ILCA's Strategy for Improving the Output of Livestock in Sub-Saharan Africa Based on Six Research Thrusts

Shozo Watanabe*

Abstract

The International Livestock Centre for Africa (ILCA), established in 1974, is an autonomous, non-profit research, training and information centre with a mandate to improve livestock production throughout sub-Saharan Africa. ILCA's headquarters are located in Addis Ababa, Ethiopia and ILCA operates research sites in four ecological zones, humid (Nigeria), sub-humid (Kenya, Mali and Nigeria), semi-arid (Niger) and highlands (Ethiopia). ILCA's research activities concentrate on the three most important ruminant species in Africa - cattle, sheep and goats along the lines of the five-year plan 1989-93. The research is organised into six main areas or thrusts: Cattle Milk and Meat, Small Ruminant Meat and Milk, Animal Traction, Animal Feed Resources, Trypanotolerance and Livestock Policy and Resource Use. The first three are 'commodity' thrusts; they seek to increase sustainable output of the three most important livestock products, meat, milk and traction. The others are 'strategic' thrusts; the information and technology they generate feed into the commodity thrusts. Within these thrusts, ILCA scientists work in multi-disciplinary teams in collaboration with colleagues in African national programs through networks dedicated to specific research areas. The most successful research achievements have already started to make an impact on smallholder production systems.

Introduction

Africa's escalating demand for food will result in added pressure on natural resources that are already threatened. There is thus an urgent need for technological innovations that raise the productivity of both livestock and crops without causing further environmental degradation.

The International Livestock Centre for Africa (ILCA), established in 1974, is an autonomous, non-profit research, training and information centre with a mandate to improve livestock production throughout sub-Saharan Africa. The activities and publications of the Centre are financed by the Consultative Group on International Agricultural Research (CGIAR). ILCA's headquarters are located in Addis Ababa, Ethiopia and ILCA operates research sites in four ecological zones, humid (Nigeria), sub-humid (Kenya, Mali, and Nigeria), semi-arid (Niger) and highlands (Ethiopia).

Through twelve years of research experience in sub-Saharan Africa and recommendations of EPR/EMR by TAC, CGIAR in 1986, ILCA sharpened the focus of its program (ILCA, 1987) and worked out the medium-term plan (ILCA, 1988b). The purpose of this paper is to present ILCA's strategy of choice, six research thrusts and highlights of the research achievements since the adoption of the present strategy (ILCA, 1987, 1988b, 1989a, 1990b).

* Faculty of Agriculture, Kagoshima University, Kagoshima, 890 Japan.

Strategy of choice

1 Mandate

ILCA's formal mandate is to assist national efforts which aim to effect a change in the production and marketing systems of tropical Africa so as to increase the sustained yield and output of livestock products and improve the quality of life of the people of this region (ILCA, 1987, 1988b).

2 Operational goals

ILCA's ultimate goal is to fulfill the Centre's formal mandate. However, as the wording of the mandate indicates, ILCA is not to pursue this goal by its own efforts alone, having been established specifically to assist national efforts. ILCA has defined a number of intermediate goals in those areas which the Centre can be expected to influence directly (ILCA, 1987, 1988b).

3 Fundamental choices

Recognizing that a centre of ILCA's size and financial resources cannot simultaneously address all the livestock problems of sub-Saharan Africa, it has elected to concentrate in the medium term on the three most numerous domestic ruminant species found in Africa - cattle, sheep and goats; to work predominantly with smallholders as the major target group; to focus on the high potential semi-arid, sub-humid, humid and highland zones; and to restrict its work to the four major livestock commodities/functions - meat, milk, traction and manure (ILCA, 1987, 1988b).

4 Research program

ILCA's research program for the 1989-93 period (ILCA, 1988b) follows the work plan outlined in ILCA's Strategy and Long-term Plan (ILCA, 1987). In the medium term, ILCA's research resources will be channelled towards solving problems in six major areas or thrusts: 1. Cattle milk and meat, 2. Small ruminant meat and milk, 3. Animal traction, 4. Animal feed resources, 5. Trypanotolerance, 6. Livestock policy and resource use.

