kimondo	101520	C.O.	Despatching.
Joseph N. Njagi	103207	C.Typist II	Typing of all official correspondence and any other related duties.
Ruth Mkala	102783	C.Typist II	
Erimina W. Mwaivu	102782	C.Typist III	
Ninah E. Joseph	102061	S.S./Typist	
Florence M. Mbuvi	101479	S.S./Typist	
Stephen Kisaingu	9151	S.S.	Office messengers
Muema Musyoki	27013	S.S.	
Jackson M. Ndeve	15868	S.S.	
Agnes Mutwiwa	101503	S.S.	
Juliana Katumo	101324	S.S.	
Peter M. Mutia	101449	S.S.	
Grace A. Oyuga (Mrs)	101480	S.S.	
Annah W. Muia	101326	S.S.	
Esther N. Mose	38013	S.S.	
Jackson M. Ndeve	15868	S.S.	Telephone Operator
Gibson N. Ndambuki	101522	C.O.	Voucher preparation. Merchants & personal claims. Monthly expenditures returns, revenue collecting & banking.
Angeline K. Ituli	101528	C.O.	
Fredrick Mungau	102370	C.O.	
<u>Purchasing and Supplies Section</u>			
Patrick M. Mwau	102836	Supp.Asst.	In Charge of Supplies Section.
Isaac O. Oyuga	16540	S/Man II	Procurement, ordering and safe custody of all stores. Physical
Sylvester M. Kau	101547	S/Man II	
Danstone N. Njagi	101548	S/Man II	

Name	P/No.	Designation	Responsibilities
Patrick N. Githinji	102618	S/Man II	checks, maint. ledger cards(S.3), issues of stores for daily use.
David I. Muthukui	101104	S/Man II	
Henry M. Kakumi	101515	S.S.	Supporting the stores personnel & performing cleaning duties in the stores.
Mutoko Mwanja	101321	S.S.	

#### Farm Management Section

Peter M. Mutua	30050	T.Asst. (Farm Manager)	General farm work & supervision
Fredrick K. Mwiandi	103001	T.Asst. (Asst.Farm Man.)	
Stephen N. Isuni	101526	S.S.	Record keeping, roll calls, temporary stores for general farm use, reports of absences to farm manager.
Boniface Kituma	101537	S.S.	
Clement M. Mailu	101531	C.O.	Provision of transport, fuel regulation monthly vehicle
Carlson W. Musyoki	101524	C.O.	

#### Masons and Plumbers

Sammy K. Kulei	27432	Artisan	Masonry
Joshua K. Kithuku	101543	Artisan	
Joseph M. Mwanza	101544	Mason	
Jackson Muungami	102091	Mason	Plumbing duties
Peter Kiarie	23190	Artisan	
Joseph N. Njogo	101924	Artisan	

#### Grazing Guards

Ekipor Marwath	13173	S.S.	Grazing guards- illegal grazers & other related activities in the farm.
David Matolo	16971	S.S.	
Joel Mutisya	100828	S.S.	
Kituku Kitonde	100829	S.S.	

#### Water Pump Attendants

Mutua Kakoi	28244	S.S.	Operating, fueling & Oiling of water pumps Reporting all mechanical defect & safe custody of all stores in pumps premises.
Katua Kitonde	9156	S.S.	
David Mbaluku	45033	S.S.	
Johnson Makiti	9158	S.S.	

