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# Capacity for Forestry Research in the Southern African Development Community

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**The CGIAR System**

The Consultative Group on International Agricultural Research (CGIAR) is an informal association of 41 public and private sector donors that supports a network of sixteen international agricultural research institutes, CIFOR being the newest of these. The Group was established in 1971. The CGIAR Centers are part of a global agricultural research system which endeavour to apply international scientific capacity to solution of the problems of the world's disadvantaged people.

**CIFOR**

CIFOR was established under the CGIAR system in response to global concerns about the social, environmental and economic consequences of loss and degradation of forests. It operates through a series of highly decentralised partnerships with key institutions and/or individuals throughout the developing and industrialised worlds. The nature and duration of these partnerships are determined by the specific research problems being addressed. This research agenda is under constant review and is subject to change as the partners recognise new opportunities and problems.

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# Acknowledgements

This study was undertaken in ten of the twelve countries comprising the Southern African Development Community (SADC), with visits made to eight of them. Twenty-eight institutions were visited and two mailed data. The authors wish to thank the institutions and the many scientists who by generously supplying the data for this work and participating in a workshop which discussed the study findings re-affirmed its relevance to the region.

The Division of Forest Science and Technology (FORESTEK) of the Council for Scientific and Industrial Research (CSIR) of South Africa has been the CIFOR collaborator in this work. Together with CIFOR, FORESTEK developed a concept for this study in 1994, which was later developed by the authors into a research project. FORESTEK also participated in many other ways including the organisation of a workshop in which the results of this study were discussed. The authors would like to thank FORESTEK for these and many other contributions, which confirmed that collaborative research in the region is both workable and effective.

# List of Abbreviations

**A. General:**

| | |
|---|---|
| ANR | Agriculture and Natural Resources |
| CIFOR | Center for International Forestry Research |
| CSIR | Council for Scientific and Industrial Research |
| FORESTEK | Division of Forest Science and Technology |
| FSTCU | Forestry Sector Technical Co-ordination Unit |
| FTP | Forestry Training Programme |
| IARCs | International Agricultural Research Centres |
| LAN | Local Area Network |
| LDC | Less Developing Country |
| NARS | National Agricultural Research Systems |
| NGO | Non-Governmental Organisation |
| SACCAR | Southern African Center for Co-operation in Agricultural and Natural Resources Research and Training |
| SADC | Southern African Development Community |

**B. In relation to tables, figures and annexes:**

| | |
|---|---|
| CEF | Centro de Experimentacao Florestal, Mozambique |
| FAB | Forestry Association of Botswana |
| FORESTEK | Division of Forest Science and Technology, S. Africa |
| FRIM | Forestry Research Institute of Malawi |
| ICFR | Institute for Commercial Forestry Research, S. Africa |
| IRA | Institute of Resource Assessment, University of Dar es Salaam |
| LESOTHO | Forestry Division, Ministry of Agriculture, Lesotho |
| NAMIBIA | Directorate of Forestry, Ministry of Environment and Tourism, Namibia |
| NTSP | National Tree Seed Programme, Tanzania |
| SUA | Sokoine University of Agriculture (Faculty of Forestry), Tanzania |
| TAFORI | Tanzania Forestry Research Institute |
| UEM | Universidade Eduardo Mondlane (Department of Forestry), Mozambique |
| U. STELL | University of Stellenbosch (Faculty of Forestry), S. Africa |
| USUTU | Usutu Pulp Company Ltd., Swaziland |
| U. ZAMBIA | University of Zambia (Biological Sciences Department) |
| U. ZIM | University of Zimbabwe (Biological Sciences Department) |
| VELD | Veld Products Research, Botswana |
| ZAMBIA | Division of Forest Research & Division of Forest Products Research, Department of Forestry, Zambia |
| ZIMFC | The Forestry Commission, Zimbabwe |

# CAPACITY FOR FORESTRY RESEARCH IN THE SOUTHERN AFRICAN DEVELOPMENT COMMUNITY

G.S. Kowero and M.J. Spilsbury


## *Executive Summary*

*In 1995 a survey of research capacity was conducted at institutions undertaking forestry-related research in the SADC countries. This document presents a review of the methods available for the assessment of research capacity and summarises previous efforts to assess research capacity in the region.*

*The methodology adopted makes use of common indicators thereby allowing comparisons across institutions. The results of the survey are discussed and re-emphasise the need to prioritise manpower recruitment, training and development; only about half of the scientists researching forestry and related issues have sufficient training and scientific exposure. The management of research is another area requiring urgent attention in order to minimise the negative impacts of many of the economic and other externalities afflicting research in the region. About 17% and 28% of the institutions surveyed allocate more than 20% of their budgets and staff time respectively, to user groups. This raises questions on how research priorities are formulated and the relevance of the research in progress. There is considerable interaction between institutions in the region, but how this can translate into co-ordinated collaborative activities remains unclear.*

*The methodology for evaluating research capacity is also presented. Although the indicators for the various research capacity parameters do not capture the totality of capacity implications, they provide useful insights on the existing local capacity to undertake forestry research in eastern and southern Africa.*


## INTRODUCTION

One possible definition of research is that it is a systematic inquiry into some phenomenon. Such an inquiry can take different forms. For example, it can be a review of literature to establish patterns or explanations for something of interest (desk research). It can also be an analysis of observations or the conduct of experiments in the field, or the laboratory, or in both. These variations provide flexibility to individual researchers and institutions in orientating their activities with respect to the issues at stake and their capacity to address them. Logically, individuals and institutions which have very limited resources for research may find desk research more appealing and field work and experimentation less viable. As capacity to undertake research increases the latter activities could assume increasing dominance, with desk research relegated to a more complementary role.

On the other hand, research can broadly be grouped as basic (pure or 'blue sky'), strategic (mission focused) and applied. Basic research is geared to the advancement of scientific knowledge whilst applied research uses existing knowledge to solve problems; and is for simplicity assumed to include adaptive research. Strategic research seeks to understand natural and human processes important to the solution of a specific problem (Collinson and Tollens 1994). Some individuals will have the skills to undertake all categories of research depending on their level of training and experience. The same is true with research institutions. Those institutions with highly trained and experienced researchers will be better placed to address basic and strategic research than institutions whose research staff have less training and exposure to research. The latter will tend to have more applied/adaptive research on their programmes. The composition of institutional research programmes is also greatly influenced by mandate.

