ILCA 1990:
Annual Report and Programme Highlights

International Livestock Centre for Africa

P O Box 5689, Addis Ababa, Ethiopia

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Foreword

This year's annual reporting sees something of a departure from previous years. In 1991, ILCA, for the first time, produced two 'annual reports'—the *ILCA Annual Programme Report 1990* and this document, *ILCA 1990:Annual Report and Programme Highlights* These complement one another and, together with the document *Research Programmes 1990: A portfolio of sub-project protocols*, provide a comprehensive picture of ILCA's research programme, from its planning through to the year's achievements.

This document presents the Centre's achievements in 1990 in a popular, easily read style that we hope will inform our readers of ILCA's achievements and also encourage them to find out more about our programmes and goals.

ILCA's programmes are diverse, including aspects of animal nutrition at virtually all sites; seed production at Debre Zeit, Ethiopia; range trends at Bamako, Mali; feed resource evaluation at Ibadan and Kaduna, Nigeria; and studies on reproductive wastage in cattle at headquarters, Debre Zeit, Mombasa, Kenya, and Bamako. ILCA-associated networks operate in nearly all countries in sub-Saharan Africa. The Centre's research, which is conducted at 18 sites throughout sub-Saharan Africa, is coordinated through a framework consisting of six thrusts with 34 themes, and comprised in 1990 more than 150 sub-project protocols. Numerous partners, both national agricultural research systems (NARS) in Africa and overseas institutes, are closely involved in the delivery of the Centre's programme.

Choosing which topics to highlight from this wide ranging programme was not easy, but we hope the topics chosen will communicate to the reader some of our excitement at our achievements.

The Cattle Milk and Meat Thrust highlight focuses on peri-urban dairying, and particularly the work of our collaborative programme with the Kenya Agricultural Research Institute at Mombasa, Kenya. The highlights of the Small Ruminant Meat and Milk Thrust are linked by their focus on interactions between animals and other components of the agricultural system. The Animal Traction Thrust highlights focus on two themes central to the Thrust's work: feeding and alternative sources of draft power.

The highlights of the Animal Feed Resources Thrust focus on *in vitro* culture work with multipurpose tree germplasm and studies of breeding systems of African clovers and *Sesbania* species; both pieces of work are important to the effective functioning of the genebank in support of research efforts at ILCA and in the NARS.

The work of the Trypanotolerance Thrust, in particular, took exciting strides in 1990. As the highlights show, the work of this Thrust, in collaboration with NARS and the International Laboratory for Research on Animal Diseases, is opening up possibilities for selection of animals that show both greater tolerance of the trypanosome parasite and greater productivity in tsetse-infested areas.

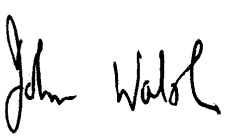
Two multi-country studies, one on land tenure and alley farming, carried out in collaboration with a developed-country institute, the other on price policies, are the highlights of the policy aspect of the Livestock Policy and Resource Use Thrust. These are complemented by a highlight on the final report of a 10-year study of the Borana rangelands of southern Ethiopia; this touches on aspects of both resource use and implications of policy for a pastoral system under stress from increasing population pressure.

Foremost among the highlights of the Training and Information Department is the topic of integration: Integration of long-term individual trainees with the Centre's research programme, and integration of several bibliographic databases to increase the effectiveness of the Centre's information services.

The importance of partnerships to ILCA's efforts to help Africa are clear from even this brief description of the highlights of 1990. A separate theme paper, following this foreword, picks up on this. Partnerships are vital to the achievement of ILCA's goals, and we wish to acknowledge the contribution of our many partners, listed in the annexes to this report, to the work reported here and in the *ILCA Annual Programme Report 1990*.

The financial resources available to ILCA in 1990 were similar to those available in 1989, yet the programmes undertaken and successfully executed increased. This is a tribute not only to the careful management of the Centre's Finance staff, but also to the care exercised by cost centre managers throughout the Centre.

The year 1990 saw considerable progress at ILCA: in research, in training and information, in the Centre's management and, perhaps most importantly, in the development of our partnerships with NARS and other organisations. ILCA is now well set to make further strides towards its goal of increasing the sustainable output of livestock in sub-Saharan Africa and contributing to improving the welfare of the people of this region.



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Partnerships: Achieving a multiplier effect

Sub-Saharan Africa is vast and has myriad agricultural systems and environments. Addressing even a fraction of the problems facing agricultural development in this region would be beyond the scope of a single research centre such as ILCA, with fewer than 70 senior staff and a budget of some US$ 20 million a year.

But by building links with others working toward the same goal—sustainable increases in food production from livestock—ILCA's efforts and influence can be multiplied.

ILCA's potential partners in its three mandate activities—research, training and information —include the national agricultural research systems (NARS) of sub-Saharan Africa; international and regional research institutes in Africa; institutes in the developed world; and producers and consumers in Africa. While ILCA has developed links with each of these categories, networking with the NARS is the Centre's primary means of collaboration in sub-Saharan Africa.

The extent of the partnerships developed by ILCA can be seen from the long list of collaborators in the Centre's research programme, given in the annexes to this report. It is also apparent from the Programme Highlights. Collaborative research features in several thrust highlights:

- with NARS in each of the thrusts
- with NARS and developed-country institutions in the Animal Traction Thrust *(Using dairy cows as draft animals,* pages 20–24) and Livestock Policy and Resource Use Thrust *(Land tenure and alley farming,* pages 38–40)
- with NARS and other international agricultural research centres (e.g. in the Trypanotolerance Thrust, pages 31–34).

Partnerships influence ILCA's operations at every level and at every stage. The Centre's strategy was developed in consultation with the NARS. A meeting of the leaders of livestock research. development and training in Africa is held every two years to ensure that this strategy is still in line with their priorities. Regular contacts with NARS through ILCA's zonal sites and regional liaison offices provide continual feedback to the research programme. Increasingly, ILCA's training and information programmes are targeted at, and directed by, participants in the collaborative research networks coordinated by the Centre. These programmes have strong feedback mechanisms to ensure communication between ILCA and the NARS flows both ways.

Since ILCA developed its strategy in 1987 it has placed increasing emphasis on networking as a complement to the zonal team approach that dominated its operations in earlier years. One of the gains of this shift in emphasis is a broader geographical impact. By the end of 1990, network research was going on in nearly every country in sub-Saharan Africa -many more than the six countries in which the Centre has zonal teams on the ground. But the biggest changes in the past two years have been the expansion of collaboration in research and involvement of the NARS in planning research for the networks.

Livestock research is both costly and highly location-specific. One of the main advantages of networking is that it permits multilocational projects. These allow the introduction of standardised models, providing the basis for drawing more reliable conclusions than can be obtained from isolated experiments conducted with limited resources.

The African Trypanotolerant Livestock Network and the African Research Network for Agricultural By-products (ARNAB)[1] have long been collaborative research networks. In both, network participants have worked in concert on problems of regional nature using common research methodologies and techniques. The value of this approach is evident from the recent strides taken by the African Trypanotolerant Livestock Network in developing practical selection schemes to improve trypanotolerance.

The Pastures Network for Eastern and Southern Africa (PANESA) also has multi-country studies in place. The network has established 12 major sites for screening and evaluating accessions of the important multipurpose tree genus, *Sesbania*. The sites cover seven countries—Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zimbabwe–and a wide range of environments—semi-arid to humid, lowland through to high altitude, unimodal and bimodal rainfall distribution and mildly acid to very acid soils.

During 1990 the other ILCA-associated networks took steps in developing collaborative research programmes. All of them held research planning meetings at which participants developed portfolios of research protocols. The meetings used the same "problem-oriented project planning" methodology used by ILCA in its own thrust planning meetings. Several of the portfolios are being considered by donors for support.

Research planning meetings provide a forum at which NARS scientists from different countries can discuss their current research programmes and future research needs. Provision of information and coordination of research efforts among partners reduces the risks of "reinventing the wheel" through lack of knowledge of what each other is doing or has done.

Partnership involves an exchange of knowledge and skills, with each partner bringing their own expertise to the research process as well as having something to learn from the other. ILCA's national partners can enrich the research process by contributing their detailed knowledge of local production systems and problems and—often—by providing a location and facilities for research. They are also ILCA's main contact with sub-Saharan Africa's farming systems, extension services and training bodies. They are at the user end of the research process, conducting their own research to adapt technology to local conditions and providing vital inputs of knowledge and experience to feed the upstream research process. ILCA, in turn, helps identify scientific methodologies appropriate to tackling specific problems, helps organise and process data and helps mobilise funds. It also provides a focus for manpower development and communication between peers.

Training and publications are the vehicles through which knowledge and skills are exchanged. Again, ILCA provides a focal point for these activities. The Centre is ideally placed to bring together scientists, technicians and policy makers from different countries to gain the knowledge needed to conduct better research or promote better policies. The partnership concept encompasses the collaboration and cooperation of numerous participants working toward mutual or complementary goals. No one individual or institution can be, or should be, judged as more or less important to the overall process.

In conclusion, partnership—in research, information and training—is fundamental to ILCA's approach to the challenge of its mandate. Only through its partnerships with other institutions and individuals is the Centre able to achieve the multiplier effect needed to make a widespread, lasting impact on the welfare of its major target group—the small-scale livestock producers of sub-Saharan Africa.

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[1] ARNAB and PANESA merged with a third network, the West and central Africa Feed Resources Network (WECAFNET), in March 1991 to form the African Feed Resources Network (AFRNET). WECAFNET was set up and supported by the Institut d'élevage et de médecine vétérinaire des pays tropicaux, France, and the Centro Internacional de Agricultura Tropical, Colombia.

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L R Randria

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Norway

ILCA's addresses

Headquarters

ILCA
P O Box 5689
Addis Ababa, Ethiopia
Telex: 21207 ILCA ET
Tel: (251–1) 61 32 15
Fax: (251–1) 61 18 92
E-mail: CGI070 (ILCA)

Liaison/Facilitation Offices

ILCA/CIPEA
BP 60
Bamako, Mali
Telex: 2459 ILCA MJ
Tel: (223) 22 21 77/22 42 79
Fax: (223) 22 42 79

ILCA
P O Box 3211
Harare, Zimbabwe
Telex: 22462 CIMMYT ZW
Tel: (263–4) 70 62 45/70 62 46
Fax: (263–4) 70 62 45

Thrust coordination

Cattle Milk and Meat Thrust/
Animal Feed Resources Thrust/
Livestock Policy and Resource Use Thrust/
Animal Traction Thrust

ILCA

P O Box 5689

Addis Ababa, Ethiopia

Telex: 21207 ILCA ET

Tel: (251–1) 61 32 15

Fax: (251–1) 61 18 92

E-mail: CG1070 (ILCA)

Small Ruminant Meat and Milk Thrust

ILCA

P O Box 80147

Mombasa, Kenya

Telex: 21465 ILCAKS

Tel: (254–11) 48 58 39/48 58 42

Fax: c/o Public (254–11) 31 55 57

Trypanotolerance Thrust

ILCA

P O Box 46847

Nairobi, Kenya

Telex: 25747 ILCA KE

Tel: (254–2) 63 20 13/63 20 66/63 20 93/63 21 22

Fax: (254–2) 63 34 81

E-mail: c/o CGU005 (ILRAD)

ILCA/ITC

PMB 14

Banjul, The Gambia

Telex: 2301 ITC GV

Fax: (220) 92 924

Zonal research sites

Highlands

ILCA
P O Box 5689
Addis Ababa, Ethiopia
Telex: 21207 ILCA ET
Tel: (251–1) 61 32 15
Fax: (251–1) 61 18 92
E-mail: CGI070 (ILCA)

Humid zone

ILCA
PMB 5320
lbadan, Nigeria
Telex: 31417/31159 TROPIB NG
Tel: (234–22) 40 03 00/14

Subhumid zone

ILCA
PMB 2248
Kaduna, Nigeria
Telex: 71384 ILCAKD NG/20711
KADTDS NG Box 038 ILCA
Tel: (234–62) 21 13 89
Fax: (234–62) 21 52 73

ILCA

P O Box 80147

Mombasa, Kenya

Telex: 21465 ILCAKS

Tel: (254–11) 48 58 39/48 58 42

Fax: c/o Public (254–11) 31 55 57

Subhumid/semi–arid zone

ILCA/CIPEA

BP 60

Bamako, Mali

Telex: 2459 ILCA MJ

Tel: (223) 22 21 77/22 42 79

Fax: (223) 22 42 79

Semi-arid zone

ILCA/ICRISAT

BP 12404

Niamey, Niger

Telex: 5406/5560 ICRISAT NI

Tel: (227) 72 27 25/72 25 29

Fax: (227) 73 43 29

E-mail: CGU004 (ICRISATSC)

Coordinators and committee chairmen of ILCA-associated networks

(as at 30 June 1991)

Cattle Research Network

Coordinator

Dr E A Olaloku
ILCA/CIPEA
BP 60
Bamako
Mali

Telex: 2459 ILCA MJ
Tel: (223) 22 21 77/22 42 79
Fax: (223) 22 21 79

Steering Committee Chairmen

West and central Africa

Dr M Mbaye
ISRA-LNERV
BP 2057
Dakar
Senegal

Telex: 51403 INTERVET SG

East and southern Africa

Prof M Mgheni
Department of Animal Science and Production
Sokoine University of Agriculture
Morogoro
Tanzania

Telex: 55308 UNIVMOG TZ

African Small Ruminant Research Network

Coordinator

Dr S H B Lebbie
ILCA
P O Box 46847
Nairobi
Kenya

Telex: 25747 ILCA KE
Tel: (254–2) 63 20 13/63 20 66/63 20 93/63 21 22
Fax: (254–2) 63 34 81
E-mail: c/o CGU005 (ILRAD)

Steering Committee Chairman

Dr Beyene Chichaibelu
Alemaya University of Agriculture
P O Box 138
Dire Dawa
Ethiopia

West African Animal Traction Network

Network Research Coordinator

Dr P Lawrence
ILCA
PMB 2248
Kaduna
Nigeria

Telex: 71384 ILCAKD NG/20711
KADTDS NG Box 38 ILCA
Tel: (234–62) 21 13 89
Fax: (234–62) 21 52 73

Steering Committee Chairman (acting)

Dr A Faye
Chef du centre de recherches zootechniques de Kolda
Institut sénégalais de recherches agricoles (ISRA)
BP 53
Kolda
Senegal

African Feed Resources Network

Coordinator (acting)

Dr J Kategile
ILCA
P O Box 3211
Harare, Zimbabwe

Telex: 22462 CIMMYT ZW
Tel: (263–4) 70 62 45/70 62 46
Fax: (263–4) 70 62 45

Steering Committee Chairmen

East and southern Africa

Dr N A Urio

Department of Animal Science

Sokoine University of Agriculture

P O Box 3004 Chuo Kikuu

Morogoro

Tanzania

Telex: 55308 UNIVMOG TZ

West and *central Africa*

Dr E Agishi
ILCA

PMB 2248
Kaduna, Nigeria

Telex: 71384 ILCAKD NG/20711

KADTDS NG Box 38 ILCA

Tel: (234–62) 21 13 89

Fax: (234–62) 21 52 73

African Trypanotolerant Livestock Network Coordinator

Dr G D M d'Ieteren

ILCA

P O Box 46847

Nairobi

Kenya

Telex: 25747 ILCA KE

Tel: (254–2) 63 20 13/63 20 66/63 20 93/63 21 22

Fax: (254–2) 63 34 81

E-mail: c/o CGU005 (ILRAD)

African Livestock Policy Analysis Network

Coordinator

The Coordinator
ALPAN
ILCA
P O Box 5689
Addis Ababa
Ethiopia

Telex: 21207 ILCA ET
Tel: (251–1) 61 32 15
Fax: (251–1) 61 18 92
E-mail: CGI070 (ILCA)

Sahelian Rangeland Monitoring Network

Coordinator and Chairman

Dr Guigma Salif
SPVA/CILSS
BP 7049
Ouagadougou
Burkina Faso
Telex: 5263/5362
Tel: (226) 30 60 51/33 36 64
Fax: (226) 30 72 47

Cattle Milk and Meat Thrust

Demand for dairy products in sub-Saharan Africa is strong and increasing, especially in urban areas. Until the mid-1980s, a large part of this demand was met by imports—more than 90% in the cases of Côte d'Ivoire, Gabon and Zaire. Between 1961 and 1985 the amount of dairy products imported into sub-Saharan increased six-fold.