Name	P/No.	Designation	Responsibilities
<u>Security Wardens</u>			
Thomas M. Kimengei	101552	Commissionaire	Security services within the office
Daniel Kaiva	15867	S.S.	
Francis Manyenze	9154	S.S.	Security against station vehicles, plants, equipment, offices, stores & workshop
Paul Mutinda	101495	S.S.	
William M. Ngwava	101509	S.S.	
Kingenda Kisuli	23656	S.S.	Security
Peter Mutuku	10906	S.S.	
Peter Thaithi	101450	S.S.	
Juma Auma	15288	S.S.	
Dominic K. Nzoka	101458	S.S.	Operation & maintenance of station's
David Kamina	101502	S.S.	
Nyamuhanga Huburia	23390	S.S.	All other duties
Peter M. Mutisya	27413	S.S.	
Kitheka Kyende	27410	S.S.	General farm duties
Joseph Kathenya	27433	S.S.	
Nzioki Masesi	38052	S.S.	
Ramadhan Hussein	101471	S.S.	
Mohamed Yusuf	101484	S.S.	
Kivanga Mbako	101482	S.S.	
Paul Musee	101506	S.S.	
Ngui Muli	12330	S.S.	
Martin Muli	101473	S.S.	
Justus K. Mbili	101489	S.S.	
Kamitu Ndaisi	101497	S.S.	
Makau Yanga	101511	S.S.	
David Kilonzo	101461	S.S.	
Lazaro Ngoloma	45034	S.S.	
William K. Musee	101488	S.S.	
Kitulu Malumba	38053	S.S.	
Peter Ndungo	37865	S.S.	
Julius Mwangangi	45028	S.S.	
George Masila	45031	S.S.	
Matheka Kasoka	101460	S.S.	
Mukuma Mbondo	45029	S.S.	
Joseph Munyao	101516	S.S.	
John Njehu	15870	S.S.	
Jackson N. Musya	101483	S.S.	
Kyalo Kioko Maitha	101459	S.S.	
Titus K. Mwau	101452	S.S.	
Joshua K. Kitonyi	101543	S.S.	
Sammy Malonza	101454	S.S.	

Name	P/No.	Designation	Responsibilities
Hallan M. Kivumbu	101462	S.S.	General farm duties
Francis N. Mutio	101507	S.S.	
John A. Khakali	6882	S.S.	
Mwangi Saro	101525	S.S.	
Wilson K. Mutua	101447	S.S.	
John W. Wambua	101478	S.S.	
Kimeu Kitonde	16970	S.S.	
George Masila	45031	S.S.	General farm duties
Lole M. Nthenge	45032	S.S.	

#### Drivers

Simon Kinama	12050	Driver I	Driving duties including: maintenance, care, cleanliness of vehicles. Report all mechanical problems to Transport officer. In charge of work tickets, goods, safe custody Report accidents to appropriate authority and in time. Not to deviate the routes specified in the work ticket. Not to carry unauthorized goods or passengers. Responsible for all damages & shortages resulting to negligence & or carelessness while executing his duties. Parking of the GK vehicle in right place & in time. And all other related duties.
Ngwala Kasoka	9159	Driver II	
Samson K. Mutunga	101163	Driver III	
Daniel M. Kisove	101162	" "	
Joseph M. Nthungu	16881	" "	
Makau Mulundi	101330	" "	
William K. Masilia	101329	" "	
Muoki Wambua	101328	" "	
Kithome D. Malawa	37288	Driver II	
Bernad Musyoki	9155	Driver III	
Josephat N. Mulika	29177	" "	
Sammy M. Nzioka	101158	" "	
Daudi K. Kieti	101331	" "	
Peter M. Mbelenzu	101160	" "	
Daniel M. Ndivo	101161	" "	
Peter M. Kyeni	101419	" "	
Phillip Ngoko	101344	" "	
Charles I. Muguna	102109	" "	
Jackson M. Mutisya	9160	" "	
Bernad Wambua	101159	" "	
Malile Makali	16530	" "	
Isaih M. Oyaro	28188	" "	

#### Plant Operators

Philip K. Kinama	37587	Plant operator.
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#### Plant and Equipment Maintenance

Paul Githuku	47932	Mechanical Insp. (OIC)
Simon M. Wambua	45179	Mechanic III
Bernad N. Kireru	101554	" "
Robert K. Mwavu	101553	" "
William K. Robert	101555	" "

Name	P/No.	Designation	Responsibilities
Mwanzia Mbai	101456	S.S.	Mechanic duties
Albert M. Saro	101325	S.S.	helping mechanics in the workshop.
Katembu Hassan Mwea	101526	S.S.	Bicycle repairs.
Michael Kathenya	38072	S.S.	

