

The pastures network for eastern and southern Africa (PANESA): Its regional collaborative research programme

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seca. Se discute los principios de la creación de la red, la membresía del país y la forma de operación y cobertura de sus programas colaborativos de investigación.

Abstract

The Pastures Network for Eastern and Southern Africa (PANESA) deals with forage and other feed resource development in sub-Saharan Africa. Emphasis is placed on forage germplasm evaluation and seeking entry-points of forage resources into mixed crop-livestock smallholder farmer production systems. Operational focus is on the arid/semi-arid, humid/sub-humid and highlands zones of eastern and southern Africa. The network's mandate seeks to improve the research capabilities of national institutions so as to alleviate dry season feed resource shortages. The rationale for the network's formation, country membership, mode of operation and coverage of its collaborative research programme are discussed.

Resumen

La Red de Pasturas para la región Este y Sur de Africa (PANESA) se ocupa del desarrollo de los forrajes y de otros recursos alimenticios en la región sub-Sahara en Africa. El énfasis de su actividad está dirigido a la evaluación de la adaptación ecológica del germplasma forrajero y a la búsqueda de fuentes de recursos forrajeros para los sistemas de producción agrícola-ganaderos, a nivel de pequeños propietarios. Su operación se enfoca a las zonas árida/semi-árida, húmeda/sub-húmeda y a las tierras altas de la región este y sur de Africa. El mandato de la red es buscar el mejoramiento de las capacidades de investigación de las instituciones nacionales, así como aliviar la escasez de alimentos en la época

Introduction

The region

The region covered by the Pastures Network for Eastern and Southern Africa (PANESA) includes the 19 countries outlined in Figure 1. Altogether this is an area that covers the 5 major ecological zones; arid, semi-arid, sub-humid, humid and highlands which account for 36, 23, 28, 4 and 8 percent, respectively, of the total land area of 10.2 million square kilometres (FAO Production Yearbook 1979; Table 1). Cattle, goats, sheep and camels constitute the ruminant livestock units of 94.8 million. The region has a total human population of 118 million (FAO Production Yearbook 1979; Table 3), 15 percent of whom live in the arid zone, 25 per cent in the semi-arid, 24 percent in the subhumid, 6 percent in the humid and 30 percent in the highland zone (> 1500 m above sea level).

The distribution of ruminant livestock units is such that 25 percent are in the arid, 18 percent in the semi-arid, 21 percent in the subhumid, 3 percent in the humid and 24 percent in the highland zone (Table 4). The productivity of these ruminant livestock is generally low although the region holds 51 percent of Africa's cattle (which represents 7 percent of the world cattle population). It produces a mere 38 percent of Africa's bovine meat (equivalent to 3 percent of the world's bovine meat) and 33 percent of Africa's cow milk (equivalent to less than 1 percent of the world's cow milk production). The milk yield of 425 kg/year/cow for the region is too low compared to 3217 kg/yr/cow in developed countries. The annual regional herd offtake of 10 percent (in 1982) represents a slaughter weight of 143 kg/hd compared to 34 percent and 218 kg/hd, respectively, in the developed countries.