Recently, with world market prices for dairy products rising and financial pressures on African governments increasing, imports have been falling, pushing down domestic dairy consumption. For example. between 1983–85 and 1985–87 milk consumption in West Africa fell from 18 kg (liquid milk equivalent) per person per year to only 12 kg.

Strong demand coupled with falling imports should create good opportunities for domestic producers. Identifying such opportunities and how best to take advantage of them is central to the work of ILCA's Cattle Milk and Meat Thrust.

Much of the demand for dairy products is concentrated in urban areas. The collection of milk from smallholder farmers scattered widely in outlying rural areas faces severe logistical problems—lack of transport, lack of refrigeration and difficulties in preserving milk in transit. For these reasons the Thrust's work on dairying has focused primarily on peri-urban producers.

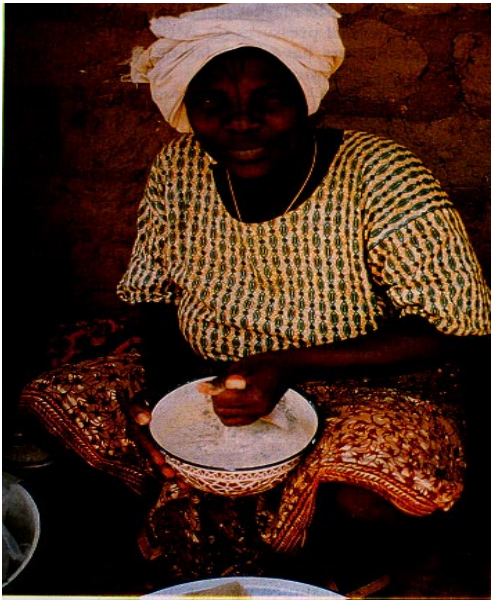
Consumption studies

In 1989–90, ILCA carried out milk consumption studies in the semi-arid zone of Mali and the humid and subhumid zones of Nigeria. These studies showed that, overall, between two-thirds and four-fifths of households regularly consumed milk or milk products. The amounts consumed annually ranged from 12 kg per person in Mall to 47 kg per person in subhumid Nigeria the high figure for the latter area reflecting a large proportion of Fulani pastoralists in the area. The Fulani traditionally depend primarily on their livestock for subsistence, and hence consume large amounts of milk and milk products.

The proportion of local products consumed ranged from negligible in humid Nigeria, where the local population has no tradition of keeping cattle, to nearly 80% in subhumid Nigeria. Households in Mall indicated that they preferred local products to imported products, but that local products are scarce and expensive.

Marketing studies

A Fulani woman selling fura (cooked millet balls) and nono (soured skim milk) in northern Nigeria.



Marketing studies in Mali, Nigeria and Ethiopia indicated that peri-urban dairy producers have a variety of marketing channels open to them. These include direct sales to consumers and "end-users" such as coffee houses; sales to milk collectors, both formal and informal; and sales to retail outlets. Direct sales from producers to consumers accounted for up to 71% of the fresh milk sold. Producers preferred this direct marketing channel because it gave them the highest profit margin.

The results of these marketing studies confirm that, given the practical difficulties and high costs of collecting and transporting milk produced in rural areas, peri-urban producers are best placed to produce milk profitably and at a price urban consumers can afford.

Smallholder dairying in subhumid coastal Kenya

The coastal region of Kenya holds considerable promise for smallholder dairy production. Much of it has a subhumid climate, which favours forage production. In addition, the region is densely populated and demand for milk considerably exceeds supply.

The National Dairy Development Project (NDDP) of the Kenyan Ministry of Livestock Development has for several years been promoting a package of innovations aimed at smallholder dairying in the coastal zone. The package consists of the use of improved dairy cows (mainly crosses between the Sahiwal breed and European dairy breeds), disease control and improved feeding, in particular through growing forages such as Napier grass *(Pennisetum purpureum).*

Napier grass (Pennisetum purpureum) *growing in a farmer's field, Kenya cost.*

A major problem facing dairy production in this zone is the decreasing amount of land available to support it. The human population is burgeoning, both through high birth rates and through immigration from other parts of Kenya, and farms are already small, averaging around four hectares of relatively low-yielding agricultural land.

In 1989, ILCA and the Kenya Agricultural Research Institute (KARI) established a joint project aimed at improving the NDDP package. The project's objective is to raise overall farm productivity, including food crop yields, while also increasing soil fertility and so improve the sustainability of the production system. Improvements focus on the use of tree and herbaceous forage legumes, food legumes and slurry from the cattle to put nitrogen and organic matter back into the soil, building an effective, sustainable nutrient cycling system.

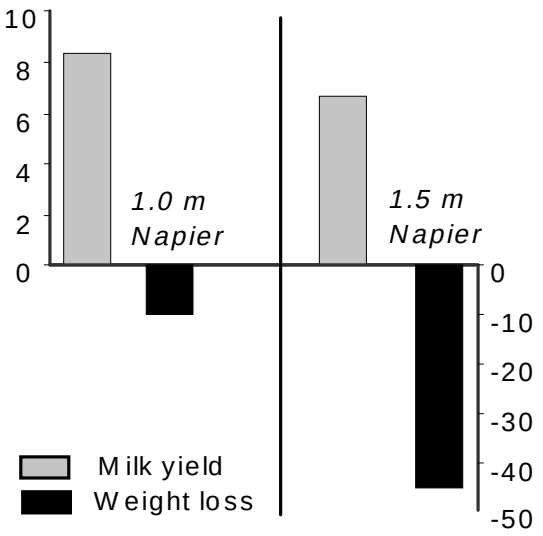
Collecting manure to apply to crops smallholder dairy unit, Kenya coast.

Studies in 1989 and 1990 of performance records from large, multi-breed crossing programmes in the coastal zone indicated the "best-bet" breeding system to support the smallholder dairying system. Although F_1, Ayrshire X Sahiwal cows gave the highest milk yields, yields from 2/3 Ayrshire-1/3 Sahiwal and 1/3 Ayrshire-2/3 Sahiwal cows were not markedly lower. The rotational crossbreeding system needed to produce the latter two crossbreds fits better into the smallholder production system because fewer purebred breeding stock have to be kept to maintain the supply of milking cows.

Crossbred cows must be well fed to produce high milk yields. The NDDP package recommended buying protein supplements such as copra cake to supplement the Napier-based diet. ILCA?s work has looked for ways to produce on the farm all the feed needed, making the system self-sustaining and more robust. The programme has explored two possibilities: interplanting Napier with herbaceous forage legumes, and alley farming — growing Napier and food crops in "alleys" between hedgerows of the leguminous browse tree, *Leucaena leucocephala.*

Interplanting Napier with *Clitoria ternatea, a* climbing, herbaceous forage legume, produced total yields of up to 26 tonnes of dry matter per hectare, 5.6 tonnes of which was *Clitoria.* This is enough to feed five dairy cattle for a whole year. Napier grown alone yielded about 20 tonnes per hectare.

Feeding dairy cows young Napier grass gives bigger milk yields and lower weight losses than feeding older grass



Including *Clitoria* thus increased both the amount of feed available and its quality. The alley farming trials are still in early stages, but preliminary findings suggest that this system holds promise as the basis of a sustainable production system in this land-poor zone.

Feeding trials showed that cows fed Napier grass harvested when 1.0 m tall gave significantly higher milk yields (8.5 vs 6.8 kg per day) and lost significantly less weight (10 vs 45 kg over the 98-day trial period) than those fed Napier cut at 1.5 m tall. Agronomy trials showed that harvesting Napier at 1.0 m tall instead of at 1.5 m tall only slightly reduced annual yields, from 16.7 to 15.7 tonnes of dry matter per hectare. Given the greater feeding value of the shorter grass, early harvesting is being recommended to farmers.

Small Ruminant Meat and Milk Thrust

Sheep and goats provide as much as 30% of the meat and milk consumed in sub-Saharan Africa and are found on smallholdings throughout the continent. Yet these species have received much less attention from research and development agencies than have cattle.

African smallholders usually keep small ruminants under low-input management systems, as an adjunct to crop production. The farmer's main interest lies in the food crops on which the family depends for survival. Nonetheless, sales of sheep and goats and their products are a vital source of cash, especially for smallholders who do not have access to credit or off-farm income. Their small size and rapid growth rates make small ruminants a more flexible short-term form of investment than are cattle.

These highlights focus on opportunities for increasing small ruminant productivity by exploiting the farm-level interactions between animal nutrition and disease, between breeds and their environment, and between crops and livestock.

The need for increased productivity

People in sub-Saharan Africa eat little meat—an average of about 10 kg per person each year, compared with over 80 kg per person in Europe. In large part this reflects the small amount of meat produced in the region. Between 1974–76 and 1986–88 per capita meat production in Africa declined by 0.7% a year, while consumption increased by only 0.1% a year. Rapid population growth, increasing urban populations, shortages of foreign exchange and slow income growth seem likely to prolong these trends well into the future. Stagnant or declining meat consumption will worsen the existing caloric and protein deficiencies in the diets of the region's people.

A study of small ruminant meat production, trade and consumption in sub-Saharan Africa between 1961–65 and 1986–88, based on data from the Food and Agriculture Organization of the United Nations (FAO), showed that:

- Over 90% of Africa's small ruminants are found in East and West Africa, with only small populations in central and southern Africa
- Africa's small ruminant population grew by an average of 1.7% a year between 1961–65 and 1986–88, with the fastest increases in central (2.8% a year) and southern (2.2% a year) Africa
- In general, offtake of animals grew more slowly than sheep and goat populations while carcase weights remained stable, indicating room for increased production and offtake. The exception to this pattern was southern Africa, where offtake increased faster than flock growth, suggesting that current levels of offtake are unsustainable unless flock productivity can be increased
- The amount of small ruminant meat available per person decreased throughout sub-Saharan Africa between 1974–76 and 1986–88, by between 0.3% a year in West and central Africa and 2.0% a year in southern Africa, suggesting that small ruminant productivity was not keeping up with the continent's rapid human population growth.

In Africa, small ruminants are kept mainly in traditional, smallholder production systems. Research will have to be directed to increasing the productivity of such systems if this pattern of declining per capita production is to be reversed.

A woman taking sheep to market, Kenya coast. Demand for small ruminant meat outstrips supply in most parts of sub-Saharan Africa.

Nutrition and endoparasite control

Up to half of all sheep deaths and morbidity on farms in the Ethiopian highlands are caused by pneumonia and endoparasites (worms and flukes). More than a third of all the animals that die are lambs between four days and four weeks old, the period when lambs are first turned out into the field. Weaning also sees a peak in deaths, with over 30% of animals dying being between three and six months old.

The results of trials conducted at ILCA's Debre Birhan research station in 1990 suggest that better feeding would help prevent these losses. The trials showed that feed supplementation had more effect on the productivity of ewes and on the survival and growth of lambs than did drenching the ewes against gastrointestinal parasites.

Supplemented ewes gained 5 kg more than traditionally managed animals, and over 3.5 kg more than unsupplemented ewes that had been drenched. Supplementation also more than doubled ovulation rates (from 17 to 37%), while drenching alone had no effect. Both supplementation and drenching of ewes increased lamb survival, but supplementation had more effect. Ewe supplementation increased milk Yields. lamb growth rates to weaning, and weaning weights; drenching alone had no effect on these characters. There was no interaction between feeding and drenching.

A healthy young lamb— but for how long? ILCA's studies in the Ethiopian highlands show that many lambs die shortly after they are put out to pasture.

In a separate trial, the supplementary feeding of female lambs increased daily liveweight gains by 6 to 26 g a day, increased conception at first oestrus by 9 to 16%, reduced overall mortality by 24 to 31 % and reduced age at first lambing by 2 to 5 months. Again. drenching alone had no effect on any of these characters, and there was no interaction between feeding and drenching.

Exploiting breed differences in parasite resistance

As in the Ethiopian highlands, gastro-intestinal parasites are an important factor limiting sheep productivity in the subhumid coastal zone of Kenya.

Over half the smallholders in the region keep sheep or goats. The animals depend on communal grazing or the limited grazing available on the household plot for much of. their feed, precluding the use of rotational grazing to prevent the build up of worm challenge. The worm burden can be controlled with drugs, but the animals must be treated frequently and the costs are too high for most smallholders. One approach that appears to hold considerable promise is to use animals that are resistant to parasites.

Studies comparing the performance of Dorper sheep from southern Africa with their crosses with the local Red Maasai breed indicated that the crossbreds are more resistant to the main intestinal parasite of the area, Haemonchus *contortus,* a blood-sucking worm. The crossbred lambs had higher survival rates and fewer worm eggs in their faeces, and required fewer anthelminthic treatments. Lambs from different sires of the same breed differed significantly in the number of worm eggs found in their faeces, indicating withinbreed differences in worm resistance.

It should therefore be possible to select within breeds for greater resistance to gastro-intestinal parasites. ILCA plans to extend these studies to cover other breeds at sites in subhumid and highland zones elsewhere in Africa.

Red Maasai X Dorper crossbred lambs show more resistance to Haemonchus contortus *worms than purebred Dorper lambs.*

Breed	Survival rate (%)	Worm eggs/g of faeces	Anthelminthic treatments (no.)
Dorper	70	354	0.23
Red Maasai X Dorper	80	181	0.18

All values for lambs to 120 days old.

Alley farming: Trade-offs between crop and livestock production

In alley farming tree foliage can be used either as mulch, helping to increase crop yields, or as feed for livestock. ILCA's studies in 1990 demonstrated that, at current prices, Nigerian farmers get more benefit from feeding their goats than from mulching their maize crop.

Scientists monitored goat feeding in two villages in south-western Nigeria. Visits were made on 17 days a month throughout the year. Among the 22 farmers covered, 10 were classified as "browse feeders"— i.e. they offered browse to their goats on at least 10% of the days when visits were made — and 12 as "non-browse feeders". Browse feeders kept nearly twice as many goats as non-browse feeders (12.2 vs 6.5 animals per household, and 6.1 vs 3.5 adult does per household).

In both villages goats roamed freely during the day, scavenging, grazing and browsing. In the evenings they returned to the vicinity of their owners' houses, where they were offered feed consisting mostly of household wastes and cassava peel and tubers, with or without browse.

Sheep and goats roaming free in a village in the Nigerian humid zone.

Animals belonging to browse feeders received browse about twice a week. Those that belonged to non-browse feeders received browse only one day every three months, on average. Browse feeders offered their animals a total of about 400 kg of browse over the year, compared with less than 10 kg offered by nonbrowse feeders.

The biggest difference between flocks was in adult survival. Only 8% of browse-fed adults died during the year, while 20% of adults in non-browse feeders' flocks died. As a result, the productivity of browse-fed flocks was 44% greater than that of flocks that did not receive browse (1 1.3 vs 7.8 kg of surviving offspring at 12 months old per surviving doe per year). On the basis of the average number of adult does in browse feeders' flocks, this equates to an extra 21.4 kg of yearling goat per household per year, or roughly two extra animals.

Pruning an alley farm in the Nigerian humid zone. ILCA results show that it is more profitable to use the foliage as livestock feed than to use it as mulch on maize.

The biggest difference between goats fed browse and those that were not was in adult survival.

Group	Litter size	Parturition interval (days)'	Weight at 1 year (kg)	Survival (%) to 1 year	Survival (%) adults
Browse feeders	1.48	280	9.47	67	92
Non-browse feeders	1.41	298	10.09	64	70

[1] Some 60% of adult females kidded more than once.

Agronomy studies indicate that if the amount of tree foliage fed to these animals were used as mulch it would increase maize grain yields by 22 to 28 kg. At current prices for maize (Naira 5/kg)*, and goat meat (Naira 15/kg liveweight), farmers thus gain more from feeding their goats than from mulching their maize crop.

* US$ 1 = ₦ 10

Animal Traction Thrust

Small-scale farmers frequently cite labour shortages as one of the major factors preventing them from cultivating more land and so producing more food. The operations that require most labour in smallholder farming systems are cultivation and weeding. Although both tasks can be mechanised, they are still done by band throughout much of sub-Saharan Africa.