The first three thrusts are aimed at increasing the output of milk, meat and traction in sub-Saharan Africa. For each of these commodity thrusts ILCA envisages a span of at least ten years, with a major review after the initial five years. The second three thrusts are strategic, their purpose being to support the commodity thrusts by providing inputs of information and/or technology. The research carried out under these thrusts may change in nature over the medium term as results of the currently planned work are gradually transferred to the commodity thrusts.

5 Mode of operation

Each thrust is both multi-disciplinary, involving a mix of disciplines drawn from ILCA's existing administrative units, and multi-locational or decentralized, involving work at several field sites representing different zones and regions of the mandate area.

To make the work of ILCA's research team as effective as possible, much of its research will be done collaboratively with NARSs, using in most cases a network approach. In the meantime ILCA has collaborative research arrangements with a number of sister organizations within the CGIAR system.

To test new technologies developed on farm as well as on-station, ILCA uses a farming systems approach in its research since the farmer's viewpoint is central to the research process (ILCA, 1988b).

Research thrusts and highlights of the achievements

1 Cattle milk and meat thrust

The basic goal of this thrust is to increase the sustainable output of milk and meat from cattle in the mixed crop-livestock smallholder production systems of sub-Saharan Africa. The thrust's research program focuses on these production systems because they appear to offer best opportunities for increasing the milk and meat output, and hence food production as a whole, in the foreseeable future.

This is largely due to the mutually beneficial interaction between crop and livestock production in these systems. Draught power and manure from cattle are important inputs in crop production, while crop by-products and residues provide feed for cattle. This is particularly true in the highlands of East Africa and in most sub-humid areas. In the humid zone of West and central Africa, diseases, especially trypanosomiasis and dermatophilosis, are major constraints on cattle production. However, if they can be controlled the potential for milk and meat production in this zone is vast.

This thrust consists of six research themes; 1) Reproductive wastage (9), 2) Feeding and management systems (17), 3) Milk processing (1), 4) Economy of cattle production (8), 5) Breed evaluation and improvement (4), 6) Network coordination (1). The figures in parentheses indicate the number of project protocols within the theme in 1991 (ILCA, 1991b).

The results of this thrust are generally of operational nature. The highlights of the research achievements include the elucidation of the meaning of early supplementation for

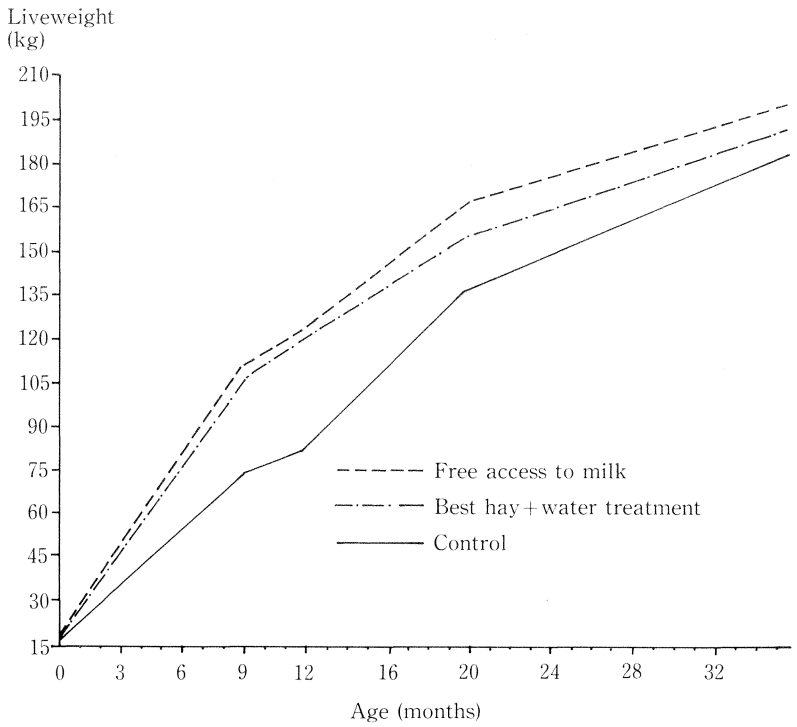

Fig. 1 Growth to three years for cattle on semi-arid rangeland in southern Ethiopia following various pre-weaning treatments from two to nine months of age.

