SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAMME/
KENYA AGRICULTURAL RESEARCH INSTITUTE
(SR-CRSP/KARI)

11TH SR-CRSP SCIENTIFIC WORKSHOP

I.L.R.A.D. - KABETE
3rd and 4th March, 1993

PROGRAMME AND ABSTRACTS

ELEVENTH SR-CRSP SCIENTIFIC WORKSHOP

ILRAD - NAIROBI

3RD AND 4TH MARCH, 1993

Day 1 - 3rd March, 1993

8.00 - 9.00	Registration

OPENING SESSION

9.00 - 9.15	Chairman, Dr. J.D. Wachira, Deputy Director (Livestock) - KARI
9.15 - 9.30	SR-CRSP - Management Entity, Davis-California, Dr. P. Conrad
9.30 - 9.45	USAID Representative
9.45 - 10.00	Keynote address Small Ruminant Production: Strategies for Sustainability Prof. S. Lebbie
10.00 - 10.30	Opening address - Guest of Honour Dr. Wellington Ngulo, Director of Research Development Ministry of Research, Technical Training and Technology
10.30 - 10.45	COFFEE/TEA BREAK

SESSION 1:
ANIMAL HEALTH

Chairman: Dr. J.S. Wafula

10.45 - 11.05	Genetic Resistance of Red Maasai Sheep to *Haemonchus contortus* ***Bain, R.K., Wanyangu, S.W., Mugambi, J.M., Ihiga, M.A., Duncan, J.L. and Stear, M.J.***
11.05 - 11.25	The Role of the Eosinophil in Resistance of Scottish Blackface Sheep of Experimental Infections with *Haemonchus contortus* ***Karimi, S.K., M. Murray, M.J. Stear and J.L. Duncan***
11.25 - 11.45	Evidence for Multiple Anthelmintic Resistance in Gastrointestinal Nematodes in Sheep in Coastal Kenya ***Mwamachi, D.M., J. Ouma, M. Magadi, L. Reynolds, R.L. Baker***
11.45 - 12.05	Identification of Proteases with Diverse Characteristics in Adult *Haemonchus contortus* Excretory-Secretory Products ***Karanu, F.N., F.R. Rurangirwa, T.C. McGuire and D. Jasmer***
12.05 - 12.25	Integral Membrane Surface Protein of Mycoplasma F38 (F38) Mediates *in vitro* Growth Inhibition of F38 ***Rurangirwa, F.R., S.M. Kihara, A.N. Wambugu and T.C. McGuire***
12.25 - 12.45	identification of *Mycoplasma F38* Surface Antigens with Goat Serum Antibodies ***Kihara, S.M., F.R. Rurangirwa and T.C. McGuire***
12.45 - 1.00	DISCUSSION
1.00 - 2.00	LUNCH BREAK
2.00 - 2.20	Preliminary Survey of Hypobiosis in a Marginal Area of Kenya ***Gatongi, P.M., Scott, M.E., Prichard, R., Gathuma, J.M. and Munyua, W.M.***
2.20 - 2.40	Comparative Study on Caprine and Bovine Besnoitiosis: Infections in Goats and Rabbits ***Njagi, O.N., Ndarathi, C.M., Nyaga, P.N.***
2.40 - 3.00	Prevalence and Characteristics of Retrovirus-associated Pulmonary Diseases of Kenya Sheep: Preliminary Results ***DeMartini, J.C., S.J. Brodie and P. Rwambo***

3.00 - 3.20	Serological Evidence for the Presence of Ovine Lentivirus Infections in Sheep Flocks in Kenya ***Rwambo, P.M., F. Mbithi, M. Shaw and J.C. DeMartini***
3.20 - 3.40	Expression of Rift Valley Fever Virus (RVFV) Glycoproteins in a Recombinant Capripoxvirus ***Soi, R.K, F.R. Rurangirwa, T.C. McGuire, J.C. DeMartini, P. Rwambo, T.B. Crawford***
3.40 - 3.55	**DISCUSSION**
3.55 - 4.10	**COFFEE/TEA BREAK**
4.10 - 4.30	Nairobi Sheep Disease Virus: Morphology, Structural Proteins and cDNA Cloning of Viral RNA ***Rwambo, P., F. Mbithi, M. Shaw and F. DeMartini***
4.30 - 4.50	Production Potentials of the Red Maasai and Black-Headed Somali under Pastoral Management Conditions without Trypanosome and Helminth Control ***Wanyangu, S.W., Mwendia, C.M.T., Bain, R.K., Mugambi, J.M. and Stevenson, P.***
4.50 - 5.10	Immunization of Sheep Against Fascioliasis Using Non-Ionic Detergent Soluble Materials of *Fasciola gigantica* Metacercariae ***Siamba, D.N., F.R. Rurangirwa and C.M. Ndarathi***
5.10 - 5.25	**DISCUSSION**