Livestock Division

Animal Range Nutrition Section

Dr. N.K.R. Musimba	29141	R.O	Range Nutrition & grazing management.
P.F. Kibet	28599	"	
Peter Kamau	27568	"	
Moses K. Mbui	28557	"	
Salim B. Shaabani	27579	"	
William J. Mnene	42406	"	
Michael Mwikya	102321	A.R.O.	Food analysis laboratory.
Simon Mwangi Mwaura	103002	T.A.	
Isaac Mwove	101514	S.S.	Support field staff

Animal Health

Dr. D.M.Chimwani	28569	Vet. Officer	Resident Veterinarian
Batrober O.Deba	103256	A.H.A.	Animal Health.
Michael Ogolla	102321	"	
Simon N.Lazarus	102932	"	
Sebastian M. Kathingo	100089	"	
Elias Mwangi	100088	"	
Simon K. Kimonyi	28754	"	
Lucy W. Gathogo(Mrs)	43072	"	
Joyce Kithome(Mrs)	42868	"	
John Mutisya	100087	"	
John Kitema Ndolo	1216	Junior T.A.	

Cattle Management Section

M. Ojowi	32050	"	Cattle Management
Francis K. Ngugi	31908	"	" "
Galcano M. Kubasu	50043	"	" (Boran stud)
Ann Wanjiku (Miss)	101535	Data recorder	Cattle Management.
Shedrack M. Muteti	101527	" "	" "
Lawrence Mutungi	101539	" "	" "
Lawrence M. Kitele	28394	S.S.	Boma foreman-Boma 5
John K. Maingi	101466	"	" " -Boma 4
Vandika Ndolo	15202	"	" " -Boma 6
James Kithu	19687	"	" " -Boma 9
Mavole W. Nzau	101500	"	" " -Boma 7
Cheptorus Chelimo	16972	"	" " -Boma 2
Onesmus Kausa	101518	"	" " -Boma 8
Charles K. Mutulu	16969	"	" " -Boma 1

Name	P/No.	Designation	Responsibilities
Awadh A. Rizgalla	101463	"	Boma foreman-Boma 3
David Maingi	9149	"	Herdsman
Julius Wangai	101508	"	"
Justus K. Ngalate	101455	"	"
Kingoo Ngutu	101496	"	"
Kivuva Muinde	12036	"	Herdsman
Muia Malui	101322	"	Herdsman (Boran stud)
Mwania Ndolo	101494	"	" " "
David Kithongo	19786	"	Herdsman (Boran stud)
Ngumbi Iluvo	37868	"	" " "
Ndavuti Mbondo	13766	"	" " "
Ndungu Wambua	101320	"	" " "
Nzuki Mutua	38051	"	" " "
Malata Mbio	101490	"	Herdsman
Maweu Mutungwa	101501	"	"
Maweu Mbondo	101467	"	"
Mutua Kioo	101505	"	"
Nguku Musembi	14388	"	"
Mwenyeu Kivai	101518	"	"
Philip Musyoka	120033	"	"
Muthiani Muthoka	101470	"	"
Ambrose L. Masila	101481	"	"
Wilson K. Malumba	38054	"	"
Richard W. Sembe	101474	"	"
Thiemeto Mwenjeri	27944	"	"
Muisyo Lui	16880	"	"
Robert K.Kakuyu	100829	"	"
Robert Waema	38058	"	"
David M. Mulandi	101474	"	"
Lange Mwoloi	101499	"	"
Joshua M. Aringa	23654	"	A.I.Services.

Sheep and Goat Management Section

Peter N. Kamau	27568	R.R.Officer	Shoats Management.
Charles K. Mugane	39615	A.H.Assist.	" "
Mandi Kiswili	38057	"	Boma Foreman
John M. Ng'an'ga	100631	"	Dip Attendant
Kitonde J. Mbindyo	27414	"	Herdsman
Sammy Kimatu	27419	"	"
Muluti Kikau	38097	"	"
Francis M. Kilungu	38056	"	Boma Foreman
Musyoka Malui	100830	"	Herdsman
Ndutu Ndovoi	100772	"	"
Mutungu Nthiwa	100832	"	"
Robert Munuve	101448	"	"
Francis Waita	101469	"	"