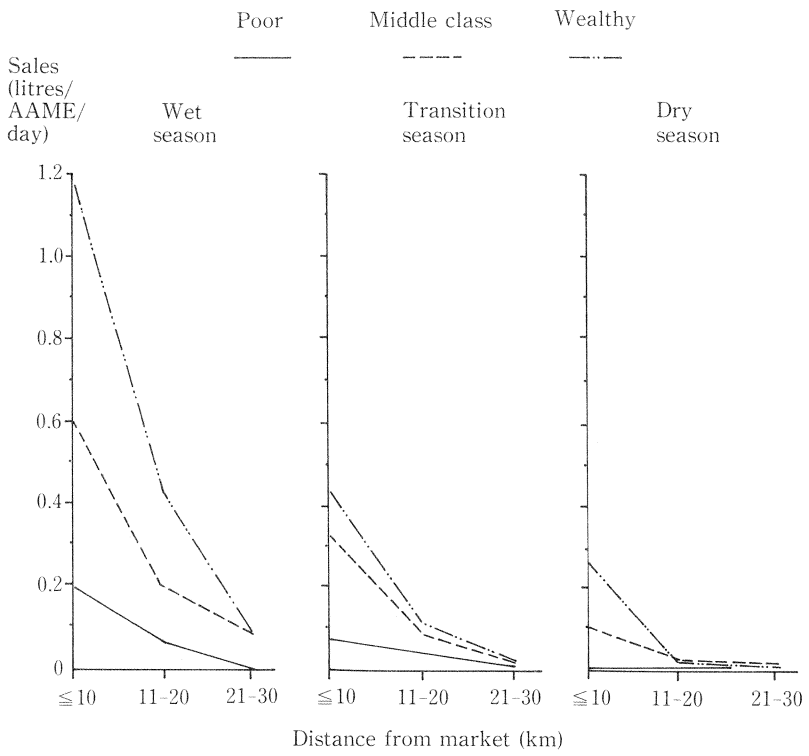

Fig. 2 Reported dairy sales (litres of milk equivalents on an energy-content basis) per reference individual (adult African male equivalent-AAME) per day for pastoral households of varied wealth, at various distances from market and in different seasons, southern Ethiopia, 1987.

Table 1 Least squares means and standard errors for reproductive and lactation traits of five cattle genotypes in three breeding systems, coastal Kenya

Breeding system/ genotypes	Age at first calving (days)			Calving interval (days)			Lactation length (days)			Daily milk yield (kg)		Lactation yield (kg)	
	n	Mean	SE	n	Mean	SE	n	Mean	SE	Mean	SE	Mean	SE
Purebreeding													
>87.5% Sahiwal	75	1,106	16	121	405	7	203	264	6	4.3	0.13	1,135	44
F_1crossbreeding													
Ayrshire×Sahiwal	57	979	19	122	404	7	184	273	6	5.5	0.14	1,504	48
Friesian×Sahiwal	34	967	24	60	397	10	95	284	9	5.5	0.20	1,533	66
Rotational crossbreeding													
2/3 Sahiwal-1/3 Ayrshire	78	1,042	15	130	396	7	224	272	6	4.5	0.13	1,228	44
2/3 Ayrshire-1/3 Sahiwal	62	1,005	18	112	424	7	174	291	7	5.6	0.15	1,609	58

calves not for early maturity but for reduction of calf mortality; reproductive characteristics and performance, and application of biotechnology in zebu and crossbred cattle; effects of forage, water, labour and marketing interventions on human welfare and cattle management in semi-arid Ethiopia; effect of supplementing grass with multi-purpose trees; peri-urban dairy and meat production; improvement of technology for local dairy products; trend of consumption of and demand for dairy products; influence of economic factors on technology development; multi-locational testing of fodder banks; assistance to NARSs in evaluation of cattle breeding programs; re-evaluation of local cattle in relation to nutrition and milk production; evaluation of comparative health and performance of dairy cattle genotypes for smallholder production, etc. (ILCA, 1987, 1988a, 1989b, 1990a, 1991a). Figure 1 shows the effects of pre-weaning treatments on the growth of cattle in semi-arid Ethiopia. Figure 2 indicates dairy sales per day for pastoral households of varied wealth in southern Ethiopia. Table 1 shows reproductive and lactation traits of five cattle genotypes in coastal Kenya.