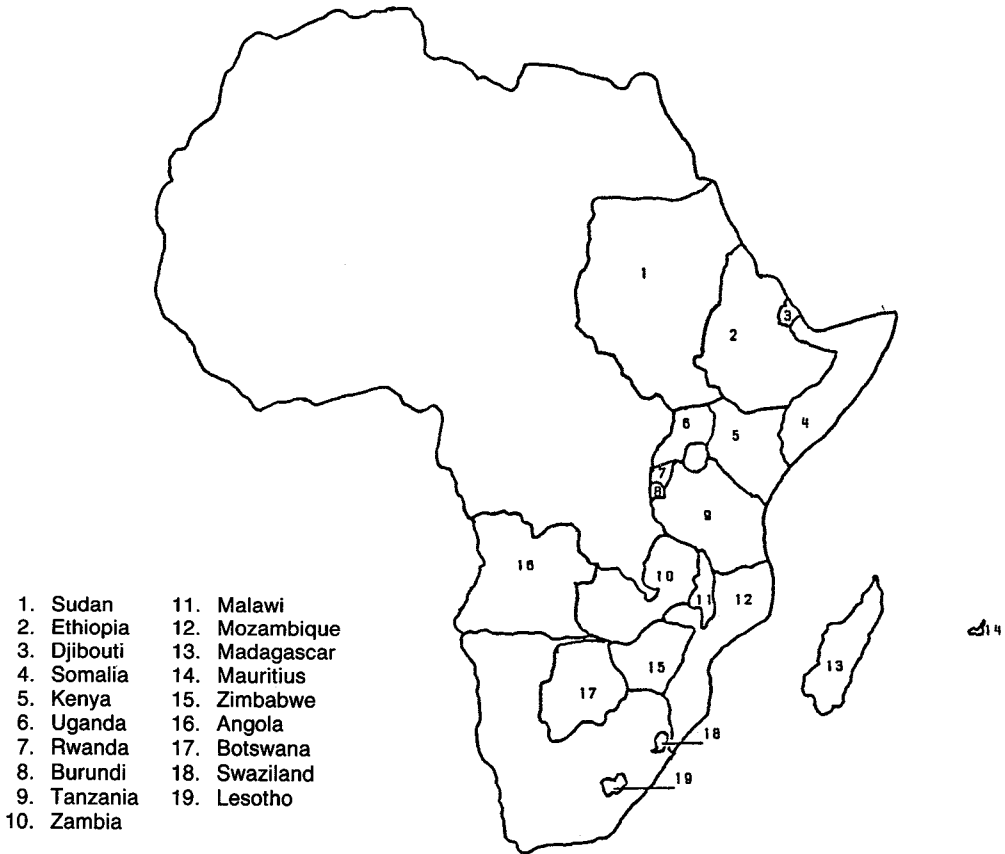


Figure 1. The Pastures Network for Eastern and Southern Africa (PANESA) membership countries.

Currently the livestock production is lagging behind human population growth and consequently imports of livestock products into the region are on the increase. On a continental scale, Africa's trade deficit in livestock and livestock products increased from US\$870 million in 1975 to US\$3140 million in 1981 (FAO Production Yearbook 1982). This figure must have further increased considerably by the end of 1989.

Background to PANESA's Networking in Feed Resources

The Special Programme for African Agricultural Research (SPAAR) has defined PANESA as the only formally organized collaborative research network dealing with animal feed resources issues in sub-Saharan Africa (SPAAR 1987a,b). Other networks, for instance the African Research Net-

work for Agricultural By-products (ARNAB) have operated primarily as information exchange networks. Unlike other networks, such as Red Internacional de Evaluation de Pastos Tropicales (RIEPT) network, which is co-ordinated by the Centro Internacional de Agricultura Tropical (CIAT), which operate in a top-down fashion, PANESA is basically a bottom-up type of network. Its decision making is through a Steering Committee of elected national scientists with representatives from both ILCA and the donor agency.

The decision to form PANESA was actually made by national scientists from east and southern Africa. ILCA only took the responsibility to administer it because the Network touches on one of the main issues related to ILCA's livestock production mandate in sub-Saharan Africa, namely, forage and feed resources.

Major constraint to livestock production

Inadequate nutrition, especially the lack of a reliable feed supply is a major technical constraint on animal production. This is particularly pronounced during the seasonal periods of nutritional stress in the dry months (ILCA 1980; Evans 1982; Haque *et al.* 1986). Sub-Saharan tropical rangelands constitute 34 percent of the total land area in the PANESA region. They provide 80–100 percent of the total feed intake by ruminant livestock. Crop residues from arable lands are also an important dry season feed resource (McDowell 1988). The tropical rangelands experience pronounced seasonal variability in rainfall resulting in a very precarious livestock feed supply (French 1957). These seasonal feed supply changes, with consequential changes in body weights of grazing livestock, cause production of these stock to be below their capacity (Topps 1977). Any improvement in forage feed supplies is likely to impact positively on livestock productivity.

Experience with feed resources

A considerable amount of research in pastures and other livestock feed resources has been done, notably in Zimbabwe, Kenya, Uganda, Tanzania, and Malawi (Katigile 1985; Katigile *et al.* 1987; Dzwela 1988; Dzwela *et al.* 1989). Local and introduced forage germplasm has been screened for adaptation to the local ecological conditions. Large-scale farms have utilized the results and have planted improved strains of *Chloris gayana*, *Panicum* spp., *Cynodon*, spp., *Macrotyloma axillare*, *Stylosanthes* spp., *Leucaena leucocephala*, and *Pennisetum* spp. However, very little of this technology has filtered down to the traditional sector (Dzwela *et al.* 1989).

The International Livestock Centre for Africa (ILCA), one of the International Agricultural Research Centres (IARC's) funded by the Consultative Group of International Agricultural Research (CGIAR) has a mandate to improve livestock production throughout sub-Saharan Africa. ILCA has carried out a considerable amount of forage research in the last decade. Outstanding in this regard has been the establishment of a forage germplasm bank with a wide tropical/subtropical base. ILCA has also undertaken to collect a fairly wide range of forage materials particularly local *Trifolium*, *Brachiaria*

and *Sesbania* germplasm from the Ethiopian Highlands and East African regions.