To many people, mechanisation in Africa conjures up disturbing images of failed tractorisation schemes. But mechanisation need not mean tractors. Instead it can take the form of harnessing animal power, an approach much better suited to the needs of African smallholders.

Animal traction is already widely used in some areas of sub-Saharan Africa, but its use is not spreading idly. For a variety of reasons farmers find it difficult to make the introduction of animal traction pay. Increasing the efficiency of animal traction is therefore central to the work of ILCA's Animal Traction Thrust.

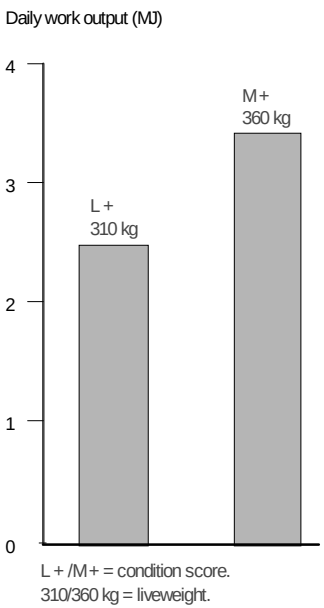
Scientists have identified several opportunities for increasing the efficiency of animal traction in the smallholder context. Widely perceived as a major problem is the fact that draft animals tend to be in poorest condition just when they are most needed for work—at the beginning of the cropping season. Improving their diets during the preceding dry season would, so the argument goes, increase their work performance during the early rains period, crucial for timely ploughing and sowing. Another problem is that specialised draft oxen work for only a short period each year, but consume valuable feed throughout it. There are two possible solutions to this problem. One is to diversify the use of draft animals, using them for other tasks on the farm besides ploughing. The other is to raise multipurpose animals that can be used for the production of meat or milk as well as traction.

ILCA studies in 1990 addressed both problems. Studies in Mali investigated whether the condition of oxen at the beginning of the cropping season affected the amount of land a farmer crops. Studies in Ethiopia examined the possibility of developing a fattening scheme under which oxen would be treated as dualpurpose (work and meat) animals, rather than specialist work animals. The Ethiopian studies also investigated the effect of work and supplementary feeding on the productivity of crossbred dairy cows.

Does the condition of work-oxen limit cropping?

The results of the Mali studies challenge one of the basic assumptions about the use of draft animals—that the amount of work oxen do at the beginning of the cropping season is limited by their poor condition at the end of the preceding dry season.

In on-station trials, heavier oxen have higher daily work outputs. On farms in Mali there is less apparent effect of liveweight on work performance of oxen.



Thin work-oxen are a common sight at the beginning of the rainy season in the semi-arid zone of Africa. That thin, light oxen can do less work than fatter, heavier oxen has been demonstrated many times in experimental trials. So it has been assumed that feeding work-oxen better during the dry season would increase the amount of work they would do.

In 1986, ILCA and the Institut national de la recherche zootechnique, forestière et hydrobiologique (INRZFH) in Mali began a series of studies aimed at quantifying the effect of dry-season weight loss on the working capacity of oxen and on areas cropped in the country?s semi-arid zone.

Preliminary survey results came as a surprise few farmers felt they had a problem with their oxen. Subsequent on-farm trials and further surveys confirmed that their feelings were correct.

During the 1989 cropping season scientists monitored the performance of 36 oxen belonging to 18 farmers in two villages. The animals were fed one of three diets: their normal unsupplemented diet, urea-treated straw *ad libitum*, or urea-treated straw ad *libitum* plus 1 kg of concentrate a day. Records were kept of the animals? activities, including the speed of work and the draft force involved, throughout the 140-day cropping season.

Neither the animals? body weight nor their condition had any noticeable effect on their work output. Animals that had lost up to 50 kg, or one fifth of their body weight, over the preceding dry season performed as much work as those in good condition. Oxen pairs used

ranged in weight from about 360 to about 760 kg and condition scores ranged from 3 to 7 on a 9-point scale (1 = very thin, 9 = very fat).

This lack of effect of body weight and condition on area cultivated is apparently related to the way farmers use their oxen. The farmers have obviously recognised the limited strength and stamina of their oxen and have adopted working practices to suit these. The study showed that the length of furrow the animals ploughed at one go was short. The animals thus had to exert maximum force for only a few seconds at a time, with long rests while the plough was turned. This has the effect of reducing the influence of the animals' weight and stamina on the amount of work done. but it also increases the time it takes to plough a given area of land.

Animal traction in Mali. Despite large dry-season weight losses in work-oxen, neither liveweight nor body condition seems to have much effect on the amount of work farmers get from their oxen.

The more detailed surveys carried out while the on-farm trials were in progress showed that oxen worked for only a short period each year, with only 22 days spent on ploughing, the most stressful task. Fewer than 1 in 20 farmers said that problems with their oxen limited the amount of land they cropped. Many farmers said that they could cultivate and crop more land, but chose not to because they did not have enough labour available for weeding, a task still largely carried out by hand.

Two important points emerge from these studies:

- Under the present system of draft-animal use, supplementing the feeding of work-oxen during the dry season is unlikely to increase the amount of land farmers crop
- There is a real opportunity to diversify the use of work-oxen by introducing mechanised weeding. This would increase the amount of time oxen spend working each year, and might also increase the amount of land cultivated. At this more intensive level of draft-animal use, better feeding practices might become worthwhile.

Oxen ploughing in the Ethiopian highlands Better Battening practices could lead to higher farm incomes.

Fattening draft oxen for sale

Many farmers in the Ethiopian highlands use draft oxen. In Ethiopia, as in Mali, these oxen work for only a short period each year. Farmers normally work their oxen for six or seven years, starting when they are about three years old. Once their working lives are over, the animals are usually fattened before being sold for meat.

Recent ILCA studies suggest that farmers may not be getting the best out of their animals under the current management system. Feeding trials in 1990 showed that young (4- or 5-year-old) oxen gain weight more rapidly over an 18-week fattening period than do older oxen, with those more than 10 years old having the slowest rate of gain. Oxen in poor condition at the beginning of the fattening period gained significantly more weight than those in good condition (69 vs 55 kg), despite their lower daily feed intake (2.15 vs 2.99 kg dry matter/100 kg liveweight).

According to these results, farmers should consider fattening their oxen for sale much earlier than at present, after only two or three seasons' work. Also, it appears that the opportunity cost of work as a byproduct of fattening animals may be less than anticipated because animals that are lean at the beginning of the fattening period make better use of the fattening ration.

Light oxen in poor condition gained more weight yet consumed less feed than heavy oxen in good condition.

Initial body condition	Initial weight (kg)	Final weight (kg)	Weight gain (kg)	Total dry-matter intake/100 kg liveweight (kg)
Poor	219	288	69	2.15
Good	267	322	55	2.99

Integrating draft power with ox fattening is one way to increase the contribution of cattle to overall farm income. Alternatively, farmers could work animals they keep for other purposes. ILCA is studying the potential for this second approach in the Ethiopian highlands.

Using dairy cows as draft animals

Replacing draft oxen with cows could increase farm productivity, since milk and calves would be produced in addition to draft power.

Some farmers in the Ethiopian highlands already keep crossbred (Friesian x local zebu) dairy cows, introduced as part of a package to stimulate smallholder dairying. These cows are larger and heavier than the local oxen usually used as draft animals, and should be able to perform the work needed on smallholdings.

But producing milk and maintaining a pregnancy already puts these dairy cows under stress. Making them work as well could reduce both their milk yield and their reproductive performance.

ILCA has been investigating the possibility of using crossbred cows as traction animals since 1983. A further series of experiments, in collaboration with the Ethiopian Institute of Agricultural Research (IAR), was started in 1989. One of the first trials in this new series examined the effects of work and feed supplementation on feed intake, milk production and body weight of 20 Friesian x Boran and 20 Simmental x Boran crossbred cows. Work consisted of pulling sledges four hours a day, four days a week, starting two weeks after calving. The force needed to pull the sledges was set at about 400 Newtons, roughly the force the cows would have to exert when working in a pair pulling an Ethiopian plough *(maresha).* The cows worked over a period of 90 days, rested for 90 days and then worked over another 90 days.

All the cows in each breed group were fed hay made from local, unimproved pasture. Half of them received in addition a supplement of oilseed cake, wheat millings, salt and bone meal. Half of the cows on each diet were worked, half were not.

Cows receiving supplementary feed ate significantly more than cows fed hay alone. Working cows receiving supplementary feed ate most, even during their resting period.

Work had relatively little effect on milk Yields. which were influenced more by feeding. Non-working cows that received supplementary feed gave the highest yield during the first 90-day period (6.1 kg of milk a day), followed by working supplemented cows (4.9 kg/day), non-working non-supplemented cows (3.8 kg/day) and working non-supplemented cows (3.2 kg/day).

ILCA is studying the effect on the productivity of crossbred dairy cows of using them as traction animals

Feed supplementation had a greater effect on feed intake, milk production and body-weight change than did work in crossbred dairy cows.

	DM intake (kg/day)[1]			Cumulative body-weight change (kg)[1]		
	90[a]	180	*270*	90	180	270
Treatment[2]	W	R	W	W	R	W
NW/NS	8.0	6.8	6.5	-32.9	-47.8	-42.3
NW/S	11.2	10.6	9.5	5.0	18.4	26.4
W/NS	9.6	7.6	7.5	-35.9	-47.5	-52.5
W/S	11.9	*12.1*	11.3	-17.9	2.7	8.5
SE	0.6	0.3	0.5	5.0	8.0	10.0
F-test probability						
Work	P<0.05	P<0.01	P<0.05	P<0.05	ns	ns
Supplement	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001

[1] Means for l0 cows per treatment.

[2] NW = non-working; NS = non-supplemented; W = working; S = supplemented.

[a] Days after parturition; W = working period, R = resting period.

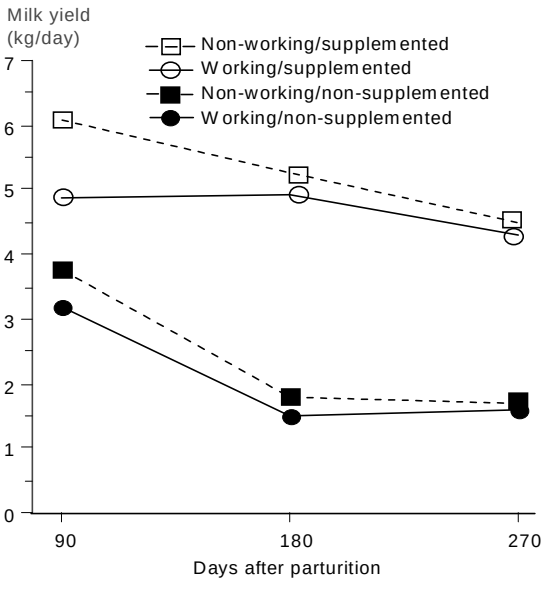
SE = standard error of means; ns = not significant.

The milk yields of non-supplemented cows fell to about 1.7 kg a day by six months after calving (during the resting period) and about 1.6 kg a day by nine months after calving (during the second working period). Milk yields of supplemented cows were much higher, at about 5.2 kg a day by six months after calving and 4.4 kg a day by nine months after calving. At six and nine months after calving there was no significant difference in milk yield between worked and non-worked cows in either feeding group.

All non-supplemented cows lost weight up to six months after calving, losing an average of nearly 48 kg of body weight. Working non-supplemented cows continued to lose weight up to nine months after calving, losing a total of nearly 53 kg. Supplemented cows that did not work gained weight throughout the study period, putting on a total of 26 kg over nine months. Supplemented cows that worked lost nearly 18 kg over the first 90-day working period, but thereafter gained weight slowly to nine months after calving.

Although working had a clear effect on the ability of cows to conceive, this was largely offset by better feeding. Three months after calving only 15% of the working cows had shown oestrus, compared with 45% of non-working cows. However, by nine months after calving all supplemented cows had shown oestrus, whether or not they had worked. Fewer than a third of non-supplemented cows had shown oestrus by nine months after calving (50% of non-working and 10% of working cows). Among supplemented cows, work apparently delayed return to oestrus after calving by about three-and-half months. Non-working cows returned to oestrus at an average of about 112 days after calving; working cows showed their first post-partum oestrus at an average of about 220 days.

Overall, these results show that crossbred dairy cows could be used as draft animals, if farmers could feed them adequately. There would probably be a slight reduction in milk yields and reproductive performance, but this would be more than offset by the value of the draft work done by the cows.



Supplementation had a much greater effect on milk yields than did work.

In a related piece of strategic research. ILCA and the Institute of Engineering Research, UK, have developed a system for recording physiological and mechanical data on traction animals working in the field. The computerised logging system, completed in early 1990, is now being used to estimate the amount of energy a crossbred dairy cow uses when working, based on measurements of its oxygen uptake. This information will allow more accurate recommendations to be made on feeding these animals for work and production.

The traction logger at work, mounted on a working cow.

Another potential use of the logger is in determining the match between animals and implements. Results from the logger will quickly indicate whether an implement imposes undue stress on an animal, making it impractical for use in the field.

Animal Feed Resources Thrust

The forage resources of sub-Saharan Africa show considerable genetic diversity. Even plants of the same species growing in different places differ from one another in important traits such as their growth potential, tolerance of water shortages and resistance to pests and diseases. Preserving this genetic diversity and using it to increase the quality and quantity of animal feed available is vital to increasing livestock productivity in the region.

Forage genetic resources activities at ILCA support the Centre's commodity thrusts. ILCA's genebank is part of a world-wide network dedicated to collecting. preserving, evaluating and disseminating plant germplasm of potential use for a wide range of purposes.

In 1990, ILCA made important advances in research in two key areas essential to germplasm management: *in vitro* culture techniques for overcoming difficulties in the management of multipurpose tree germplasm; and understanding of the breeding systems appropriate for seed production of several African clover *(Trifolium) and Sesbania* species held in the genebank.

In vitro multiplication of multipurpose trees

ILCA is testing numerous multipurpose trees for their usefulness under various conditions. Tree species that have been extensively tested include *Leucaena leucocephala* and *Gliricidia sepium* in the alley-farming system in West Africa and at Mombasa on the Kenyan coast, and *Sesbania sesban* in the Ethiopian highlands. Other potentially useful species indigenous to Africa include *Erythrina brucei, Faidherbia albida* (also known *as Acacia albida)* and *Acacia tortils.* Accessions of tree species vary widely in their productivity and feeding value.

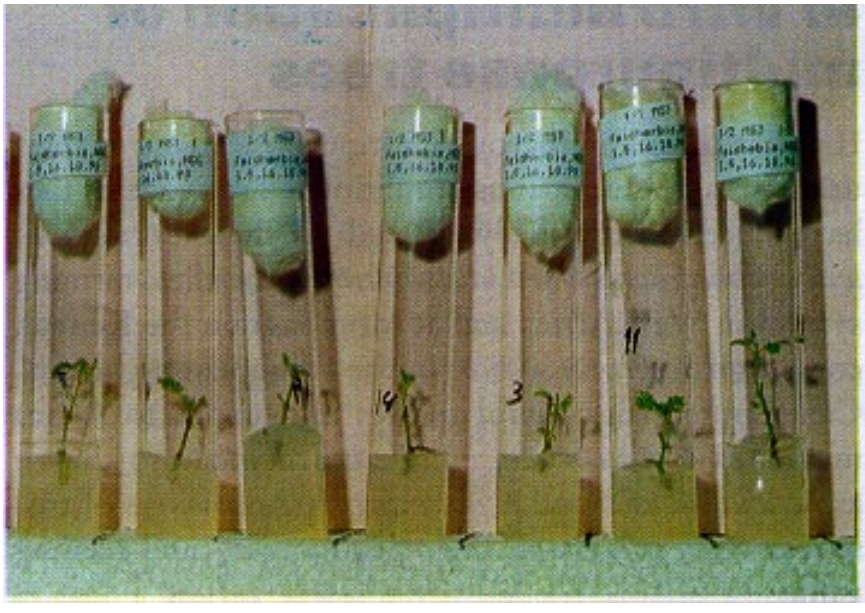
Maintaining a collection of tree species poses special problems for genebanks. Trees take several years to mature and produce seed, and occupy large areas of land. Added to that, most of the multipurpose trees ILCA is working with are thought to be outcrossing—i.e. they normally set seed when pollinated by another plant of the same species. To keep each accession pure, it must produce its seeds in isolation from other accessions of the same species.