2 Small ruminant meat and milk thrust

The objective of this thrust is, to increase the sustained output of small ruminant meat and milk in mixed crop-livestock farming systems, thereby improving the quality of life of

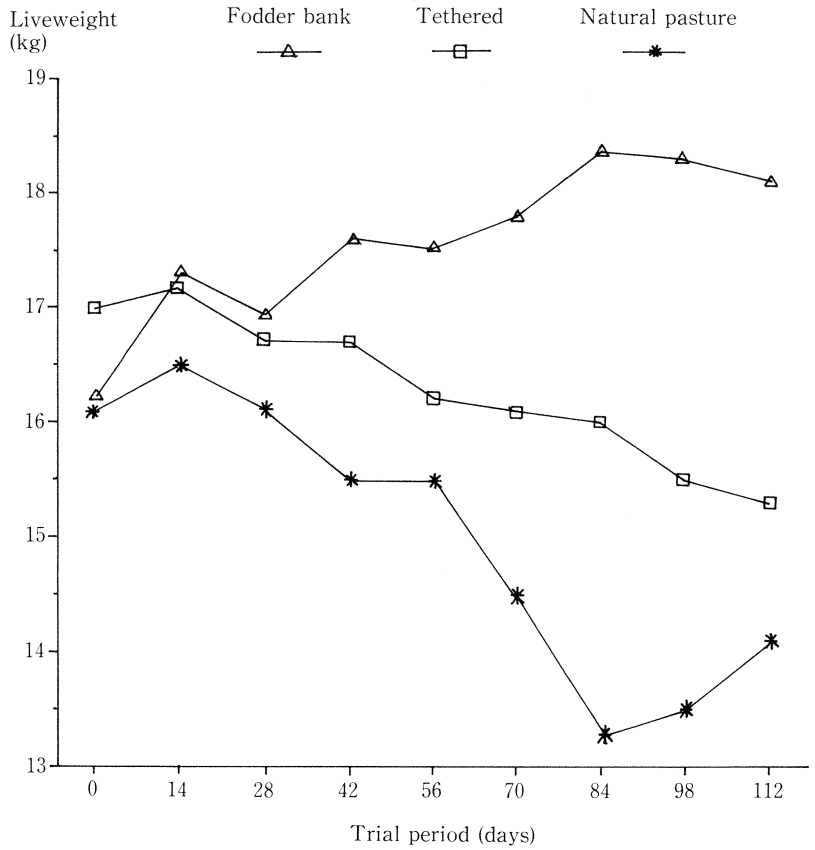

Fig. 3 Effects of tethering on natural pasture and grazing on natural pasture and fodder banks on weight changes in adult goats, Abet, Nigerian sub-humid zone, 1988.