Collaborative research

PANESA is a collaborative research network research network co-ordinated by ILCA and initially funded by the International Development Research Centre of Canada (IDRC). It is planned through PANESA, to encourage and develop the research capabilities of the membership countries in forage germplasm evaluation and feed resources development. Not all countries have the same types and ranges of agroecological zones so they will naturally focus on those zones that are both relevant and developmentally and economically important to them. Based on the distribution of the human agricultural population and the distribution of ruminant livestock (Tables 3 and 4) the extent of ecological zones (Table 1) and the livestock populations by countries (Table 2), it is possible to group countries with respect to the agro-ecological zones in which they might concentrate their forage screening and development.

- i) *Highlands* — Ethiopia, Burundi, Kenya, Rwanda, Tanzania, Uganda and Lesotho.
- ii) *Humid/sub-humid* — Angola, Malawi, Zimbabwe, Zambia, Mozambique, Tanzania, Swaziland, Madagascar and Uganda.
- iii) *Arid/semi-arid* — Angola, Botswana, Ethiopia, Somalia, Sudan, Zimbabwe, Tanzania, Kenya and Djibouti.

Statistical data were not available for Lesotho, Mauritius and Swaziland.

Further to these groupings it is necessary to consider technical capacity. While some countries are spread across all three groups, some, e.g., Angola, have scarcely the resources to work in one zone while Kenya has active research going on in all three.

The Humid/Subhumid zone

Livestock is generally considered as part of a farming system. The zone is characterized by 180 to over 270 plant growing days. The land is capable of growing a wide range of cash and cereal crops as well as feeding livestock. Here ruminant livestock production is heavily dependent upon fibrous residues and by-products pro-

Table 1. The extent of ecological zones in Eastern and Southern Africa (FAO 1979)

Country	Total land areas	Arid	Semi-arid	Sub-humid	Humid	Highlands
(,000 sq km)						
Angola	1247	53	275	708	94	116
Botswana	585	432	153	—	—	—
Burundi	25	—	—	6	1	—
Djibouti	22	22	—	—	—	19
Ethiopia	1101	490	111	85	—	415
Kenya	569	425	52	11	—	80
Madagascar	582	45	116	227	177	17
Malawi	94	—	20	61	9	5
Mozambique	766	90	324	322	30	—
Rwanda	25	—	—	7	1	17
Somalia	627	626	1	—	—	2
Sudan	2376	1357	592	333	24	71
Tanzania	886	95	259	415	17	101
Uganda	200	1	33	100	53	13
Zambia	741	—	236	488	—	14
Zimbabwe	388	69	225	94	—	—
Total	10233	3704 36%	2399 23%	2854 28%	406 4%	797 8%

duced on the farm plus, grass, weeds and tree trimmings and verges to tethered, herded or confined livestock. The availability of these feeds may be markedly influenced by the intensity of crop production practices, for instance, stubble burning to permit double or triple cropping may reduce the availability of straw to feed livestock (Preston and Nuwanyakpa 1986; Little and Said 1987; Reed *et al.* 1988; Said and Dwozela 1989).

Forage technology research and development

in this zone must be geared towards incorporation of cultivated forages and fodders in the crop farming systems to support dairy and beef stock in integrated and economically well balanced systems of agriculture.

The unimodal annual rainfall distribution pattern in the major part of this zone dictates that the major research thrust must provide the livestock with a succession of feed sufficient both in quantity and quality throughout the year (Strange

Table 2. The ruminant livestock population in Eastern and Southern Africa, in terms of Tropical Livestock Units (TLU), (FAO 1979)

Country	Camels	Cattle	Sheep	Goats	TLU
(,000 head TLU ¹)					
Angola	—	3120	220	930	2299
Botswana	—	3300	450	1200	2475
Burundi	—	836	336	585	677
Djibouti	25	32	310	520	130
Ethiopia	966	25900	23234	17120	13131
Kenya	550	10470	4000	4500	8729
Madagascar	—	8744	658	1583	6345
Malawi	—	790	140	860	653
Mozambique	—	3000	5150	2150	1010
Rwanda	—	640	257	786	553
Somalia	5400	3800	10000	16000	10660
Sudan	2500	17300	17200	12200	17550
Tanzania	—	15300	3000	4700	11480
Uganda	—	5367	1068	2144	4078
Zambia	—	1800	51	300	1295
Zimbabwe	—	5000	754	2061	3781
Total	9441	105399	65828	67639	94846

¹ Tropical Livestock Unit; Camels: 1.0, Cattle: 0.7; Sheep/goats: 0.1.