ILCA has been experimenting with *in vitro* culture of multipurpose tree germplasm for some time with a view to overcoming these problems, and as a way to provide disease-free vegetative material for distribution. *In vitro* culture involves taking tissue from a plant and growing it in sterile conditions as cultures in the laboratory. In this way. thousands of clones

genetically identical copies—can be produced from a single plant, ensuring that all the offspring will have identical productive and nutritive characteristics. The tissue used in the culture can be treated to eliminate disease organisms.

Plants regenerated from meristems—the so-called non-adventitious material found in shoot and root tips—are genetically stable and identical to the parent plant. Meristematic tissue is used when the objective is to produce large numbers of identical plants for distribution and testing. However, plant breeders and geneticists working with a limited range of germplasm may wish to induce increased genetic variability. In this case, regeneration from adventitious material—parts of the plant that do not normally produce roots or shoots—is used.

Faidherbia albida *plantlets undergoing rapid clonal propagation* in vitro.



Work on determining techniques suitable for the *in vitro* culture of tree germplasm started in 1989. In 1990, non-adventitious regeneration was successfully achieved with *Erythrina brucei*, *Faidherbia albida* and *Acacia tonilis*, while shoots were regenerated from adventitious material from *Sesbania sesban*, *Faidberbia albida* and *Acacia tortilis.*

Plantlets were grown in *in vitro* culture and then successfully established in normal soil in the greenhouse using minimum-facility techniques—i.e. simple techniques that require no special equipment and that can be easily adopted by national programmes with limited facilities. The successful completion of the cycle from field to the laboratory and back to the field demonstrates that *in vitro* culture can be used to distribute multipurpose tree germplasm to national programmes in Africa.

Sesbania sesban plants *established in pots from plantlets grown* in vitro.

A potential spin-off from this work is the use of *in vitro* culture techniques to screen multipurpose tree accessions for their polyphenolic content. Most multipurpose trees studied by ILCA contain polyphenolic compounds, which affect the nutritive value of the foliage when fed to animals. Accessions that contain large amounts of polyphenolics generally provide poorer-quality feed. During the trials on *in vitro* culture techniques, ILCA's scientists noticed that accessions with high levels of polyphenolics stained the culture medium and tended not to survive in culture. Those with low polyphenolic contents survived and did not stain the culture medium. Thus it may be possible to use *in vitro* culture techniques as a screening mechanism, following this with rapid clonal propagation to develop, selected lines with better feeding values.

The achievements of this work in 1990 were such that ILCA is now developing a training course on *in vitro* dissemination techniques for national programme staff.

Breeding systems of African clovers and *Sesbania*

ILCA's genebank holds the world's most extensive collections of African clovers and *Sesbania*, a fodder tree found throughout the tropics. Both clovers and *Sesbania* hold promise for improving the feeding of ruminant livestock in Africa, and their ability to fix nitrogen will help improve soil fertility and boost the yield of subsequent food crops. Studies carried out by ILCA and African national programmes have identified the highest yielding and most nutritious accessions for a range of environments.

But one aspect of these plants that has gone largely unstudied is their breeding systems. Whether they are outcrossing or selfing has important implications for maintaining the purity of accessions in ILCA's genebank. Maintaining purity is essential if promising accessions are to be distributed to national programmes for further evaluation and development as animal feeds. Outcrossing accessions will produce seed carrying some of the characteristics of neighbouring accessions of the same species. Selfing accessions will produce pure seed, simplifying the tasks of germplasm maintenance and dissemination.

Trials were conducted in 1990 to determine the breeding systems of 11 important annual African clovers: *Trifolium bilineatum, T. decorum, T. mattirolianum, T. rueppellianum, T. resupinatum, T. quaryinianum, T. tembense, T. schimperi, T. steudneri, T. baccarinii* and *T. pichisermollii*. Different experiments assessed the ability of plants to set seed in isolation, and when pollinated by another plant of the same accession or by a plant of a different accession.

Six of the clovers—*T. quailinianum, T. tembense, T. schimpeiri, T. steudneri, T. baccaiinii* and *T. pichisermollii*—proved to be selfing, pollinating themselves without the involvement of any "pollinating agent" such as bees. Growing them in isolation to produce pure seed for the genebank should pose no special problems.

Clovers growing in evaluation plots at ILCA's headquarters site, Addis Ababa, Ethiopia. Studies of clovers' breeding system are aimed at keeping accessions in the genebank pure.

In the other accessions—*T. bilineatum, T. decorum, T. mattirolianum, T. rueppellianum* and *T. resupinatum*—individual plants did not set seed when grown alone. Plants of these self-incompatible accessions need other plants of the same accession around them. and pollinators such as bees, to produce seed. The fact that individual plants are self-incompatible but that different plants of the same accession are compatible indicates a degree of genetic variation within the accessions, which thus represent a population rather than a single genotype.

Producing seed of these self-incompatible accessions poses problems for the genebank. The method used at present is to allow only one accession of any species to flower in the multiplication plots at any one time. The disadvantage of this method is that only a few accessions can be multiplied each year, restricting the stock of seed of each that is available for distribution.

Similar work is being carried out in Ethiopia on *Sesbania* species. A large number of flowers have been observed under natural conditions and when bagged, with and without tripping—manipulating the flower to release pollen—and manual crossing following emasculation. The results (see Table) clearly show that the most promising species *(S. sesban* and *S. goetzei)* are self-compatible but are also able to outcross. Experiments are continuing to determine the amount of outcrossing that occurs under natural conditions. as the first step in developing appropriate seed multiplication methods for use by African national programmes.

Sesbania sesban *and* S. goetzei *are clearly self-compatible, but their lowers must be tripped, either by "Pollinating agents" such as bees, as under natural conditions, or by band, to ensure reasonable levels of pod set.*

Treatment	*Sesbania sesban*			*Sesbania goetzei*		
	No. of flowers	No. of pods produced	Pod set (%)	No. of flowers	No. of pods produced	Pod set (%)
Natural conditions (control)	570	193	34	253	125	49
Flowers tripped and bagged	478	107	22	196	52	27
Flowers bagged without tripping	493	10	2	234	2	1
Flowers emasculated, pollinated by hand, then bagged	398	22	5	234	17	7

Trypanotolerance Thrust

In many parts of Africa, livestock production is dependent on trypanocidal drugs. But evidence from south-western Ethiopia indicates that the efficacy of these drugs is breaking down.

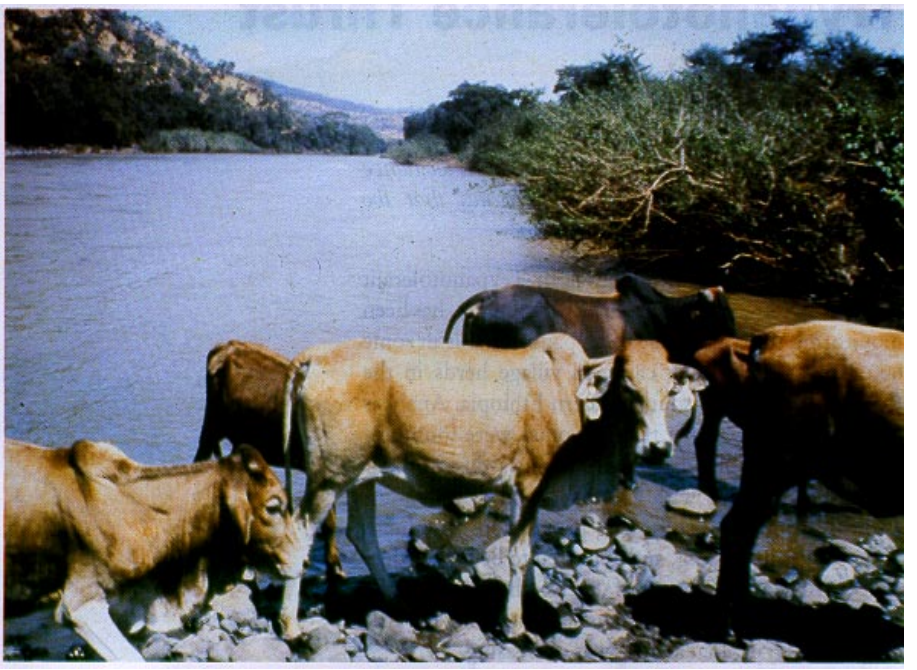
For the past five years the African Trypanotolerant Livestock Network, which ILCA coordinates, has been monitoring the occurrence of trypanosomiasis in some 600 East African Zebu cattle in village herds in the Ghibe river valley in south-western Ethiopia. Analysis of the data showed that trypanosomes were found repeatedly in the blood of many animals despite their having been treated with a trypanocidal drug, diminazene accturate (Berenil). The proportion of animals infected was increasing, and appeared to be higher than expected given the degree of "tsetse challenge" in the area. Taken together, these signs suggested that the efficacy of the trypanocidal drug was decreasing.

By 1989, in any one month over 30% of the cattle were found to be infected with *Trypanosoma congolense,* the predominant trypanosome in the Ghibe area. Re-analysing the data to pick up only new infections—taking into account only those animals that had been free of the disease for the previous two months—showed a new infection" rate of less than 20%. The difference between this value and 30% was taken as an indication of the level of recurrent infection. Thus over one-third of the animals infected with *T. congolense* were suffering from recurrent infections, i.e. infections that had not been cleared by drug treatment.

Samples of *T. congolense* from Ghibe tested at the International Laboratory for Research on Animal Diseases (ILRAD), Nairobi, Kenya, showed clear evidence of a build up of drug resistance. Of 12 isolates tested, all showed a high prevalence of trypanosomes resistant to Berenil and homidium chloride, another common trypanocidal drug. All but one showed a high proportion of trypanosomes resistant to the third commonly used trypanocidal drug, isometamidium chloride.

Studies are now under way at other sites of the African Trypanotolerant Livestock Network to determine how widespread the problem of drug resistance is. The results of the Ghibe study are a portent of what is likely to become an increasingly serious problem. They underscore the urgent need to seek alternatives to drug therapy as a means of maintaining livestock in tsetse-infested areas, pointing to an increasing role for trypanotolerant livestock.

East African Zebu cattle in the Ghibe river valley of south-western Ethiopia. ILCA studies of these animals, maintained using trypanocidal drugs, indicate that drug resistance is building up in trypanosomes.



Increasing the feasibility of selection for trypanotolerance

The signs of trypanosomiasis infection are the presence of trypanosomes in the blood and anaemia, caused by the destruction of red blood cells by the parasites. Previous studies have shown that the key indicators of trypanotolerance are the abilities to limit the number of parasites in the blood (parasitaemia control) and to maintain relatively high levels of red blood cells when infected by trypanosomes (anaemia control).

Previous work by members of the African Trypanotolerant Livestock Network has shown that the degree of anaemia in trypanosome-infected cattle, as measured by the packed red cell volume (PCV) in the blood, is correlated with such production traits as reproductive performance and growth—animals able to maintain high PCV levels are more productive than those with low PCV values.

Studies in 1989 demonstrated that an animal's ability to maintain high PCV levels when infected with trypanosomes is a heritable trait and identified conditions for field testing to assess trypanotolerance levels. This opened the way for practical breeding programmes aimed at producing cattle that are both more trypanotolerant and more productive. Such breeding programmes are currently being evaluated at Mushie Ranch in Zaire.

While the degree of anaemia is relatively simple to measure, determining the degree of parasitaemia has proved more difficult. In the past, this depended on observation of trypanosomes in peripheral blood using conventional parasitological techniques. However, there is evidence that animals may be infected even when trypanosomes cannot be found by these techniques.

Trypanotolerant cattle, such as these N'Damas, offer the best hope for exploiting areas infested with tsetse flies and trypanosomiasis. Recent studies by the African Trypanotolerant Livestock Network have demonstrated practical possibilities for selecting for greater trypanotolerance and productivity.

In 1990, this problem was overcome by using an antigen-trapping monoclonal-antibody-based ELISA (enzyme-linked immunosorbent assay) test for trypanosomes, developed by ILRAD. This test demonstrates the presence of trypanosome antigens in the blood, an indication of infection. Animals that tested positive with the ELISA test but exhibited no trypanosomes by the parasitological test were termed "antigenaemlc". This was taken as a sign that the animal was better able to control parasite development than an animal in which trypanosomes were found.

A trial at the OGAPROV (Office gabonais d'amélioration et de production de viande) ranch in Gabon showed that parasitaemic animals had significantly lower average PCV and daily weight gain than antigenaemic animals. There were no differences in these characters between antigenaemic and non-infected animals. There were indications from this work that ability to control parasitaemia may also be heritable.

The ELISA test thus offers, for the first time, a practical means of identifying animals with a superior ability to control parasitaemia, providing the opportunity for selection based on this criterion as well as on that of anaemia control.

Further tests at OGAPROV ranch indicated that the effects on growth rate of ability to control anaemia were similar in both antigenaemic and parasitaemic animals. This suggests that it may be possible to select on the basis of PCV in antigenaemic animals as well as in parasitaemic animals. This would be of major benefit because it would allow selection to be carried out in areas where trypanosome challenge is less severe.

Livestock Policy and Resource Use Thrust

The system perspective adopted by ILCA leads to important research external to livestock production. Thus ILCA scientists are concerned both with the sustainable utilisation of natural resources supporting animal agriculture in Africa and with providing policy makers with better information on the likely effects of policies affecting the livestock sector.

Government policies are part of the environment in which African farmers work. Policies that favour farmers should help boost production. Those that operate at the expense of farmers can stifle productivity and sound the death knell for innovations, no matter how good they may be technically.

Government policies in Africa, especially those affecting the livestock sector, are too often not based on a good understanding of their potential consequences. The multiple objectives of policy makers may lead to conflicts between one objective and another, or the combined effect of a mix of policy instruments may be quite different from what was originally intended. ILCA is well placed to conduct the multi-country studies needed to compare experiences and increase understanding of the potential effects of policies.

Price policies: The move away from taxing farmers

During the 1980s government policies affecting the livestock sector in Côte d'lvoire, Mali, Nigeria. Sudan and Zimbabwe have moved gradually away from taxing producers, according to an ILCA study completed in 1990. This should encourage increased livestock production and the adoption of improved technology.

A livestock market in Ethiopia. Favourable government policies can promote adoption of improved practices and stimulate production.

The study, covering the period from 1970 to 1986, found that national livestock policies had numerous objectives and employed a variety of policy instruments. Objectives included increased self-sufficiency in meat and milk, promotion of exports, stabilisation and control of inflation, generation of revenue for the government, improved nutrition and provision of employment opportunities.

Self-sufficiency was the most common objective. Unfortunately, production and consumption trends and self-sufficiency ratios (the ratio of domestic production to total consumption) show that this objective eluded the countries studied for most of the period covered by the study. Consumption of milk, in particular, increased faster than production in all five countries between 1971 and 1985.

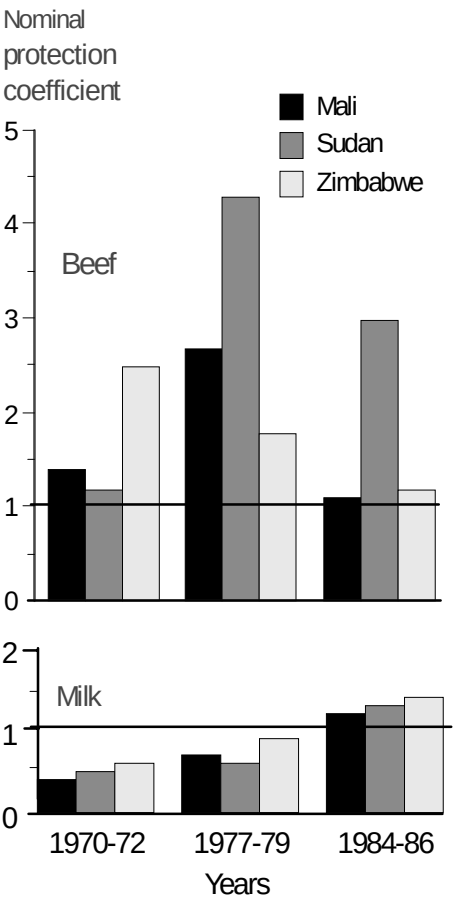
The policy instruments used included controlled prices, input subsidies, trade taxes, consumer subsidies, import licences and foreign exchange allocations.