Name	P/No.	Designation	Responsibilities
<u>Wildlife Management Section</u>			
Dr. Tariq Qureshi	101199	R.Officer	WildLife Research
D.T. Ole Kimongo	102520	T.Officer	Wildlife Management (On Study Leave)
Johnathan Maweu	101536	S.S.	Data recorder
Mulei Muinde	26905	"	Boma Foreman
Kyalo Kalimbi	101323	"	Herdsman
Nzioka Mutulu	16973	"	"
<u>Range Management Division</u>			
<u>Range Plant Ecology Section</u>			
E.K.Maranga	40646	R.R.O.	Head-(Plant Ecology /Physiology Section)
Ali R. Ali	32071	"	Plant Ecology/ Physiology section
Daniel Arap Too	27576	"	
D.S. Mbakaya	39480	"	
Charles Kilobi	42471	"	Field T.Officer
Joel K. Muindi	100372	"	" " "
D.T. Cheruiyot	100374	"	" " "
Joseph O. Mwango	102523	"	Asst. Head Field T.Officer
James I. Ndemwa	26070	T.Assistant	" " "
Peter O. Manoti	42899	" "	" " "
Albert M. Owaka	42900	" "	" " "
Allan W. Macharia	102277	" "	" " "
Paul K. Koskey	102276	" "	" " "
Ruth N. Mwau(Miss)	101525	S.S.	Field Support Staff
Moses M. Wanyama	101541	"	" " "
Stephen I. Tuo	101595	"	" " "
Mulwa S.Ndeto	9148	"	" " "
Nzau Ngali	101491	"	" " "
Fredrick Ngalate	101534	"	" " "
Timothy W. Wekulo	27689	T.O.	Transport Officer
<u>Soil and Watershed Management Section</u>			
Ally A. Tifow	100373	A.R.O	Range Watershed.
Jacques Ngovia	101504	S.S.	Support Staff.
<u>Agrometeorology Section</u>			
D.K. Musembi	32369	R.O. II	Research Officer and Head of sect.
M.N. Khasatsili	103097	T.O.A.R.O. (A.R.O.) III	Immediate Deputy and overall supervisor.
D.N. Gathogo	39535	T.A.	Asst.to T.O.
C.N. Malumba	101530	S.S.	Met Observer.

Name	P/No.	Designation	Responsibilities
J.N. Mbindyo	101533	C.O.	General duties.
Stephen N. Mukunza	101521	S.S.	" "

#### Socioeconomics Section

S.N. Onchoke	29932	A.R.O.	Range Economics (Study leave)
F.K. Asambu	32014	"	"
Justus M. Kavoi	102473	T.Officer	Head of Section- Field data collection and supervision. Data tabulation.
Josephat K. Irohah	39636	T.Assistant	"

#### Research Support Services

##### Analytical Laboratory

Benson D.M. Ogega	28137	Lab. Techn.	Head of the section
Peter M. Gachanja	39634	T.Assistant	Sample analysis
Charles M. Konde	16334	Junior L.Tech.	" "
Michael O. Omieno	37944	S.S.	Assists in various activities and does General cleaning of Labs. and glassware

##### Library

Phillip M. Mwandau	102093	C.O.	Library attendant.
Florence M. Mbuvi	101429	S.S./Typist	Cataloguing of books & journals.

##### Computer Services

D.K. Musembi	32369	R.O. II	Head-Computer and Library services. Instructs all staff on the usage of computer.
Peter M. Gachanja	39634	T.A.	Feeds Labs. data in the computer.
Ninah E. Joseph	102061	S.S./Typist	Feeds Administra- tion data in the computer.
Florence M. Mbuvi	101479	S.S/Typist	"