Table 3. Percentage distribution of the human agricultural population in Eastern and Southern Africa by ecological zones (FAO 1979)

Country	Human population	Arid	Semi-arid	Sub-humid	Humid	Highlands
	(,000 persons)			(%)		
Angola	4025	7	30	18	9	35
Botswana	646	82	18	—	—	—
Burundi	3658	—	—	—	—	100
Djibouti	116	100	—	—	—	—
Ethiopia	25320	6	43	5	3	44
Kenya	12318	23	3	—	—	74
Madagascar	7148	8	11	42	31	8
Malawi	5029	—	—	100	—	—
Mozambique	6671	6	55	35	3	—
Rwanda	4183	—	—	—	—	100
Somalia	2852	99	—	—	—	1
Sudan	3828	52	22	24	2	—
Tanzania	14179	4	37	34	—	25
Uganda	10421	—	—	41	34	23
Zambia	3678	—	40	55	—	—
Zimbabwe	4233	22	50	28	—	—
Total	118305	15	25	24	6	30

1980). Forages and fodder crops in this mixed farming system have an additional role of increasing or maintaining the productivity of arable land through leys, intercropping and alley cropping. Likely plant genera to concentrate efforts on are *Chloris*, *Panicum*, *Pennisetum*, *Cynodon*, *Digitaria*, *Desmodium*, *Macrotyloma*, *Stylosanthes*, *Centrosema*, *Macroptillum*, *Leucaena*, *Aeschynomene*, *Gliricidia*, and *Sesbania* based on the experience of a few countries that have engaged in widespread germplasm evaluation work.

Highlands zone

Due to altitude, temperatures are relatively low, below 20°C during the growing season which may vary from 90 to over 270 days (ILCA 1987). In some countries such as Ethiopia this zone is characterized by high densities of both human and livestock population. The major agricultural activity is cropping, dairying and sheep farming. The forage research technology must primarily be based upon plants that are adapted to cool season growing, seasonal frost and acid soils to

Table 4. Percentage distribution of tropical ruminant livestock units in Eastern and Southern Africa by ecological zone (FAO 1979).

Country	Livestock population	Arid	Semi-arid	Sub-humid	Humid	Highlands
	(,000 head)			(%)		
Angola	2299	20	28	27	2	—
Botswana	2475	82	18	—	—	—
Burundi	677	—	—	—	—	100
Djibouti	130	100	—	—	—	—
Ethiopia	13131	19	15	12	5	49
Kenya	8729	35	5	—	—	60
Madagascar	6345	19	36	21	19	5
Malawi	653	—	—	100	—	—
Mozambique	1010	34	35	26	5	—
Rwanda	553	—	—	—	—	100
Somalia	10660	95	—	—	—	5
Sudan	17550	34	34	30	2	—
Tanzania	11480	6	33	42	—	20
Uganda	4078	—	9	56	10	25
Zambia	1295	—	69	30	—	1
Zimbabwe	3781	26	35	38	—	—
Total	94846	25	18	21	3	24