With respect to the eastern and southern African region, there exists latent (under-utilised) capacity in some highly trained individuals and in the institutions to which they belong for undertaking applied research of strategic significance, specifically public good-related research of regional or global interest. The

main limitations are often the scope of the individual country/institutional research agendas which tend to lock scientists to local issues, in addition to very limited tangible regional collaboration in research. Of course, other research inputs will be limiting too, but if the above two limitations are first addressed, collective efforts would probably ameliorate the other seemingly insurmountable constraints like funding.

The capacity for research institutions to undertake these various forms of research with respect to forestry and related problems was the subject of an investigation carried out in 1995-96 by the Center for International Forestry Research (CIFOR) and the Division of Forest Science and Technology (FORESTEK) of the Council for Scientific and Industrial Research of South Africa. The study focused on research capacity in ten of the twelve countries comprising the Southern African Development Community (SADC). These were Namibia, Botswana, South Africa, Swaziland, Mozambique, Zimbabwe, Zambia, Malawi, Lesotho and Tanzania. The study did not attempt to determine priority areas for research since this is the responsibility of national and regional institutions.

In this study forest research capacity was defined as "the extent/degree to which a research institution is capable of effectively directing its resources towards the resolution of forestry and related problems".

The main objective was to assess the research capacity available in eastern and southern Africa to support integrated forest and woodland resource management, with special emphasis on both resource and socio-economic issues. More specific objectives were to:

- evaluate adequacy of research capacity to support decisions on resource policy;
- examine the extent of linkage between forest research institutions and other relevant institutions;
- evaluate, as far as possible, the adequacy of research supporting resources and infrastructure; and
- identify main constraints to research and capacity building.

Ideally, the output of a research institution should provide a measure of its capacity. Most commonly output is quantified by the publications produced by the institution. Whilst published output is undoubtedly a valuable measure it does not necessarily reflect current potential or actual impact on the problems to which the research is directed. Some of the capacity associated with the reported results could have re-located to other institutions. Also new or recently acquired resources cannot be linked with such output, much as they are part of the institution's capacity. Additionally, some types of research take relatively long periods of time before any publishable results can be obtained; but this does not mean that researchers are not working nor that the capacity of the institution is low. For example, Walton (1994) notes that it took 15 to 20 years for research networks in Central America, to have any impact in developing improved and sustainable production systems. Therefore, at any time the capacity of an institution (or even a network) is evaluated, there will be some accomplished tasks (output) and ongoing ones, both of which are a reflection of the institution's capacity.

This study goes beyond an examination of an institution's reported results and an account of its human and physical resources, to a more detailed examination of how the institution deploys its resources in its own research environment. The efficiency with which a research institution interacts with its work environment is indicative of its capacity to further its research agenda within the limitations imposed by its own composition and external work environment. The results of the study will therefore complement efforts made on human and physical resources assessments reported in FTP/SADC (1994) and Burley *et al.* (1989).

The justification for undertaking this study rests on various premises. The first is an observation made by SADC (1992a) in its forestry research plan for the SADC region that

> .....the forestry research systems are rather weak in the SADC countries. Even in Malawi, Tanzania, Zambia and Zimbabwe, countries which have fairly well established forestry research establishments, the capacities and capabilities are limited. In other SADC countries, Angola, Botswana, Lesotho, Mozambique, Namibia and Swaziland, there hardly is an operational public forestry research institution.....Strengthening of national forestry research systems is the first priority and principal strategic guideline for mobilising forestry research for sustainable resource management in the SADC region.

Secondly, appropriate capacity for research and technological transfer will provide significant leverage in transforming the management and use of natural resources in the SADC region in a direction which is sustainable and environmentally acceptable.

Thirdly, CIFOR's policy requires that a research agenda should not be imposed on any institution, rather activities of mutual interest be undertaken in collaboration with national institutions, whether public or private, and with individual scientists on their own merit. This study therefore assists CIFOR in developing a better understanding of its potential research partners in the eastern and southern African region.

Lastly, the interactions between CIFOR staff and national research staff have helped the related research institutions in the SADC region become more familiar with CIFOR and its *modus operandi*, another factor in facilitating collaborative research.

## PREVIOUS FORESTRY CAPACITY-RELATED WORK IN THE SADC REGION

In practically all the countries which supplied data for this study, some form of a national forestry research plan exists. The plans outline the forestry and related challenges in addition to the presentation of strategies for dealing with them. In many of these plans the research capacity, in terms of human, financial and other inputs, to meet these challenges is a planned capacity; very much depending on foreign assistance to develop it. The assumptions regarding donor generosity are one factor which tends to make many of these plans appear very ambitious. Other factors include the desire to overcome a myriad of problems in the shortest period possible; that is the desire for rapid economic development. In short, many of the existing national and regional forestry research plans depend on a capacity which does not exist and which most national governments are not capable of providing from their own local resources.

Little work has been done in the region to assess critically the existing research capacity and how it can most effectively be mobilised for increased efficiency.

The most recent and comprehensive study of this type was undertaken in 1994 by the SADC Forestry Sector Technical Co-ordination Unit (FSTCU) (FTP/SADC 1994). A survey was made of one element of capacity and human resources, and covered all SADC countries, with the exception of South Africa and Mauritius. This study examined capacity, not in relation to research alone, but with respect to forestry development as a whole. As such, the capacity to undertake research is not explicitly addressed and the study is limited to consideration of human resources in the forestry sector. However, some forestry-related research is presently being undertaken by sectors outside the mainstream of forestry. University faculties, departments and institutes specialising in geography, biology and social sciences, among other disciplines, are in some cases involved in forestry and related issues. Such human resources, while not captured in the report, are also important for forestry development.

Another detailed study was conducted by Burley *et al.* (1989). This was undertaken in twenty-two countries in eastern and southern Africa, including all the present SADC countries, except Angola and Namibia. The study recommended priority research areas for forestry and assessed the capacity to undertake research in the identified priority areas. An important finding was that research in the region is

> ...often isolated, unprogrammed and irrelevant to current problems; it is not based on existing knowledge and any results that are obtained are rarely put into practice in a systematic manner.

