LPU WORKING PAPER No.3

The allocation of resources to livestock research in Africa

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JUNE 1984

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SUMMARY

This paper presents a theoretical and historical survey of resource allocation to livestock research in Africa. It discusses issues emerging from this survey that are of relevance to the formulation of ILCA's research policy.

In recent years, much has been written on the allocation of resources to agricultural research. Writers have put forward a number of decision-making models for guiding resources between alternative research areas. A need for such aids to decision-making has been expressed for two reasons. On the one hand, the application of research-based technologies in the twentieth century accounts for a large share in output growth of the agricultural sector in developed countries. Research activity has been seen to generate high returns in terms of improved factor productivity and rising farmer incomes. On the other hand, the value of output from investment in any particular line of research is uncertain. This uncertainty is related to how far research workers can generate technologies that will be adopted by producers.

Decision-making models vary from simple rules of thumb to more complex models based on calculating the expected flow of costs and benefits from alternative research projects. Intermediate in complexity are scoring models which provide rules for resource allocation in circumstances in which several criteria must be taken into account. It is recommended in this paper that a scoring model be adopted to help ILCA decide which research projects to fund. This is because such scoring models require that research workers and policy-makers take explicit account of the likely contribution made by different kinds of research to specified economic and social objectives.

The direction that national agricultural research policy takes is subject to a number of forces. In some cases, the government plays the major role in funding and setting priorities for research work. In other cases, farmers have a much greater say in determining the kind of research that gets done. In yet other cases, members of the research community themselves are instrumental in deciding which research fields will receive priority.

A survey of the past allocation of resources to livestock research in 10 African countries illustrates the variety of forces under which research policy has operated at different dates and in different places. Two general patterns emerge from this historical survey. In countries like Zimbabwe, Botswana and to a lesser extent Kenya, the direction that livestock research has taken has been greatly influenced by powerful producer groups. These producers have demanded that research be oriented towards the generation of technologies to improve their commercial beef and dairy farming enterprises. The existence of close relations between farmers and research workers has helped guide resources into those areas of research that can produce practicable technologies. In addition, these large-scale commercial producers have had access to credit and other resources necessary for the adoption of improved production methods.

In the seven other African countries studied (Senegal, Mali, Niger, Cameroon, Tanzania, Nigeria and Sudan) there has been a far weaker link between livestock producers and research workers. This has been largely due to the absence of a significant European settler group in the livestock sector. The direction that livestock research has taken has been largely determined by the priorities set by members of the research community themselves. Veterinary research has been and remains of predominant importance in most research budgets. This may be accounted for by the crucial role played by veterinary work in controlling epizootic diseases in earlier decades. Animal breeding and genetic work has usually taken second place in research budgets, ahead of work on nutrition, animal husbandry and socio-economic research. A number of writers have questioned the continued high share of resources going into veterinary and genetic work. They argue for more attention to be paid to animal nutrition and to the development of technologies that may be feasible for adoption by the smaller livestock-keeper.

Various issues emerge that are of relevance to ILCA from the discussion of decision-making models and from the survey of past resource allocation to livestock research. These include the following: firstly, the need to define a limited number of objectives so that the contribution of alternative research projects to each of these can be compared in a consistent manner; secondly, the requirement that researchers keep in close contact with livestock producers, so that new production techniques developed are of practical value to these producers; and thirdly, the need to coordinate the research programme of ILCA with those of national governments.

INTRODUCTION: AIMS AND CONTENT OF THE PAPER

This paper presents a theoretical and historical survey of resource allocation to livestock research in Africa. The purpose of the survey is to see whether there are lessons to be learnt from this for ILCA's research policy. Part One looks at decision-making models formulated to guide the allocation of funds between alternative lines of research and assesses their relative merits. Part Two presents various theories that have been put forward to account for the direction that research has taken in different contexts. It then discusses the lessons that can be learnt from case studies of resource allocation to research in the past. Part Three reviews the past allocation of resources to livestock research in 10 African countries in order to identify the main factors that have influenced national livestock research policy. Part Four looks at the general conclusions that emerge both from the country studies and from the description of decision-making models. These conclusions will serve as the basis for a discussion of ILCA's research policy and objectives. Part Four ends with proposals for further work that could usefully be done on livestock research policy in order to gain a greater depth than has been possible in this short report.

PART ONE: THEORY OF RESEARCH RESOURCE ALLOCATION

1.1 Research and Output Growth

Increases in output come from several sources: (i) from an increase in the factors of production available, (ii) from an upward shift in the production function; and (iii) from a more efficient use of existing resources. This paper will look at the second of these sources although mention will be made of the third in this section. An upward shift in the production function comes about through the use of improved technologies and higher quality inputs. Research has as its aim to develop new technologies that permit a greater level of output to be achieved with existing resources.

A number of studies have been carried out to try to assess the profitability of expenditure on agricultural research, and these are summarised in Pinstrup-Andersen (1982, pp. 102-104). These studies indicate very high rates of return to research expenditure, of more than 20% and in some cases much greater than this. These high rates would suggest that more research ought to be done, since few investments in the public sector could hope to return rates of 15% or more. While the methodology of these calculations of rates of return to research is subject to dispute, their presentation has encouraged debate on issues surrounding research resource allocation and has focussed interest on how to decide on:

(a) the amount of money that should go into research in comparison with other uses; and

(b) the distribution of the research budget among different research projects.

1.2 Allocation of Resources to Research vs Other Uses

This question is not the subject of this paper. However, two points will be made. Firstly, the size of the agricultural research budget for a country is usually compared with its gross domestic product (GDP) to assess whether agricultural sufficient resources are going into research. A figure of 0.5% of agricultural GDP to be devoted to research has been put forward by the 1974 UN World Food Conference in Rome, as a target for developing countries to achieve by the year 1985. Current figures are far below this percentage for many developing countries, as is shown in Oram's work (1983). Secondly, an issue which appears in many of the documents by research institutes and policy-makers, is the balance to be maintained between expenditure on research and on extension activities. Extension-advocates argue that at any particular time most producers are not using resources in the most efficient way, nor have producers adopted many technologies currently available that could raise their productivity. They stress, as a consequence, that it would be better to concentrate on trying to achieve a more efficient use of existing resources, for instance, by encouraging producers to adopt known technologies or by reforming pricing and marketing policies. Advocates of research, in contrast, argue that funds must continue to be put into the development of new technologies since the research process is a long and uncertain business.

They emphasise that while many unused technologies may exist, these are often not economically viable under current conditions, and that therefore research needs to be done on finding more appropriate technologies.

1.3 Allocation of Resources between Research Projects

Having decided on the amount of funds to be allocated to research, the next decision that must be made is what kind of research to engage in and which out of a large number of projects should receive funding. Various decision making models are put forward in the literature and several will be described briefly here. They are not perfect substitutes for each other but rather their usefulness differs with the decision to be made, as will be seen below. Before describing the decision-making models, it needs to be asked why resource allocation among competing research projects should present such a problem.

Why does Resource Allocation to Research Present a Problem?

Neo-classical economic theory would tell us that research funds should be allocated between alternative projects in such a way that the maximum research output is achieved, with each last dollar spent gaining the greatest possible increment in research output. This would appear to be a reasonable decision criterion to follow until account is taken of the great uncertainty surrounding the production of useful research results. For many research projects, it is not known with any certainty what the outcome of a given expenditure of manpower and resources will be in terms of utilisable technology. Nor with the development of a new technology is it known whether this will be of economic value and adopted by producers. Thus, research is unlike production in many other sectors of the economy where a fairly well-defined relationship exists between inputs and output. In addition, the application of new technology for the production of particular goods is rarely neutral in its impact on the distribution of welfare in society. Some technologies, for instance, greatly reduce the demand for labour in the rural economy, causing widespread unemployment. Other technologies, by increasing the production of basic food grains create, through a fall in prices, a net welfare gain for many sections of the population. A number of writers argue

that researchers should not bother themselves with the distributional impact of the technologies they develop and that other measures, such as fiscal policies, should be used to counteract adverse changes in welfare. However, most researchers would acknowledge that the distributional impact of any line of research should be evaluated.

It can be seen that even if the first problem discussed, i.e. perfect certainty about the outcome of the research process, could be solved, the second problem remains and is a question where value judgements must inevitably be made.

1.4 Models to Help Decision-Making

1) Rules of thumb. This general approach to the allocation of research resources is widely used implicitly, if not explicitly. An example of a rule of thumb is to distribute the research budget among different commodities in proportion to the current value of production of each commodity. Thus, if the value of cattle production is US$100 million, of sheep and goats US$50 million and of poultry US$25 million, this model would tell us to allocate resources to research on the three species in the ratio of 4:2:1. Alternatively, it might be decided that research resources should be allocated roughly in proportion to the export value of different animals in order to improve foreign exchange earnings. If cattle contribute US$30 million, sheep and goats US$1 million and poultry nothing to export earnings, this model would suggest an allocation of resources to research in the ratio of 30:1:0 to the three species. These rules of thumb indicate how research resources might be allocated were a single criterion to be taken. However, they are very insensitive to a number of considerations. The productivity of research may differ across commodities. The output, for example, of US$1,000 allocated to research on cattle may be lower than that of US$1,000 spent on poultry research. If we are aiming at maximising research output then a simple rule of thumb may not guide us well. Similarly, simple rules of thumb cannot cope with the pursuit of multiple objectives; for example, increasing export earnings, maximising rural employment and achieving self-sufficiency in dairy products. The method set out in the following section has been developed to guide resource allocation when a number of criteria are to be taken into account.

2) Scoring models. The models attempt to provide for more complex decision-making situations, by laying down a small number of objectives, each of which is given a weight according to the priority attached to it. Thus, for instance, research on cattle could have the following objectives and weights attached:

	Objectives	Weights
(i)	growth in productivity	3
(ii)	reduction in variability of income	2
(iii)	distribution of welfare gains towards the poorest 25% of the human population	4
(iv)	increase in export earnings	5

These objectives are not necessarily either independent or mutually compatible; for instance, research aimed at expanding exports of beef could well stress levels of management and inputs that had little relevance to the poorest section of the population.

The choice of weights to be attached to each objective is the responsibility of national governments. Researchers must then assess a number of research projects and estimate how far each is likely to contribute towards the objectives laid down earlier. A scale is adopted to rate the size of the estimated effect that a project will have on each objective. An example of this is shown below:

Effect on objective	Scale
Large and positive	+ 2
Small and positive	+ 1
None	0
Small and negative	- 1
Large and negative	- 2

The likely effect of a research project can then be reduced to a single

aggregate figure composed of the sum of each objective's weight multiplied by the scale of the estimated effect on this objective from the research project. Projects can then be compared and those with the highest scores chosen for funding. An example of such a comparison is presented here.