SESSION 2:
SOCIO-ECONOMICS/PRODUCTION SYSTEMS AND FEED RESOURCES

Day 2 - 4th March, 1993

Chairman: Dr. A.W. Mukhebi

8.30 - 8.50	Changes in Livestock Tenure Western Kenya Farming Systems: A Preliminary Study ***Domingo Martinez***
8.50 - 9.10	Dairy Goat Farmers Training at Livestock Training Institute Tengeru, Arusha ***Ghamunga, S., H. Kyomo, E. Kinsey and D. Lubambe***
9.10 - 9.30	Differential Adoptive Behavior and Gender of Decision Maker Dual Purpose Goat Technology in Western Kenya ***Sheikh D. and J.C.O. Nyankori***
9.30 - 9.50	How Farmer Oriented Research with Dual-Purpose Goats in Western Kenya Evolved ***Semenye, P.P. and W.R. Getz***
9.50 - 10.05	**DISCUSSION**
10.05 - 10.20	**COFFEE/TEA BREAK**
10.20 - 10.40	Farmers' Reasons for Owning Small Ruminants in a Case Study of Small Ruminant Production and Marketing in the Semi-Humid Zone of Kaloleni Division, Coast Province ***Otieno L., C. Ackello-Ogutu, G. Mullins, L. Reynolds***
10.40 - 11.00	Evaluation of Small Ruminant Marketing in Coastal Kenya ***Otieno, L., C. Ackello-Ogutu, G. Mullins, L. Reynolds***
11.00 - 11.20	A Comparison of Dual Purpose Goat Technology Under Project and Farmer Management ***Sheikh, D., A.N. Mbabu, and M.F. Nolan***

11.20 - 11.40	Technology and Household Expenditures: A Case Study of Western Kenya ***Ethuro, D.E.***
11.40 - 11.55	**DISCUSSION**
11.55 - 12.15	Evaluation of Multi-Purpose Tree Legumes for Fodder: The Case of *Sesbania sesban* in Western Kenya ***Otieno, K.***
12.15 - 12.35	Constraints to the Integration of the CCPP Vaccine into Kenya's Animal Health delivery system ***Michele Lipner***
12.35 - 12.55	Offtake and Milking Strategies of Goat Farmers in Ngozi Province (Burundi) ***Rey, B.***
12.55 - 1.10	**DISCUSSION**
1.10 - 2.15	**LUNCH BREAK**

SESSION 3:
BREEDING AND SYSTEMS ANALYSIS

Chairman: Dr. A.N. Abate

2.15 - 2.35	Why is Growth Rate in Inadequate Parameter for Evaluating the Response to a Supplementary Feeding Program for Weaner Sheep? ***Carles, A.B.***
2.35 - 2.55	The Specificity of Bovine Microsatellite Primers in Other Ruminants ***McIssac, M., S.J. Kemp and A.J. Teale***
2.55 - 3.15	Goat Microsatellite Dinucleotide Repeat Polymorphisms Detected in the Kenya Dual Purpose Goat ***Bhebhe, E., S.K. Davis, J.F. Taylor, J. Derr, F. Ruvuna, J. Kogi and F. Rurangirwa***
3.15 - 3.35	Genetic Resistance to Gastrointestinal Parasites in Dorper and Red Maasai x Dorper Lambs in Coastal Kenya ***Baker, R.L., L. Reynolds, D.M. Mwamachi, J. Ouma***
3.35 - 3.50	**DISCUSSION**
3.50 - 4.05	**COFFEE/TEA BREAK**

4.05 - 4.25	Estimates of Breed Additive and Heterozygosity Parameters in the KDPG ***Ruvuna, F., J.F. Taylor, J. Kogi, M. Kones, B.A.J. Mwandotto, C.O. Ahuya and S. Mkuu***
4.25 - 4.45	Lactation Curves of Crosses Among Galla and East African with Toggenburg and Anglo-Nubian ***Kogi, J., F. Ruvuna, J.F. Taylor, B.A.J. Mwandotto, C.O. Ahuya and S. Mkuu***
4.45 - 5.05	Kidding Interval: An Important Factor in Breeding Management of Dairy Goats: A Case Study of Dairy Goat Project in Arumeru, Arusha ***Ghamunga S, H. Kyomo, M. Kilimba and D. Lubambe***
5.05 - 5.20	**DISCUSSION**
5.20 - 5.30	**CLOSING REMARKS**

ABSTRACTS

1. ANIMAL HEALTH

1.1 Genetic Resistance of Red Maasai Sheep to *Haemonchus contortus*

Bain, R.K., Wanyangu, S.W., Mugambi, J.M., Ihiga, M.A., Duncan, J.L. and Stear, M.J.

Red Maasai sheep have been reported to be resistant to infection with *Haemonchus contortus*. Recent work at Muguga has shown that Red Maasai sheep display lower faecal egg counts and lower mortalities than certain other breeds. Red Maasai sheep also maintained higher haematocrit levels during infection and a greater degree of eosinophilia was noted while animals were under challenge. The difference in resistance is evident under natural or artificial challenge and regardless of whether naturally challenged animals share pasture with susceptible sheep or graze separately. It is felt that Red Maasai sheep offer an immediate, cheap and sustainable approach to improved productivity in areas where haemonchosis is a serious problem.

1.2 The Role of the Eosinophil in Resistance of Scottish Blackface Sheep to Experimental Infections with *Haemonchus contortus*

Karimi, S.K., M. Murray, M.J. Stear and J.L. Duncan

Eosinophil responses were measured in twenty naive, purebred Scottish Blackface lambs, following experimental infection with 50,000 *Haemonchus contortus* 3rd stage larvae. There were marked variation in response. The correlation between peripheral blood eosinophilia and faecal egg counts was negative and significant (p,0.01) during the second and third infections. At the same time the correlation between peripheral blood eosinophilia and body weight was positive and significant ($p<0.02$). Similarly, the correlation between peripheral blood eosinophilia and abomasal tissue eosinophilia was positive and significant ($p<0.01$). Thus, eosinophilia is a measure of resistance and can possibly serve as a marker for selecting sheep that are resistant to *H. contortus*