The report further notes that

> African research capacity has declined alarmingly in the past 20 years in terms of: numbers, training and career structure for staff; extent, location, relevance and maintenance of facilities; continuity and management of programmes, staff and funding; monitoring and interpretation of research results and relation to existing information and current activities elsewhere; interaction with users of research results, lack of inclination of many graduates and some technical staff to work in the field, particularly in areas remote from cities.

Some of these issues are also examined in this report.

Further, Burley *et al.* (1989) observe that donor agencies have to some extent contributed to this decline in the following ways:

- donor technical and administrative missions distract local research staff from their activities, add to existing problems of bureaucracy, and often compete for resources or unnecessarily repeat studies and projects;
- donors often provide research funding in the absence of a firm government commitment for counterpart support, thereby decreasing chances of carrying through such tasks;
- donors often provide for project research components that are not integrated with the national research plan or are not part of overall national priorities.

Unlike the earlier report (FTP/SADC 1994), which did not discuss in detail the results of its manpower survey or even relate it to capacity to undertake research, the report by Burley *et al.* has gone to great lengths to identify forestry research problems and gave some suggestions on how to overcome them. Priority research areas for the region are proposed and resource implications for implementation are also identified.

There are numerous reviews, surveys and other types of documentation which touch on forestry research capacity in the region in a much broader context. For example, Someshwar (1994) reports on efforts by the World Bank to build forestry capacity in Sub-Saharan Africa based on Bank projects in the region. The study views forestry capacity in totality and makes no distinction between capacity for research and that for developmental forestry work. Odera and Pape (1994) review a programme to support forestry research in Sub-Saharan Africa, the overall aim being to build capacity for forestry research. The African Academy of Sciences (1994) reports on its experience in building research capacity in Africa and makes recommendations on how this may be strengthened. Ridker (1994) describes World Bank activities/projects

in human resources development in Sub-Saharan Africa; identifying where the Bank faltered and how improvements can be made.

Jaycox (1993) emphasises the crucial role of human and institutional capacity to the development of Africa. The African Development Bank (1994) notes that Africa has the weakest institutional capacity to successfully implement sustainable forestry development programmes, and that in the Bank's lending policy for forestry development programmes, institutional capacity building and human resources development are priority areas. Gilbert *et al.* (1994) give an account of problems facing agricultural research systems in the small countries of West Africa. Many of the small and emerging forestry research institutions in the SADC region can benefit from the experiences of these West African institutions. They also emphasise the inevitable requirement for many African research institutions to collaborate in research.

With respect to collaboration in research, Walton (1994) reports on the outcome of a roundtable discussion between leaders of national agricultural research systems, international research centres, regional centres and the donor community suggesting that the research areas which can lend themselves to regional approaches are: natural resource management; environmental issues; pests and diseases; basic foods; methodologies; training; in addition to information on regional problems. He notes further that higher priority is given to natural resource management and environmental problems, and that the issues involved favour a regional approach since they are complex, often cut across national boundaries, and would require international co-operation if they are to be resolved. In this connection Walton (1994) identifies the following as the main reasons in favour of a regional approach to research:

- to exchange information and combine the collective experience of professionals in the same field,
- to achieve economies of scale and efficiency by concentrating scarce human, financial, and other resources on key national and regional problems,
- to minimise duplication,
- to capture the effects of research spillover,
- to rationalise human resource development,
- to mobilise research efforts on transnational problems that require collaboration between countries.

Research is increasingly becoming client-driven and output-oriented. National economies are rapidly becoming market-oriented and part of larger regional economic groupings. In a competitive trade environment, sharing of research results among regional institutions is unlikely to be a good marketing strategy. This and other drawbacks to a regional research approach are summarised in Table 1.

# METHODOLOGY

## Survey of methodologies

Following a review of literature and discussions with a number of people, the following alternative approaches have been used to evaluate research capacity.

- Use of an external review team. This approach appears to be favoured by funding agencies and some individual research institutions, and is probably the most widely used research evaluation approach (Bengston *et al.* 1988). Under this approach capacity to execute research is usually one of the items examined. The level of detail depends on a number of things including the competency of team members in appraising research capacity and the priority accorded to such capacity in the evaluation. In this respect, Ruttan (1978) notes that a research review should not limit itself to the assessment of quality and value of the programme in force, rather it should engage in a dialogue with the staff and management to find ways of increasing efficiency and contributing to the evolution of a highly productive programme. The survey reported in Burley *et al.* (1989) is one such example of an external review team, in this case commissioned by the World Bank to provide information to guide Bank decisions in its agricultural support programme for the region. CIFOR has also adopted this approach in an internally commissioned external review which was undertaken in 1995. In both cases the methodology adopted, which is client-driven, considered many more variables than those specific to the capacity to undertake research.
- It is also common to use checklists which give an indication of the research capacity of an individual institution. Check lists can be used either on their own or in combination with other approaches. Bengston *et al*. (1988) report that checklists developed by Schweitzer and Long (1979), have been used for investigations of science and technology institutions in Nigeria, Malaysia and Colombia. The checklists were used to guide the structure of interviews with the institutions studied.
- Though not strictly a research capacity evaluation approach, *ex post* evaluation of impacts of various forestry programmes implemented in a particular locality can provide information on research capacity. The impact of research is partly a function of the capacity available to produce results and to make them known and adopted by potential users. Example evaluations include those by