Zimbabwe made extensive use of controlled prices. These were administered by two parastatals, the Cold Storage Commission and the Dairy Marketing Board, which purchased meat and milk respectively from producers. Consumer prices, particularly of beef, were subsidised by the government. In contrast, Côte d'Ivoire used input subsidies to reduce producers' costs of production. This instrument was used to encourage producers to adopt modern technologies, including feeds and veterinary drugs.

The study highlighted the multiple objectives of policies affecting the livestock sector, many of which conflicted with each other. For example, in most of the countries policies were in force with the objectives of both providing producer price incentives and stabilising or reducing consumer prices.

On balance, real producer prices increased over the study period, i.e. nominal prices increased faster than the cost of living. The nominal protection coefficient[2]—the ratio of domestic producer price to the border equivalent price—indicated that policies in the study countries implicitly subsidised beef production over the period studied, although in Mali, Sudan and Zimbabwe milk producers were implicitly taxed for most of the study period.

Price policies in study countries implicitly subsidised beef production, but in Mali, Sudan and Zimbabwe milk producers were taxed for most of the study period.



Except in the cases of beef in Côte d?Ivoire and Zimbabwe and milk in Mali, there was a gradual shift from consumer subsidisation to taxation during the study period.

Official exchange rates were used to estimate nominal protection coefficients. Since official exchange rates in Africa often overvalue the national currency, the results may overstate the actual levels of consumer taxation and producer subsidisation. The analysis thus demonstrated the important implications of exchange rates for domestic pricing policies and highlighted the need to address exchange-rate distortions at the same time as tackling direct price distortions.

A calculation of the costs and benefits of the policies followed by the countries studied indicated marked effects on production and consumption. The most striking case is that of milk in Mali. The analysis indicated that the "negative protection" of milk production between 1970 and 1972 reduced domestic production by 208 000 tonnes and increased consumption by 36 000 tonnes. Thus, in effect, the policies could have increased imports by 244 000 tonnes. Mali actually imported a total of only 13 000 tonnes of milk

[2] The nominal protection coefficient (NPC) provides an indication of the taxation or subsidisation rate on producers, and hence of the degree of distortion affecting the market. An NPC of 1.0 indicates that producers are receiving prices equivalent to world market prices and are being neither taxed nor subsidised. A ratio greater than 1.0 suggests that producers are being subsidised and consumers taxed, while a ratio less than 1.0 indicates a tax on production and a subsidy for consumption.

during this period. Hence, had policies not distorted prices, Mali might well have become more than self-sufficient in milk. Social costs—earnings forgone as a result of suboptimal policies—ranged in 1984–86 from US$ 1.1 million for Zimbabwe to US$ 416 million for Nigeria.

Land tenure and alley farming

Another aspect of the policy environment that markedly influences adoption of technology is the control farmers have over their "factors of production"—including their rights and obligations under the prevailing land tenure system.

Unclear land tenure discourages farmers from adopting technologies that provide long-term benefit if the benefit is tied to a piece of land. An example of such a technology is alley farming, in which leguminous browse trees are planted in hedgerows to provide nitrogen for the soil and/or high-quality feed for livestock. Planting trees is a long-term investment, with the benefits to soil fertility becoming apparent only over several years.

In 1989, the Land Tenure Center (LTC) of the University of Wisconsin-Madison, in collaboration with ILCA, started a study of land tenure systems in Cameroon, Nigeria and Togo. Surveys were carried out in each country by national scientists, with assistance from LTC and ILCA staff. The survey in Nigeria covered areas where ILCA and the International Institute of Tropical Agriculture (IITA, Ibadan, Nigeria) had already conducted on-farm research on alley farming and involved 84 alley farmers, 49 ex-alley farmers and 107 conventional farmers. The surveys in Cameroon and Togo included only a few alley farmers, because the system has been less widely introduced there.

The surveys showed that farmers acquire land through various means, including purchase or being given land (5–10% of fields in each country), divided inheritance[1] (half the fields in Cameroon and Nigeria, a quarter in Togo) and undivided inheritance[2] (a third of all fields in each country). Secondary access[3] was important in Togo, particularly where land was scarce.

The relationship between land tenure and the uptake of alley farming was established by comparing farmers who continue alley farming, those who began alley farming but have stopped, and those who have never adopted alley farming.

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[1] Divided inheritance: land that is divided among the heirs, giving each full control over their own parcel of land.

[2] Undivided inheritance: land that passes to the heirs collectively, with the result that no one person has absolute control over any part of the land.

[3] Secondary access: generally implies land obtained through a rental agreement, pledge or loan.

Initial analysis of the data shows that most continuing alley farmers had obtained their land through divided inheritance. In contrast, most farmers who had not adopted alley farming, and those who had stopped, had land obtained through undivided inheritance. In Nigeria, 70% of alley farmers' fields were held under divided inheritance, while 60% of ex-alley farmers' fields were held under undivided inheritance.

Feeding browse from an alley farm to sheep and goats in southern Nigeria. Studies of the influence of land tenure system on adoption and practice of alley farming should facilitate the spread of this system.

Characteristics associated with divided inheritance land included:

- a higher incidence of tree planting than on other types of land
- a higher incidence of commercial and fruit trees
- greater use of inputs to enhance soil fertility
- better soil fertility
- closer proximity to the homestead
- more frequent fallowing.

Farmers thus appear willing to invest more in land obtained under divided inheritance than in land held under other types of tenure. Apparently, their greater security of tenure makes them more likely to take a longer-term view, since they can expect to be the principal beneficiary of any investments they make.

Ethiopian rangelands system study

A 10-year study of the Borana production system in southern Ethiopia was completed in 1990. The final report testifies to the profound changes taking place in this once purely pastoral society as its human population continues to increase. It also challenges the commonly held view of pastoral people as reactionary and unwilling to change.

The human population of the Borana rangelands is growing rapidly, at 2.5% a year. The population of cattle, from which the Borana traditionally derived almost all their sustenance, has also grown, but more slowly and erratically, owing largely to the periodic setbacks caused by drought. As a result, the ratio of cattle to people has fallen, reducing the Borana's ability to subsist on animal products alone. Milk may have met all the Borana's food-energy needs as recently as 1959, but by 1983 it provided only 60%. Computer projections suggest that by the end of the century it is likely to meet less than 40% of the Borana's food needs.

The Borana have responded to the falling milk supply per person by increasing cropping and milk sales. Selling milk when there is too little for the household's needs may seem illogical. Yet, at 1990 prices, the amount of maize that can be bought by selling a litre of milk provides 18 times as much energy as does the milk itself. This milk-for-grain trade will become an increasingly essential support mechanism for the Borana society.

Increased cropping and milk sales have implications for women and their role in the production system. Borana men see livestock herding as men's work, and already complain of shortages of labour for herding. As young men increasingly migrate to urban centres in search of alternative employment, any additional work in rural areas will almost inevitably fall to women and older children. Processing and selling milk is already considered a woman's task, as is tending crops.

The Borana rangelands of southern Ethiopia. A 10-year study has revealed a system under pressure, with increasing resource degradation, and worsening food security for the people.

Easing women's work-loads

Caring for calves and fetching water for the household are two labour-intensive tasks that women already perform. Both have been studied by ILCA, in collaboration with CARE, a non-governmental relief and development agency working in southern Ethiopia.

Traditionally, women collect dry grass during the dry season to feed to calves. CARE proposed haymaking during the long rainy season as a way to ease the burden on women. Trials demonstrated that haymaking was technically feasible and that calves fed hay were able to maintain their weight during the dry season, whereas traditionally managed calves lost weight.

It was originally thought that making hay in the wet season would take less time than collecting grass in the dry season, but in fact hay-making did not markedly reduce the amount of work women did. The lack of effect was in part related to an unusually good dry season during the labour study—scattered showers provided ready supplies of feed. But it also seemed that women interviewed during the design phase of the project had exaggerated the amount of time they spent collecting feed in the dry season.

Borana women taking milk to market. Increasingly, milk sales underpin the Borana production system, as the amount of milk available falls short of that needed to feed the people.

Easing the task of fetching water was addressed by installing large (100 000-litre) cement cisterns near homesteads. These cisterns fill with water during the rainy seasons, providing dry-season water supplies.

Again, ILCA's studies showed this did not have the expected effect: instead of reducing the amount of time women spent fetching water, it changed the women's behaviour. Those who had to fetch water from distant wells usually did so only once a week. Women who had access to a nearby cistern tended to fetch smaller amounts of water every day, spending considerable periods at the cistern talking with other women. The total amount of time spent did not differ markedly, but fetching water became a pleasanter and more sociable activity.

The amount of water used was 74% greater in households with access to a cistern than in those that had to fetch water from a distant well (125 vs 72 litres per family per week). Women with access to a cistern also gave their calves more water than did those who used wells. This may have an important effect on calf growth—ILCA's studies have shown that calves that receive more water grow faster than traditionally managed calves.

Scope for development

The synthesis of 10 years' results reveals a pastoral system in flux. Much of the change has been driven by population pressure on available natural resources.

The longer-term perspective of the study has highlighted the changing opportunities for intervention, driven both by changes in the livestock population between droughts and by changes in the external environment.

For example, interventions such as calf-feeding management or selling livestock to finance the building of water cisterns would be most likely to succeed when the cattle population is high. The fall in milk "surpluses" in recent years has rendered milk processing and preservation interventions largely irrelevant to the average Borana household.

The changes in the external environment that have had, or are likely to have, marked effects on the Borana system relate to improved communications and policies. Improved communications—in particular, the road running from Addis Ababa to Kenya through the Borana rangelands—have increased the Borana's exposure to external influences and have opened up new market opportunities. The increasing dependence of the Borana on purchased cereals makes it important for them that the central government adopt policies that promote favourable terms of trade between livestock products and cereals.

Training and Information Department

Working in partnership with national agricultural research systems (NARS) is central to ILCA's approach to research. Such an approach presupposes the availability of partners—people and organisations-willing and able to work alongside ILCA, using common methods and from a common base of knowledge.

ILCA's training programmes are aimed at making its research partnerships more effective. In this they are, in themselves, the products of a partnership-that between the Training and Information Department and ILCA's Research Department. Training is provided at a variety of levels, from technicians and field workers through young scientists who have recently completed their doctoral degrees to senior officials and policy makers. Training is targeted at specific needs identified by colleagues in African national programmes, particularly those involved in ILCA—associated networks.

Lack of information is a problem for many scientists working in livestock research in sub-Saharan Africa. African national programmes are seriously underfunded. Most of their money goes on staff costs, leaving little for research and less for their libraries and information services. Subscriptions to journals, payable in scarce foreign exchange, are rising, putting ever increasing pressure on library budgets.

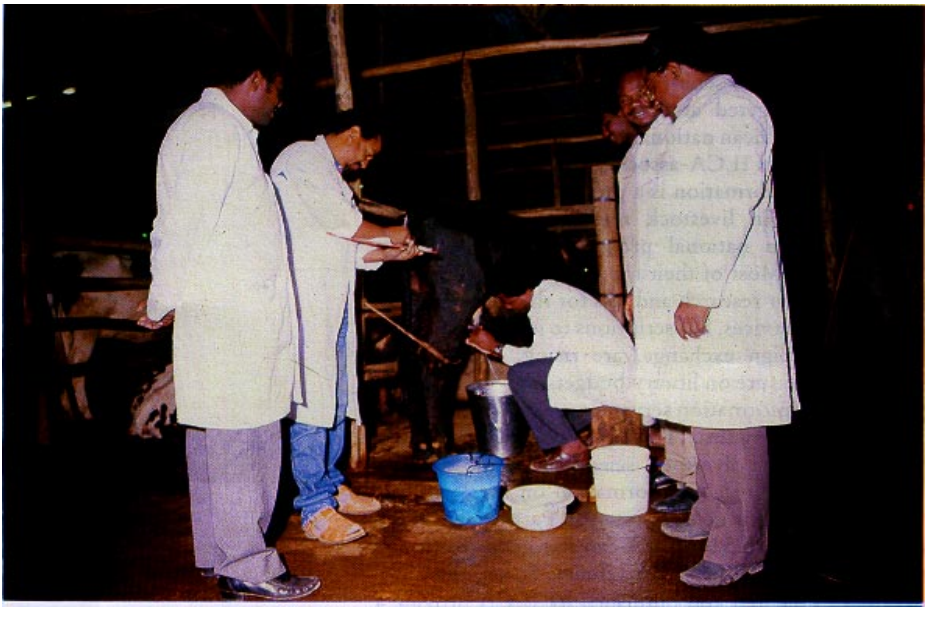
ILCA's information services are a small bright spot in this gloomy picture. Through these services, more than a thousand livestock scientists in sub-Saharan Africa regularly receive information on the latest developments in their fields of interest. Participants in the networks supported by ILCA can also get access to the unique holdings of the ILCA Library. Specialised bibliographies prepared and published by ILCA provide a ready reference in such diverse fields as smallholder dairying, beef cattle production and land and tree tenure in West Africa. A unique collection of "non-conventional" literature, assembled from 26 countries in sub-Saharan Africa, gives scientists access to national programme documents that might otherwise never have left the offices where they were produced.

Individual training

ILCA's individual training programmes fall into two main categories, long-term and short-term.

Long-term training takes the form of graduate or post-doctoral associateships. During 1990 a total of 41 graduate associates and 11 post-doctoral associates contributed to ILCA's research programmes at various sites in Africa. Details of long-term trainees at ILCA in 1990 are given in the annexes to this report.

Trainees on ILCA's milk production course gaining "hands-on" experience of smallholder dairying ILCA's training emphasises practical experience, as well as theoretical aspects.



Graduate associates

Graduate associateships offer young scientists, usually Africans opportunities to advance their education through supervised research in Africa. These scientists spend up to three years at ILCA conducting research towards MSc or PhD degrees. But as well as representing a training opportunity, the work of graduate associates is part of ILCA's own approved research programme.

The integration of research by graduate associates with ILCA's research programme is well illustrated by the work on smallholder dairying in the subhumid coastal zone in Kenya (see *Smallholder dairying in subbumid coastal Kenya,* pages 3–6 of this report). The core of this programme,

carried out in close collaboration with the Kenya Agricultural Research Institute (KARI), consists of work conducted by three graduate associates. The three, all KARI staff, are working towards their PhDs, with three British universities, in the fields of animal disease control, animal nutrition and forage agronomy. ILCA staff provide local supervision, while visits by the associates' university supervisors bring in outside expertise, further strengthening the programme.

Post-doctoral associates

Post-doctoral associateships allow recently qualified scientists, usually Africans, to conduct research on problems relevant to livestock production in Africa. This research is conducted in close collaboration with ILCA scientists and normally lasts two years. As with the graduate associates, post-doctoral associates' research is an integral part of ILCA's research programme.

One example of the work of a post-doctoral associate reported in these Highlights is the research on cow traction (see *Using dairy cows as draft animals,* pages 20–24). This work is central to one of the Animal Traction Thrust's main themes, the development of alternative sources of draft power.

Short-term trainees

Short-term trainees come to ILCA for a short period, usually less than three months, to gain skills and knowledge in a specific field or to complete a particular piece of research for which they need ILCA's facilities. Included in this category are undergraduate associates students, commonly from the developed world, working towards their first degree, who come to ILCA to gain experience of working in Africa. Many short-term trainees are involved in the activities of ILCA-associated networks.

A total of 28 short-term trainees spent time with ILCA programmes in 1990, receiving training in such topics as improved laboratory techniques in plant and animal nutrition, forage evaluation, genetic resources activities and seed production and handling.

Group training

Most of the courses offered by ILCA are intended for junior scientists from African national programmes, many of them participants in the various research networks coordinated by ILCA. A major aim of the courses is to provide these people with the skills and knowledge they need to participate fully in the collaborative research programme.