Project One: A research project to establish crossbreeding trials to produce a fast-growing beef animal scores the following:

Objective	Effect	Weight	Product
(i)	large, positive (+2)	3	+ 6
(ii)	none (0)	2	0
(iii)	none (0)	4	0
(iv)	large, positive (+2)	5	+10

This gives a total of +6 + 10 equalling 16.

Project Two: A project aimed at doing research into improving the utilisation of crop residues for dairy cow nutrition scores the following:

Objective	Effect	Weight	Product
(i)	small, positive (+1)	3	+ 3
(ii)	large, positive (+2)	2	+ 4
(iii)	small, positive (+1)	4	+ 4
(iv)	none (0)	5	0

This gives an aggregate total of 3 + 4 + 4 equalling 11.

If insufficient funds existed to finance both projects, then with the above weights and assessements of each project in achieving objectives (i) to (iv), the choice should be to fund Project One.

The difficulties with this method include: (a) the largely subjective assessment researchers must make of the likelihood of a particular project contributing towards a given objective, since this involves not only an

evaluation of the researcher's success in producing the looked-for result, but also the likelihood and rate of its adoption, and in the case of its adoption the implications of this for the objectives listed. As Anderson and Parton (n.d.) mention, models like this can merely pool ignorance and the exercise in quantification should not blind decision-makers into thinking that the resulting aggregates are not subjective estimates; (b) the weights attached to each objective are laden with value judgements, and different people are likely to differ in the importance they attach to each one; (c) the time of researchers taken up by such an exercise may be considerable, time which could have been spent doing more valuable work.

Despite these drawbacks, however, scoring models do have several points in their favour: (a) they are less crude in their method than simple rules of thumb, since several criteria are jointly considered; (b) the process of assessing different research proposals is of value in itself, since it provokes a close analysis of components within a project and explicit consideration of the role of research in contributing towards certain social and economic objectives. Scoring models are thus a satisfactory compromise between a cheap but insensitive method and one which is complicated and expensive to carry out in practice.

3) Cost-Benefit models. These models require that an estimate is made of research costs over the length of a project and of the probable distribution of benefits from the project over time. In most cases a discount rate is used to attribute lesser value to costs and benefits that occur in the distant as opposed to the near future. The two flows are compared and, depending on their relative size, a project is either accepted or rejected. Data for a cost-benefit model could come from a systems study from which several lines of future research are proposed. These research proposals are then compared by estimating the costs and benefits flowing from each one.

While this model seems to provide a fairly clear guideline to whether or not to fund a research project, the calculations are based on a number of assumptions. The cost flow may be relatively easy to calculate. Calculation of the flow of benefits, however, depends on assigning probabilities of success to the research project and to the rate of adoption by producers of

the new technology. Both of these are highly uncertain events, without a known probability distribution attached to each outcome.

1.5 Overall Conclusions about Research Resource Allocation Models

1) How much time and energy should be spent on evaluating alternative research projects? Anderson and Parton (n.d.) suggest that the optimum time to be spent on evaluation is likely to increase with the number of projects to be considered, with greater uncertainty of the research outcome and with a greater number of people in the decision-making unit.

2) No single model is appropriate for answering all resource allocation questions; for example, cost-benefit models can only be applied when a considerable amount of data relevant to alternative projects has already been acquired.

3) Decision models based on very detailed calculations are inappropriate for the allocation of resources between alternatives where the outcome is highly uncertain. As Shumway (1983) points out "no rules or formal procedures can make objective outputs from subjective inputs, no matter how precise and elegant they may appear" (p.93).

4) A definition of the research organisation's objectives and the relative importance attached to each one would clarify the decision-making process. The relative weights attached to each objective could vary from region to region; for example, maintaining existing levels of output and reducing variability in incomes might be given greater priority in semi-arid zones, while promotion of export earnings might be given greater weight in zones of higher rainfall and potential.

5) There is much to be said for researchers spending a certain amount of time assessing their research projects in terms of achieving particular objectives. A demand that this be done should not be considered an infringement on the researcher's time. The exercise may in itself clarify inconsistencies, or reveal methods by which to improve the chances of

successful development and adoption of new technologies.

6) Any allocation of resources has implicit value judgements contained within it. Where the allocation of resources to research leads to the successful development and adoption of a new technology this will in turn lead to a change in resource use, in the production and prices of different commodities and in the distribution of welfare. The decision-making process should explicitly spell out the distributional consequences of any particular allocation of resources between alternative projects to clarify the nature of the choice to be made.

7) There are no clear objective rules by which the resource allocation problem can be solved. Subjective probability estimates of success are needed to compare the expected outcome of each research project. Value judgements are also necessary to decide which outcomes represent the greatest addition to social welfare.

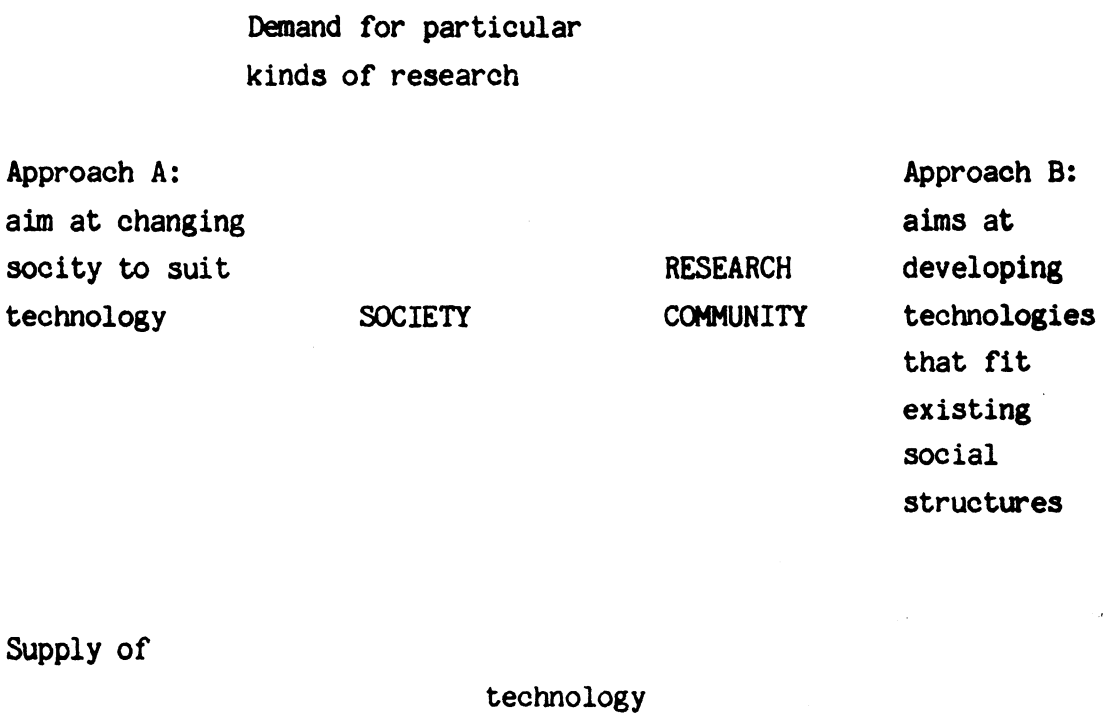
8) Some basic data collection along the lines suggested by Jahnke and Kirschke (1983) would make clearer the implications of any particular emphasis in the research programme. These writers present a wide range of criteria that could be used for judging the allocation of resources to different fields in agricultural research. These include: the relative share in total production of different species; the role of each species in achieving self-sufficiency in food supplies; how far each species contributes to current export earnings; the nutritional value of the output of each; the relative scarcity and prices of factors used in the production of each species, and so on. This data collection could then provide the basis for decision-making procedures based on a simple rule of thumb. However, decision-makers must also consider the likely productivity of resources devoted to different fields of research when choosing where to invest resources. More detailed data on the consequences of pursuing specific lines of research would be required before an informed choice could be made.

PART TWO: THE NATURE OF THE RESEARCH PROCESS

2.1 Theories Accounting for the Direction of Research and Technological Development

In discussing the role of research in changing technologies and its interaction with society it is useful to have a simplified model demonstrating the links. In Diagram 1, the research community and developers of technology are put in one box while society (composed of producers, consumers and government) is put in another box. Society makes demands upon researchers to pursue particular interests; for example, farmers try to influence the research programmes of agricultural research institutes, consumers pressure governments to invest more money in medical research, and governments spend money encouraging research on more advanced computers or military equipment. Most governments feel that research must be directed and that scientists must not be allowed simply to go their own way.

Diagram 1. A simple model of the relationship between Society and the Research Community.



However, it is also the case that the research community in itself has a certain power to influence the kind of research which is carried out. Some kinds of necessary research are not the sort of immediately relevant applied research that gets commissioned by particular interest groups. In addition, researchers are themselves in the position of informing funders of the importance and relevance of their particular discipline or approach to problem-solving. In understanding the pattern of research that gets done, it is essential to recognize the political involvement of the scientific community in the process. Researchers are not just passive recipients of funds; they compete among themselves for limited resources and hope to influence the allocation of resources to different fields of research. Schultz (1970) coins the term "research entrepreneur" to describe the role that researchers play in affecting the kind of research that gets funded. The term implies that researchers are comparable with producers of other goods and, to be successful, must know how to package and sell their particular expertise.

Jamieson (1978) neatly summarises the theories that have been put forward by a number of authors to account for the pattern and direction of the relationship between research efforts in different countries and epochs. The hypotheses presented by her attempt to place special emphasis on a single factor, whether this be relative prices and scarcities of production factors (Hayami and Ruttan, 1977), the role of particular interest groups such as commercial farmers in determining what research gets done (de Janvry, 1977), or the central role played by the research community itself through its close links with government and the prevalence of particular viewpoints as to the importance of one kind of research versus another. In contrast to a "single factor" approach, I argue that no single theory satisfactorily accounts for the nature and direction of research efforts. The extent to which any of these theories satisfactorily explain what has happened depends on historical experience, and the links between the research community and consumers of research. In addition to theories attempting a rational explanation for the distribution of research resources, it must also be acknowledged that there is a random element in the direction that research may have taken in the past, due for example to the interests and experience of the research staff available at a particular moment.

2.2 Lessons to be Learnt from the Past Allocation of Resources to Livestock Research in Africa

It is instructive to look at how resources have been allocated to different kinds of livestock research in Africa in the past. Various lessons can be learnt that are of value in deciding future research strategies, and three of these will be discussed below.