**Table 1**. Some positive and negative aspects of regional approaches

| Positive | Negative |
|---|---|
| **From the NARS perspective** | |
| 1. Share information, methodologies, training<br>2. Increase political commitment<br>3. Attract special funding<br>4. Increase national exposure for national systems and scientists<br>5. Help develop less well-off NARS<br>6. Promote research which otherwise may not be attempted at the national level | 1. Competition in some domains<br>2. Free-riding (national systems benefiting without contributing)<br>3. High costs of participation for small NARS<br>4. Decisions likely to be taken for political rather than technical reasons<br>5. Dominance of strongest member(s)<br>6. Inadequate follow-up of regional initiatives<br>7. Diversion of research effort from NARS research priorities |
| **From the perspective of regional organisations** | |
| 1. Better co-ordination among researchers and institutions<br>2. Improved donor contacts/negotiations Changed attitudes of some members (e.g., towards training)<br>3. Common services - information, evaluation<br>4. Establishment of consultative processes | 1. Slowness in bringing about action<br>2. Generation of rules and bureaucracy<br>3. Risk of territoriality or 'turf' concerns impeding rational decisions |
| **From the donor perspective** | |
| 1. Increased awareness of specific issues<br>2. Promotion/implementation of new approaches<br>3. Increased efficiency in use of resources<br>4. Better co-ordination<br>5. Possibility of bringing in new partners<br>6. Demand-led, problem-focused research possible | 1. Reduction of investment in overall strengthening of NARS<br>2. Unclear links to national plans<br>3. Proliferation of networks<br>4. Limited possibility of making long-term commitments (continuity) |
| **From the IARC perspective** | |
| 1. Better priority identification<br>2. Greater stability/flexibility than other actors<br>3. Possibility of decentralisation<br>4. Possibility for incorporation of related research activities and findings<br>5. Capacity building through research a possibility<br>6. Peer group pressure between NARS centres helps push progress in research | 1. Pressure from donors to administer projects instead of NARS<br>2. Possible 'turf' syndrome<br>3. Danger of substitution for technical work of NARS |

Source: Adapted from Walton (1994)

Ridker (1994), and Someshwar (1994). Alvez (1984), Elz (1984), and Bengston *et al*. (1988) share the view that impact studies tend to be useful in justifying past actions and expenditures or can serve to support new research proposals, and help to build credibility and/or political support, but are unlikely to be of direct use in improving the organisation and management of a research institute; things which are important in improving research capacity. The authors do not fully concur with this view, research effort that leads to large positive impacts will always be favoured in preference to research that make no measurable difference. Analyses that attempt to investigate *how* research efforts yield an impact, as well as attempting to quantify it, can contribute much to the improved management of research. This category of analysis is a great improvement on the quantification of *outputs* because the emphasis is on the quantification of *outcomes*; i.e. the extent to which research has not only succeeded in providing a solution to a problem, but also the extent to which solutions are adopted and benefits accrue to the users. Since the definition of research capacity focuses on resolution of problems through research, research outcome should be an important consideration in evaluation of research outputs. Nevertheless, impact assessments per se are not the most efficient means of estimating institutional research capacity.

- Bengston *et al.* (1988) report on an approach proposed by Clark (1980) in which the deviation of a research institution from 'optimal' behaviour serves as a measure of performance and research policy. The six characteristics constituting optimal behaviour of a research institution were identified as: well-developed internal and external technical communications; socio-economic communications (or 'adequate liaison with the productive sector'); a programme-centred research approach as opposed to a research organisation along lines of scientific disciplines; employment of economists in the institution to assess proposed research projects and help guide project selection; decision making structures consisting of a series of research committees within the institution to review proposed projects and decide on renewal of existing projects; and finally, the priorities of a research institution should be linked to the country's overall development plans or national objectives. Clark suggested a number of proxy variables to make the evaluation quantitative, but did not test this approach in the field and the authors of this document have yet to find a study which tests this approach using empirical data.

With the exception of that proposed by Clark (1980), all the other approaches mentioned earlier tend to concentrate on a descriptive account of the variables under investigation with very little attempt at showing how they feature within the institution or in relation to other similar institutions. Quantification of the relationships between the variables under study is also minimal.

## Study methodology

The approach adopted in this study is based on checklists and a modification of the methodology used by Bengston *et al.* (1988) in their study of forestry research capacity in the Asia-Pacific region. The approach is based on the analysis of certain indicators within the institutions' *external* and *internal environments* which are assumed to be related to research capacity, in addition to evaluating available *research support* within the institutions.

### *External environment*

Within the external environment of each institution, three indicators were identified:

- *Scientific interactions with other research institutions*. Such interactions are perceived to be instrumental in overcoming the phenomenon of 'research isolation'; in addition to facilitating the development and sharing of resources, research methods and findings. Interactions among institutions can help to create the 'critical mass' of scientists required for some tasks; something which individual institutions might not have. They contribute to confidence building among researchers and institutions, and would appear to be a prerequisite for developing national and international collaboration in research.
- *Interactions with educational/training institutions*. This may benefit research institutions through increased opportunities for training their staff, as well as possibilities for sharing resources like staff, libraries, laboratories, software, computers and other equipment.
- *Interactions with users of research outputs*. Research should be responsive and relevant to local needs. One indicator of this is the extent to which researchers interact with their clients. Forestry research in the region is becoming increasingly demand-driven, and therefore researcher-client interactions are a necessity if research is to fulfil its function and if the research outputs are to lead to successful outcomes (impact).

### *Internal environment*

Three indicators were identified for the institutional internal environment.

- *Salary and related incentives*. The monthly disposable income of researchers, comprised of net salaries and other monetary benefits, is one of the driving forces behind employment in research

institutions. How researchers fare financially in relation to colleagues with similar qualifications in other institutions may influence the rate of staff turnover, the development and stability of research programmes, and staff morale in an organisation.

- *Non-salary incentives*. These may be instrumental in increasing the capacity for an institution to attract, retain, increase productivity of its researchers, and to motivate individual staff. Where an institution is not competitive with respect to salary or in economies where base salary is heavily taxed, a good incentive scheme may adequately compensate.
- *Use of formal and informal evaluations in decision making.* The capacity to do research is also related to how an institution decides to manage its research resources. Formal and informal evaluations on completed and on-going research can provide information useful for better management of research.

### *Indicator for research support*

Support to scientific staff in terms of technicians within an institution, was considered an important input to research. The availability of technicians allows researchers to spend less time on technical matters and more time on scientific issues, thus increasing effective research time.

Annex 1 details the means of quantifying the indicators and the underlying assumptions.

### *Indicator for research outputs*

There are many forms of research output other than those that appear in published format. For example, software, demonstration research plots and oral presentation of research results to user groups, it is a key indicator of the capacity of a research institution, and should be expressed in proportion to the number of research staff.