Staff List, Buchuma Range Research Station

Name	P/No.	Designation	Responsibilities
William Mnene	42406	R.O. II	Officer-in-Charge
Gideon S. Munga	102519	T.O.	
Joseph Bii	49912	T.O.	
Danda M. Kengo	100270	T.O.	
Andrew Mwambi	5944	T.A.	
Daniel King'aru	6556	T.A.	
Caleb Mulusa	30052	T.A.	
Obadiah R. Masila	102275	T.A.	
George A. Anyamba	102278	T.A.	
Daniel Shambi	50219	T.A.	
Stephen Righa	23664	C.O.	
Nicholas Wamwandu	101776	C.O.	
Patrick C. Tsuma	101783	S/Man	Storekeeper
Charles M. Kali	101532	D/Coll	Data Collector
Jesca Mulusa (Mrs.)	101777	D/Coll	" "
James O. Mbani	101593	D/Coll	" "
Edward Liya	101778	D/Coll	" "
Josephat I. Baridi	27635	Driver III	Driving vehicles
Kiteto Mwadeghu	100598	Driver III	" "
Juma Mumo	101156	Driver III	" "
Anesmus K. Kurema	102034	Driver III	" "
Pascal M. Mwachofii	45191	Artizan III	Artizan
Sajuma M. Tungunya	101786	P/Oper III	Plant Operator
Eliud K. Mwabili	101785	P/Oper III	" "
David M. Mutuku	101787	Commissioner III	Commissioner
Crispus G. Ndunguu	101715	Commissioner III	"
John M. Machira	101717	Commissioner III	"
Mariane V. Shighadi	365013	C/Typist (S.S.)	Typing
Loyce L. Zenge (Miss)	41943	C/Typist (S.S.)	"
Zacharia Kianga	13116	J.A.H.A. (S.S.)	Art. Inseminator
Paul M. Munyoki	14036	Subordinate	Stores
Mweri Mangi	10892	"	General Duties
Lugwo Lalo	13107	"	General Duties
Javan D. Kala	27937	"	General Duties
Edward Mwakulegwa	38034	"	General Duties
John S. Tinye	101754	"	General Duties
Viewline Muna (Miss)	101761	"	General Duties
Joseph M. Dende	101767	"	General Duties
Philip M. Anjeru	101757	"	General Duties
Charles O. Otieno	101744	"	General Duties
Peter O. Weke	101774	"	General Duties
Isabella K. Kioga	101594	"	General Duties
Peter M. Mbevi	101982	"	Herding
Nguta Lewa	13110	"	Herding
Rai Nyondo	16861	"	Herding Duties
Mbui Kanyembwe	16865	"	Herding Duties
Mwatela Lewa	27938	"	Herding

Name	P/No.	Designation	Responsibilities
Robosha K. Mwavula	101751	Subordinate	Herding
Mtenzi G. Nyale	101752	"	Herding
Nyambu Mwachugu	101753	"	Herdsman
Ndegwa Mwero	101756	"	Herdsman
Robosha Mrabai	101760	"	Herdsman
Mzungu N. Mwandori	101762	"	Herdsman
Ngao G. Rai	101763	"	Herdsman
Tsuma C. Rsuma	101765	"	Herdsman
Mnazi N. Chaka	101769	"	Herdsman
Yawa M. Ruruma	101770	"	Herdsman
Ngala K. Mwamlongo	101772	"	Herdsman
Javan M. Mwandigha	101758	"	Herdsman
Chilache M. Mwanlongo	101749	"	Herdsman
Mungumi Tuku	13111	"	Fence Maintenance
Nyae Chaka	13108	"	Watchman
Bembeyu Mwendakazi	16864	"	Watchman
Elijah M. Katumi	101773	"	Watchman
Jaji M. Kadzomba	101771	"	Watchman
Nzavila Mbetsa	15913	"	Cleaning water trough
Ndoro Karisa	16858	"	Boma Foreman
Njuguna Kamau	13958	"	Mechanic
Mwavula N. Wachenje	45162	"	Mason/Carpentry
Samilo M. Mwamela	101327	"	Office Messenger
Agnes N. Kiongo (Miss)	101741	"	Office Messenger
Jane I. Onyisa (Miss)	101742	"	Office Messenger
Mgandi Mbao	101755	"	Toilet Attendant
Phinias O. Lago	101789	"	Met. Recording
George G. Wandeto	101887	"	Generator
James K. Guchu	101759	"	Generator
Simon K. Mutua	101745	"	Signwriter

PERSONNEL CHANGES OF THE KIBOKO RANGE RESEARCH EXPANSION PROJECT DURING 1985

New Personnel Arriving at Station

Name	P/No.	Designation	Remarks
Mr. A. M. M. Gitunu	29909	R.R.O. I	Transferred from Laikipia
Mr. F. O. Omwono	39481	A.R.O. III	Transferred from Buchuma
Mr. P. M. Githuku	47932	Mech. Insp. III	Transferred from Nakuru
Mr. O. K. Waweru	101418	Driver III	Transferred from Buchuma
Mr. J. K. Mwololo	100859	S/S	" "
Mr. Muthui Mulwa	100783	S/S	" "
Mr. M. M. Masyuki	100864	S/S	" "
Mr. F. M. Mwinzi	100865	S/S	" "
Mr. Kithikii Malawa	100866	S/S	" "
Mr. R. K. Mutua	38044	S/S	" "