1.3 Evidence for Multiple Anthelmintic Resistance in Gastrointestinal Nametodes in Sheep in Coastal Kenya

Mwamachi, D.M., J. Ouma, M. Magadi, L. Reynolds and R.L. Baker

A faecal egg reduction test was carried out using Ivermectin (oral and injectable forms), Panacur (fenbendazole) and Levamisol. Eighty 6-7 month old sheep with an average weight of 14 kg (range 9-20 kg) were weighed and sampled for FEC on day 0. The animals were then divided into 5 groups and groups 1-4 treated with the anthelmintics, each animal in a group receiving a constant dose calculated using the heaviest animal in the respective group. On days 10 and 11 the sheep were again weighed and sampled for FEC. Results indicated a percent reduction of 77, 13, 42, 92 and a percent lower confidence limit of 65, -28, 16 and 56 for injectable Ivermectin, oral Ivermectin, Panacur and Levamisol respectively. Thus there was clear evidence of resistance to Ivermectin and Panacur, injectable Ivermectin being more effective than the oral form. Levamisol

was the most effective anthelmintic, although resistance seems to be developing. Larval cultures indicated that the parasites were predominantly *Haemonchus contortus* (66%), with *Trichostrongylus spp* (30%) and *Oesophogastomum* (4%) also being identified. This disturbing situation will be discussed in terms of possible further trials to elaborate this finding further (e.g. which parasite species are resistant) and strategies being considered to lengthen the effective life of the available anthelmintic drugs.

1.4 Identification of Proteases with Diverse Characteristics in Adult *Haemonchus contortus* Excretory-Secretory Products

Karanu, F.N., F.R. Rurangirwa, T.C. McGuire and D. Jasmer

Host tissue penetration and feeding by helminth parasites may be mediated by mechanical processes and histolytic products released by the parasites. To investigate potential histolytic products released by adult *Haemonchus contortus*, proteases in excretory-secretory (ES) products were analysed. The optimum activity of ES proteases was at pH 5.0, although activity was observed over a wide pH range. Four protease bands were observed on gelatin-containing polyacrylamide gels, with estimated molecular weights (Mr) of 32, 35, 38 and 40 kDa. Proteases of 32 and 35 kDa were active at pH 5-8 while activity of the 38 and 40 kDa proteases was inhibited at pH 8.0. Based on inhibition studies, the four proteases identified on gelatin-containing polyacrylamide gels were classified as cysteine proteases. Evidence was also obtained for an aspartic protease in ES products, but was not visualised on gels. Comparison of ES proteases between two *H. contortus* isolates demonstrated geographic differences in estimated molecular weight of predominant proteases. The diversity of adult *H. contortus* ES proteases may indicate variable functional requirements of proteases, and could have important immunological implications.

1.5 A Monoclonal Antibody (FE8-18) Reacting with an Integral Membrane Surface Protein of Mycoplasma F38 (F38) Mediates *in vitro* Growth Inhibition of F38

Rurangirwa, F.R., S.M. Kihara, A.N. Wambugu and T.C. McGuire

Mycoplasma belong to the class Mollicutes which represents a divergent and rapidly evolving group of small procaryotes taxonomically unified by their common lack of a cell wall and the presence of a single limiting membrane. This surface is clearly critical to the interaction of these organisms with their environment; in particular, membrane-associated proteins are likely to mediate a variety of transport functions and must contribute to the surface topology of mollicutes, dictating their interactions with a variety of hosts, both as parasites of the host cell surfaces and as potential targets of the immune response.

Analysis of antigens by specific antibodies has been useful in defining potentially important surface structures of some mycoplasma species. Elucidation of mycoplasma surface antigen structure is also important in light of the involvement of surface antigens in antibody-mediated metabolic and growth inhibition tests, which are widely used to classify mycoplasma species. The characterisation of surface structures defining these

serological specificities has been established in remarkably few cases.
Monoclonal antibodies were produced against F38, the etiologic agent causing contagious caprine pleuropneumonia in goats, by immunising Balb/C mice with killed F38. The spleens of the mice with high antibody activity in ELISA were fused with X63/Ag.8 cells. The resulting monoclonal antibodies were tested for their growth inhibiting activity against F38. Monoclonal antibody FE8-18 (Ig2a isotype) was found to inhibit the growth of prototype F38 and 5 other isolates. Immunoblot of solubilized whole F38 cells revealed that Mab FE8-18 reacted with an epitope on a protein with an apparent molecular weight of 24,000 (p24). The p24 is shown by Triton X-114 phase fractionation to partition efficiently into the hydrophobic detergent phase. The external orientation and membrane association of the p24 antigen were further established by demonstrating that trypsin treatment of intact mycoplasma cells with 150ug trypsin cleared p24 to a limit fragment of apparent molecular weight of 21,000. Mab FE8-18 did not react with other mycoplasma species belonging to the "Mycoplasma mycoides cluster". These results localize on epitope responsible for antibody-mediated mycoplasma growth inhibition onto a specific, surface-exposed integral membrane protein of this organism. Since the monoclonal antibody does not bind to the surface of other species of mycoplasma in the "Mycoplasma mycoides cluster", the epitope identified also defines a structural marker of antigenic surface differentiation of Mycoplasma F38 isolates.

Analysis of the antigenic and structural features of the p24 surface antigen may therefore be useful in the development of immunodiagnostic and/or immunoprophylactic reagent against contagious caprine pleuropneumonia.