## Limitations of study methodology

There are a number of limitations associated with the study in general, and more specifically with the methodology adopted. An appreciation of these is important in evaluating the results. These include:

- limitations associated with the individual indicators in capturing expected capacity aspects. For example, using the ratio of technical staff to research staff in gauging the extent of research support without first establishing the optimum ratio for the institution may lead to inconclusive results. Also, research funding could have been used as an indicator and therefore strengthen the assessment of research support had all institutions supplied this information. However, only a modest overview is made using the limited data available.
- the number of indicators chosen for the study may not give a full picture of the research capacity in all institutions. For example, organisational aspects within institutions may not be adequately quantified through this approach. Some indicators relying, for example, on research funding were omitted from the study for lack of adequate data.
- survey data may be biased by respondents providing information on behalf of an institution, in which case a distorted picture of the institution's capacity for research could emerge.
- coverage of institutions involved in forestry-related research was incomplete. The survey gave emphasis to the major players in individual countries. Only 19 of the 28 national institutions contacted constitute the sample for this study.
- there are various economic and social factors influencing the performance of the institutions surveyed, and hence their capacity to conduct research; factors for which indicators were not assigned, but for which a qualitative assessment was given. These included level of economic development of individual countries, endowment with forest resources, role of forestry in the socio-economic development of individual countries and forestry development in public and private sectors.

These limitations notwithstanding, the methodology chosen is simple to understand yet provides useful information; nevertheless it has potential for improvement. Although the methodology does not lend itself to determination of optimum or absolute values of capacity for each institution, it has the merit of determining *relative research capacity*, i.e., how the capacity in one institution relates to that of another. It is also capable of highlighting some aspects of institutional comparative advantage which are useful for the development of collaborative research among institutions. The approach is also relatively efficient in summarising a large body of information relevant to a particular institution.

# RESULTS AND DISCUSSION

A discussion of the results is presented at two levels. First a brief overview is made on research resources, namely research staff, financial resources, and research support facilities. This will give a limited picture on the capacity of the individual institutions to undertake research.

The second part of the section is devoted to processes which enhance research capacity. These are examined in relation to how the institutions are able to manage and/or benefit from their external and internal

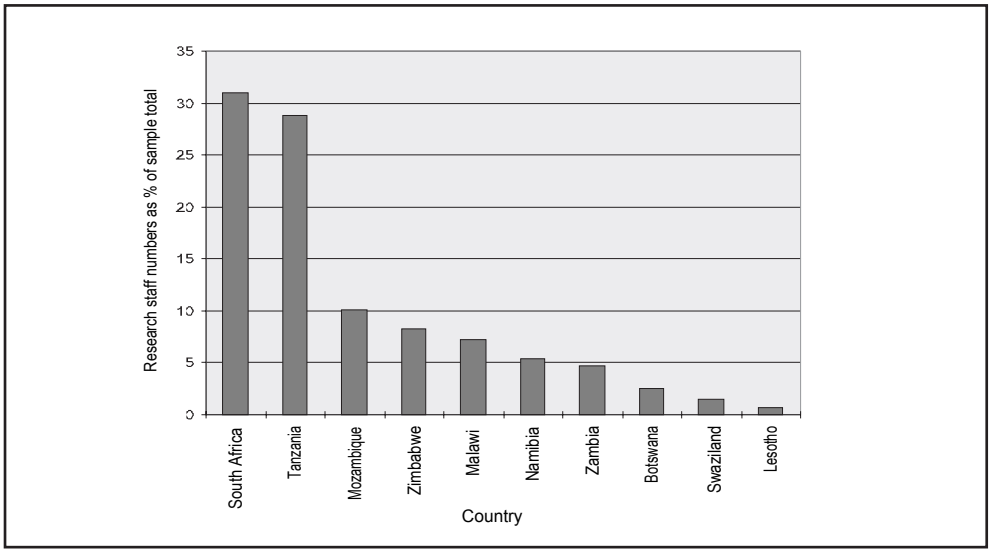


**Figure 1**. Distribution of forestry-related researchers in the SADC region

environments. Research support staff shall also be evaluated under this section.

## Research resources

### *Human resources*

A key input to research is the human resource, both scientific and support staff. In this section the focus will be on the essential human resource, that is scientific staff. It is the scientific staff who conceive, direct and seek/attract funding for research. Without them the other resources cannot be effectively mobilised and organised for research.

The data on the distribution of researchers in the region, as presented in Figure 1 (based on Annex 2), have to be interpreted carefully. First the distribution of research staff as a percentage of total researchers in the region may give the impression that South Africa and Tanzania are ahead in terms of forestry and related researchers. Zambia, Botswana, Swaziland and Lesotho (in that order) are at the other end of the spectrum, while Mozambique, Zimbabwe, Malawi and Namibia (in that order) are in between. Such a distribution of research manpower is often used to give an indication of the relative capacity to conduct research. However, for a sample with such diverse institutions as the one constituting this study, it would be risky to, for example, conclude that Namibia has better capacity for research than Zambia; or Mozambique is stronger than Zimbabwe in forestry research.

The research institutions considered in this study are at various levels of evolution; levels which will influence the type of capacity present. For example, forestry training at the University of Stellenbosch has been extant for over sixty years, while Swaziland is working on how to elevate its forestry section at the level of the department, let alone thoughts of a research unit. The implication is that the type and quality of manpower present in these institutions will most probably match the evolutionary history of these institutions.

Figure 2 (also based on Annex 2), shows a different distribution of manpower, specific to researchers trained to the level of M.Sc. and Ph.D. degrees and with at least four years experience in their institutions after obtaining these academic qualifications. The hypothesis is that people with this level of qualification and experience are the ones most qualified to conduct research. They have the capacity to formulate, direct, interpret and synthesise research results. They could occupy leadership positions within their institutions, positions which can influence the direction of research. In short this group would most probably constitute the major human driving force in research.

Again from Figure 2, South Africa and Tanzania appear to have more of this level of research manpower. With the exception of the relative positions of Botswana, Swaziland and Lesotho in Figure 1, the scenario given in Figure 2 is very much different with respect to the other countries in the region. Although in terms of absolute numbers Mozambique appears to have more forestry-related researchers than Zimbabwe, and Namibia more than Zambia (Figure 1), the message from Figure 2 is that Zimbabwe has more trained and experienced forestry-related researchers than Mozambique, and the same is true of Zambia in relation to Namibia. Therefore Figure 2 better represents the present capacity to conduct research in the region.