Personnel Who Have Departed From the Station

Name	P/No.	Designation	Remarks
Mr. G. G. Mbijwe	25711	R.O. II	Transferred to AHITI-Kabete
Mr. A. M. Abdille	32070	A.R.O. III	Transferred to Garissa
Mr. W. J. N. Mnene	42406	A.R.O. III	Transferred to Buchuma
Mr. S. K. Cheruiyot	32015	R.O. II	Resigned and joined Egerton College
Mr. S. J. Chirchir	100741	R.O. II	Resigned and joined AFC
Mr. P. K. Tung'et	100371	A.R.O. III	Transferred to Lanet
Mr. Samuel Kimani	35694	H.C.O.	Transferred to Nyahururu
Mr. E. N. Kinyoe	45035	Mason	Deserted
Mr. P. N. Munguti	37865	S/S	Deserted
Mr. M'syoka Ngui	100827	S/S	Deserted
Mr. C. M. M'Irugura	102109	Driver III	Dismissed
Mr. S. K. Mathuku	101164	Driver III	Dismissed
Mr. J. S. Cheruiyot	101542	S/S	Transferred to Nakuru with replacement
Mr. J. M. Mwangi	100632	S/S	Transferred to Naivasha
Mr. M. W. Nzau	101500	S/S	Jailed

## APPENDIX 5

### BUDGET AND EXPENDITURES

By the time the ink of the signatures on the contract had dried the necessity was recognized for changing certain items in the budget. Six amendments were submitted to and approved by the Government of Kenya and a seventh amendment had been requested but not approved by the Government of Kenya when this report was written. Each of the amendments required changes in the budget and the schedule. Amendment 1 reduced the Technical Assistants to be supplied by Winrock International from six to five.

Amendment 2 provided for the purchase of additional equipment which was necessary to operate the station and to conduct research.

Amendment 3 was permission from the Government of Kenya to permit research officers with a diploma from Egerton College to pursue a Bachelor of Science degree. After the awarding of the Bachelor's degree these officers returned to the National Range Research Station to do the necessary research for a Master of Science thesis.

Amendment 4 provided for non-degree training for research and technical officers who lacked the necessary skills to perform their assignments at the National Range Research Station or at the Buchuma Range Research Station.

Amendment 5 changed the schedule of work and rearranged efforts made necessary because of the inability of the GOK contractors to supply physical facilities agreed upon in the contract as well as inability to provide other services.

Amendment 6 extended the Kiboko Range Research Expansion Project to 30 June 1986, with the provision for one Technical Assistant supplied by Winrock to be posted at the National Range Research Station during the seventh and last year. Amendment 6 and all of the previously mentioned amendments did not ask for a change in the total USAID funds.

The necessity to pay operational costs for the station and the shortfall of GOK funds during the 1983-84 drought made it necessary to request another amendment which was to obtain additional funding from USAID. Extra costs for training had already been incurred since most research officers extended their stay in the United States beyond the length of time planned for in the budgets. Funds for additional training of research officers had been committed prior to the 1983-84 drought which resulted in the need for more funding.

An amendment was approved by USAID in September 1984 to increase the funding from USAID by \$197,827 for the Kiboko Range Research Expansion Project. This amendment was sent on 9 October to the Ministry of Agriculture and Livestock Development for the approvals by the appropriate GOK officials. In early 1985 a search revealed this amendment request was lost. By July 1985 the funds available from USAID for the project were reduced to \$120,000. Another amendment, this time for only \$120,000 was approved by USAID, was sent to the Ministry of Agriculture and Livestock Development for approvals by the appropriate GOK officials. The status of this amendment could not be ascertained in November 1985 and presumably it was lost. Another copy of the latest amendment was submitted in December 1985. This amendment was quickly approved by the Ministry of Agriculture and Livestock Development. The final approval needed from the Financial Secretary of the Government of Kenya was obtained 13 June 1986.

Table 1 itemizes the expenditures for Field Salaries, Home Office Salaries, Fringe Benefits, Overhead, Sub-Contract, Travel and Transportation, Equipment, Allowances, Other Direct Costs, New Training, Contingency, Imprest and Total Expenditures for each of the seven years (ending 30 June). The final costs will be found in the last project billing.

Listed below are the names of research officers of the Kiboko Range Research Expansion Project, the length of time needed for training and the training costs.