1.6 Identification of *Mycoplasma F38* Surface Antigens with Goat Serum Antibodies

Kihara, S.M., F.R. Rurangirwa and T.C. McGuire

Mycoplasma sp. F38 (F38) causes contagious caprine pleuropneumonia (CCPP) of goats with morbidity and mortality rates of 100% and 70% respectively. The organism induces *in vitro* F38 agglutinating and growth inhibiting antibodies (GI) in the serum of some CCPP recovered or hyperimmunized goats. Agglutinating and growth inhibiting antibodies are directed against surface antigens of certain Mycoplasmas. Such antigens may be useful in the induction of protective immune responses in the respective hosts. In some Mycoplasmas, antigens inducing GI antibodies are proteins or glycolipid haptens. The role of polysaccharides in the induction of GI antibodies has not been demonstrated although there is evidence to show that some mycoplasma polysaccharides are intimately associated with membranes. *Mycoplasma F38* produces a polysaccharide which can be purified from other either *F38* organisms or media components by phenol extraction. To determine whether the polysaccharide is present on the surface, we absorbed hyperimmune goat serum to *F38* with untreated, periodate treated or trypsin treated *F38* polysaccharide and tested the absorbed serum for growth inhibiting and *F38* agglutinating antibodies. Unabsorbed and immune sera absorbed with periodate treated polysaccharide inhibited growth of 10^6 colony forming units and caused agglutination of *F38* organisms at a titers of 1:16 and 1:64 respectively. Serum absorbed with the

untreated or trypsin treated polysaccharide had no growth inhibiting or *F38* agglutinating activities. In western blots of solubilized whole *F38*, unabsorbed or serum absorbed with periodate treated polysaccharide reacted with a poorly resolving antigen in the stacking gel while no such activity was observed with untreated or trypsin treated polysaccharide absorbed sera. Activity of the sera to protein antigens was unchanged. Immune serum activity to the polysaccharide was also observed on western blots of the untreated or trypsin treated polysaccharide. This activity was abolished on the periodate treated polysaccharide both in the stacking and resolving gels. This indicated that absence of activity in F38 blots probed with polysaccharide absorbed sera was due to removal of antibody to this antigen and that the poorly resolving antigen is a polysaccharide. Preimmunization serum whether unabsorbed, absorbed with either the untreated, periodate or trypsin treated polysaccharide did not show any activity in any of the above tests. This indicated that the *F38* polysaccharide is on the surface of *F38* and induces growth inhibiting and agglutinating antibodies. The potential use of such an antigen in protective immunization is therefore implied.

1.7 A Preliminary Survey of Hypobiosis in a Marginal Area of Kenya

Gatongi, P.M., Scott, M.E., Prichard, R., Gathuma, J.M. and Munyua, W.M.

Following widespread cases of fatal haemonchosis in lambs and kids in arid and semi-arid regions of Kenya, an epidemiological study of nematodes under field conditions was undertaken in a marginal area using both sheep and goats. Parasite population was monitored by pasture larval counts, faecal egg counts and total worm counts at autopsy. This included both traces and permanent grazers. Climatological data included precipitation, temperature and relative humidity.

Postmortem results showed high percentages (about 80% of arrested larvae (EL_4) immediately after the rains. The percentage of arrestment gradually increased with the coming of the dry season while adult worm population proportionately decreased. Later within the dry period the proportion of the arrested larvae decreased while the population of the adult worms appeared to rise. *Haemonchus* was the most common genus (about 73%) followed by *Trichostrongylus* (about 18%) and then *Oesophagostomum* (8%). Results of this survey suggest that parasite population density was responsible for the arrestment. The arrested forms replaced natural deaths of the adult worms during the dry season and thus kept the animals highly parasitised at a time that pasture infectivity was virtually nil. It is the first time that this phenomenon has been reported in the country.

1.8 Comparative Study on Caprine and Bovine Besnoitiosis: Infections in Goats and Rabbits

Njagi, O.N., Ndarathi, C.M., Nyaga, P.N.

Investigations were carried out to study the disease symptoms that developed from *Besnoitia* strains of parasites that affected cattle and goats. *Besnoitia* parasites were isolated from chronic natural cases of bovine and caprine besnoitiosis. Each isolate was used to infect a set of experimental hosts comprising both weaned local goats and Newzealand white rabbits.

Two distinct clinical syndromes were established that revealed obvious differences in pathogenicity between the two isolates. Recipients of the bovine isolate developed typical signs of acute besnoitiosis often leading to deaths before the chronic disease could establish. Deaths occurred within 18 hrs after infection in rabbits due to toxicity of bovine *Besnoitia* bradyzoites. Recipients of the caprine isolate developed a mild disease only marked by development of fever after an incubation period of 10-14 days and chronic cysts in the hosts.

It is proposed that *Besnoitia* organisms causing besnoitiosis in goats and cattle should be considered as strains of *Besnoitia besnoiti*.

1.9 Prevalence and Characteristics of Retrovirus-associated Pulmonary Diseases of Kenya Sheep: Preliminary Results

DeMartini, J.C. and S.J. Brodie

Ovine pulmonary carcinoma (OPC, sheep pulmonary adenomatosis) and ovine lentivirus (OvLV, maedi-visna virus) both have been reported in Kenya previously. However, there have been few if any studies on these diseases in Kenya within the last 20 years. In studies involving 165 sheep on farms in the Laikipia area and the Loita Hills of Kenya, we found seroprevalence of OvLV to be 0 to 35%. Among 9 culled sheep necropsied, lesions of OvLV-associated interstitial pneumonia were found in 7 and lesions of OPC were found in 2 animals. Studies of OvLV isolates recovered from 6 sheep are continuing to compare their antigenic profiles with OvLV strains from North America.