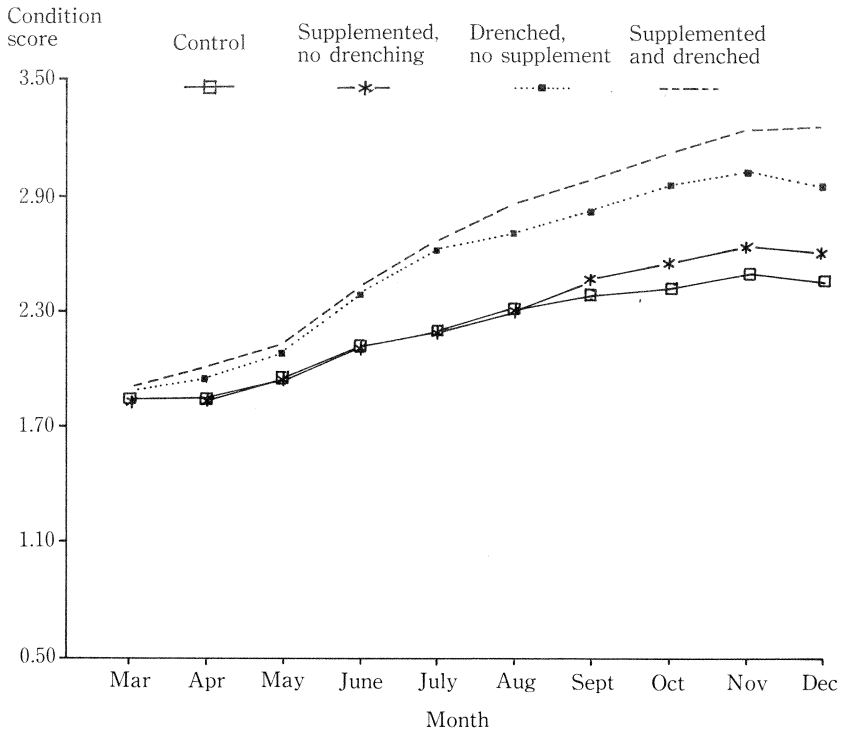

Fig. 4 Effect of dietary supplementation and endoparasite control on condition score of Menz-type ewes, Debre Birhan, Ethiopian highlands, 1988.

the people of sub-Saharan Africa. Sheep and goats, with their small body size, high reproductive capacity and rapid growth rate are ideally suited to production by resource-poor smallholders. They can be integrated into the overall production system, absorbing surplus labour and consuming a small amount of otherwise unused feed. The low capital requirement for starting or expanding small ruminant production means that risks are low and that the enterprise is well suited to low-input systems.

Small ruminants provide almost 30% of the meat consumed and around 16% of the milk produced in sub-Saharan Africa. Increased production will boost farm income, generating cash with which to purchase inputs for other production activities.

The thrust consists of six research themes; 1) Economics of small ruminant production (5), 2) Breed evaluation and improvement (4), 3) Forage and feeding systems (12), 4) Reproductive wastage (4), 5) Management systems (4), 6) Network coordination (1).

The highlights of the research achievements include market demand study; analysis of interventions in nutrition, reproduction, health and management; socio-economic analysis of alley farming with small ruminants; characterization and evaluation of African small ruminant breeds in collaboration with NARSs; sheep fattening systems in African highlands; development of feeding systems for small ruminants in the Sahel; evaluation of multi-purpose trees in alley farm production; effects of dietary supplementation and endoparasite control on the reproductive performance of Menz sheep; effect of trypanosomiasis on nutrient utilization during pregnancy and lactation in West African Dwarf sheep; prospects for improving small ruminant production in farming systems of humid and sub-humid zones, etc. Microbial

metabolism of protein in the rumen with protein source from multi-purpose trees is under study. Figure 3 shows the effects of the quality of pasture on the weight changes in adult goats in the Nigerian sub-humid zone. Figure 4 indicates the effect of dietary supplementation and endoparasite control on condition score of Menz-type ewes in Ethiopian highlands.

3 Animal traction thrust

Only 10-15% of Africa's farmers are considered to use animal traction at present. Most draught animals are found in the semi-arid and highland zones, where they are used primarily for ploughing and threshing, but perform few additional tasks on the farm. The outcome of past investments in animal traction has often been disappointing because crucial inputs have been lacking, technologies have been inefficient and animals have been inadequately fed. In the highland and semi-arid zones ILCA needs to intensify and diversify the uses of draught animals while increasing the quantity and quality of their feed. In the sub-humid zone ILCA needs to examine the constraints on the adoption of animal traction, and to seek to overcome them by introducing packages that combine all the necessary inputs. In both cases the main aim will be to provide low-cost technology that enhances both the profitability and the sustainability of agriculture.

This thrust consists of six research themes; 1) Intensified/diversified use (5), 2) Introduction of traction (2), 3) Feeding strategies (1), 4) Alternative uses (3), 5) Nutrients in manure (0), 6) Network coordination (1).

The highlight of the research achievements is the Vertisol Management Project in Ethiopian highlands. The project involving the development of animal-drawn implements, landshaping for water and soil management, cropping systems on drained Vertisols and the performance of traction animals, is now coming to the final stage. On-farm technology verification demonstrated the large benefits from using the improved practices developed in the project. Figure 5 shows a broadbed maker developed in the project and Table 2 indicates the increase of crop yields by the improved practices.

4 Animal feed resources thrust

Except in the humid zone, feed shortages during the dry and sometimes even the rainy season constrain animal output in almost every production system of sub-Saharan Africa.