Trainee	Degree	Months	Dollars
J. I. Anonya	none	12	16,392
Ali R. Ali	BS + MS	47	62,291
F. K. Asambo	BS	16	40,000
S. K. Cheruiyot	BS + MS	41	55,734
P. M. Kamau	BS + MS	48	63,935
P. F. K. Kibet	BS + MS	44	60,652
E. K. N. Kinuthia	MS	32	44,259
J. I. Kinyamario	MS	32	44,259
E. K. Maranga	MS	25	34,424
D. S. Mbakaya	BS + MS	48	65,569
M. K. Mbui	MS	30	40,981
W. J. Mnene	BS + MS	42	57,373
D. K. Musembi	MS	46	62,291
N. K. R. Musimba	Ph.D	41	56,007
W. N. Ndegwa	MS	43	49,177
W. N. Ojowi	BS	15	40,000
S. N. Onchoke	MS	42	57,373
T. Qureshi	MS	29	39,342
S. B. Shaabani	MS	34	45,898
A. A. Tifow	BS	16	40,000
D. K. Too	MS	34	45,898
B. M. Woie	Ph.D	41	60,652

Table 1 - Project expenditures by year with the percent of the final project budget shown. Figures shown are those available prior to the final project billing and audit.

PROJECT EXPENDITURES BY YEAR (in \$000)							
Budget category	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year	Seventh Year
Field Staff Salaries	64,222.18	176,055.86	228,577.36	297,580.54	282,723.93	300,649.13	155,373.95
Home Office Salaries	21,532.20	12,962.01	12,499.92	22,350.44	12,772.86	13,819.97	16,308.81
Fringe Benefits	11,610.49	25,683.07	32,063.79	50,361.05	54,378.76	51,211.25	32,958.86
Overhead	34,828.05	80,695.90	104,643.85	128,844.98	138,065.95	143,634.91	78,599.22
Sub-Contract	50,000.00	133,928.49	175,361.49	188,409.26	234,136.68	156,440.68	35,368.82
Travel & Transportation	32,174.07	82,505.83	33,362.66	91,751.49	55,355.73	46,114.49	29,563.53
Equipment	249,406.30	32,417.35	46,386.08	51,292.24	51,854.58	25,415.59	1,309.55
Allowance	7,051.61	53,902.53	21,937.90	62,594.88	7,964.58	38,210.43	18,755.14
Other Direct Costs	13,333.72	41,156.71	60,498.44	100,858.11	94,633.34	97,990.57	58,919.62
New Training	.00	.00	.00	.00	34,424.63	51,731.18	35,098.84
Contingency	.00	.00	.00	.00	28,246.21	64,782.73	3,473.68
Imprest	2,000.00	.00	.00	.00	.00	.00	.00
Total Expenditures	406,238.62	639,307.75	715,331.49	994,042.99	994,557.25	990,000.93	465,730.02

  

Budget category	PERCENT EXPENDED							BUDGET
	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year	Seventh Year	
Field Staff Salaries	4.3%	16.3%	31.7%	51.8%	71.0%	91.3%	101.8%	1,478,400.00
Home Office Salaries	19.9%	31.9%	43.4%	64.1%	75.9%	88.6%	103.7%	108,237.00
Fringe Benefits	4.1%	13.1%	24.3%	41.9%	61.0%	78.9%	90.5%	285,473.00
Overhead	5.0%	16.6%	31.7%	50.2%	70.1%	90.8%	102.1%	694,839.00
Sub-Contract	5.2%	19.0%	37.2%	56.7%	81.0%	97.2%	100.8%	965,512.00
Travel & Transportation	8.7%	31.0%	40.0%	64.8%	79.7%	92.2%	100.1%	370,315.00
Equipment	54.0%	61.0%	71.0%	82.1%	93.3%	98.8%	99.1%	462,237.00
Allowance	3.2%	28.1%	38.2%	67.0%	70.6%	88.2%	96.9%	217,248.00
Other Direct Costs	2.9%	11.8%	24.9%	46.8%	67.3%	88.5%	101.3%	461,308.00
New Training	.0%	.0%	.0%	.0%	28.0%	70.2%	98.7%	122,808.00
Contingency	.0%	.0%	.0%	.0%	30.4%	100.0%	103.7%	93,042.00
Imprest	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	2,000.00
Total Expenditures	9.2%	21.4%	35.0%	53.9%	72.8%	91.6%	100.5%	5,261,419.00

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