During 1990, ILCA offered 12 courses, 9 in English and 3 in French. The courses were attended by a total of 176 people from 30 countries in sub-Saharan Africa.

In the light of feedback from course participants, several courses were completely revised during 1990. The main revisions were to the content, tailoring this to the needs identified by participants, and the adoption of a modular format. The latter will make future revisions easier both for ILCA and NARS staff using the materials as the basis of their own courses.

From 1991, five modular courses will be offered under the overall title of Livestock Production Methods. These are: Improving Milk Production in Africa; Ruminant Nutrition and Feeding Systems; Rural Dairy Processing; Forage Evaluation and Production; and Forage Seed Production.

The revised courses focus on research for diagnosing and solving production problems. All have a module on the application of farming systems research to the central theme of the course. The emphasis is on using a combination of on-station and on-farm research to develop and apply technology that will improve existing methods of production. Elements covered by each course include:

- review of the basic principles underlying the subject of the course
- introduction to farming systems research methodology
- characterisation and analysis of production constraints
- methods for improving existing production systems
- on-station and on-farm research methodologies
- communication skills.

Training courses at ILCA in 1990.

Course title	Thrust[1]	Number of participants	Number of countries
Livestock hygiene[2]	C, SR, AT	1 4	7
Economics of animal health[2]	C, SR, AT, T	15	10
Small ruminant production[2]	SR	15	8
Rural dairy processing	C, SR	14	10
Introduction to applied statistics	All	15	7
Improving milk production[2]	C, SR	15	9
Animal nutrition	C, SR, AFR, AT,T	12	9
Forage evaluation and production	AFR	14	8
Livestock policy	LPRU	18	12
Forage seed production	AFR	18	12
Biometrics	All	14	10
Forage seed conditioning	AFR	12	9
Total		176	30

[1]C = Cattle Milk and Meat; SR = Small Ruminant Meat and Milk;

AT = Animal Traction; AFR = Animal Feed Resources;

T = Trypanotolerance; LPRU = Livestock Policy and Resource Use.

[2]Course offered in French.

Trainees coming to ILCA gain first-hand experience of developing and using training materials and methods

The process of revision is continuing, with comments being sought from network collaborators and current and former course participants. Increasing the involvement of ILCA's NARS partners in the design and delivery of training will ensure the continuing and improved relevance of the Centre's training efforts.

Training materials and methods

ILCA's Training Materials and Methods Unit produces slide/tape self-teaching modules, visual aids and training manuals. The aim of this Unit is to strengthen ILCA's training programmes and to provide materials and methods that will allow the courses currently offered by ILCA to be hosted and taught by national programmes. The Unit also collaborates with other agricultural research centres in Africa in the development of training materials on topics of common interest.

Communication is increasingly recognised as a key stumbling block in many research, development and training programmes. Starting in 1990, all ILCA's training courses include a module on "communication skills". Skills taught by the module include message design, speaking techniques preparation and use of visual aids, and preparation of publications for various outlets. Armed with these skills, participants in ILCA's courses will be better prepared not only to conduct research but also to communicate their findings and expertise to others.

Integrating information sources

Major steps were taken in 1990 to improve the information retrieval services of ILCA, and in particular the use made of the Centre's databases.

ILCA's library holds unique collections of information, and is growing steadily. The number of entries on the Centre's computerised database of library acquisitions rose by more than a dozen each day throughout 1990. Bibliographic data relating to ILCA's mandate were received monthly from two major global databases, CABI (Commonwealth Agricultural Bureaux International, UK) and AGRIS (the agricultural information service of the Food and Agriculture Organization of the United Nations). Details of ILCA's holdings of non-conventional literature, collected from 26 countries in sub-Saharan Africa, have also been entered on a separate database.

The fact that all this information has been held in different forms and on different databases has made comprehensive searches difficult, time-consuming and open to omissions.

Work in 1990 set about putting an end to this babel of databases. The library acquisitions database was restructured to allow import of bibliographic data directly from CABI and AGRIS database tapes. The database containing the catalogue of the microfiche collection was amalgamated with the library acquisitions database.

In line with this effort, information services staff worked on new "search profiles" of the regular users of the SDI (selective dissemination of information) service provided by ILCA. These search profiles-lists of keywords and other indicators of the research interests of the user-are the key to access to the information stored in the system. In a monthly run, the computer matches a user's search profile with the records added during the past month, selecting only those records that match his or her interests. The new search profiles use a more comprehensive base of information than the old profiles, and will, ILCA hopes, make sure that users are kept abreast of all information that will benefit their work.

The new service also provides for user feedback. This is carefully analysed to ensure that the service is meeting needs and to allow search profiles to be further modified as necessary.

ILCA research protocols and programme activities, 1990

Cattle Milk and Meat Thrust

Reproductive wastage and hygiene management

Effects of early supplementation on cattle growth and development under simulated pastoral management *(Ethiopia)*

Effect of early weaning on the growth and yearling weight of Arsi x Friesian calves *(Ethiopia)*

Comparative study of the reproductive characteristics and performance and the application of biotechnology in zebu and crossbred cattle under different production and management systems *(Ethiopia)*

Estimation of disease risk to dairy cattle in coastal subhumid Kenya *(Kenya)*

Postpartum comparative study on zebu Maure and N'Dama cows *(Mali)*

The reproductive physiology of Bunaji cattle in the subhumid tropics of West Africa *(Nigeria)*

Feeding and management systems

Effects of forage, water, labour and marketing interventions on human welfare and cattle management in semi-arid Ethiopia *(Ethiopia)*

The Borana Plateau of southern Ethiopia: Synthesis of pastoral research, development and change, 1980–90 *(Ethiopia)*

Effect of supplementing Napier grass with cottonseed cake or *Sesbania sesban* on the milk production of crossbred cows *(Ethiopia)*

Alternative year-round feeding systems for milk production *(Ethiopia)*

Supplementation of native hay or oats/vetch with concentrates and its effect on milk production. feed intake and on the digestibility of the diets of crossbred cows *(Ethiopia)*

The effect of three different calf rearing strategies on the performance of calves from birth to 12 weeks of age *(Ethiopia)*

Multipurpose trees as supplementary feed for crossbred cattle *(Ethiopia)*

On-farm introduction of forage-based feeding packages for crossbred dairy cattle in the Ethiopian highlands *(Ethiopia)*

Feed resources for smallholder dairy production in coastal subhumid Kenya—agronomic practices *(Kenya)*

Feed resources for smallholder dairy production in coastal subhumid Kenya—utilisation (*Kenya*)

Study of the animal husbandry aspects of meat and milk production around Bamako (*Mali*)

Effect on milk offtake of the early introduction of feeds other than maternal milk in calf diets *(Mali)*

Peri-urban dairy production in the subhumid zone of Nigeria *(Nigeria)*

Optimal fodder bank utilisation for reproductive efficiency of Bunaji cattle *(Nigeria)*

Measurement of the rate of feed intake and digesta flow of Bunaji cattle *(Nigeria)*

Evaluation of the role of minerals in the nutrition of Bunaji cattle *(Nigeria)*

Evaluation of grass/legume mixtures for grazing and stall-fed cattle *(Nigeria)*

Cattle under oil palm *(Nigeria and Togo)*

Traditional cattle systems in the derived savannah *(Nigeria)*

Milk preservation and processing technologies

The microbiological and chemical composition *of Ititu* and factors affecting its production *(Ethiopia and Canada)*

The manufacture of butter on-station and on-farm from milk and cream using different types of churns *(Ethiopia)*

Processing of scamorza cheese in rural areas *(Ethiopia)*

A survey of milk production and utilisation by smallholders in the urban area of Debre Zeit *(Ethiopia)*

Economics of cattle production

Consumption of and demand for beef and dairy products *(Ethiopia)*

Influence of economic factors on technology development *(Ethiopia)*

Characterisation of coastal subhumid farming systems *(Kenya)*

Estimation of current and long-term demand for livestock products *(Kenya)*

Socio-economic obstacles to increased milk production in the Bamako area: Study of production costs and returns to dairy producers under various production systems *(Mali)*

Socio-economic obstacles to increased milk production in the Bamako area: Study of the efficiency of dairy marketing systems operating in the Bamako area *(Mali)*

Identification of tenure constraints to increased milk production in the subhumid zone of Mali *(Mali)*

Multilocational testing of fodder banks *(Nigeria)*

Milk processing, marketing and consumption in southern Nigeria *(Nigeria)*

Economic analysis of alternative cattle production systems in the humid zone *(Nigeria)*

Breed evaluation and improvement

Assistance to NARS in evaluation of cattle breeding programmes for western and central Africa and East and southern Africa *(Ethiopia)*

Evaluation of milk production in cattle breeds and crosses in small-scale herds in Ethiopia and Ghana *(Ethiopia and Ghana)*

Nutrition and productivity of Bunaji cattle *(Nigeria)*

Evaluation of the comparative health and performance of dairy cattle genotypes for smallholder production in the subhumid tropics *(Kenya)*

Network coordination

Cattle Research Network *(ILCA and NARS)*

Small Ruminant Meat and Milk Thrust

Economics of small ruminant production

Marketing and demand studies: Patterns in sub-Saharan Africa *(Ethiopia)*

Analysis of interventions in nutrition, reproduction. health and management (*Ethiopia*)

Socio-economic analysis of alley farming with small ruminants *(Nigeria)*

Breed evaluation and improvement

Characterisation and evaluation of African small ruminant breeds *(Ethiopia, Nigeria, Tanzania and Togo)*

Performance evaluation of Ethiopian highland sheep breeds under varying management *(Ethiopia)*

Forage and feeding systems

Evaluation of feeds for use in feeding systems for small ruminants *(Ethiopia)*

Development of appropriate fattening systems for small ruminants in African highlands *(Ethiopia)*

The use of fodder from multipurpose trees as sources of protein in diets for small ruminants: Microbial metabolism of protein in the rumen *(Ethiopia)*

On-farm verification of sheep fattening: The strategic use of concentrates in sheep fattening *(Ethiopia)*

Evaluation of feed resources in the Sahel through intake and metabolism trials *(Niger)*

Introduction of forage legumes in Sahelian cropping systems *(Niger)*

Development of feeding systems for small ruminants in the Sahel *(Niger)*

Productivity of West African Dwarf goats on improved pasture in a mixed crop/livestock system in the subhumid zone of Nigeria *(Nigeria)*

On-farm wet-season supplementation of West African Dwarf goats in the subhumid zone of Nigeria *(Nigeria)*

Small ruminant feeding systems development *(Nigeria)*

Evaluation of MPTs in alley farm production systems *(Nigeria)*

Reproductive wastage and hygiene management

Effects of dietary supplementation and endoparasite control on the reproductive performance of Menz-type sheep *(Ethiopia)*

The effect of health constraints on reproductive and productive performance of sheep in the highlands *(Ethiopia)*

The effect of controlled mating, season of lambing and strategic supplementation on lamb output and ewe reproductive performance *(Ethiopia)*

Importance of non-genetic and genetic parameters for helminth parasite control in small ruminants *(Kenya)*

Effect of trypanosomiasis on nutrient utilisation during pregnancy and lactation in West African Dwarf sheep *(Nigeria)*

Systems and economics

Evaluation of the contribution of crossbred goats to improved milk production and social welfare in smallholder mixed farming in medium-potential areas of sub-Saharan Africa *(Burundi)*

Constraint quantification in highland sheep production *(Ethiopia)*

Prospects for improving small ruminant production in farming systems of the humid and subhumid zones *(Nigeria and Togo)*

Network coordination

African Small Ruminant Research Network *(ILCA and NARS)*

Animal Traction Thrust

Intensified/diversified use of draft animal power

Vertisol resource assessment, agroclimatology, crop modelling and water management *(Ethiopia)*

Animal-drawn implements for Vertisols *(Ethiopia)*

Land-shaping for water management and soil conservation *(Ethiopia)*

Cropping systems on drained Vertisols *(Ethiopia)*

Traction animals: Performance evaluation and implement fit *(Ethiopia)*

Vertisol management in the Ethiopian highlands: On-farm technology verification *(Ethiopia)*

Introduction of animal traction into new areas

Animal traction in Niger. Why is it poorly developed? *(Niger)*

Draft animal power in inland valley *(fadama)* agriculture in the subhumid zone of Nigeria *(Nigeria)*

Feeding strategies for draft animals

The effect of body condition and age on the fattening of draft oxen fed teff straw *(Eragrostis teff)* based diets *(Ethiopia)*

Effect of feed supplementation and physical characteristics of oxen on work capacity and incidence of problems in work *(Mali)*

Alternative sources of draft power

Alternative sources of draft animals: The use of dairy cows and single oxen for land cultivation *(Ethiopia)*

Energy expenditure of draft crossbred dairy cows *(Ethiopia)*

Alternative sources of draft animals: Use of crossbred dairy cows for traction (IAR/ILCA collaboration) *(Ethiopia)*

Network coordination

Animal traction network in Africa *(ILCA and NARS)*

Animal Feed Resources Thrust

Resource assessment and services

Forage genetic resources *(Ethiopia)*

Soil nutrients and water, reviews and Soils Laboratory *(Ethiopia)*

Forage seed production at the intermediate *level (Ethiopia)*

Application of agro-ecological modelling to assess land suitability and impact of improvement of fodder resources *(Subhumid West Africa)*

Initial evaluation of feed resources Feed resources evaluation *(Ethiopia)*

Feed resources evaluation (*Ethiopia*)

Soil fertility and rhizobium studies on forage legumes *(Ethiopia)*

Evaluation of forage legume genetic resources in the subhumid zone *(Nigeria)*

(i) Establishment of nutrient criteria for promising legumes and determination of nutrient deficiencies in major soils. (ii) Potassium requirements of grass/legume mixtures in the soils of the subhumid zone of Nigeria *(Nigeria)*

Agronomic evaluation of herbage legume germplasm *(Nigeria)*

Multipurpose trees

Agronomic evaluation of accessions of multipurpose trees *(Ethiopia)*

Management of *Sesbania* species *(Ethiopia)*

Evaluation of multipurpose trees in the subhumid zone of Nigeria *(Nigeria)*

Initial evaluation of multipurpose trees *(Nigeria)*

Agronomic evaluation of best-bet lines *(Nigeria)*

Evaluation of MPTs in production systems: Intensive feed gardens *(Nigeria)*

Legume forages in crop–livestock systems

Nutrient cycling in legume-based crop–livestock systems *(Ethiopia)*

Agronomic studies on selected forage legumes *(Nigeria)*

Evaluation of legumes in management systems: Fodder banks *(Nigeria)*

Trypanotolerance Thrust

Trypanosomiasis epidemiology

Determination of the contribution that tsetse evaluation can make in predicting trypanosomiasis situation *(Côte d'Ivoire, Ethiopia, Gabon, Senegal, The Gambia and Zaire)*

Epidemiology of trypanosome resistance to trypanocidal drugs *(Côte d'Ivoire and Ethiopia)*

Factors affecting susceptibility to trypanosomiasis *(Senegal and The Gambia)*

Diagnosis of trypanosomiasis *(Gabon and Zaire)*

Trypanotolerance

Effect of trypanosomiasis on animal health and performance *(Gabon)*

Effect of interactions between trypanosomiasis and other diseases on animal health and performance *(Côte d'Ivoire and Zaire)*

Effect of trypanosomiasis on animal health and performance: Effect of interactions between trypanosomiasis and other diseases on animal health and performance *(The Gambia)*

Criteria of trypanotolerance and their linkage with animal performance *(Gabon and Zaire)*

Genetics of trypanotolerance

Genetic aspects of criteria of trypanotolerance and development of practical genetic improvement programmes *(Gabon and Zaire)*

Biological and economic evaluation of productivity responses to interventions

Biological and economic evaluation of productivity responses of trypanosusceptible livestock to alternative tsetse control methods *(Ethiopia)*

Evaluation of the strategic use of trypanocidal drugs to improve cow fertility *(Gabon)*

Strategic nutritional supplementation (*Senegal* and *The Gambia)*

Biological and economic evaluation of productivity of N'Dama cattle in a *metayage* system under trypanosomiasis risk (*Zaire*)