(i) To test the success of particular resource allocation strategies.
Suppose that in the past Kenya had used a cost-benefit model to distribute resources to different kinds of livestock research, whereas Cameroun had used a simple rule of thumb. After a period of 20-30 years we could inspect the record to see which had proved the more sensitive in guiding scarce resources into their most productive use. However, where no single system of resource allocation has been practised and where policies, institutions and the primacy given to different disciplines have changed over time, the comparison of different countries' strategies is more complex. Each case shows a mixture of strategies followed; some rules of thumb mixed with pressure group activity and subject to the quirks of research directors, staff availability and government officials at different points in time. Thus, if this study tells us anything on this question it is rather that the direction that research takes is subject to a number of forces. If we want to try to be more consciously involved in guiding resources within this sector, we should at least be aware of these influences so that decision-makers can take them into account.

(ii) To assess the research coverage by different species and disciplines.
A look at the research that has been carried out in the past should collect material on the breadth and depth of research done in different fields to assess which subjects have been well covered and which relatively neglected. This would avoid the duplication of research done from ignorance of what had already been achieved and would guide resources to underresearched fields.

(iii) To indicate the relative productivity of particular research fields and methodologies. One of the main problems in constructing sophisticated decision-making models in research resource allocation is that the output of the search process is highly uncertain in many areas. The fact that the application of US$1 million and 10 scientist-years to subject A has produced benefits of US$3 million over 15 years in the past tells us very little about the value that might be expected from a similar expenditure on subjects B, C or D in the future. However, some lessons can be learnt from the kind of results from research into particular fields in the past. For example, as will be seen in Part Three, most African countries have spent a large amount of money and time on breeding trials - both by selection and by crossing with exotic animals. The results have been mixed, with some substantial productivity increases registered when such animals are compared with unimproved local stock. However, as most researchers in this field will admit, the successful adoption and maintenance of high levels of productivity of these animals by those outside the research station require a level of inputs (disease control, nutritional supplementation, etc.) that precludes them having much impact on overall levels of livestock productivity in these countries. Consideration of past performance in genetics research might lead us to conclude that resources allocated to this field have had a relatively low value in terms of finished output of widely utilisable results and lead us to question the very high proportion of research budgets devoted to this field.

The relative productivity of different research methodologies may also be tested by looking at historical data on research resource allocation. Several writers, such as Crawford (1977), argue that for some kinds of basic research a certain minimum level of effort, or "critical mass", is required if significant progress is to be made. This "mass" must be achieved by concentrating a number of high-quality researchers in a particular field. According to this view spreading resources over a wide area means that the total research effort in a single subject area is insufficient to achieve significant progress. The experience of wheat and rice improvement work would tend to support an argument in favour of limiting research to a few specific issues. This may be a valid model for certain kinds of research, but a decision must still be taken as to which among the possible basic research problems should receive this treatment.

2.3 Major Trends in Livestock Research in Africa

In general, in the past 30 to 40 years, research into livestock production has followed a common pattern in most of the countries looked at in this paper, although some small differences in emphasis exist and the particular case of Zimbabwe stands out as an exception to the rule. Research and development policy towards the livestock sector seems to have gone through three main stages, described in brief below.

1) The Veterinary Phase

Initially, the main forms of research and provision of services were oriented towards the understanding and control of the major epizootic livestock diseases. This can be seen as a consequence of the memory of devastating disease outbreaks like the rinderpest epidemic at the end of the nineteenth century and the very real menace to stock from a number of other diseases. However, with the results of campaigns against many of the major diseases, by 1971 an IEMVT report notes that the nutritional condition of stock in tropical Africa is at least as important a factor as disease in explaining low animal productivity, if not more so.

2) The Scientific and Technological Phase

With much early successful disease control work already accomplished the major research work following World War Two was oriented towards transferring technology that would achieve rapid gains in animal productivity, using as a paradigm the experience of stock-breeding and management developed in Europe and North America. The main emphasis was placed on genetic improvements through breeding and selection and the introduction of management systems and technology developed for commercial producers, such as intensive fattening and ranching schemes. This approach to livestock development parallels similar trends in other sectors of the economy in the 1950s and 1960s during which policy-makers thought that much of the technology required for increased productivity existed and that producers should be persuaded to adopt such techniques by extension and education activities. In terms of Diagram 1 showing the links between technology and

society, the emphasis was heavily on technology as a given and trying to get society to adapt to these new techniques. It is only recently that opinion has shifted towards the alternative approach whereby the direction of research is oriented towards existing social structures and the constraints under which traditional producers operate. A recent document from USAID (1982) sums up one result of this phase: "A principal lesson learned is that the technology promoted in the past often did not overcome or alleviate many of the constraints faced by the small farmer" (p. 11) and the same could be said for the livestock-keeper. A similar assessment is made by Evenson and Kislev (1975) who note that "programmes designed to transplant 'modern' technology continuously came up against the realisation that the technology offered had little or no advantage over the old and traditional methods, given the economic, soil and climatic conditions facing producers" (p. 156).

3) The Reassessment, Farming Systems and Socio-Economic Research Phase

Growing dissatisfaction with the role given to science in society in the late 1960s coupled with critical debate on the impact of many scientific advances on wider measures of social progress led to a re-assessment of the relationship between technology and society. Economic constraints and social institutions became relevant subjects for study, not as parameters that must be changed to fit a particular technology but rather as features of the landscape that researchers may work within. Thus the term "alternative technology" was coined by Schumacher in 1973, implying by this new technologies that would not demand too great an upheaval within existing social structures. In the field of livestock, the long drought period in the early 1970s that hit the Sahel and East Africa gave added impetus to the search for new approaches to livestock research and development. It was seen that little was known about traditional herding systems, actual levels of livestock and pasture productivity and their variability, the social institutions and objectives of traditional producers, and the economic environment and constraints under which they were operating. More emphasis was laid on doing socio-economic research in order to clarify some of the issues brought up by the failure of science to transform the productivity of these systems. In addition, farming systems research developed as a methodology to take account of the complex interaction of socio-economic and

technical factors. It emphasised the need to see how the key elements fit together rather than to focus attention on a single element, as in traditional component research.

In the last few years a strong feeling has been developing that the social scientists have not, however, been able to provide the answers to many of the questions thrown up by earlier work. The current position is one of uncertainty. No single approach seems to offer quick solutions to improving livestock and cropping systems.

PART THREE: LIVESTOCK RESEARCH POLICY IN AFRICA

3.1 Sources of Data for a Study of Resource Allocation to Livestock Research in Africa

Material on the past allocation of resources to livestock research and on research policy comes from a variety of sources. Governments provide estimates of planned expenditure on different kinds of research, in some cases classified in terms of the institute receiving funds. Other government departments, such as the veterinary service or the ministry of agriculture, give some details of research being carried out for each commodity. Research stations themselves give details of staffing levels for different disciplines and of their research programme. Often, however, no financial data are given for the overall budget or for the allocation of funds to different kinds of research. A few studies have been done on the allocation of resources to agricultural research and ISNAR is now trying to collect standardised information on research budgets and manpower according to commodity and discipline for developing countries. ECA has attempted to document the institutes dealing with livestock research in Africa according to their major lines of research, but despite a recommendation that detailed financial and manpower estimates be collected, little progress has yet been made on this.

In 1971, the FAO began a programme, the Current Agricultural Research Information System (CARIS), which aims to produce an inventory of ongoing agricultural research work in developing countries. However, inconsistencies emerge when these data are compared with those from other

sources. This suggests that CARIS does not yet have total coverage of research being undertaken. Finally, for the francophone states of West and central Africa, the documents of the IEMVT provide a certain amount of information on research work in progress and the relative importance of different disciplines.

Several problems arise from the little data that are available. Occasionally figures are given for staff members by discipline but their work may include not only research, but also teaching and the provision of services, such as in veterinary work. Figures may be available on the number of research projects currently being pursued by subject, but whether a piece of research is presented as a single project or a number of related projects is somewhat arbitrary. Data may be available on the funds allocated to different kinds of research but these figures may include capital expenditure, or exclude salaries according to the budgeting system that operates.

Inevitably, the picture presented by the data available is sketchy. A few bold pencil strokes dominate an otherwise bare sheet of paper. However, enough similarity emerges between most of the cases studied to present a reasonable outline of the pattern that research has taken. It might be possible to get much more detailed data by investigating government expenditure accounts if these are broken down in sufficient detail. In addition, up-to-date reports from different research stations might be obtained with details of resource allocation by field, by contacting researchers working in a number of countries and asking for their help in obtaining the necessary documents. It remains to be decided whether this allocation of resources would be worth the greater detail and coherence of the picture that resulted.

Country Studies

The countries chosen for study are the following:

Group I: Senegal, Mali, Niger, Cameroun
Group II: Kenya, Zimbabwe, Botswana
Group III: Nigeria, Tanzania, Sudan

The countries have been grouped on the basis of a number of factors. Group I consists of four francophone states in West and central Africa, Cameroun presenting a greater mix of ecological zones than the three other largely Sahelian states. These countries have maintained strong links with the French veterinary institute, the IEMVT, which continues to play a major if declining role in financing, management, and training of researchers in all aspects of livestock production. Group II is composed of three anglophone states, two of which experienced an extended period of white settlement which resulted in the direction of agricultural research and services to serve the interests of this group of politically powerful commercial farming interests. Botswana, as will be seen later, followed a research policy closely modelled on that of neighbouring Zimbabwe. Group III consists of three anglophone countries in none of which was a European settler class of importance but in which livestock production plays a major role in terms of value of output, contribution to exports or the proportion of the population engaged in this sector. Table 23 in the Appendix summarises basic data on the 10 countries studied.

3.2 Group I: Francophone West and Central Africa

In several countries, an agreement between the national government and France has allocated responsibility to IEMVT for managing the central veterinary laboratory and animal production research institutes, France providing 50% of the finance and many of the professional staff. Some of these arrangements are now changing with the emergence of new research agencies on the scene and a movement away from bilateral links with the former colonial power. However, until recently the IEMVT has had a central role in deciding the kind of research that has been done. A report by IEMVT (1971) outlines the major achievements in animal health and production research up to that date and

compares the changing importance of different issues as research has proceeded. This is illustrated by looking at past and future research needs in disease control, where it is concluded that, for instance, future research on rinderpest can be given a low priority as this seems to be manageable using existing vaccines whereas many of the more complex diseases require a large research input in order to clarify their epidemiology and reduce their impact on livestock. Schwabe (1980) makes a similar point within the Sudanese context, referring to progress made in understanding the pattern and mechanisms of transmission of some diseases, and he concludes that hard research work remains to be done on what he terms the "epidemiologically complex" diseases (p. 42), such as trypanosomiasis and helminthiasis. The IEMVT paper also notes that problems of malnutrition cannot be overemphasised and that these now constitute at least as great a barrier to improving productivity as does disease. In this context, the author outlines the main progress that has been made in the field of nutritions consisting of pasture mapping, analyses of rangeland productivity, grazing behaviour and recent intensive fattening schemes using agro-industrial byproducts. The last he considers particularly fruitful to pursue in low-rainfall zones such as the Sahel where seasonal weight loss in the absence of supplementary feeding may be very substantial.