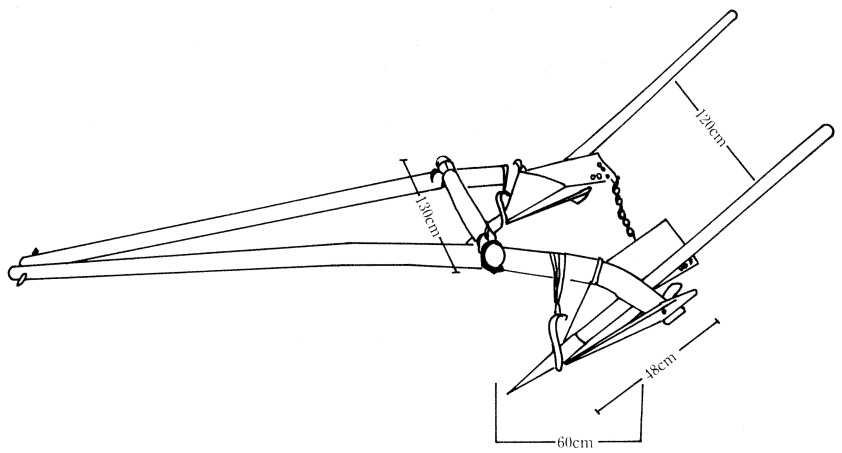

Fig. 5 Diagram of the 1987 broadbed maker. No permanent modifications are made to the two mareshas used.

Table 2 Grain and straw yields, gross revenue and gross margins from wheat grown on broadbeds and on traditionally managed plots at Debre Zeit, Dejen, and Inewari, Ethiopia, 1989

	Debre Zeit		Dejen		Inewari	
	Broadbed	Trad[Z]	Broadbed	Trad[Z]	Broadbed	Trad[Y]
Grain yield						
kg/ha	1,353	1,029	1,281	892	1,274	1,347
CV (%)	10	20	20	33	59	69
Sig. level	P<0.01		P<0.001		P=0.72	
LSD (5%)	162		172		403	
Straw yield						
kg/ha	3,335	2,628	2,235	1,761	2,820	2,554
CV (%)	8	24	15	24	49	55
Sig. level	P<0.01		P<0.001		P=0.43	
LSD (5%)	447		240		665	
Gross revenue						
EB/ha	1,083	830	737	516	994	1,071
CV (%)	8	18	20	32	56	67
LSD (5%)	114		97		292	
Gross margin						
EB/ha	904	652	542	321	799	822
CV (%)	10	23	27	51	70	82
LSD (5%)	114		97		292	

Note : Means of 10 plots at Debre Zeit, 21 plots at Dejen and 35 plots at Inewari.
[Z] Flat seedbed.
[Y] Hand-made broadbeds.
US$1=EB2.07

Even where feed is plentiful it may be low in nutritive value, may form an unbalanced diet lacking critical elements, or may be inefficiently converted into protein and energy within the animal. This thrust seeks to alleviate these constraints by providing feed resource packages to NARSs and ILCA/NARS commodity research programs. These packages combine forage legumes, fodder trees and agro-industrial by-products with existing feed resources. The thrust carries out research to identify the best feed combinations for given species and classes of stock, and to measure their benefits in terms of increased output from the whole system.

This thrust involves five research themes; 1) Service and resource assessment (7), 2) Feed resources evaluation (5), 3) Multi-purpose trees (5), 4) Legumes in mixed farming systems (2), Network coordination (1).

ILCA's forage germplasm collection grew to more than 10,000 accessions of grass, legume and browse species. The provision of germplasm from the genebank has been served on request. The highlights of the research achievements, indude the evaluation of forage legume genetic resources and accessions of multi-purpose trees; merit of multi-purpose trees in alley farming and intensive feed gardens with crop-livestock systems; soil fertility and rhizobium; fodder banks in Nigeria, etc. Table 3 indicates the evaluation of yields of forage accessions in Southwest Nigeria. Remarkable increase of fodder offtake and crop yields in alley farming was demonstrated. The major multi-purpose trees for up to mid-altitude are *Leucaena leucocephala, Gliricidia sepium, Sesbania sesban, Acacia albida, A. seyal, A. tortilis* and *Erithrina spp.*, and for high altitude *Chamaecytisus palmensis*.