Economic evaluation of village cattle production under trypanosomiasis risk *(Côte d'Ivoire, Ethiopia, Kenya, The Gambia, Togo and Zaire)*

Livestock Policy and Resource Use Thrust

Policy services

Policy services *(Ethiopia)*

Policy research

The role of credit in promoting investment and the adoption of technology by smallholders in livestock development in sub-Saharan Africa *(multi-country)*

The organisation of animal health services *(multi-country)*

Impact of livestock pricing policies on meat and milk output in selected sub-Saharan African countries *(multi-country)*

Land tenure and trees in West Africa *(Cameroon, Nigeria and Togo)*

Range trends

Trends in range resources productivity and management in the Sahel *(Mali and other Sahelian countries)*

Semi-arid livestock

Categorisation of mixed farming systems in the semi-arid zone *(Ethiopia)*

Holistic assessment of the role of livestock in mixed farming systems in the Sahel *(Niger and semi-arid West Africa)*

Nutrient cycling by ruminants in the Sahel *(Niger)*

Assessment of uses of crop residues in the Sahel of West Africa *(Niger)*

Resource surveys

Resource surveys *(multi-country)*

Network coordination

Networking needs *(multi-country)*

Training and Information Department

Training programmes

Training materials and methods

Documentation

Publishing

Research collaborators, 1990

Africa

Botswana

Botswana Agricultural College

Burundi

Projet caprins de Ngozi

Cameroon

Institute of Agronomy Research

Côte d'Ivoire

Société de développement des productions animales

Ethiopia

Addis Ababa University, Faculty of Veterinary Medicine
Agricultural and Industrial Development Bank
Alemaya University of Agriculture
CARE-Ethiopia
Institute of Agricultural Research
Ministry of Agriculture, Soil Conservation Research Project

Gabon

Office gabonais d'amélioration et de production de viande

The Gambia

Department of Livestock Services

Ghana

Animal Research Institute

Kenya

Isiolo Livestock Development Project
Kenya Agricultural Research Institute
Ministry of Livestock Development: Mariakani Veterinary Investigation Laboratory; provincial, district and divisional veterinary departments
National Veterinary Research Centre, Muguga
University of Nairobi

Lesotho

Southern Africa Development Coordination Conference Coordination Unit

Mali

Institut national de recherche zootechnique, forestière et hydrobiologique
Office malien du bétail et de la viande

Nigeria

Ahmadu Bello University, College of Agriculture and Animal Science; Department of Soil Science
Bauchi State Rural Development Authority
Calabar Polytechnic
Federal Livestock Department
Kaduna State Ministry of Agriculture
Kano Agriculture and Rural Development Authority, Rano
Katsina State Government
Michael Okpara College of Agriculture, Owerri
National Animal Production Research Institute
National Livestock Projects Division
National Veterinary Research Institute
Obafemi Awolowo University
River State University of Science and Technology, Port Harcourt
University of Agriculture, Makurdi
University of Ibadan, Department of Agronomy

Niger

Chef de service, Arrondissement ressources animales, Birni n'Konni
Institut national de recherches agronomiques au Niger

Senegal

Institut sénégalais de recherche agronomique

Sudan

Livestock and Meat Marketing Corporation

Togo

Projets petits ruminants
University of Benin

Zaire

Compagnie J van Lancker
Développement progrès populaire
Institut national d'étude et de recherche agronomique
Laboratoire vétérinaire de Kinshasa

Zimbabwe

Ministry of Lands, Agriculture and Rural Settlement

Outside Africa

Australia

University of Melbourne

Canada

International Development Research Centre
McGill University

Finland

Agricultural Research Centre of Finland

France

Institut d'é1evage et de médecine vétérinaire pays tropicaux

Germany

University of Berlin
University of Bonn, Institute of Animal Nutrition
University of Giessen
University of Hohenheim

Italy

University of Milan

Norway

Agricultural University of Norway

The Netherlands

Agricultural University, Wageningen

United Kingdom

Agricultural and Food Research Council, Institute of Engineering Research
Agricultural and Food Research Council, Institute of Animal Physiology and Genetics Research
Centre for Tropical Veterinary Medicine, University of Edinburgh

Overseas Development Administration
University of Aberdeen
University of Glasgow
University College of North Wales, Bangor
University of Reading

United States of America

Texas A & M University
University of California, Berkeley
University of Louisiana
University of Wisconsin
Utah State University

International organisations

African Development Bank
Centre régional de formation et d'application en agrométéorologie et hydrologie opérationnelle
Centre régional de télédetection Ouagadougou
Centre Internacional de Agricultura Tropical
Centre Intenacional de Mejoramiento de Maiz y Trigo
Comité permanent inter-Etats de lutte contre la sécheresse dans le Sahel
Food and Agriculture Organization of the United Nations
Institut du Sahel
Inter-African Bureau for Animal Resources
International Board for Plant Genetic Resources
International Board for Soil Research and Management
International Centre of Insect Physiology and Ecology
International Council for Research in Agroforestry
International Crops Research Institute for the Semi-Arid Tropics
International Fertilizer Development Center
International Food Policy Research Institute
International Fund for Agricultural Development
International Institute for Applied Systems Analysis
International Institute of Tropical Agriculture
International Laboratory for Research on Animal Diseases
International Trypanotolerance Centre
International Union for the Conservation of Nature and Natural Resources

Staff list, 1990

Professional and supervisory staff

DIRECTOR GENERAL's OFFICE

J Walsh, *Director General*
Antonio Silla, *Internal Auditor*
J Reeves, *Public Awareness Specialist*
R A Stewart, *Assistant to the Director General and Director of the Donor and Board Secretariat***
Tehout Workalemahu, *Executive Secretary*

RESEARCH DEPARTMENT

K J Peters, *Deputy Director General (Research)* **
H Fitzhugh, *Deputy Director General (Research)**
A K Diallo, *Programme Liaison Officer, West Africa*
J A Kategile, *Programme Liaison Officer, East/Southern Africa*
A Tall, *Research Operations Manager*

Animal Science Division

Animal Nutrition and Management

P R N Chigaru, *Animal Production Scientist (Head* of Section)**
C B O'Connor, *Dairy Technologist*
M Moens, *Dairy Technologist (FAO Associate Specialist)*
A N Said, *Animal Nutritionist/ARNAB Co-ordinator*

Animal Production and Management

Belete Dessalegn, *Animal Scientist***
D L Coppock, *Animal Scientist/Ecologist*
W Mwenya, *Animal Breeder (Visiting Scientist)*
S Okantah, *Animal Breeder (Visiting Scientist)***
P Osuji, *Cattle Milk and Meat Thrust Coordinator*
S Sibanda, *Animal Scientist (Post-doctoral Associate)**

Small Ruminant Research Network

R T Wilson, *Animal Scientist/Network Coordinator***
S H B Lebbie, *Animal Scientist (Visiting Scientist)*
B Rey, *Veterinarian/Animal Production Scientist (seconded from the Institut d'élevage et de médecine vétérinaire des pays tropicaux)*

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* *Joined ILCA in 1990.*
** *Left ILCA in 1990.*

Animal Reproduction and Health

O B Kasali, *Veterinarian/Pathologist (Head of Section)*
Azage Tegegne, *Veterinarian (Post-doctoral Associate)*
E G Mukasa-Mugerwa, *Animal Scientist*
Tamrat Yigzaw, *Chief Laboratory Technician*
Tekelye Bekele, *Veterinarian*
P Viviani, *Veterinarian (FAO Associate Expert)*

Plant Science Division

D Thomas, *Forage Agronomist (Head of Division)*
D Siaw, *Agronomist (Post-doctoral Associate)*
S Jutzi, *Forage Agronomist***
A Larbi, *Forage Agronomist (Post-doctoral Associate)*
L Mugwira, *Plant Nutritionist (Visiting Scientist)***

Genetic Resources

J Hanson, *Head of Forage Genetic Resources Section*
M van de Wouw, *Zwai Site Coordinator**

Herbage Seed Unit

R Griffiths, *Seed Production Specialist (Head of Unit)*

Soils and Plant Nutrition

I Haque, *Soil Scientist (Head of Section)*
E A Aduayi, *Soil Scientist (Visiting Scientist)**
N Luyindula, *Soil Microbiologist (Post-doctoral Associate)* **
Tekalegn Tadesse, *Chief Research Assistant*

Livestock Economics Division

S Sandford, *Economist (Head of Division)*
Addis Anteneh, *Economist*
R Brokken, *Economist*
S Ehui, *Economist**
P N Ngategize, *Economist (Post-doctoral Associate*)**
Senait Seyoum, *Chief Research Assistant*

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* *Joined ILCA in 1990.*
** *Left ILCA in 1990.*

Research Support Division

Computer Science and Biometrics

E Bruns, *Manager, Computer Services*
T Metz, *Scientific Programmer*
E W Richardson, *Biometrician***
J Sherington, *Biometrician*

Experiment Station—Debre Birhan

Negussie Akalework, *Station Coordinator/Project Supervisor*

Experiment Station—Debre Zeit

S Crosse, *Animal Scientist (Team Leader)*
R Franceschini, *Veterinarian (Research, Associate)***
H Khalili, *Animal Nutritionist (Associate Scientist)*
S Sovani, *Veterinarian (Research Associate)***
Tadesse Tessema, *Station Coordinator*

Experiment Station—Headquarters

Aklilu Askabe, *Animal Scientist (Farm and Grounds Manager)*

Resource Survey

Assefa Eshete, *Photo Interpreter*
Michel Corra, *Ecologist*
Tassew G/Medhin, *Pilot*

Zonal Research Sites

Highlands—Ethiopia

M A Mohamed-Saleem, *Agronomist (Team Leader)*
Abate Tedla, *Forage Agronomist*
Abiye Astatke, *Agricultural Engineer*
H Airaksinen, *Agronomist (Associate Expert)***
K-D Gautsch, *Animal Scientist***
Getachew Asamenew, *Agricultural Economist*
U Schulthess, *Agronomist (Research Associate)*
K L Srivastava, *Soil and Water Engineer (ICRISAT)**
T Varvikko, *Animal Nutritionist (Associate Scientist)*
E Zerbini, *Animal Scientist (Post-doctoral Associate)*

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* *Joined ILCA in 1990.*
** *Left ILCA in 1990.*

Humid Zone—Nigeria

M A Jabbar, *Agricultural Economist*
T A Mohamed, *Animal Scientist (Post-doctoral Associate)***
E Sabiiti, *Range Ecologist (Post-doctoral Associate)*

Subhumid Zone–Nigeria

R von Kaufmann, *Agricultural Economist (Team Leader)*
E Agishi, Agronomist*
J Agwu, *Reproductive Physiologist (Post-doctoral Associate)*
H Jansen, *Livestock Economist**
P Lawrence, *Animal Traction Network Coordinator**
I Obed, *Animal Scientist**
M Peter, *Head of Administration and Accounts**
G Tarawali, *Forage Agronomist*

Subhumid/Semi-arid Zone–Mali

P Bartholomew, *Forage Agronomist (Team Leader)***
M I Cissé, *Ecologist***
S Debrah, *Economist*
D Diakite, *Administrator*
L Diarra, *Ecologist*
K Fofana, *Chief Accountant*
P Hiernaux, *Ecologist*
S D Maiga, *Veterinarian***
M Mattoni, *Veterinarian***
E A Olaloku, *Cattle Research Network Coordinator*
A Reese, *Animal Scientist*
S Soumare, *Sociologist*
A Traoré, *Veterinarian***

Trypanotolerance/Subhumid Zone—Kenya

J C M Trail, *Animal Geneticist (Team Leader)***
B H Dzowela, *PANESA Coordinator*
G d'Ieteren, *African Trypanotolerant Livestock Network Coordinator*
P Itty, *Agricultural Economist (FAO Associate Specialist)***
P N de Leeuw, *Ecologist*
G Mullins, *Agricultural Economist (Post-doctoral Associate)**
S M Nagda, *Senior Biological Data Analyst*
M Oriaro, *Administrative and Finance officer**
A Ouattara, *Bilingual Assistant to the Network Coordinator*
J M Rarieya, *Biological Data Analyst*
L Reynolds, *Small Ruminant Meat and Milk Thrust Coordinator*
G J Rowlands, *Animal Production Scientist*
W Thorpe, *Animal Scientist*

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* *Joined ILCA in 1990.*
** *Left ILCA in 1990.*

Semi-arid Zone—The Gambia

K Agyemang, *Animal Production Scientist*
D Little, *Animal Nutritionist*

Semi-arid Zone—Niger

J M Powell, *Agro-ecologist (Team Leader)*
D Roxas, *Animal Scientist***
T O Williams, *Livestock Economist*

Network Sites

Network site- Trypanotolerance, Ethiopia

Woudyalew Mulatu, *Veterinarian*

GOVERNMENT RELATIONS IN AFRICA

M Sall, *Director of Government Relations in Africa*

TRAINING AND INFORMATION DEPARTMENT

M E Smalley, *Director of Training and Information*

Training

L Padolina, *Head, Training Programmes Unit*
B R Tripathi, *Head, Training Materials and Methods Unit*
Werqu Mekasha, *Training and Conference Officer*

Information

L J Haravu, *Head of Information**
S Adoutan, *Translator/Editor*
I Alipui, Assist*ant Editor*
Azeb Abraham, *Librarian*
Manyahlshal Kebede, *Production Manageress***
Marcos Sahlu, *Supervisor, Documentation*
P J H Neate, *Science Writer*
D Niang, *Revisor/Editor*
J Stares, *English Editor/Writer*
C De Stoop, *Assistant Translator*

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* *Joined ILCA in 1990.*
** *Left ILCA in 1990.*

GENERAL SERVICES

W Michel, *Head of General Services*
Alemayehu W/Giorgis, *Travel Officer*
G Daniels, *Manager, Housing and Catering**
Ephraim Bekele, *Liaison Service Officer*
F Leone, *Physical Plant Manager*
P Monaia, *Supervisor, Maintenance*
Sahle Kebede, *Catering Officer*
Tafesse Akale, *Protocol Officer*
Tekeste B Habtu, *Procurement Officer*
Tesfaye Mekoya, *Chief Safety Officer*
J A Thersby, *Warden***

PERSONNEL DIVISION

B K Johri, *Personnel Manager*
Ahmed Osman, *Assistant Personnel Officer*
A Conti, *Personnel Officer***

FINANCE

M Klass, *Financial Controller*
Belayhoun Wondimu, *Chief Accountant*
Emmanuel Tesfa Mariam, *Budget Officer*
Kiros Tsegaye, *Supervisor, Disbursement and Collection*
Negussie Abraham, *Supervisor, General Accounts*

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* *Joined ILCA in 1990.*
** *Left ILCA in 1990.*

Post-doctoral and Graduate Associates at ILCA in 1990

Post-doctoral Associates

Start	End	Name/ nationality	Project title	Thrust*/ country
1988	1990	Jane O Agwu, Nigerian	Reproductive performance of the Bunaji cattle	C/Nigeria
1988	1990	Peter Ngategize, Ugandan	Analysis of small ruminants (sheep and goats) in a farming systems context	LPRU/Ethiopia
1989	1991	Azage Tegegne, Ethiopian	Comparative reproductive physiology in zebu crossbred cattle, and embryo transfer experimentation	C/Ethiopia
1989	1991	Asamoah Larbi, Ghanaian	Initial forage evaluation and feeding management	AFR/Ethiopia
1989	1991	Ercole Zerbini, Italian	Effect of work on milk production and reproduction in crossbred dairy cows	AT/Ethiopia
1989	1991	Daniel Siaw, Nigerian	Evaluation of *Sesbania* spp accessions at Debre Zeit	AFR/Ethiopia
1989	1990	Tag EJ Sir Ahmed Mohamed, Sudanese	Study of peri-urban cattle agropastoralism in the derived savannah of Oyo State, south-west Nigeria	C/Nigeria
1989	1991	Elly N Sabiiti, Ugandan	Alley farming in the humid zone of Nigeria	AFR/Nigeria
1989	1990	Ndiku Luyindula, Zairian	Rhizobium studies on forage tree legumes	AFR/Ethiopia
1990	1991	Gary Mullins, American	Study of the economics of cattle milk and dairy products consumption and marketing, and small ruminant production and marketing survey, both in the coastal subhumid farming systems of Kenya	C/SR/ Kenya
1990	1991	S Sibanda, Zimbabwean	Feeding and management of crossbred dairy calves and of sheep	C/SR/ Ethiopia

* C Cattle Milk and Meat; SR = Small Ruminant and Milk; AT = Animal Traction; AFR = Animal Feed Resources; LPRU = Livestock Policy and Resource Use.