As far as breeding is concerned, he notes that in the past francophone work has tended to put more emphasis on selection and improvement of local stock breeds, whereas anglophone work has pursued crossbreeding to a greater extent. There has been an almost total disregard of livestock species other than cattle, an orientation similar to research patterns in other countries, and which is presumably justified in the minds of decision-makers by the relative significance of each species in total livestock output.

The research policy of the IEMVT has been strongly influenced by its background as a school for veterinary medicine. Table 1 presents, for 1967 and 1982, the distribution of staff between disciplines which are classified differently in the two Annual Reports for those years. The emphasis does not seem to have changed much over this period, assuming that some of the 55 doctors of veterinary medicine in 1967 were engaged in zootechnical work, an assumption supported by the research results outlined in the report.

Table 1. Distribution of staff by discipline, IEMVT, 1967 and 1982

1967		1982	
Discipline	No.	Discipline	No.
Doc. vet. med.	55	Animal health	30
Pharmacists	3	Zootechnology	20
Agronomists	8	Nutrition	6
Forestry		Agrostology	18
Horticulture, etc.	11		
Total	77		74

Source: Annual Reports of IEMVT, 1967 and 1982.

The substantial importance of pasture research in IEMVT's work can also be seen. The Annual Reports of former IEMVT stations, such as Wakwa (Cameroun), emphasise that research on pasture production has been of continuous importance and an essential input into other livestock improvement, schemes in particular the development of crossbred cattle. The IEMVT (1971) notes the large areas of pasture that have been mapped, the thousands of species that have been identified and analysed, and the many varieties of forage that have been screened in trials. However, as the work of the project Production Primeire au Sahel (PPS, 1982) on Sahelian pastures in Mali has shown, the large body of data collected on pasture composition, species, etc. does not aid the researcher in understanding the fundamental processes accounting for variability in production from year to year.

Livestock Research in Cameroun

Cameroun pr:sents an example of a ountry with reaso..ably detailed data on research expenditure by species and discipline, at least for the year 1980. The figures are presented in Table 2 below. A clearly elaborated policy with respect to livestock research is laid down in government documents. The purposes of the policy are to: identify favourable gene pools for meat and milk production under Camerounian conditions; cross local with exotic gene pools; evaluate the economic application of research results; educate farmers in modern production techniques; improve standards of living and protein supplies; save foreign exchange, and to create employment (ONAREST, 1980).

Table 2. Cameroun : Distribution of budget to livestock research by institute, species and subject matter. ONAREST, 1980. ('000 FCFA)

Subject matter	Total	INSTITUTION/SPECIES		
		Wakwa Cattle	Mankon/Poultry and monogastric stock	Mankon/ Goats
Total budget	99,661	75,954	14,825	8,882
% of total	100%	76%	15%	9%
Feed, nutrition and pastures budget	30,360	20,490	6,725	3,145
% of total	30%	21%	7%	3%
Genetics and breeding budget	50,542	43,075	4,120	3,347
% of total	50%	43%	4%	3%
Vet.med. budget	12,855	8,645	2,550	1,660
% of total	13%	9%	3%	1%
Husbandry budget	3,594	2,394	1,200	-
% of total	4%	2%	1%	-
Technology budget	2,310	1,350	230	730
% of total	2%	1%	0.2%	0.7%

The cattle research station at Wakwa was set up in 1952 while the two other stations dealing with monogastric animals and goats were not established until the 1970s. The recent change in emphasis in research towards animals other than cattle is also seen in the research programme of the University of Cameroun, where in 1973 there was the following distribution of research projects by subject:

Table 3. University of Cameroun, distribution of research projects, 1973.

Discipline	No.
Cattle	5
Sheep and goats	7
Pigs	4
Poultry and rabbits	5
Unspecified animal health issues	1
Pastures	10
Total	32

Source : University of Cameroun, 1973.

Half of the projects concerned species other than cattle. This current emphasis in research is not surprising given the ecology of Cameroun although in terms of the total research budget, shown in Table 2, cattle research still takes three quarters of government funds to livestock research. Of particular importance within the cattle research budget is the place of genetic improvement through selection and crossbreeding experiments, which alone takes up 43% of the total livestock research budget. This work has involved the development of crossbred animals which have proved very vulnerable to streptothricosis. Their vulnerability to illness has shifted research efforts towards selection from local breeds. Work is also being done on ways to control this disease. The central place occupied by breeding work in research budgets reappears for many different countries and deserves brief discussion here.

The decision to engage in breeding work involves a long-term commitment of funds to maintain a large body of animals in good condition and to paying the staff necessary for effective evaluation of the results. When research budgets are under pressure, genetic research tends to take priority because of the previous investments made, and the lack of flexibility in the budget, since animals cannot be sold and re-acquired according to the finance available. For Cameroun, second to genetic work in the budget (Table 2) is research work on feed, nutrition and pastures which account for almost one third of total funds. This is an especially large proportion of the research being done on non-cattle species. Veterinary research plays a relatively minor role, presumably because the country relies on supplies from one of the major IEMVT laboratories in Africa. Neither research on herd management nor on processing technology play any significant role in total budgets.

Livestock Research in Senegal, Mali, Niger

The continuing importance of veterinary research in two of these countries may be seen from Table 4, which presents the number of research projects by subject in the livestock sectors of Senegal and Niger.

Table 4. Distribution of livestock research projects: Senegal, 1974 and 1978, and Niger, 1973.

Country/year	No. of projects	Of which on animal health	
		No.	%
Senegal 1974[a/]	31	18	58
Senegal 1978[b/]	51	32	63
Niger 1973[c/]	9	5	56

Sources: Senegal 1974[a/], Boeckm et al, 1974.
Senegal 1978[b/], CARIS, FAO, 1978.
Niger 1973[c/], CARIS, FAO, 1973.

Table 5 presents the breakdown of livestock research projects being undertaken in Senegal in 1974, from which it can be seen that, after veterinary research, work canbreeding is next in importance.

Table 5. Distribution of research projects by discipline Senegal, 1974.

Discipline	No. Projects	%
Health	18	58
Breeding	6	19
Nutrition & production	4	13
Agrostology	3	10
Total	31	100

Source : Boeckm et al, 1974.

The emphasis on animal health is also seen for Niger from figures given on the distribution of government staff between veterinary and livestock research, in Table 6.

Table 6. Distribution of research staff employed by the Ministry of Livestock Development, Niger, 1974.

Posting	Senior Staff	Assistants	% of total staff
Vet. Labs	14	27	80
2 cattle research stations	2	3	10
1 goat research station	1	-	2
3 poultry research stations	1	3	8
Total	18	33	100

Source : Niger, Ministere de l'Economie Rurale, 1974 Annual Report.

For Mali, data on research by the veterinary laboratory is not included; of the 11 projects under way in 1979, 7 were for genetics, 2 for nutrition and 2 for pastures (Mali/CRZ 1980). However, too much attention should not be paid to the number of projects recorded for each discipline since projects may differ greatly in size. In the case of Mali, one of the 2 pasture research projects is that of the Dutch PPS programme, a major research undertaking with numerous personnel of different disciplines and many different components within the work programme.

The central importance of foreign or international research institutes in total research resources available to Mali is seen by a breakdown in total resources allocated to livestock research for 1979 (in Table 7).

Table 7. Percentage of research expenditure in Mali, 1979, by source.

Source	% of research expenditure
ILCA	61
Holland/(Pasture Research Programme)	15
France/(Artifical Insemination Programme)	3
Mali government	21
Total	100

Source : Mali/CRZ, 1980.

Comparable data are not available from elsewhere, but these figures would suggest a major budgetary problem at the national government level. This report by Malian livestock researchers (CRZ, 1980) also notes the increasing share of the research budget taken up by fixed wage and salary costs, leaving little or no funds available for other costs. For example, in 1966/67 salaries and operating funds were in roughly equal proportion whereas by 1978 salaries were six times the funds available for operating costs.

Breeding and Selection

Breeding and selection still retain an important place in livestock research. The tendency has been to emphasise selection and observation of indigenous breeds. In Mali, selection concerns the performance of local Fulani and Maure cattle as well as the Sahiwal. Senegal, while continuing with crossbreeding trials of local Zebu and Pakistan breeds, has stated that its policy is to discontinue crossbreeding with exotic animals because of their low resistance to disease (Marches Tropicaux, 1982). In Niger little crossbreeding work has been attempted. The main animal research station concentrates on selection of local Azaouak cattle. In the 1940s work was started on introducing Astrakhan sheep but this was soon abandoned because of their great susceptibility to disease. The current goat breeding programme at Maradi concerns the indigenous red goat.

Species Distribution of Research

In the past most emphasis has been given to cattle, particularly to beef animals, in breeding, nutrition, management and disease control research. One or two pieces of research looked at sheep and goats, poultry and pigs, but it was not until the 1960s and 1970s that more work has been done on these species.

The distribution of health projects by animal species in Senegal may be seen from Table 8. The figures tabulated continued emphasis on cattle, although multi-species disease research is also a significant component.

Table 8. Distribution of livestock health projects[a/] by species in Senegal, 1978 (%).

Species	% of health projects
Multi-species	28
Cattle	44
Sheep and goats	9
Horses	6
Poultry	12
Total	100

[a/] Total number of livestock health projects = 32.

Source : CARIS, 1978.

In the past, horses came in for a lot of offical interest, especially during the early colonial period. As early as 1897 the governor-general at Dakar suggested the establishment of studs throughout France's West African territories to promote the improvement of local horse breeds by the use of imported Arab stallions. Work on breeding race-horses, for example, was begun in Senegal in the early part of this century (Doutressoulle, 1947).

In Niger even in the 1950s there is still mention made of trying to get more breeding research done on local equine stock and a certain annoyance is expressed that the indigenous population have not responded with enthusiasm to the creation of "societes hippiques" in the major towns (Niger, 1946). Donkeys receive almost no mention in any reports, except for it being noted that some attempt was being made to upgrade local stock by importing breeds from Morocco. Camels, similarly, have been almost totally neglected; Doutressoulle (1947) justifies this lack of attention by their declining usefulness with the development and spread of motorised transport.

3.3 Group II : Zimbabwe, Botswana, Kenya

Livestock Research in Zimbabwe

The material on Zimbabwe discussed here relates almost exclusively to the period before independence in 1980, during which the direction of livestock research was dominated by white farmer interests.