1.10 Serological Evidence for the Presence of Ovine Lentivirus Infections in Sheep Flocks in Kenya

Kwambo, P.M., F. Mbithi and J.C. DeMartini

Ovine lentivirus (ovine progressive pneumonia, maedi-visna) infections have for long been suspended to occur in sheep flocks in Kenya and may have originated from South Africa with imported merino sheep. The annual losses on some farms have been estimated at 15-25%. Currently, a diagnostic test for OvLV does not exist and no control programmes are in place. Thus, development of a sensitive diagnostic test to allow identification of infected sheep for culling is needed. Ovine lentivirus (OvLV) has recently been isolated from lung explants obtained during necropsy of sheep with severe

respiratory distress. The virus was grown in lamb testis (LT) cells in which syncytia were detectable 3-4 days after infection. The virus was clarified at 10,000 rpm for 2 h at 5°C. The pellet was suspended in TEN buffer and used in western blot to screen for anti-OvLV antibodies in sera collected from clinically sick and from apparently healthy animals in the same flocks. Of 60 sera screened by western blotting, 35% and 60% had IgG to OvLV gp105 and p27, respectively. Sera from virus positive animals had antibodies to gp105 and p27. 28% of the 60 sera were positive for OvLV by AGID test. Sheep sera positive for a North American OvLV isolate had reactivity to gp105 and p27 of the Kenyan isolates. In addition, monoclonal antibodies to p27 and p17 of North American OvLV reacted with the Kenya isolates. The results indicate that OvLV is common in sheep flocks in Kenya and is related to the North American isolates.

1.11 Expression of Rift Valley Fever Virus (RVFV) Glycoproteins in a Recombinant Capripoxvirus

Soi, R.K, F.R. Rurangirwa, T.C. McGuire, J.C. DeMartini, P.R. Rwambo, T.B. Crawford

Rift Valley fever is a zoonotic vector borne viral disease of economic importance in Africa. A live tissue culture vaccine is used in domestic ruminants but is abortifacient and thermolabile. To circumvent the abortifacient and thermolabile properties of the vaccine, the M segment of RVFV that encodes G1 and G2 glycoproteins was inserted into the thymidine kinase (TK) locus of the Capripoxvirus vaccine for sheep and goats. A vaccinia insertion plasmid containing the M segment flanked by TK sequences was used and recombinant virus selected with mycophenolic acid. The M segment is expressed under control of the vaccinia virus early/late promoter, p7.5. The expressed G1 and G2 were indistinguishable from the authentic RVF virus glycoproteins in size and reactivity with monoclonal antibodies as determined by IFAT and western blotting. A recombinant vaccinia virus expressing the G1 and G2 glycoproteins has been shown to induce neutralizing antibody to RVFV and protects against challenge with virulent virus.

The recombinant Capripoxvirus expressing the RVF glycoproteins would be an economical bivalent thermostable vaccine for control of Capripoxvirus and RVF virus infections in domestic ruminants.

1.12 Nairobi Sheep Disease Virus: Morphology, Structural Proteins and cDNA Cloning of Viral RNA

Rwambo, P., F. Mbithi, Shaw, M. and J. DeMartini

Analysis of Nairobi sheep disease virus (NSDV) infected BHK-21 cells and 143-B cells by thin-section electron microscopy revealed that virions bud into smooth membrane vesicles of the golgi complex. This is characteristic of members of the virus family Bunyaviridae to which NSDV belongs. Analyses of ^{35}S-methionine labelled lysates of virus infected cells on SDS-PAGE identified several virus induced proteins including 100 (110), 85, 60, 45 and 29 kDa respectively. The 110, 45, 35 and 29 kDa proteins were

immunoprecipitated with recovered sheep serum and the 29 kDa protein was the most predominant protein in infected BHK-21 cells. Viral RNA was purified and polyadenylated at the 3' end to allow oligo-dT primed cDNA synthesis. Size fractionated cDNA were ligated into NotI-SalI cut pSPORT1 for transformation. Colonies were selected on blue/white screening and by immunoscreening. The antibody reactive colonies were further analysed for cDNA inserts in DNA gels. Inserts of various sizes of cDNA were observed. Further analyses of these inserts and the proteins they code for is in progress.

1.13 Production Potentials of the Red Maasai and Black-Headed Somali Sheep under Pastoral Management Conditions without Trypanosome and Helminth Control

Wanyangu, S.W., Mwendia, C.M.T., Bain, R.K., Mugambi, J.M. and Stevenson, P.

Parasitological and production data of the Red Maasai and the Black-headed Somali sheep reared under pastoral conditions without trypanosome and helminth control were compared. Results obtained showed no statistical difference between the two breeds in the faecal egg count (FEC), parasitaemias due to trypanosomes, packed cell volume (PCV), differential faecal larval counts and lambing rate. The Red Maasai however, had significantly higher trypanosome infection rates ($p < 0.001$) while the Black-headed Somali had higher weight gain ($p < 0.05$).

1.14 Immunization of Sheep Against Fascioliasis Using Non-Ionic Detergent Soluble Materials of *Fasciola gigantica* Metacercariae

Siamba, D.N., F.R. Rurangirwa and C.M. Ndarathi

Sheep were immunized four times in four weeks with Triton X-114 soluble material of *F. gigantica* and challenged with 150 metacercariae of *F. gigantica*. Flukes were recovered at 12 weeks of infection at which time immunized sheep had 87% less *F. gigantica* than the controls. The immunized sheep had lower GD and GGT levels than the controls indicating less liver damage in the vaccinated groups. These studies demonstrate that tegumental molecules of *F. gigantica* metacercariae has the potential to serve as vaccine in sheep exposed to this parasite disease.