Graduate Associates

Start	End	Name/ nationality	University/ institute	Degree	Project title	Thrust*/ country
1986	1991	Yemi Akinbamijo, Nigerian	Agricultural University, Wageningen	PhD	Studies on aspects of trypanosomiasis and West African dwarf sheep production	SR/Nigeria
1987	1990	Zere Ezaz, Ethiopian	University College of North Wales	PhD	Effect of dietary supplementation and strategic endoparasite control on the performance of Menz ewes and lambs	SR/Ethiopia
1987	1990	Aboubacer Maiga, Malian	University of Rennes	PhD	The ecology of rangelands in the Gourma region of Mali	LPRU/Mali
1988	1990	Michael Peters, German	Justus Liebig University	PhD	Evaluation of the performance of selected promising legumes in competition with the natural vegetation and under different early season management procedures	AFR/ Nigeria
1988	1990	Ulrich Rittner, German	University of Hohenheim	PhD	*Acacia albida* as a protein supplement for sheep	SR/Ethiopia
1988	1991	Norbert Steinmuller, German	University of Hohenheim	PhD	Genetic resources and management of *Sesbania sesban and S. goetzei* in the semi- and mid-altitude zone and semi-humid high-altitude zone of Ethiopia	AFR/ Ethiopia
1988	1991	Susan Hoefs, German	University of Göttingen	PhD	Evaluation of feed resources available in the Sahel through intake, digestion and metabolism trials	SR/Niger
1988	1991	Ikechukwu Ezenwa, Nigerian	University of lbadan	PhD	Strategic management of tree-based pastures for dry-season fodder production in southern Nigeria	AFR/ Nigeria
1988	1990	Anthony Omoregie, Nigerian	University of Ibadan	PhD	The effects of phosphorus on yield and quality of *S. hamata and C. pascuorum* in major soil types of the Nigerian subhumid zone	AFR/ Nigeria
1988	1991	Boubacar Hassane, Nigerien	Utah State University	PhD	Economics of cattle production/multi-Vocational testing of fodder banks	C/Nigeria
1988	1990	Ali Aboud, Tanzanian	University of Reading	PhD	Sorghum stover for small ruminants	SR/Ethiopia
1988	1991	Kezie Buyebinam, Togolese	University of Göttingen	PhD	Prospects for improved small ruminant production in farming systems of the humid zone in Togo	SR/Nigeria
1989	1990	Darius Campbell, British	University of Reading	PhD	Mineral supplementation of Bunaji cattle	C/Nigeria

* C = Cattle Milk and Meat; SR = Small Ruminant Meat and Milk; AT = Animal Traction; AFR = Animal Feed Resources; LPRU. = Livestock Policy and Resource Use.

GraduateAssociates (cont'd)

Start	End	Name/ nationality	University/ institute	Degree	Project title	Thrust*/ country
1989	1991	A S Tening, Cameroonian	University of Ibadan	PhD	Potassium requirements of grass/legume mixtures in the soils of the subhumid zone of Nigeria	AFR/ Nigeria
1989	1990	Michael Vabi, Cameroonian	University of lbadan	PhD	An analysis of social relations between indigenous cultivators and Fulani graziers in selected derived savannah regions of Nigeria and Cameroon	C/Nigeria
1989	1990	Akmal El-Kholy, Egyptian	University of London	PhD	Cytogenetics and interspecific hybridis-ation of African clovers	AFR/ Ethiopia
1989	1990	Getaneh Hailu, Ethiopian	University of New South Wales	MSc	A comparison of liveweight gain of local zebu oxen fed a straw-based diet or supplemented cereal byproducts against supplementation with urea/molasses	C/Ethiopia
1989	1991	Solomon Mogus, Ethiopian	Institut fiir Tierernahrung	PhD	Effect of processing oilseed cakes on their nutritive value: *in vitro* N-degradability and nitrogen metabolism in growing sheep fed a basal diet of maize stover	C/Ethiopia
1989	1991	Gashaw Geda, Ethiopian	Alemaya University of Agriculture	MSc	Assessment of the feed resource base and performance of crossbred dairy cows distributed to smallholders in the Selale development project	C/Ethiopia
1989	1990	Lulseged Gebre Hiwot, Ethiopian	University of Missouri-Columbia	PhD	The productivity of selected tropical and temperate grass species interseeded with selected annual legumes during the year of establishment	AFR/ Ethiopia
1989	1991	Christophe N Kouame, Ivoirien	University of Florida	PhD	Introduction of forage legumes in Sahelian cropping systems	SR/Niger
1989	1991	Seiffuddin H Maloo, Kenyan	University of Glasgow	PhD	Vector-borne diseases and preventive medicine programmes in smallholder dairy cattle in coastal Kenya	C/Kenya
1989	1991	Rahab Muinga, Kenyan	University of Aberdeen	PhD	Dairy cow nutrition for smallholder dairy production systems in coastal subhumid Kenya	C/Kenya

C = Cattle Milk and Meat; SR = Small Ruminant Meat and Milk; AT = Animal Traction; AFR = Animal Feed Resources; LPRU = Livestock Policy and Resource Use.

Graduate Associates (cont'd)

Start	End	Name/ nationality	University/ institute	Degree	Project title	Thrust*/ country
1989	1991	Joseph G Mureithi, Kenyan	University of Reading	PhD	Agronomy of forages and crops for smallholder dairy production systems in coastal subhumid Kenya	C/Kenya
1989	1990	Ahmed Mohamed Hassan, Somali	University of Hohenheim	PhD Small	ruminant production analysis	SR/ Somalia
1989	1991	Abdi Adam Jama, Somali	Texas A & M University	PhD	Evaluation of forage legume genetic resources for the subhumid zone of West Africa	AFR/ Nigeria
1990	1991	Otto Wiegand, American	University of Wisconsin	PhD	Microbial metabolism of protein from MPTs in the rumen	SR/ Ethiopia
1990	1990	Peter Achuonjei, Cameroonian	University of Illinois	PhD	Dairy marketing research	LPRU/Mali
1990	1990	Lili Beka, Ethiopian	Ecole nationals vétérinaire d'Alfort	PhD	Survey of sheep production systems in the Debre Birhan region of Ethiopia	SR/ Ethiopia
1990	1991	Bekele Shiferaw, Ethiopian	Agricultural University of Norway	MSc	Assessment of land-use conflicts for livestock production/contributions of crop-livestock integration for sustainability of agriculture in the Ethiopian highlands	LPRU/ Ethiopia
1990	1991	Daniel Dauro, Ethiopian	University of Montpellier	PhD	Competition and regeneration patterns of selected Trifoliums under natural pasture and intercropped situations in the Ethiopian highlands	AFR/ Ethiopia
1990	1991	Kidane Gebre Meskel, Ethiopian	Alemaya University of Agriculture	MSc	Harvesting native hay for optimum quality and quantity in the central Ethiopian highlands	C/Ethiopia
1990	1991	Yohannes Kebede, Ethiopian	McGill University	PhD	Crossbred dairy technology in Selale	LPRU/ Ethiopia
1990	1993	Stefan Kachelriess, German	Justus Liebig University	PhD	Management practices for seed multiplication of selected forage legumes in northern Nigeria	AFR/ Nigeria

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Graduate Associates (cont'd)

Start	End	Name/ nationality	University/ institute	Degree	Project title	Thrust*/ country
1990	1991	Emmanuel Osafo, Ghanaian	University of Reading	PhD	Improving the use of sorghum stover as ruminant feed in Ethiopia	SR/Ethiopia
1990	1990	Claudio Mancini, Italian	CESAR	MSc	Economic evaluation of the inland-valleys agronomic system	AT/Nigeria
1990	1990	Fabio Italian	CESAR	MSc	Smallholder dairy marketing in the	C/Ethiopia
1990	1990	Edoardo Gherzi, Italian	CESAR	MSc	Role of livestock in stabilising and sustaining farming systems in The semi-arid zone	LPRU/ Nigeria
1990	1991	Oluwatoyin Oshitoye,	University of Ibadan	MSc	Establishment success of different forages under oil palm	AFR/ Nigeria
1990	1991	Felix N Ikpe, Nigerian	Rivers State University of Science Technology	PhD	Manure management for cropping	LPRU/ Niger
1990	1991	Calvin Antonza II, Nigerian	Ahmadu Bello University	PhD	Social and economic constraints to the introduction of animal traction	AT/Nigeria

* C = Cattle Milk and Meat; SR = Small Ruminant Meat and Milk; AT = Animal Traction; AFR = Animal Feed Resources; LPRU = Livestock Policy and Resource Use.

Publications by ILCA staff in 1990/91

Annual Reports

ILCA Annual Report 1989
CIPEA Rapport Annuel 1989

Research reports

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Financial Summary

INTERNATIONAL LIVESTOCK CENTRE FOR AFRICA
BALANCE SHEET at 31 December 1990
(US$ '000)

ASSETS

Current assets	**1990**	**1989**
Cash	8 906	6373
Receivable from - donors	1 185	3 008
- employees	120	88
- others	1 898	1 140
Inventories	1 460	1 148
Deposits and prepayments	201	191
Construction work in progress	63	57
Total current assets	13 833	12 005
Fixed assets		
Buildings	11 109	10 407
Research and laboratory equipment	3 923	3 563
Computer	2 195	1 612
Furnishings and office equipment	3 097	2 745
Vehicles and aircraft	3 310	3 438
Other	3	81
Total fixed assets	23 637	21 846
Total assets	37 470	33 85

LIABILITIES AND FUND BALANCES

Current liabilities		
Accounts payable employees	$ 372	$ 317
Other payables and accruals	5 750	5 023
Contributions received in advance	1 449	1 117
Total current liabilities	7 571	6 457
Fund balances		
Invested in fixed assets - Core	22 713	21 056
- Special projects	924	790
Working capital	4 561	4 212
Capital development fund	1 701	1 336
Total fund balances	29 899	27 394
Total liabilities and fund balances	37 470	33 85l

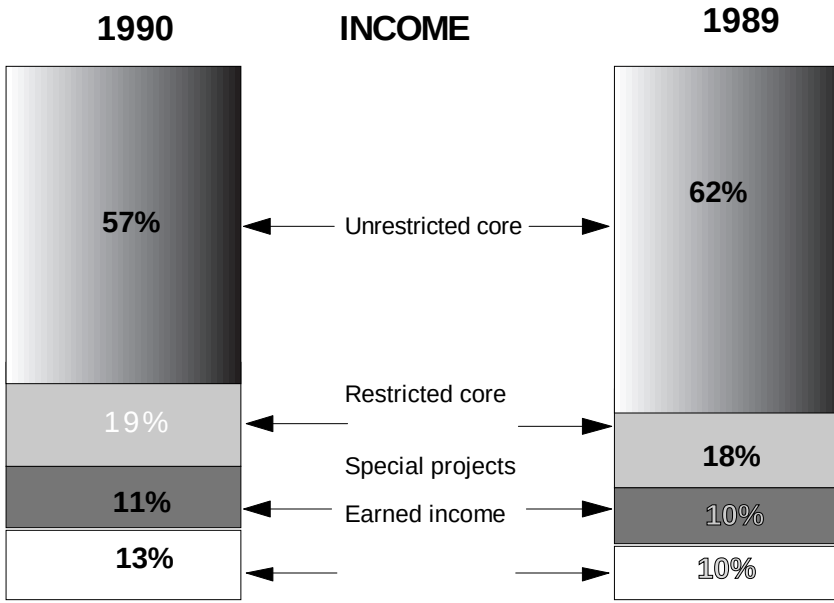
INTERNATIONAL LIVESTOCK CENTRE FOR AFRICA
STATEMENT OF REVENUE, EXPENDITURE
AND FUND BALANCES
for the year ended 31 December 1990
(US$ '000)

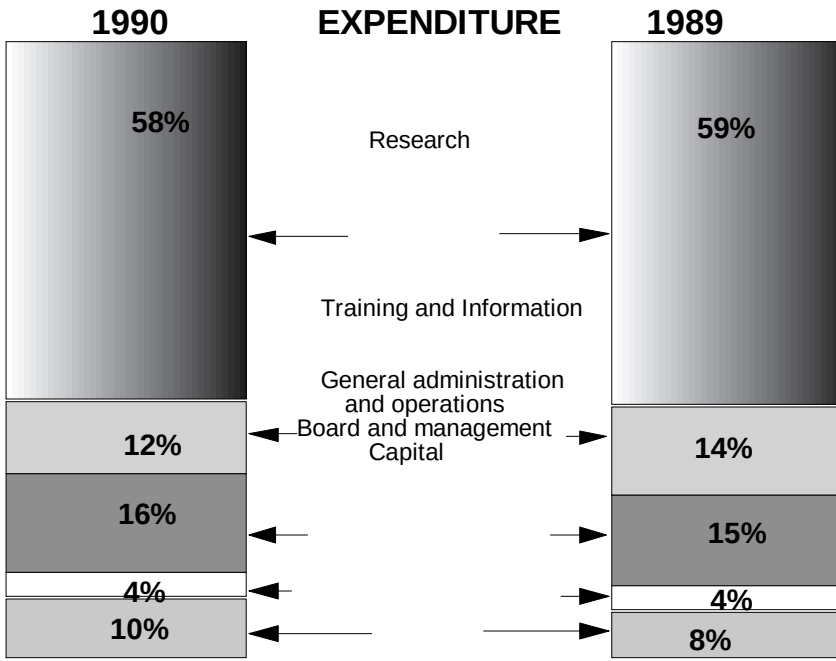
Revenue	**1990**	**1989**
Core contributions	18 142	18 294
Special project grants	2 762	2 315
Earned income	2 768	2 090
Capital development fund	365	376
Total revenue	24 007	23 075
Operating expenditure		
Research	13 534	12 534
Information services	1 224	1 183
Training and conferences	1 479	1 699
General administration and operations	3 795	3 219
Board and management	1 005	786
Total operating expenditure	21 037	19 421
Capital expenditure	2 256	1 778
Total expenditure	23 293	21 199
Excess of revenue over expenditure	714	1 876
FUND BALANCES		
Opening balances		
Working capital	4 212	2 489
Capital development fund	1 336	1 183
Total opening balances	5 548	3 672
Excess of revenue over expenditure	714	1 876
Closing balances		
Working capital	4 561	4 212
Capital development fund	1 701	1 336
Total closing balances	6 262	5 548

INTERNATIONAL LIVESTOCK CENTRE FOR AFRICA
STATEMENT OF GRANT REVENUE
for the year ended 31 December 1990
(US$ '000)

Core	**1990**	**1989**
African Development Bank (ADB)	250	200
Australia	119	-
Austria	175	175
Belgium	831	663
Canada	958	881
Denmark	492	398
Finland	927	1 184
France	374	328
Germany	1 126	1 034
India	24	24
International Development Research Centre (IDRC)	178	200
International Fund for Agricultural Development (IFAD)	153	-
Ireland	311	275
Italy	671	1 509
Japan	416	275
Nigeria	19	-
Norway	622	515
Organization of Petroleum Exporting Countries (OPEC)	-	60
Sweden	384	272
Switzerland	2 033	1 597
The Netherlands	408	384
United Kingdom	486	515
United States of America	2 885	3 000
World Bank	4 300	4 065
Stabilization Fund	-	760
Total core contributions	18 142	18 294
Special project and cooperative		
Agence de coopération culturelle et technique	-	7
Australia	34	108
Australia Centre for International Agricultural Research	-	10
ADB	33	-
European Economic Community	1 504	642
Finland	376	418
Ford Foundation	12	7
Germany	433	617
International Board for Plant Genetic Resources	-	28
IDRC	220	95
IFAD	-	179
Ireland	-	4
Norway	150	200
Total special project and cooperative	2 762	2 315
Total grants	20 904	20 609

Source and application of funds, 1990 and 1989





Research expenditure by thrust