Zimbabwe presents an example where a very firm idea has been held about the role of research institutions in relation to the potential users of results. Du Plessis (1966) notes that the conduct of research should be one of the main functions of the Ministry of Agriculture and that the government should ensure that a high proportion of the value of total agricultural output be devoted to research. It is observed that "agricultural research has paid tremendous dividends to the agricultural industry and to the country as a whole" (Mugwira, 1982), and some results of past livestock research are given showing a rise in the average weaning rate of beef calves from 49% to 60% and of average milk yields from 580 to 740 gallons per cow.

In order to direct resources to different kinds of research an important role in deciding priorities has been played by farmer groups, both through their financial contributions to particular research stations and through formal representation on the Agricultural Research Council which allocates funds to different projects. The main objective of research has been "to attain greater efficiency in agricultural production and consequently better profits for the producer" (Zimbabwe, 1971). Producer participation through the Agricultural Research Council is seen as a significant and necessary element in establishing research priorities since "research work cannot be left to chance or to the whim of each individual worker" (du Plessis, 1966); " it is hoped that research workers in their turn can provide the information that producers need" (Zimbawbwe, 1975).

The main livestock research priorities were laid down in a Cabinet Report on research in 1971 in which the major problem facing livestock production was seen as the interaction between beef animals and the veld in areas of low rainfall and the need for research to understand this system, given the part that beef plays in the country's exports. This orientation is similar to that of earlier research work, which looked at livestock management

techniques compatible with long-term conservation of the rangelands. Du Plessis (1966) notes that veld management research must receive high priority because this type of environment accounts for 90% of the country. Veld management research has concentrated on the relative merits of rotational versus continuous grazing techniques, on bush clearance methods, on intersowing of pastures with legumes, and on the economic feasibility of nitrogen fertilisation of pastures. The importance of research on animal nutrition is also emphasised in Annual Reports of the research stations, and particularly the need to maximise the efficiency of conversion of foodstuffs into meat. This has led to intensive feeding trials aiming at reducing the length of time taken for beef steers to reach slaughter weight and avoiding losses in livestock weight during the dry season.

Data on the distribution of research projects within the Division of Livestock and Pastures confirm this picture of heavy emphasis on beef production and pasture studies. Taking the number of research projects funded by the government for 1975, 1976 and 1979 it can be seen that research in these two areas accounts for 70-80% of the projects carried out.

Table 9. Distribution of research projects within the Division of Livestock and Pastures, as at September 1975, 1976 and 1979.

	1979		1976		1975	
	No of projects	%	No of projects	%	No of project	%
Beef cattle	14	27	27	27	25	32
Pastures	23	44	48	58	37	48
Dairy cattle	3		2		2	
Sheep	4		7		2	
Pigs[a/]	-	29	1	15	7	20
Poultry	8		3		5	
Total	52	100	83	100	77	100

[a/] Research into pigs is carried out by a different department.

Source : Department of Research and Specialist Services. Annual Reports for 1975, 1976, 1979.

Some selection and crossbreeding work has been carried out in order to obtain animals suited to the different environmental regions of the country, but a number of writers emphasise the satisfactory performance of native cattle under ranching conditions (Marandellas, 1966).

Sheep have not received much attention, a policy justified by the observation that Zimbabwe is not sheep country. Dairy cattle have also had little research done on them, a policy that West (n.d.) thinks has been wrong and shortsighted.

Veterinary services and research appear to have received very much less in terms of funding than in the other countries studied here (due to the country's reliance on South Africa for supplies of veterinary products). The operating costs of different services for 1970/71 are shown below.

Table 10. Government expenditure on veterinary services and four livestock research stations 1970/71.

	Expenditure	
	Rhod. $	%
Livestock and pasture research stations	410,422	86
Veterinary services[a/]	60,000	12
(of which research:	18,000)	
Tsetse & trypanosomiasis research	8,500	2
Total	478,922	100

[a/] Including diagnostic services.

Source : Zimbabwe, 1971.

Livestock research policy has been strongly oriented towards the European commercial farming sector although all research stations are said to have paid some attention to the local needs of African agriculture (West, n.d.). Of the four research stations funded in 1971, one - Makoholi - was primarily oriented towards African cattle production, receiving 10% of operating funds disbursed for that year (Zimbabwe, 1971). Some writers argue that the research work done is applicable to both European and African agriculture although, at the same time admitting that the problems faced by many communal areas are far from the same as those for commercial farmers (Matopos, 1965). McCabe (1976) admits that "the research conducted by the Department is of prime benefit to the more sophisticated sectors of the agricultural community" and that expenditure in the communal areas should be for extension and development activities rather than research. A similar view is expressed by the 1965 Annual Report of Matopos Research Station in the following statement: "While the results of research on the station are applicable to both European and African-farmed areas, the sociological and educational problems in the latter are such that the findings can have little impact" (Matopos, 1965).

However, by 1982, it is recognized that the communal areas have received very little attention from researchers and that efforts must be made to re-orient activities towards these regions (Mugwira, 1982).

Livestock Research in Botswana

There are many similarities between the livestock research policy of Botswana and that of Zimbabwe. Both countries have made their priority maximising beef cattle production on the veld under a ranching style of management. The central role of the livestock sector in the Botswana economy was recognized early by the colonial administration and received many more resources than did agriculture. Roe (1980) mentions that a separate Agricultural Department was only set up in 1935/36, some 30 years after the establishment of the Veterinary Department. The grass research station at Morale started work in 1936 and even at the crop research station at neighbouring Mahalapaye some 50% of experimental plots were devoted to fodder and pasture varieties in the 1930s (Roe, 1980).

The early work at the Morale Research Station is described by McKay (1968), the main themes being to determine the level of beef production attainable from the range under different systems of grazing and to assess their effects on the vegetation. However, McKay notes that few valid results emerge from this work due to faulty experimental design, such as insufficient numbers of animals used in trials.

Recent livestock research activity by the Animal Production Research Unit has been well summarized in a number of papers (ILCA, 1982; Pratchett, 1983; de Ridder, 1984). Since independence, research has continued to be oriented towards beef production under commercial systems of production, a procedure which tends to emphasise maximum production per livestock unit rather than per hectare (de Ridder, 1984). Given the important contribution of beef production to the national economy and to export earnings, APRU's research policy has been to support improved and sustained animal production in a semi-arid environment. Dairy cattle have received no attention. Breeding work has focussed on crossing local varieties with certain exotic breeds, a policy that ILCA (1982) finds of questionable value, given their unsuitability for traditional grazing conditions. The veterinary services were set up early

but seem to have done little research until the joint research programme on foot-and-mouth disease started in 1964 with the Animal Virus Research Institute. Up until this time the work of the veterinary services had been limited to diagnostic and extension work, provision of A.I. and the establishment of government breeding herds to upgrade local stock. While the past research emphasis has been to maximise the profitability of beef cattle production, in the last few years there has been the gradual recognition that research must increasingly be oriented to the study of traditional grazing systems in the communal areas. It is acknowledged that such work should take account of the inputs available to and the objectives of livestock-keepers in these areas.

Hitchcock (1982) criticises the lack of research effort in the communal areas and contrasts the minimal orientation of research towards the communal areas with the fact that 85% of the cattle population is held on the communal lands. This highly biased allocation of resources is only explicable in terms of the interests of particular groups in developing commercial beef production and the consequent adoption of technology and strategy from neighbouring states. In addition, it has been and is still widely believed that no livestock management improvements are worth undertaking under communal systems of grazing, so that research should only be oriented towards developing "improved systems of livestock management" that involve some element of fencing and control of stocking rates. The key role of this research orientation on the formation of the Tribal Grazing Lands Policy is stressed by Hitchcock (1982).

Social science research in Botswana has been somewhat better developed than in many countries, (in particular) since the establishment of the Rural Sociology Unit within the Ministry of Agriculture in 1972, and has focussed in particular on the production systems and strategies of producers in the communal areas. However, in a recent report by the Rural Sociology Unit (1980), the authors discuss some of the problems in the relationships between socio-economic researchers and scientific or administrative staff. They admit that the research unit has often not been able to provide "the type of in-depth analysis of local community inter-relationships and attitudes required by the Range and Livestock Management Project, although the Project also proved incapable of adequately utilising the information and guidance which the unit was able to provide " (RSU, 1980). They also describe how

socio economic research results are often ignored where it does not suit the ideas of project planners, citing the case of the Livestock Development Project No.1 that, despite sociological advance warning that the project would not work, was carried through and subsequently turned out to be "anything but a success" (RSU, 1980).

Livestock Research in Kenya

Agricultural research policy in Kenya is described by a number of writers as having been greatly influenced by the pressure that white settler farmers could bring to bear on the relevant institutions, a situation that is seen even more strongly in the case of Zimbabwe. This bias in livestock research can be seen in the heavy concentration of effort on: breeding, on cattle, and in particular on dairy production; and on the medium- to high-potential areas. Even in the post-independence period much of this bias is still present, according to Jamieson (1978), who accounts for this by "the replacement of European farmers in the high-potential areas by wealthy Africans" who have "greater success relative to peasant farmers in placing demands on the research system" (p. 2). Only recently has there been some change in emphasis towards traditional livestock producers, the semi-arid zones and species other than cattle, two examples of the latter being the FAO/UNDP research programme on assessing indigenous breeds of sheep and goats and joint research by IPAL/ICIPE and the University of Nairobi on camels in northern Kenya. However, for 1976-77, Jamieson (1978) produces data on government expenditure for the 22 agricultural research stations funded by the Ministry of Agriculture. These show that of the 12 stations that include livestock and pasture research within their programmes, only two (at Machakos and Kiboko) are concerned with the drier areas that make up such a large part of Kenya's land area. These two stations receive less than 20% of the budget allocated to the 12 stations conducting some livestock research.

The actual content of the research carried out in Kenya is described by Muturi (1981) as being the result of pressures coming from two sources - on the one hand from the demands made by researchers themselves and on the other from the demands of government, farmers and other interest groups for relevant research. He, among other writers, such as Chudleigh (1976), notes that established bodies continue to attract funds regardless of the content of

their research programme. He accounts for this by bureaucratic inertia and the success that some researchers have in lobbying for their own interests. This situation, similar to that observed in many other cases, prompts the government from time to time to inject a sense of purpose into the research process, often by reallocating the responsibility for guiding this process to a newly created body. An overall lack of direction in deciding the allocation of resources to different kinds of research in Kenya is also mentioned in IDS (1974). Priorities are often left to the research workers themselves who provide little or no information on the economic feasibility at farmer level of the work they are conducting. Chudleigh (1976) supports this observation that research results rarely get translated into extension activities. A reason given by Muturi (1981) for the lack of research policy is the poor data base with which to guide decision-makers in allocating resources to different sectors, and he makes a plea for the collection of data that might clarify the consequences of any particular allocation [as has subsequently been described in more detail by Jahnke and Kirschke (1983)].

The allocation of resources to different kinds of livestock research in Kenya is shown in Table 11.