According to Bengston *et al.* (1988), forestry research administrators from less developed countries (LDC) in the Asia-Pacific region identified the level of training of researchers as being the most important factor limiting research capacity in their countries. A

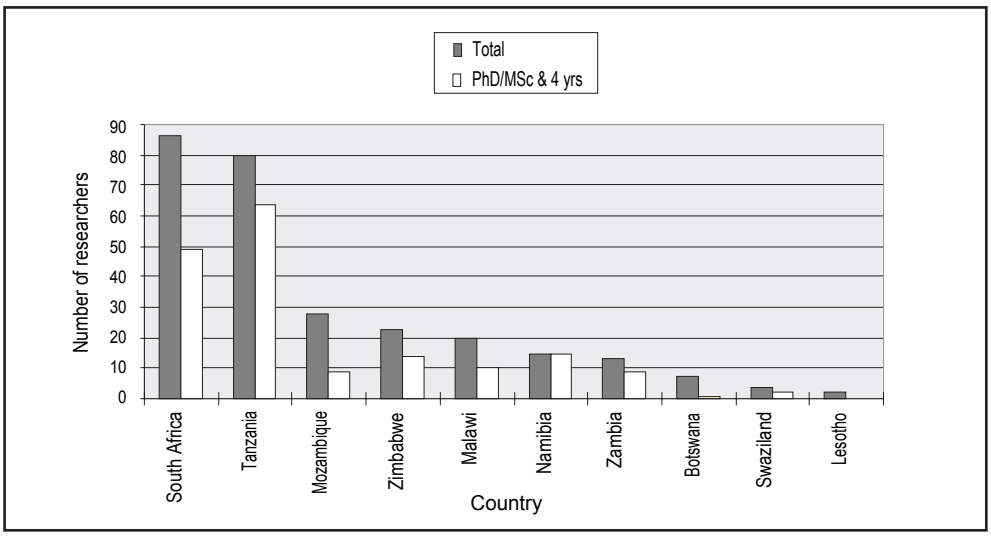


**Figure 2**. Distribution, by country, of researchers with M.Sc. or Ph.D. and more than 4 years experience

similar observation was made for LDCs outside the Asia-Pacific region. Further, it was noted that this factor was of less significance in the developed countries of the region.

The study reported by Bengston *et al.* (1988) was undertaken almost ten years ago; so comparisons of its findings with those reported in this study should be made with caution. In that study about 10% of the total research staff in the LDCs of Asia-Pacific had Ph.D. qualifications and represented the smallest proportion of researchers trained at degree level. In this study about 33% of the national researchers are Ph.D. holders, 35% have masters degrees, and 23% have first degrees. Approximately 8% of the researchers are expatriates. On the whole, about 68% of the researchers have training at a level sufficient for meaningful research, that is to say they have at least a masters degree. Of this sub-sample, about 85% have at least four years experience after obtaining their highest qualifications. This represents about 58% of the total forestry and related research manpower in the region; implying that almost half of the researchers need more training and exposure.

An interesting scenario emerges when one attempts to locate where this capacity is based in individual countries. In Tanzania, Zambia, Zimbabwe and Mozambique most of the qualified researchers are found in university establishments (Figure 3). The opposite is the case with South Africa. Only South Africa, Zimbabwe, Malawi and Tanzania have fully fledged forestry research institutions; Swaziland, Lesotho and Botswana have yet to fully recognise research, even at a level of a section, in their national forestry establishments.

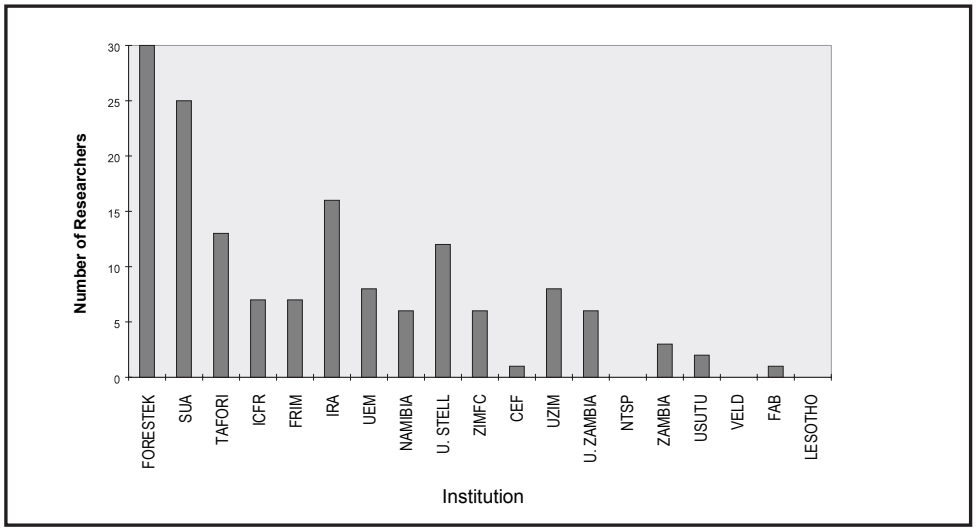


**Figure 3**. Researchers, by institution, with M.Sc. or Ph.D. and at least 4 years experience

**Table 2**. Distribution of research operational expenses in some institutions (%)

| Institution | 1991 | | 1992 | | 1993 | | 1994 | |
|---|---|---|---|---|---|---|---|---|
| | Local | Foreign | Local | Foreign | Local | Foreign | Local | Foreign |
| TAFORI | n.a | n.a | 100 | 0 | 100 | 0 | 100 | 0 |
| SUA | 1.4 | 98.6 | 2.1 | 97.9 | 2.3 | 97.7 | 3.6 | 96.4 |
| U. ZIM | 41.9 | 58.1 | 44.6 | 55.4 | 26.9 | 73.1 | 26.9 | 73.1 |
| CEF | n.a | n.a | n.a | n.a | 100 | 0 | 77.8 | 22.2 |
| ZAMBIA | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 |
| U. ZAMBIA | 0 | 100 | 0 | 100 | 100 | 0 | 100 | 0 |
| FRIM | 100 | 0 | 54.3* | 45.7 | 27.9* | 72.1 | 10.4 | 89.6 |
| VELD | 37.9 | 62.1 | 34.5 | 65.5 | 50 | 50 | 11.3 | 88.7 |
| ICFR | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 |
| LESOTHO | 33.3 | 66.7 | 25 | 75 | 20 | 80 | 33.3 | 67.3 |

* incomplete data n.a.= not available.