Table 3 Yields of forage legume accessions following three months regrowth[z], Ibadan and Fashola, south-west Nigeria, 1989

Species/cultivar	ILCA accession no.	Dry-matter yield (kg/ha)	
		Ibadan	Fashola
Centrosema macrocarpum	12,146	5,350	5,005
Pueraria phaseoloides	156	4,780	4,069
Stylosanthes scabra cv Seca	140	4,400	2,877
Desmodium tortuosum	174	3,626	495
Centrosema arenarium	12,451	3,000	2,138
Stylosanthes hamata cv Verano	75	2,975	2,533
Calopogonium caeruleum	272	2,800	Died
Desmanthus virgatus	312	2,350	2,125
Stylosanthes viscosa	6,860	2,300	6,558
Centrosema pubescens	219	2,175	2,755
Stylosanthes guianensis cv Graham	73	2,100	2,879
Desmodium cinereum	448	1,960	3,264
Centrosema sp.	153	1,775	Died
Desmodium ovalifolium	10,870	1,460	Died
Stylosanthes scabra cv Fitzroy	441	1,148	3,563
Desmodium sandwicense	6,990	1,032	Died
Centrosema sp.	12,184	650	1,106
Macroptilium atropurpureum	69	600	1,343
Cassia rotundifolia	10,789	600	2,835
Centrosema sp.	12,182	483	593
Stylosanthes guianensis cv Cook	4	333	Died
Desmodium distortum	7,263	96	1,909
Calopogonium mucunoides	6,750	Died	1,597
Lablab purpureus	6,529	Died	565

[z] Regrowth harvest taken 25 months after planting.

5 Trypanotolerance thrust

The goal of this thrust is to contribute to improved livestock production in tsetse-infested Africa by developing a better understanding of factors affecting the performance of trypanotolerant animals and effectiveness of trypanosomiasis control measures. In pursuing this goal, ILCA and the International Laboratory for Research on Animal Diseases (ILRAD), Nairobi, Kenya, have been collaborating with NARSs for several years in the African Trypanotolerant Livestock Network. Collaborating scientists use standardized approaches in taking field measurements, making analyses and interpreting the data.

The thrust's research program is focused within regional seven groups located at four sites of the network. This thrust contains five research themes; 1) Trypanosomiasis epidemiology (6), 2) Trypanotolerance (6), 3) Genetics of tolerance (2), 4) Biological/economic evaluation (6), 5) Network coordination (1).

Trypanotolerance thrust is now reaping the benefits of the first research period. The highlights of the research achievements include tsetse evaluation to predict trypanosomiasis incidence; resistance of trypanosoma to trypanocidal drugs; criteria of diagnosis including ELISA, etc. The most remarkable finding is the ability of controlling anaemia (PCV) for criteria of trypanotolerance and the linkage with animal performance of N' Dama. The genetic aspects of the criteria of trypanotolerance have been elucidated. Table 4 shows the

Table 4 Influence of various criteria of trypanotolerance on calving interval, calf weaning weight and cow productivity, Mushie Ranch, Zaire, 1989

	Decrease in calving interval		Increase in calf weaning weight		Increase in cow productivity[z]	
Criterion	days	%	kg	%	kg	%
Low versus high time detected parasitemic	68	14.2	2.8	2.1	17.1	15.5
Low versus high parasitemia score (within high time detected parasitemic)	20	4.1	3.2	2.4	5.6	5.2
High versus low PCV (within low time detected parasitemic)	27	6.3	7.8	5.8	12.6	10.4
High versus low PCV (within high time detected parasitemic)	59	11.5	12.2	9.4	23.7	24.1

[z] Weight of eight-month-old weaned calf produced per cow per year.
Note : PCV=Packed cell volume

Table 5 Heritabilities of, and genetic and phenotypic correlations between, growth, average packed cell volume (PCV) and lowest PCV reached on test

	Growth	Average PCV	Lowest PCV reached
Parasitemia detection and parasitemia score not included in analysis			
Growth	0.22±0.28	0.41±0.73	−0.13±0.74
Average PCV	0.35	0.35±0.30	0.96±0.20
Lowest PCV reached	0.29	0.72	0.48±0.31
Parasitemia detection included in analysis			
Growth	0.38±0.30	0.71±0.42	0.28±0.55
Average PCV	0.32	0.63±0.33	0.99±0.17
Lowest PCV reached	0.25	0.66	0.51±0.32
Parasitemia detection and parasitemia score included in analysis			
Growth	0.39±0.31	0.70±0.42	0.28±0.55
Average PCV	0.32	0.64±0.33	1.00±0.17
Lowest PCV reached	0.25	0.67	0.50±0.32