Table 11. Distribution of government funds for livestock research in Kenya, 1979/80.

	Research staff		Budget allocation	
	No.	%	Pound '000	%
Vet. research	73	57	1,674	63
Animal husbandry	40	31	485	18
Range research	16	12	19	19
Total	129	100	2,672	100

Source: Wang'ati, 1981.

From this table it would appear that veterinary research takes the major part of government funds and manpower. However, the veterinary budget includes diagnostic work and the preparation of vaccines, so that its content is not strictly comparable to that of the other kinds of research mentioned.

The allocation of government funds in Kenya to different areas of livestock research for the period 1970-1974 is shown in Table 12, reflecting the great importance given to veterinary medicine and the small budget allocated to range research. A few large items, however, account for the bulk of resources allocated. For example, half of the funds to veterinary research are accounted for by plans to decentralise veterinary work from Kabete to regional laboratories. Similarly, more than 70% of the resources allocated to animal husbandry are for a beef-finishing feedlot project at Nakuru.

Table 12. Planned government Expenditure on livestock research, Kenya, 1970-1974.

	Expenditure	
Research field	Ksh.	%
Veterinary research	900,000	54
Animal husbandry	622,000	37
Range management	145,000	9
Total	1,667,000	100

Source : Kenya Development Plan, 1970-74.

The East African Livestock Survey of 1967 (EALS, 1967) considered continued heavy expenditure on veterinary research justifiable, particularly for those diseases that hamper the development of the meat export industry, such as cysterciosis. When account is taken of the presence of international veterinary research bodies, in particular ILRAD and ICIPE, the very large proportion of manpower going to this field is evident (see Table 13). However, these last two are international research organisations with a much wider mandate than Kenya alone.

Table 13. Distribution of scientific manpower in livestock research by qualification, Kenya, 1979/80.

Research field	BSc	MSc	PhD	Total	%
Livestock[a/]	9	9	1	19	16
Animal production and disease	37	16	29	82	71
Range research	7	4	4	15	13
Total	53	29	34	116	100
Total all agricultural research	107	88	51	306	

[a/] Unspecified livestock research.

Source: Wang'ati, 1981.

More than half of the research workers with PhDs are working in animal production and disease, mainly at the two above named organisations. Overall, livestock research seems to be getting a very high proportion of qualified manpower going to an agricultural research, relative to the proportion of livestock production in total agricultural output (see Table 23).

Data presented by Muturi (1981) and reproduced here in Table 14 show a lesser concentration on veterinary research by government over the plan period 1979-1983 than seemed to be the case from Table 11. This may be because Muturi excludes some proportion of expenditure on veterinary medicine attributable to provision of services rather than to research.

Table 14. Planned distribution of government funds to livestock research, Kenya, 1979-1983.

Research field	Ksh. ('000)	%
Veterinary research	3,177	35
Animal production	3,786	42
Range research	2,021	23
Total	8,984	100
Total agricultural research	40,446	

Source: Muturi, 1981.

Breeding

The East African Livestock Survey of 1967 mentions the very great allocation of funds to breeding programmes, not only in Kenya but also in Tanzania and Uganda. For example, almost all resources at Naivasha Animal Husbandry Research Station are put to breeding work. The authors of the survey consider this a waste of resources, because there are insufficient staff to supervise and interpret results and because "the improvements in production which result from genetic studies on improved or exotic breeds are unlikely to compare with those that result from nutritional and management studies" (p. 138).

Pastures

Pratt (1975) summarises the main gaps in pasture research, emphasising in particular the lack of attention paid to the semi-arid rangelands. He supports his argument for more rangeland research on the basis that these areas cover more than 80% of Kenya's land area, support around half the domestic livestock and provide a habitat for almost all wildlife, on which Kenya's tourist industry depends. He sees the main problems as lying in the management of grazing resources and the need to create viable production systems in the more marginal areas, rather than emphasising increases in productivity based on new technology. An increase in emphasis on the

extensive semi-arid rangelands is in contrast to the policy laid down in the 1974-78 Development Plan which states that research policy must be oriented towards projects where the results in terms of increased farm incomes will be highest and that this means that animal production research should be concentrated in the higher potential areas. These contrasting views are the result of two conflicting rules of thumb. The first argues for a greater proportion of research finance to be spent on those areas that represent a high proportion of total land area and support a high proportion of wild and domestic stock, while the second uses likely productivity growth as the criterion on which to distribute research funds.

3.4 Group III: Tanzania, Nigeria, Sudan

Livestock Research in Tanzania

Tanzania's current livestock research policy is presented in a government paper of 1983 which casts the role of research as being "to identify solutions to constraints which limit the development of the livestock industry" (Tanzania, 1983). The necessary orientation is seen as being towards applied rather than to basic research. Research policy is to be controlled by the Ministry of Livestock Development and the National Science Research Council. However, the policy intends to continue with breeding work on indigenous and exotic stock, as well as more applied work on pastures, nutrition, disease control and farming systems research. This is despite the frequent comments of researchers on the importance of improving environmental and health factors before work on breeding can be successfully put into practice.

MacFarlane (1970) presents for the period 1950-1970 a report on animal production research (i.e. excluding veterinary research) which gives the range of work undertaken in terms of species and discipline, as shown in Table 15.

Table 15. Distribution of research projects under the Ministry of Agriculture, Tanzania, 1950-1970.

Discipline	No. of projects planned		Species or subject matter: Cattle	Sheep and Goats	Poultry	Pasture	Other
Breeding	22	(10)[a]	12	8	-	-	2
Husbandry	33	(14)	18	8	2	4	1
Physiology	28	(4)	18	7	-	-	3
Nutrition	19	(4)	12	3	2	-	2
Total	102	(32)	60	26	4	4	8

[a] Indicates the number of projects abandoned.

Source: MacFarlane, 1970.

Interpretation of these figures in the absence of financial and manpower allocation must be cautious, but a number of points emerge from the table, both about the distribution of research interests and about what happens to different research projects.

Firstly, cattle predominate as the species receiving most research attention with 59% of the research projects. This is understandable given that cattle represent a very high proportion of total livestock units in Tanzania (see Table 23 in the Appendix). Secondly, there is a fairly even distribution of research projects by discipline. Thirdly, a high proportion of projects were abandoned in both breeding and husbandry research. Reasons given for this include: changes in policy (accounting for the giving up of research on pigs and several small ruminant projects) and staff shortages which account for the four poultry projects abandoned. MacFarlane notes that even of those projects that were carried out, many were not properly pursued, analysed and written up.

A collection of research station reports for the 1970s gives a varied picture of the range of research being carried out, as is shown in Table 16 below. The data in for the first three stations indicate that a considerable amount of manpower is going into breeding work but that husbandry and nutrition are given equal attention. The geographical position of the station obviously has an influence on the content of the programme. West Kilimanjaro stresses work on dairy production while Mpwapwa's research bias is towards beef production and the development of feeding systems in prospect of the need to quarantine steers before export. Tanga on the other hand is concerned with looking at cattle production in humid coastal regions. There seems to be little work done on pastures and grazing management apart from the case of Mbeya, where the bulk of the research projects are concerned with this subject. However, the Mpwapwa Annual Report of 1975 does include a statement of change in policy from emphasis on breeding to wider questions concerning animal production.

Table 16. Distribution of research officers and projects for four research stations in Tanzania in the 1970s.

Station	Year	Number of officers	subject matter	
Tanga	1978	3 of which:	All breeding Work	
West Kilimanjiro	1973	9 of which:	Animal production	4
			Dairying	2
			Disease and AI	3
Mpwapwa	1974	13 of which:	Breeding	5
			Ruminant nutrition	2
			Pig production and nutrition	4
			Grazing management	2
		Number of projects		
Mbeya	1978/9	44 of which:	Husbandry	3
			Breeding	1
			Health	5
			Nutrition	5
			Pastures	30

Sources : Annual Reports for the respective research stations.

Livestock Research in Nigeria

Nigeria presents a case where a considerable amount of research has been done and where a large number of institutions are currently involved in various aspects of livestock research.

The National Plan objectives for livestock production and for research policy include: to achieve self-sufficiency in livestock products, to improve rural

incomes and human nutrition and to maintain the ecosystem in balance (Ademosun, 1976). The objectives of the National Animal Production Research Institute (NAPRI) at Shika are more precise, and include genetic and nutrition research on species of economic importance. There is considerable debate on the criteria to be used in allocating research funds to different fields. Idachaba (1981) argues that the livestock sector has received too great a proportion of the research budget in terms of its relative importance in total production. However, Ademosun (1976) considers that insufficient attention has been paid to research in this field in comparison with other areas of agriculture and, within the livestock sector, that sheep and goat research has been neglected. This point is also made in a report by the Ministry of Agriculture (1974) on agricultural development policy for 1973-1985, recommending that far more research should be done on sheep and goats, given their small size, reproduction rates and their capacity to subsist on waste products.

The balance between research and extension activities in Nigeria is discussed by a number of writers. Ademosun (1976), for example considers that too much emphasis has been placed on work done at research stations without considering how to apply and disseminate the results to the population. Von Kaufmann (1981), in considering the role that ILCA should play, presents a similar analysis, finding a major gap between the research station and the farmer, with very little work done on transforming research results into practical techniques.

The high proportion of resources going into veterinary research is noted by Ademosun (1976) and he accounts for the concentration of research on veterinary work by the composition of the National Livestock Development Committee which is staffed by veterinarians and administrators. He recommends that a greater balance in the committee's composition (including those with a background in husbandry, nutrition and range management) would ensure a better allocation of research resources. The consequences for livestock research policy in Nigeria of being run largely by veterinarians was noted as early as 1950 by Shaw and Colville. They account for the role of this group by circumstances, such as the Second World War, which left veterinarians in charge of the livestock services, and by the evidently important historical role that veterinary medicine has played in improving conditions of livestock production, leading to close relations and contacts

between the veterinary department and livestock-keepers. They recommend that veterinary work should only be considered a subsidiary part of the livestock services and that staff levels be increased in the fields of husbandry, genetics and economics. However, data on the distribution of funds to the different research institutes continue to stress veterinary work as Table 17 demonstrates.

The animal production station, NAPRI, accounted for 15% of the budget in both 1965/66 and 1977/78 while the majority of resources went to animal health research and training at the Trypanosomiasis Research Institute (NITR) and the Veterinary Research and Training Laboratory (NVRI) at Vom. A substantial allocation of funds in 1977/78 went to the Leather Research Institute (LRIN). Comparable data for 1965/66 were not found for this institute.

Table 17. Distribution of funds to government livestock research institutes, Nigeria 1965/66 and 1977/78.