Another interesting phenomenon is that the countries further south (i.e., South Africa, Swaziland and Botswana) have a dominant private sector research component while those in the north rely more on government-funded research establishments; private sector research is almost absent. This is mainly because of the influence of South Africa on the economies of Swaziland and Botswana. All three countries are signatories to a 'customs union'; a grouping whose terms facilitate commercial and other exchanges between countries. Practically all the commercial plantation forest area of Swaziland (about 6% of the country's land area) is owned by South African companies (Kowero 1989). This is concomitant with the wood processing capacity. The research capacity attributed to Swaziland in this study is technically South African capacity based in that country.

Finally, an examination of the common research agenda for SADC countries (SADC 1992b) and individual country forestry research plans, reveals that both are very ambitious and lack human and other types of resources to carry them through. If all funds required for these undertakings were made available now, none of these countries would be in a position to implement its research plans relying solely on its own human resources. Considerable training and exposure is necessary, in addition to collaboration to make better use of the human resources available in the region. Qualified manpower constraints are some of the reasons for the lag in evolution of forestry research in many of these countries. Other considerations include the level of economic development of individual countries, endowment and role of forest resources, and emphasis on education, science and technology.

No effort was made to categorise researchers according to specialisation, but certainly there would be a skewed development in favour of the bio-physical areas as opposed to the socio-economic and policy areas. The latter are two areas which have yet to be developed in many traditional forestry establishments in this region. This has important implications with respect to the types of forestry research the region is capable of addressing. As the practice of forestry becomes more people-centred the challenges this will create will force the forestry sector to shift from its present emphasis on product quantity, quality, and markets to one which matches these product attributes to improved social welfare and sustainability of forest resources. For this, policy and socio-economic aspects will increasingly become central to forestry capacity development and assessment.

### *Financial resources*

The common denominator to all research activities is funding. Without funds training and staff recruitment as well as execution of research tasks are not possible. The importance of long-term financial commitment to success in capacity building and in research is an issue which has been strongly emphasised (Burley *et al.* 1989; African Academy of Sciences 1994; Someshwar 1994; Walton 1994).

For the research capacity survey, financial data was classified into two broad categories; local and foreign research funds. The former includes all research funds for an institution originating within its own country, whilst the latter includes contributions to the research budget that originate outside the institute's own country. The figures represent the net budget available after staff salaries and allowances had been deducted.

Unfortunately, few institutions were able to provide comprehensive information with respect to their financial resources. Only 50% provided data on their research operational costs (excluding salaries of employees) as summarised in Table 2 and Figure 4.

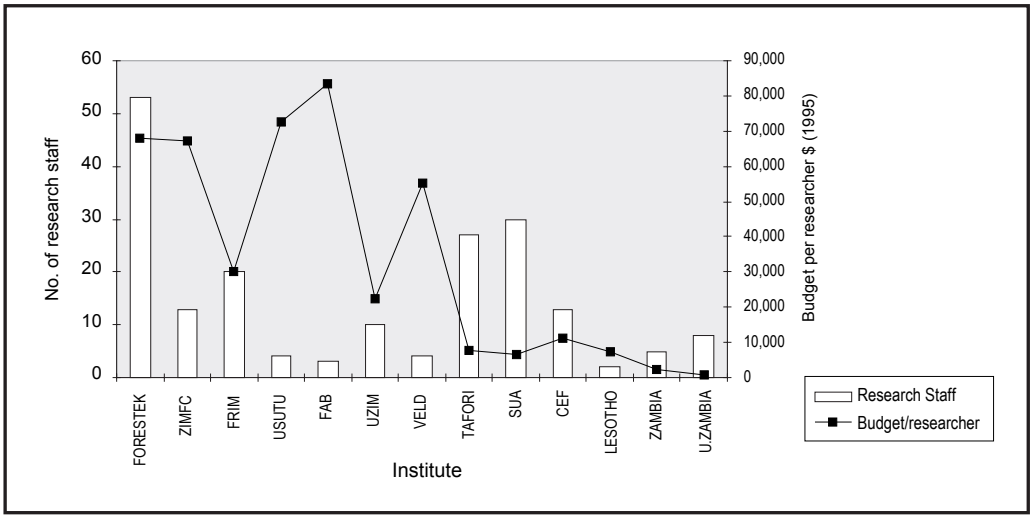


**Figure 4**. Number of research staff by institute and nominal budget per researcher

The extent of funding for many government-financed institutions is frequently inadequate, often shows considerable annual variation, and in many cases bears no relation to the volume of work on the stated research agenda. Of course the adequacy of any budget is highly dependent on the type of research work undertaken. The data available highlighted the high degree of variability that exists, not only between institutions, but frequently from year to year within an individual research organisation. The extent to which organisations must rely on local funds and the extent to which different organisations are successful in securing funds from external sources also show considerable variability.

Only the two research divisions within the Department of Forestry of Zambia and TAFORI have been wholly locally financed in the four years of this analysis. Throughout this period SUA has had over 95% reliance on foreign funding for its operational research expenses. The other institutions that provided data, have foreign funding which is at least 50% of total research operational expenses for 1993 and 1994.

Financial resources are subject to political and economic externalities which can generate uncertainty in the funding environment and create serious strains on the institutions, inhibiting their capacity to deliver or meet expectations. For example, externalities such as currency exchange fluctuations can greatly alter the 'buying power' of the research budget. If a currency is devalued, then the 'buying power' of the local currency research budget is reduced, especially so in relation to imported inputs, whilst that from external ('hard currency') sources is enhanced in the domestic market. During the period of analysis, many governments have been implementing various economic austerity measures including massive devaluation of their currencies. Under such conditions institutions with a high proportion of foreign funding will be better cushioned from adverse effects of such measures compared with those with heavy reliance on government funding. In real terms, government funding of agricultural research in the region is declining (Gakale *et al.* 1996). Under such circumstances, a good balance between foreign and local funding is therefore desirable.