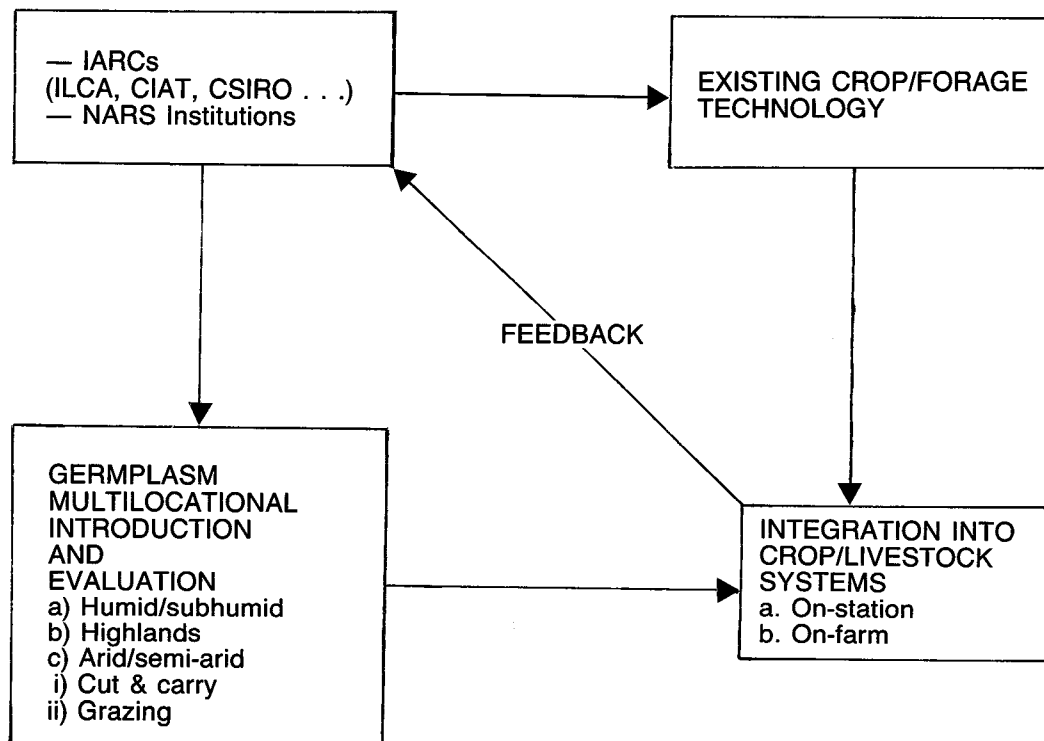


Figure 2. Schematic presentation of PANESA's Collaborative Research. IARC = International Agricultural Research Centre; NAR = National Agricultural Research Centre.

some extent. Notable in this group are the genera *Trifolium*, *Setaria*, *Lupinus*, *Vicia* and *Medicago*.

Arid and Semi-arid zones

These areas are characterized by a short growing season of 90 to 180 days (ILCA 1987). There is less potential in this zone for cultivation and consequently emphasis is on management of natural wild plant communities which provide most or all of the stock feed. As the rainfall decreases, the economic potential shifts from the crop/livestock economies towards complete dependence on livestock in the tribal grazing lands where pastoralists subsist largely on milk and meat. This is a zone that offers excellent facilities for beef ranching and the rearing of small ruminants (sheep and goats).

Since natural grass/bush/tree communities provide almost all livestock feed requirements, there is widespread evidence of deterioration due

to overgrazing, bush encroachment and soil erosion (Strange 1980). Forage/fodder technology research in this zone must have emphasis on perennial plants that are able to survive in drought conditions and provide some "keep" for livestock during the dry periods. The ability to maintain some greenness and succulence after the start of dry weather is a valuable property possessed by some plants, especially trees and shrubs, such as *Leucaena leucocephala*, *Acacia* spp., *Crotalaria* spp., *Cajanus cajan*, *Stylosanthes scabra*, *Desmanthus virgatus*, *Cassia* spp. A few grasses such as *Cenchrus ciliaris* and *Eragrostis superba* and some species of *Panicum* and *Sorghum* also have this property.

Research mandate of PANESA

Specific research mandates of PANESA are outlined in the schematic presentation shown in

Figure 2. Briefly they are:—

- (a) To evaluate promising pasture/forage/browse plant germplasm for adaptation and production in different representative ecological zones in the different membership countries.
- (b) To develop appropriate pasture/forage production technologies that could be integrated into the prevailing crop/livestock production systems.

The objectives are being achieved through collaborative experimentation developed through PANESA with membership countries. Regional/subregional multilocation adaptation and evaluation trials involving a wide range of forage grass and legume (including browse trees) germplasm is conducted...

For those countries in which forage introduction (including local collection) and initial evaluation of germplasm has been done (e.g. Kenya, Zimbabwe, Ethiopia, Tanzania, Malawi and Uganda to some extent), PANESA's research emphasis is on the integration of available forage technology into the crop/livestock production systems in order to improve the livestock feed resources.

The achievements of this national collaboration were highlighted at a recent review meeting, held in March, 1990, in Nairobi, Kenya with collaborating scientists from 14 of the 19 membership countries. The following topics were considered to be adequately covered in the collaborative research currently being implemented.

- Evaluation of fodder trees and shrubs for forage yield, nutritive value and multipurpose uses such as species of *Leucaena*, *Sesbania* and *Crotalaria* in Kenya, Malawi, Tanzania, Zimbabwe, Uganda, Ethiopia and Rwanda.
- Herbaceous forage legume germplasm screening and evaluation for semi-arid, sub-humid and highlands situations in Kenya, Tanzania, Malawi, Sudan, Swaziland, Mozambique, Uganda, Botswana, Mauritius, Zambia and Zimbabwe.
- Feed resources in animal production systems covering grazed pasture and indoor feeding situations in Kenya.
- Definition of entry points for forages (herbaceous and shrubs) in the crop-livestock farming systems of Tanzania, Zimbabwe and Mozambique.

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