		1965/66[a]		1977/78[b]	
Institute	Field	Nigerian Pound	%	Naira	%
NVRI	Vet. Med.	252,450	54	7,472,360	41
NITR	Tryps.	143,825	31	4,546,000	25
NAPRI	Production	70,509	15	2,640,000	15
LRIN	Leather	n.a.		3,477,576	19
Total		466,784	100	18,149,936	100

Sources: [a]: Peterson, 1966.
[b]: Idachaba, 1981.

Data on the distribution of manpower at the Veterinary Research Institute at Vom for 1976 tend to confirm a heavy emphasis on health work, although some breeding and nutrition work is also carried out (NVRI, 1976). As shown in Table 18, out of a total of 24 research officers, excluding teaching and diagnostic staff, animal health researchers account for 16. Peterson (1966) in his study of agricultural research in Nigeria lists the functions of the

Vom station in order of priority as: (i) the training of students; (ii) the production of vaccines; and (iii) involvement in research. He finds that research programmes have been highly vulnerable to staff turnover, with changes in emphasis according to arrivals and departures. Beck (1967) finds research at Vom in 1966 at a standstill due to lack of staff. This relative lack of emphasis on research was upheld by the then Director of the station who argued that a large body of research results had accumulated over the years which as yet had not been put into practical use and that, rather than continue engaging in more research, resources should go into educating producers on the use of new techniques.

Table 18. Distribution of staff by subject at the Veterinary Research Institute in Vom, Nigeria, 1976.

Field	No. of research officers
Animal production	4
Biochemistry	4
Bacteriology	6
CTVM, Edinbourgh[a/]	3
Parasitology	3
Virology	4
Total Research Staff	24
Teaching staff	5
Diagnostic staff (including outstations)	13

[a/] Centre for Tropical Veterinary Medicine.

Source : NVRI, 1976.

Beck (1967) takes up this point in his report on the priorities for Nigerian agricultural research and argues strongly in favour of continued resource allocation to research, supporting his case by the observation that in many fields of livestock production little or no information is actually available

and that the long-term development of the livestock sector is heavily dependent on continued research. The lack of socio-economic research on agricultural production in West Africa is noted by Herrmann (1969); he considers that social and economic factors constitute one of the strongest deterrents to productivity growth, particularly in the case of livestock. A certain amount of socio-economic work has been done in this field, including the work of Stenning (1959) on the WodaaBe in the 1950s and of de St. Croix (1945) and later researchers such as Fricke (1978).

Species distribution

Peterson (1966) reviews the livestock research programmes in different regions of the country in the 1960s conducted by the Ministry of Agriculture and by universities, and he approves the concentration of resources in the old Western Region on dwarf breeds of cattle and small stock, poultry and swine, given their regional importance (see Table 19).

Table 19. Distribution of research projects by species
Ministry of Agriculture, Western Region,
Nigeria, 1965/66.

Species/field	No. of projects
Dwarf cattle	20
Swine	5
Sheep	2
Pastures	6
Total	33

Source: Peterson, 1966.

In northern areas, the research emphasis has been almost entirely on cattle. Work at NAPRI has concentrated on these animals until very recently.

Breeding Research

The Institute for Agricultural Research at Samaru has been the major body conducting research in the northern part of the country, and the importance of livestock research within this programme can be seen in the distribution of staff between the different sectors shown in Table 20. Animal sciences account for 27% of all research officers.

Table 20. Distribution of senior staff by subject matter, IAR, Samaru, 1965/66.

Subject matter	No. of research officers	%
Central services	17	22
Plan science	26	34
Animal science	21	27
Soil science	6	8
Agric. economics	7	9
Total	77	100

Source: Peterson, 1966.

The following figures were available for 1968/69, shown in Table 21, giving a breakdown of manpower to different disciplines. It is noted that the main aim of the husbandry and animal science research programme has been crossbreeding of Friesian and local Fulani cattle to develop milk production. An additional aim has been the establishment of three indigenous breeding herds for stud purposes. In the light of the early research plan to monitor the performance of selected local breeds under optimal management conditions, research into fodder and use of supplements started alongside breeding and selection work, as an integral part of that programme.

Table 21. Distribution of livestock research officers by subject matter at Shika (NAPRI), 1968/69.

Field	No. of Officers
Animal sciences	4
Animal husbandry	5
Grasslands research	2
Biochemistry/nutrition	2
Total	13

Source : IAR, 1969.

Breeding work in general is subject to much criticism from various authors. El-Shimy (1969) notes that in the work at Vom there was no consistent breeding policy and that no breeding programme was fully executed before being replaced by another. The Department for Veterinary Research makes a similar comment for 1964/65, stating that the long-term research programme carried out between White Fulani and various exotics had been poorly managed, and an indiscriminate amount of crossing had been allowed to occur. In a report from 1950, having noted that livestock production problems should be the work of the animal nutritionist rather than the geneticist, the recommendation is made that selection and nutritional work on local breeds should take priority over crossbreeding work using exotic animals (Shaw and Colville, 1950). The report states that "no serious effort seems to have been made in the last 20 years to collect and collate evidence on the economic potentialities of the indigenous stock under controlled conditions and on a higher place of nutrition: no investigation has been made of those many factors which at present might be regarded as placing limitations on livestock productivity" (p. 24, Shaw and Colville, 1950). This is a fairly strong attack on colonial livestock research and development policy and prescient of similar views not expressed until many years later. In their assessment of overall agricultural policy the authors note the lack of any coherent strategy, the impetus behind improvements in productivity having derived from the need to feed troops during two world wars. They conclude that "improvisation rather than planning has been at the root of livestock policy, if indeed there can be said to have been a policy at all" (p. 17).

Livestock Research in the Sudan

Sudan presents an example of a strong and thriving tradition in the provision of veterinary services and the conduct of research; this service is said to be the only agricultural extension service with a well-developed network in the country (IBRD, 1979). Since 1960 there has been a Sudanese Veterinary Journal for the publication of research results in this field, and the continuing importance of research is evident from the large volume of material and studies documented in the Annual Report of the Chief Veterinary Officer. It is however unclear how this is achieved, for in the Veterinary Service Annual Report of 1976, of the 45 staff members with a BVSc or above, 27 (i.e. 60%) are on study leave abroad.

Gameel and Yousif (1975) stress the importance of veterinary work and research in controlling livestock disease in the Sudan, not only because of the economic cost from livestock deaths, but also because control of certain diseases is essential in the development of the Sudanese meat export industry. The authors note the high percentage of condemned carcasses. The FAO (1973) also mentions the importance of research and development in the livestock sector since not only does the sector provide for exports and help to meet growing domestic demand for dairy products, but it also provides a livelihood for much of the population, many of whom are in the least developed regions of the country. However, it is also pointed out that any improvement in the performance of the livestock industry is dependent on improving transport and communications, marketing systems, pricing policies and processing facilities, in addition to the development of new technologies.

Khalil (1960) confirms that in the past all the efforts of the Ministry of Agricultural Resources have been devoted to the control of the major epizootic diseases, at the expense of an almost total neglect of research on animal husbandry and range management. However, by 1960, six research stations had been or were about to be set up as well as nine poultry farms. Research at these six animal research stations concentrates on selection of local cattle breeds, intensive fattening-schemes for cattle and sheep, a dairy research centre and the screening of forage plants. Table 22 shows the distribution of research projects by subject area for the Sudan in 1978. The continuing importance of veterinary research can be seen, and a substantial body of work seems to be being done in the usually neglected area of meat processing, marketing, etc.. However, as with all other data on research projects, the breakdown by project does not necessarily correspond with an equivalent distribution of manpower and finance.

Table 22. Research projects current in the Sudanese livestock sector in 1978.

Subject area	No. of projects	%
Veterinary research	39	61
Meat production, processing and marketing	11	17
Nutritional performance of beef cattle, digestibility trials	11	17
Breeding Kenana cattle	1	
Forage legume screening	1	5
Rangeland monitoring	1	
Total	64	100

Source : FAO (CARIS), 1978.

In general, the research policy has been biassed away from production in the traditional sector and most work has been done on cattle, despite the fact that camels, sheep, and goats also are of considerable importance for this country. The main aim of research has been to increase meat production using feedlots and irrigated pastures. Ferguson (1969) justifies this research bias in terms of the likely rates of technology adoption, in the following statement: "It is however reasonable that the highest priority should be given to research for schemes which are or will be highly developed, or highly capitalised, rather than for traditional agriculture and animal husbandry, where there is greater difficulty in getting the findings adopted and there is likely to be less at stake" (p. 64). The IBRD (1979) notes a similar tendency in crop research in which the emphasis has been on station-based research of little relevance to the traditional sector. A further point made by IBRD (1979) is that research has been conducted on compartmentalised lines, by discipline, with little or no interdisciplinarity. They explain this by the way in which different areas of research are allocated to separate ministries and recommend commodity wide research boards to be set up.

PART FOUR: CONCLUSIONS AND IMPLICATIONS

Conclusions on the past pattern of resource allocation to livestock research must necessarily be cautious, given the low quantity and quality of data available on this subject. Only limited information could be found on the distribution of finance, manpower and projects between different species and disciplines. Alternative sources of material came from statements of government policy and from the observations of contemporary observers. In order to identify major differences in the direction of past livestock research policy the 10 countries studied were classed into three groups. Part Four starts with a discussion of the findings for each group and the factors accounting for differences in the past pattern of research resource allocation. It then considers how governments have sought to justify the direction that research policy has taken and notes some of the practical difficulties faced by national research institutions. Part Four continues with an assessment of ILCA's research policy in the light of conclusions emerging from the country studies. It ends with proposals for further work that could usefully be done on livestock research policy to gain a greater depth than has been possible in this report.

4.1 Conclusions from the Country Studies

Three countries made up Group II - Zimbabwe, Botswana and Kenya. The experience of this group demonstrates how strong an influence may be exerted on the research community by a well-organised group of producers. In the cases of Zimbabwe and Botswana, certain producers, by participating in the research process, have had a major role in directing research towards subjects of immediate relevance to the profitability of their farming enterprises. Since beef cattle play such an important part in the economy and trade balance of both countries, research has been oriented towards maximising output of meat production under extensive grazing conditions and achieving optimal levels of nutritional and mineral supplementation. In contrast to the organised commercial livestock sector, traditional livestock producers have had little possibility for making demands on the research system for the pursuit of work relevant to their needs. Kenya presents a more mixed case, in which, while much of the budget has been committed to research for the high-potential areas of commercial livestock production, there has also been heavy investment in veterinary research.