2. SOCIO-ECONOMICS/PRODUCTION SYSTEMS AND FEED RESOURCES

2.1 Changes in Livestock Tenure Western Kenya Farming Systems: A Preliminary Study

Domingo Martinez

During the more than ten years of study and on-farm research in small farms in Western Kenya, changes have occurred due to the project intervention, but also to other exogenous circumstances. To sort out the relative impact of the program in the farming systems, a survey was applied to 221 farmers during March and April, 1992, including 157 participant and 64 non-participant households. This paper will summarise the first findings of this work, especially those referred to livestock tending, by comparing the size and composition of the herds in 1984 with those of 1992.

2.2 Dairy Goat Farmers Training at Livestock Training Institute Tengeru, Arusha

Ghamunga, S., H. Kyomo, E. Kinsey and D. Lubambe

Livestock Training Institute Tengeru started six training farmers way back in 1983. Eighty groups of about 25 farmers each have been trained in-campus on various skills of dairy cattle husbandry, pig husbandry, milk processing, dairy goat husbandry, agroforestry and poultry husbandry by December 1992.

This paper gives an insight on the various farmers achievements on the skills taught based on evaluations carried out in 1991 and 1992, it also includes suggestions on what can be done to further improve the mode of operation of the farmer's courses to the benefit of the dairy goat farmers.

2.3 Differential Adoptive Behavior and Gender of Decision Maker Dual Purpose Goat Technology in Western Kenya

Sheikh D. and J.C.O. Nyankori

The dual purpose goat technology was developed for the small holder. There has been male out-migration from the small scale farms to urban areas in search of jobs (Mbabu 1988). This has led to females taking up traditional male roles including heading households and managing the farms. This study is conducted to investigate the implications of these changing roles with respect to the adoption patterns of the dual purpose goat technology. Specifically, this study was conducted to assess whether there are any differences in the adoptive behavior of male and female farm decision makers.

Results indicate that female farm decision makers are engaged more in activities that require low capital and relatively lower human capital. On the other hand male farm decision makers had higher probabilities of adopting technological items that require relatively higher human capital and capital.

2.4. How Farmer Oriented Research with Dual-Purpose Goats in Western Kenya Evolved

Semenye, P.P. and W.R. Getz

This paper describes how farmer oriented research with dual-purpose goats in western Kenya evolved. Research was based on a multidisciplinary team engaged in farming systems research that involved farmers throughout the technology development process. This was made possible by the Small Ruminant collaborative Research Support Program (SR-CRSP), whose goals, functional and organisational designs enabled ample support for farmer oriented research.

In the paper highlights of technical constraints solutions and failures affecting the dual-purpose goats productivity are given. Finally an impact assessment is presented from which the readers are free to make their own conclusions on the success of the programme in western Kenya. A Monoclonal Antibody (FE8-18) Reacting with an

2.5. Farmers' Reasons for Owning Small Ruminants in a Case Study of Small Ruminant Production and Marketing in the Semi-Humid Zone of Kaloleni Division, Coast Province

Otieno L., C. Ackello-Ogutu, G. Mullins, L. Reynolds

The average flock size was 10 in 76 households. Flocks were established through purchase from fellow farmers. Sale for cash need was the farmers' main reason for keeping small ruminants. Periods of food deficit in the household were closely linked to the seasonality of cash need. Producer household consumption of small ruminant meat was mainly limited to the festive season.

2.6 Evaluation of Small Ruminant Marketing in Coastal Kenya

Otieno, L., C. Ackello-Ogutu, G. Mullins, L. Reynolds

The marketing system of small ruminants in coastal Kenya was studied through a case study in Kilifi and Kwale Districts. Five channel levels were identified: (i) producers, (ii) assemblers, (iii) itinerant traders, (iv) retailers and (v) consumers. Price discovery was by one-to-one bargaining at all the channel levels. Prices per head were dependent on animal characteristics and market supply conditions including supply from outside the study area. The marketing system was both technically and price efficient as shown by marketing margins and cost analysis as well as market integration evaluation.

2.7 A Comparison of Dual Purpose Goat Technology Under Project and Farmer Management

D. Sheikh, A. N. Mbabu and M. F. Nolan

Land scarcity as a result of population pressure and the traditional transfer of land from fathers to sons has led to land subdivisions into smaller and smaller units making it difficult to maintain herds of cattle. A related problem is unreliable rainfall resulting in food and feed scarcity. The dual purpose goat and its technological package is designed

to serve small farm units under unreliable rainfall conditions. As part of the project activities, the dual purpose goat was distributed to randomly selected farmers in order to assess social acceptability of the package under farmer management conditions.

The selected participating farmers were to collaborate with the project according to agreed terms, spelt out in a mutually agreed contract. According to the contract, full ownership of the goats was envisioned to follow two successful kidding or in September 1990. Following 1990, there was the gradual withdrawal of the project and hence less technical assistance to the participating farmers. However, monitoring of the farm units and participating farmers did not stop. As part of this monitoring process, the number of farmers still keeping the dual purpose goat was assessed in 1992. Tentative results indicate that 48.6% of the participating farmers are not keeping the DPG. Reasons given for not keeping the DPG include deaths of dual purpose goats or sale of the goats to cater for emergency cash needs including funeral expenses, hospital expenses, food purchases etc. Partly as a result of the absence of the goat from half the farms results also indicate that level of utilization of some of the techpacks especially those related directly to the dual purpose goat has gone down.

2.8 Technology and Household Expenditures: A Case Study of Western Kenya

Ethuro, D.E.