Note : ±SE.
Heritability is the value on the diagonal.
Genetic correlation is the value above the diagonal.
Phenotypic correlation is the value below the diagonal.

linkage of PCV with animal performance and Table 5 genetic parameters of growth rate and PCV. Thus, selection for PCV measured over a short test period appears to be an effective strategy for rapid genetic improvement of trypanotolerant cattle.

6 Livestock policy and resource use thrust

Better policies and resource management are crucial to livestock development in Africa.

Policy problems are ubiquitous and broadly similar in kind throughout the continent. However, there is a need to compare the experiences of different countries in their search for solutions, since these will often vary according to the natural and socio-economic environment. Problems of resource use, on the other hand, are most acute in the semi-arid and arid lands, where the long-term future of agriculture appears to be threatened. Here there is a need to develop better methods to assess both resources and long-term productivity trends, and to improve the role of livestock in stabilizing and sustaining farm income and crop production in marginal areas.

The research activities in this thrust will therefore concentrate on cross-country comparison of the critical policy issues affecting technology uptake, and on the sustainability of crop and livestock production in the semi-arid zone.

This thrust accommodates six research themes; 1) Policy services (1), 2) Policy research (2), 3) Range trends (1), 4) Semi-arid livestock (4), 5) Resource services (1), 6) Network coordination.

The highlights of the research achievements include policy service with issuing of Livestock Policy Manual, Livestock Systems Research Manual and Handbook of African Livestock Statistics; elucidation of the role and impact of credit and pricing policies in livestock production; land and tree tenures in West Africa; trends in range resources productivity and management in the Sahel, etc. Categorization of mixed farming systems and the role of livestock in mixed farming systems in the Sahel are currently being investigated.

7 Training and information

The department of Training and Information has a responsibility for training as well as issuing publications and information and is nick-named the seventh thrust. The department supports and complements the objectives of the Centre, and of ILCA's colleagues in NARSs (ILCA, 1989c, 1989d).

The department issued a Training Policy and Procedures Manual in May, 1990. The training programs cover two main themes, individual training for graduate students, post-doctoral scientists and senior scientists, and group training for NARS scientists and technicians in research methods and techniques. The ILCA Training Database since 1977 was made available in 1990.

The information services consist of Library and Information Processing, and Publication Units. The total collection of the library amounted to 28,004 books, 6,518 reprints and 28,370 microfiches in 1990. The Library and Information Processing Unit through their documentary resources, database, and retrieval services provide access to external sources of information. The ILCALERTS Selective Dissemination of Information Service was provided as an automated alerting service in 1990.

ILCA's publications facilitate a two-way flow of information by disseminating the Centre's work and providing a publishing outlet for scientists from NARSs (ILCA, 1989a, 1990b). The English and French Copy Units are responsible for ensuring that ILCA's research results may be pulbished and disseminated in a variety of official ILCA series.

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Discussion

Pradhan, K. (India) : How are the network research projects relating to animal production in ILCA conceived and further implemented in Africa? Who evaluates and monitors the progress of these projects?

Answer : The ILCA's networks in sub-Saharan Africa were conceived to extend ILCA's programs into partnership relationships with national colleagues as well as to cover ILCA's physical and financial research capacity and to strengthen that of national colleagues. The networks have been organized with emphasis placed on livestock production in sub-Saharan Africa. There are six networks at present. The coordination of the network systems is one of the major assignments of ILCA in sub-Saharan Africa and the activities are carried out in the related research thrusts. A part of the financial need of the networks is supported by ILCA. Each network has a coordinator located at an appropriate site, not nesessarily at ILCA headquarters, for example the Feed Resource Network is located in Kenya and the Animal Traction Network in West Africa. The networks are operated autonomously either by the national leader or ILCA leader. The progress of the network is being monitored through the Annual Programme Review of ILCA and Biennial Meeting of African Leaders of Livestock Research, Training and Development, both held at ILCA headquarters.