The experiences of the seven countries making up Groups I and III (Senegal, Mali, Niger, Cameroun, Nigeria, Sudan and Tanzania) show what happens to the research process in the absence of a powerful producers' lobby to guide resource allocation. In these cases, members of the research community themselves have often been instrumental in determining the overall direction that research policy has taken. The history of livestock research demonstrates the power that a particular discipline can wield in acquiring funds and establishing itself as having a monopoly on the most appropriate expertise. This is particularly noticeable in the case of veterinary medicine which in most cases takes up a large proportion of the budget for livestock research and services. Scheper (1978) accounts for the heavy concentration of resources in this field as a consequence of the controlling position in livestock departments that veterinarians established for themselves during the earlier colonial period. In most cases, the central position of veterinary medicine remains unchallenged, although there has been a shift in emphasis at the margin in terms of resources allocated to other aspects of livestock production, such as husbandry and socio-economic work. Cameroun presents an exception to this rule, with a low proportion of the research budget spent on animal health, presumably because the country imports its medical supplies from elsewhere.

After veterinary work, breeding and genetic research take up a large part of livestock research resources, due to the high cost of maintaining the large herd required in good nutritional and health conditions. Much nutritional and pasture research has been an integral part of any breeding programme so that the overall proportion of resources going into genetic work is greater than the strict breakdown of resources to different disciplines would imply. Such breeding programmes are a long-term inflexible commitment of funds to an aspect of livestock production improvement that has had very limited impact on the majority of livestock-keepers in tropical Africa. That so many resources have gone into this field is probably due to the tendency, noted earlier, for research and development policy to have been heavily influenced by technologies and forms of management practised by stock-keepers in Europe and North America. In these latter areas where animal health and nutrition can be closely monitored, selective breeding programmes have been an important source of productivity growth for the livestock sectors. However, in the African context many writers have questioned the continued emphasis on

costly and often inadequately controlled genetic work and have recommended that research funds should be re-directed towards improving nutrition and methods of husbandry.

Government policy towards the overall allocation of resources within livestock research tends to be guided by simple rules of thumb. For example, the Kenya Government, using expected productivity growth as its criterion, argues that the main thrust of research should continue to be on the medium- to high- potential areas (Kenya, 1970). The Cameroun Government justifies a recent shift in livestock research policy towards hitherto neglected species (pigs, poultry and goats) by the latters' relative importance in the more humid areas of the country. In Zimbabwe and Botswana, the importance of beef exports to their economies has meant that most resources have been allocated to research of use to large-scale commercial beef producers. Use of a single criterion for allocating resources between species and regions inevitably produces disagreement, since critics of the established policy can argue that a different criterion should have been used. For instance, in the case of Nigeria, Ademosun (1976) thinks that research on sheep and goats has been unjustifiably neglected, given their relative numbers and their wide distribution. In the case of Kenya, Pratt (1975) regards the lack of work done on the semi-arid rangelands as a mistake because these rangelands cover a very large part of the country and they support a high proportion of its wild and domestic stock.

A case can be made in favour, or against, almost any allocation of resources by the careful selection of a single criterion as the basis for decision-making. This has led several writers to seek a more satisfactory decision-making system that is able to take account of multiple criteria. Idachaba (1981), for example, recommends the collection of certain kinds of data for different crops or livestock species (e.g. their role in export earnings or in contributing to nutritional needs). This data collection, similar to that suggested by Jahnke and Kirschke (1983), would help establish research priorities by indicating the current relative importance of different kinds of animal in, say, meeting food requirements, in providing employment or in earning foreign exchange. A scoring model, incorporating a few key objectives, could then be used to decide on the allocation of resources between different kinds of research.

National livestock research organisations are in many cases very short of funds and a large part of the budget is often absorbed by fixed costs, such as staff salaries. This leaves little available for the actual operating costs of conducting a research programme. The high cost, already noted, of establishing and maintaining breeding stations adds an extra burden of inflexibility to research budgets. The case of Mali was noted in particular, firstly for the very high share of funds going into staff salaries and, secondly, for the very large part played by external finance in funding livestock research in the country.

4.2 Implications for Research Policy from the Discussion of Decision-Making Models and of Past Patterns of Resource Allocation to Livestock Research in Africa

1) Part One looked at the advantages and drawbacks to different decision-making models in helping guide resources between alternative lines of research. It was concluded that a simple kind of scoring model would be of use in assessing the contribution of different research projects to meeting given objectives. National governments in consultation with ILCA could establish priority objectives for different areas. Research work at ILCA could then be assessed in relation to these priorities and research workers asked to estimate the extent to which current or proposed research would achieve those objectives. It would be a valuable exercise for both researchers and policy-makers to follow through the implications for productivity, prices, welfare distribution, etc. of concentrating on particular kinds of research work.

2) The optimal amount of time to be spent on research appraisal needs to be decided. It was suggested by Anderson and Parton (n.d.) that a larger amount of time should be spent on deciding what kind of research to fund in situations where there were many potential areas for research, a high degree of uncertainty about the outcome of different lines of research and a wide number of views and objectives to take into account. In theory, appraisal of research policy should be pursued up to the point where the marginal benefits equal the marginal costs of this procedure. In practice, it will be difficult to determine this optimum point, but it would probably be agreed that a quarter of a researcher's time would be too great a share to be spent on the appraisal, rather than the pursuit, of research. Conversely, a policy

of zero time spent on research appraisal would find few supporters. A reasonable figure would seem to lie in the 5 to 15% range, some people devoting more time and others less to this procedure. However, all research workers would be expected to spend some time considering the alternative research projects that they could undertake and justifying a particular research choice in terms of various criteria.

3) There is some discussion in the literature on the correct balance of resources to allocate to basic as opposed to applied research. Definition of these terms is far from clear-cut. In general, basic research appears to be working within a longer time horizon, to be locationally non-specific and for its results to be potentially more uncertain. In contrast, applied research tends to involve work on a practical problem or the adaptation of technology to a specific location in a context where there are fewer unknown parameters. A choice as to the balance between the two kinds of research must be made because they both compete for scarce funds. They are also, in part, complementary. On the one hand, basic research receives guidance from the practical issues facing more applied work, and on the other hand applied research is the means by which basic research results are developed into practicable technologies. Most national agricultural research programmes are strongly applied in approach (EALS, 1967; Putt and Shaw, 1982). Muturi (1981) in the Kenyan context recommends that only 5% of government funds be used for basic research and that the predominant focus of national institutes should be towards the development of immediately utilisable technologies. Set against the immediate constraints faced by national governments, ILCA would be justified in devoting a larger percentage of expenditure to basic research. What that figure should be is not clear. Should basic research take up as much as half of the research budget and, if not, should it be a third, a quarter or a fifth? Whatever the chosen figure, be it 20 or 30%, there is a strong argument put forward by writers such as Crawford (1977) for concentrating these resources on a few specific basic research issues, rather than spreading resources thinly over a wide range of problems. This argument is based on the idea that there is a threshold level for the investment of time and manpower in a particular research area and that below this threshold, the probability of gaining useful results will be very low. Choice of those few alternative lines of basic research, however, remains to be made. If the talent of scientists is especially important in basic research, choice of the projects to be financed might need to depend on the capacities of staff

currently employed or that could be attracted from elsewhere.

4) Much of the argument about the allocation of the budget between basic and applied research applies equally to deciding on the right balance of resources between headquarters and country programmes. A number of writers, such as Schultz (1977), argue strongly that history shows the importance of research being conducted in close relation to the relevant producers. Fishel (1971) also notes in the past that "the principal contribution often came about because scientists had the ability to propose research relevant to specific local producers". Isolation from communities in which the results of research are supposed to be applied is unlikely to produce relevant or useful work. This is a strong argument for the support of well-funded country programmes by ILCA. Set against this is the concern expressed by the 1981 Quinquennial Review team for the need for greater direction of the country programmes by senior research staff at headquarters. This justifiable concern for scientific excellence should nonetheless be tempered by the need to maintain strong contacts between the research community and those producers demanding and consuming the results of that work.

5) The relationship between ILCA's work and that of national governments must also be looked at. The direction of research policy in countries like Zimbabwe and Botswana has been strongly influenced by a powerful beef producers' lobby. In cases like these, one could argue that ILCA should direct its attention to the research needs of livestock-keepers who have little or no influence on national research policy. A similar conclusion would be reached if ILCA were to decide to give priority to research in those areas and subjects that have been relatively neglected. However, one possible disadvantage of such an approach could be that neglected areas have received little work done on them for good reason. It may, for instance, be the case that the possibilities for achieving large gains in productivity and marketed output will be much lower for marginal, small-scale livestock producers than for commercial farmers in higher rainfall zones.

6) A further consideration for ILCA to take into account in deciding the allocation of resources to different kinds of research is how far it needs to bow to the views of its funders. ILCA is obviously vulnerable to having its funds cut off were it to stray substantially from its mandate. ILCA could benefit from the development of a consistent methodology in the assessment of

the research it carries out, a methodology that would indicate to its funders the logic of its research programme in relation to the objectives that the organisation aims to achieve. However, despite a consistent methodology for guiding resource allocation between different kinds of research, donors could nonetheless disagree with the emphasis given to different objectives within ILCA's mandate. For example, different donors could place widely varying emphasis on the pursuit of fast productivity growth as against raising the incomes of the poorest section of the population. These are the weights that must be decided on before a scoring model can be used. Decision-making models do not help with a conflict of opinion of the sort described here. They can, however, help clarify the size and nature of the consequences flowing from the choice of one allocation of resources when compared to another.

4.3 Suggestions for Further Work

This study has been limited by the short time and patchy data available. In the future, it might be worth looking at the following:

(i) The distribution of ILCA's past and current research budget in the light of some of the issues discussed here.

(ii) A more detailed survey of two or three countries, made possible by an intensive search for data in government budgets and research station reports. This survey would investigate how research priorities have been laid down and the consequences of these priorities for livestock productivity and development.

(iii) A case study of the rate of return to investment in livestock research in tropical Africa. There appears to be no case study yet done on this topic within the African context, in contrast to the considerable amount of work done on the returns to agricultural and livestock research, particularly in North America. Choice of the case study would have to depend on data availability.

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APPENDIX

Table 23. Distribution of livestock by species, selected in African countries, 1979.

Country	Total live-stock units ('000)	Of which: Cattle	Sheep	Goats	Other	& of livestock in agric. GDP
Botswana	2,475	93%	2%	5%	-	n.a.
Cameroun	2,512	84%	9%	7%	-	9.9
Kenya	8,729	84%	5%	5%	6%	34.8
Mali	4,512	69%	13%	13%	5%	36.3
Niger	3,317	63%	8%	19%	10%	29.8
Nigeria	11,715	72%	7%	21%	-	11.0
Senegal	2,256	87%	8%	4%	1%	21.3
Sudan	17,550	69%	10%	7%	14%	36.3
Tanzania	11,480	93%	3%	4%	-	24.5
Zimbabwe	3,781	93%	2%	5%	-	35.7
All tropical Africa	137,308	75%	7%	9%	9%	17.4%

Source: Jahnke, (1983).