Past studies in rural development have focussed on production aspects of rural household activity. Consequently, little if known about household consumption and expenditure behaviour. Yet household expenditures stimulate economic growth as indicated theoretically by the final demand multiplier. The purpose of the study is to evaluate the demographic and economic determinants of household expenditures.
Data are from a survey of farmers in western Kenya conducted in the summer of 1990. The data set contains information on household and farm characteristics, income resources and household expenditures. Aggregate household expenditures as well as expenditures on specific product categories were estimated using Tobit models. Results from these models were then used to test hypotheses about the effects of demographic and economic factors on household expenditures.
Age of the respondent, education, income levels of the household and employment status of the family were found to be the key determinants of the expenditures. Any technological intervention geared to the improvement of the living standards of the rural populace should be cognizant of these factors. Increases in household expenditures form an obvious barometer for the measurement of increased incomes resulting from such technological improvements.

2.9 Evaluation of Multi-Purpose Tree Legumes for Fodder: The Case of *Sesbania sesban* in Western Kenya

Otieno, K.

The use of multi-purpose tree (MPT) legumes as sources of supplementary feed for ruminants is considered with a discussion of an experimental work undertaken in western Kenya to evaluate the effect of three cutting frequencies (monthly, bimonthly and four-monthly) on total yield, leaf fraction and the nutritive quality of the forage (leaf fraction) of four accessions of *Sesbania sesban* var. *nubica* grown at three sites in western Kenya. The sites differed in altitude, soils and rainfall pattern.

Results for leaf dry matter (DM) yield, mineral and nitrogen content, two-stage *in vitro* DM digestibility, nylon bag DM and nitrogen degradability and the effect of rainfall on DM yield are reported for one of the sites (Maseno).

2.10 Constraints to the Integration of the CCPP Vaccine into Kenya's Animal Health Delivery System

Michele, E.L.

CCPP vaccine has been available for use since 1987, but its integration into the disease prevention for this occurrence, SR-CRSP carried out a socio-economic study between March and November 1992. The study entailed formal and informal interviews and extensive archival search. Findings indicate that contrary to common belief, CCPP is endemic in most of the areas where goats are commonly kept. It is also apparent that despite the relative low cost of the CCPP vaccine, as compared with the treatment of the disease using antibiotics, vaccination campaigns have only tended to occur if and when donor or government support is provided. This calls for further studies to explain why farmers have not tended to initiate vaccination for their goats on their own accord.

3. BREEDING AND SYSTEMS ANALYSIS

3.1 Why is Growth Rate in Inadequate Parameter for Evaluating the Response to a Supplementary Feeding Program for Weaner Sheep?

Carles, A.B.

The principle parameters of livestock response to interventions are growth, survival, fertility, and lactation. However, response occurs at two levels - the individual, and the flock (dynamics), due to interactions amongst these four parameters. Thus for a complete analysis of the response to any intervention, however simple, all four parameters should be considered with their respective interactions. The complexity of such an analysis has usually precluded such an approach; however, computer programs are now available that enable this to be done quite simply. The use of one such program (LPEC) will be demonstrated in the evaluation of the costs and benefits of a supplementary feeding program for weaner sheep.

3.2 The Specificity of Bovine Microsatellite Primers in Other Ruminants

McIssac, M., S.J. Kemp and A.J. Teale

A panel of primers designed to amplify polymorphic bovine microsatellites and thus provide markers for a bovine gene map, was applied to genomic DNA from a range of wild and domestic ungulates in order to evaluate their cross-species performance and their potential as tools in studies of genetic distance. Polymorphic loci were identified in all ruminant species and a correlation was seen between the specificity of the primers, the polymorphism of their products and the evolutionary relationships between the bovid and non-bovid species studied. Approximately 60% of bovine primers were found to amplify polymorphic microsatellites in sheep and goat. This indicates that the ongoing efforts to map the bovine genome will have direct and immediate applicability to the mapping of the ovine and caprine genomes.

3.3 Goat Microsatellite Dinucleotide Repeat Polymorphisms Detected in the Kenya Dual Purpose Goat

Bhebhe, E., S.K. Davis, J.F. Taylor, J. Derr, F. Ruvuna, J. Kogi and F. Rurangirwa

The paper is focussed on the development of microsatellite markers in the goat. Microsatellites are short, tandemly repeating elements that are randomly distributed throughout the genome and show a relatively high degree of polymorphism. Clones from a size selected ($\leq$800bp) goat genomic library were hybridized to either a (GT)15 or (CT)15 probe generated by nucleotide synthesis on an Applied Biosystems DNA/RNA synthesizer and end labelled using γ^{32}P ATP. All positive clones were sequenced to determine the number of repeats in the microsatellite sequence and the nucleotide sequence of the regions flanking the microsatellite. Nucleotide sequence information for the regions flanking each microsatellite facilitated the designing of primer pairs for polymerase chain reaction (PCR) amplification of each microsatellite region. PCR

primers were synthesized for those microsatellite regions containing a minimùm of ten dinucleotide tandem repeats. Three temperature PCR on DNA from twelve unrelated four-way cross goats and three unlinked goat pedigrees was carried out to determine informativeness of each microsatellite sequence and allelic segregation pattern respectively. To date, over 20 goat microsatellites have been identified, of these, four are polymorphic and all four exhibit a codominant mode of inheritance. All polymorphic microsatellites are being scored in 250 goats from ten sire families. Microsatellite primer conservation between the genus caprine and Bos is being assessed. Statistical analysis using Best Linear Unbiased prediction methodology will be carried out to determine associations between microsatellite marker genotype and resistance/resilience to *Haemonchus contortus*.

3.4 Genetic Resistance to Gastrointestinal Parasites in Dorper and Red Maasai x Dorper Lambs in Coastal Kenya

Baker, R.L., L. Reynolds, D.M. Mwamachi, J. Ouma, M. Magadi and J.E. Miller

Research was initiated in the present project in 1990 at the coastal Kenya site at Diani Estate (Baobab Farms). The lambs born in July/August 1991 repesented four genotypes generated by a diallel crossing design of Red Maasai (12) and Dorper (12) rams to Dorper (200) and F_1 Red Maasa x Dorper (200) ewes. These lambs were regularly monitored for both packed cell volume (PCV) and faecal egg counts (FEC) from birth to one year of age as measures of resistance to endoparasites. Relative to the straightbred Dorper the 3/4 Red Maasai lambs at one year of age were lighter (by about 1 kg), but had higher PCV (29.2 vs 27.3), lower FEC (1197 vs 1846 epg) and lower mortality from birth to weaning (23 vs 45%).

The Dorper and F_1 ewes, plus a small group of Red Maasai ewes (18) were mated again in November/December 1991 to a largely different set of Dorper (12) and Red Maasai (12) rams. The lambs born in April/May 1992 now represented 6 genotypes, but very few strightbred Red Maasai (8) and F_1 Dorper x Red Maasai (7) were born. The results up to 6 months of age are very consistent with those from the previous lamb crop. Relative to the strightbred Dorper both the 3/4 Red Maasai and the straightbred Red Maasai lambs were more resistant to endoparasites as shown by higher PCV, lower FEC and lower mortality.

In addition to the evidence for genetic variation for resistant between breeds, there is also evidence for within breed genetic variation. Combining the 1991 and 1992 data and all breed groups REML heritability estimates were 0.21 $\pm$ .13 for FEC at Weaning (3 months) and 0.18 $\pm$ .11 for FEC in 5 month old lambs. The heritability estimate for liveweight in 5 month lambs was 0.24 $\pm$ .16.

These results support previous evidence that Red Maasai sheep are relatively resistant to endoparasites. The preliminary estimates indicate that there is cope to further improve the genetic resistant of Red Maasai sheep to endoparasites if that is deemed desirable.

3.5 Estimates of Breed Additive and Heterozygosity Parameters in the KDPG

Ruvuna, F., J.F. Taylor, J. Kogi, M. Kones, B.A.J. Mwandotto, C.O. Ahuya and S. Mkuu

This paper derives expected values of breed constants estimated from F1 and 4-way crosses for birth weight, weaning weight and yearling weight. A multiple trait genetic evaluation system using Best Linear Unbiased Prediction (BLUP) procedure is discussed. Implementation of animal models using the computer program Multi-trait Derivative Free Restricted Maximum Likelihood (MTDFREML) on a personal computer (PC) is highlighted. The program allows the estimation of genetic parameters and the prediction of breeding values for multiple traits. Breeding values are used for ranking individual KDPG animals allowing rational selection decisions within the flock.

3.6 Lactation Curves of Crosses Among Galla and East African with Toggenburg and Anglo-Nubian

Kogi, J., F. Ruvuna, J.F. Taylor, B.A.J. Mwandotto, C.O. Ahuya and S. Mkuu

Morning milk yield data of nursing does recorded at Ol'Magogo from 1990 to 1992 were used to determine goat lactation curves. The goat breeds represented in the data were straightbred East African (E) and Galla (G) and their crosses with Toggenburg (T) and Anglo Nubian (N); TxE, TxG, NxE, NxG and TxExNxG. Wood's equation $Y_n = An^b e^{-cn}$ was fitted to the data. The Y_n represents the average morning milk yield (gms) in the n^{th} week of lactation, and A, b, and c are parameters which determine the shape of the lactation curve. The A values for TxE, TxG, NxE, NxG and TxExNxG were 473, 712, 812, 685 and 620 gms; b values were: 398, 168, 124, .-0821 and 446; and c values were: .035, .020, .0112, -.043 and .051, respectively. The estimated week of peak yield post kidding (b/c) for TxE, TxG, NxE, NxG and TxExNxG were: 11, 8, 11 and 9; and morning milk yield at peak was, 835.85, 860.40, 966.53 and 1,043.88 gms, respectively. Because the data were for morning milk only, the results underestimated the potential average daily yield in comparison to the expected yield from 2x milking without overnight suckling.

3.7 Kidding Interval: An Important Factor in Breeding Management of Dairy Goats: A Case Study of Dairy Goat Project in Arumeru, Arusha

Ghamunga S, H. Kyomo, M. Kilimba and D. Lubambe

Dairy goats are becoming very popular among farmers of Arumeru district, this has called for a rapid expansion of the "get one give two" programme (SR-CRSP 9th Conference pp. 155)

In a recent study carried out in the project area, it has been found out that kidding interval though compensated to some extent by the twinning characteristic of dairy goats, plays a major role in influencing the expansion of the project.

3.8 Offtake and Milking Strategies of Goat Farmers in Ngozi Province (Burundi)

Rey, B.

The flocks of 104 farmers participating in the Ngozi crossbreeding goat project and of 93 non participating farmers were monitored between November 1989 and December 1991. This study analyses goat offtake and milking in order to identify farmers' strategies in raising local and/or crossbred dairy goats.

Most offtake corresponds to sales, with little home slaughtering being practiced. Farmer type does not affect the age at which male kids are sold (one year irrespective of genotype). Participating farmers sell their female goats at a latter age than non participating farmers (3 years vs 2 years; $P<0.01$). Two thirds of participating farmers have accepted the practice of milking crossbred does. 50% were milked in the 3 months following parturition.

Farm budgets calculated on a 20 farmer subsample indicate differences in farm gross margins between participating and non participating farmers. Participating farmers have higher livestock gross margins; this difference is due to milk sales. Meanwhile, participating farmers also have reduced off-farm activities as compared to non-participating farmers; the sum of the farm gross margins and off farm income however does not vary between farmer types illustrating the opportunity cost of labour.