It would appear that domestic economic problems have resulted in research being under-financed in government-funded institutions, forcing the institutions to pursue external funding sources which are unreliable and unlikely to be sustainable. Whilst utilisation of international sources of finance for research is commendable, institutions should also develop their own internal means for financing research. These could include such self-financing mechanisms as production of saleable results and products, raising funds from industry and the private sector through contracting of services, and through feedback of a proportion of revenue from taxes on selling standing timber into research (African Academy of Sciences 1994).

The magnitude of the research budget per research worker is a useful indicator which can serve to flag those institutions that may have adequate manpower but insufficient resources to realise their potential (Figure 3). Conversely, some organisations may have disproportionately large research budgets per researcher. Very small organisations like FAB and VELD are unlikely to benefit much from economies of scale. Also some organisations, e.g., FAB and VELD, allocate a significant proportion of their 'research' budget to extension activities. Others such as FORESTEK supplement their centrally funded budget with client-commissioned research.

In some countries there is insufficient demand for forestry research to be driven by market forces. Primary forest production is still very much under gov-

ernment control, with the private sector dominant in wood processing. Many wood processing units are small, requiring little or no professional manpower and therefore represent a poor market for the services of many research institutions.

Inadequate research funding is not a problem confined to the forestry research institutions of SADC. Gakale *et al.* (1996) note that in the majority of SADC member states, with the exception of Namibia and Botswana and possibly South Africa, the resources allocated to the NARS from their national treasuries are, in real terms, declining and that the region is trying to address this issue through the following actions:

- Collecting evidence of the impact of past research to make a case for an increased funding allocation to ANR sectors.
- Sensitising treasury and ministry of finance staff on the need for increased allocation of resources for research – a policy dialogue with policy makers.
- Regional collaboration in research in order to avoid duplication of efforts and to share research findings.
- Establishment of clear national and regional priorities for research.
- Better linkages and collaboration with IARCs to ensure the efforts are complementary and that IARCs' priorities reflect the national and regional priorities.
- Rationalisation of on-going activities.
- Looking for alternative funding mechanisms.

### *Research support facilities*

A quick overview was made of research facilities available in these institutions. These included laboratories, libraries, and computers. The condition of field stations/centres/zones in some of the institutions was appraised. The level of sharing between some of these facilities was also examined. Table 3 summarises the results which are detailed in Annex 5.

Of the sixteen institutions which provided information on their laboratory and library facilities, almost half of them (56%) have their laboratories fairly well equipped and both equipment and buildings are in a satisfactory physical condition. About 6% do not have laboratory facilities and 13 % do not have library facilities. The remaining institutions have inadequate laboratory facilities which are poorly equipped, and small libraries which are poorly resourced. In short the development of library and laboratory facilities in about more than half (54%) of the institutions is poor.

Almost half of the institutions with inadequate laboratory facilities and poorly equipped libraries reported very limited sharing of laboratory, library and computer facilities with other institutions. This could indicate a low level of research activity and also raises the issue of research quality. Literature is the key to research and so are good laboratory and data processing facilities. It is also in this group that one finds about 16% of the institutions not able to reciprocate benefits received from other institutions; that is to say they only benefit from others. Although the study indicates that 68% of the institutions enjoy a two-way (mutual) sharing of resources, the majority of them are the ones with good library, laboratory and computer facilities. The implication is that the

**Table 3**. Research support facilities in sample institutions

| Facility | No. of institutions | Adequate & in good condition (%) | Inadequate & in poor condition (%) | Non-existent (%) |
|---|---|---|---|---|
| Laboratories | 16 | 56 | 38 | 6 |
| Libraries | 16 | 56 | 31 | 13 |
| Field stations/centres/ zones | 13 | 31 | 31 | 38 |
| Computers | 17 | 65 | 30 | 6 |

* The classification is: Mutual (two-way) sharing; institutions only deriving benefit from others, do not share.

institutions with better facilities are better placed to interact with other institutions than the poorly equipped ones, an observation reinforced when the interaction between an institution and its environment is examined.

Of the seventeen institutions which provided information on computer facilities, 65% have adequate facilities, in that the majority of the scientists have access to a computer. Of this sub-sample about 64% have electronic mail services. A few have LANs within their institutions. The extent to which computers are used purely for word-processing, administrative, private and routine work compared to scientific purposes, like data analysis and writing, was not evaluated. Even for the institutions with relatively poor computer facilities, it is unlikely that they can efficiently use more equipment given their small number of scientists. Many may need replacement of obsolete hardware and provision of more relevant software.

Another aspect examined was the possession of field stations/centres/zones. These can provide considerable flexibility for research institutions to experiment in the field. Of the thirteen institutions which responded on this issue, about 62% have such facilities, with about half supported by good infrastructure (roads, laboratories, offices and residential quarters for workers). Several institutions have other facilities including nurseries and field trial plots. A number reported a backlog of unprocessed data (some stretching over a period of 20 years) from field experiments and other recordings. When this is viewed against the fairly abundant computer capacity in the region, one may hypothesise that the constraint lies more with availability of skilled manpower and willingness to share resources, than on inadequate computing/analytical facilities.

Many of the institutions have laboratory, library and computer facilities which are adequate and in good condition. For those without these facilities or those in which they are inadequate, the potential for sharing with other institutions exists. Sharing of these resources is reportedly already high and should be further encouraged so that it is expanded beyond institutions which are relatively well resourced. The unsatisfactory condition of about half of the field stations/centres managed by a majority of these institutions and other field trials will continue to constrain research results in subjects that rely on these resources.

## Research environment

The way research institutions interact with their environment affects the capacity for involvement in research. This section presents results relating to interactions between institutions in individual countries, as well as how individual institutions compare to others sampled. Annex 3 presents detailed results for individual institutions.

### *External research environment*

*Interactions between research institutions*

Table 4 summarises the amount/level of research-related interaction and the benefits resulting from such interaction as perceived by the institutions.

(a) Interactions between individual and related national research institutions

From the survey, it appears that contact between individual institutions surveyed and other national forestry-related institutions is frequent and satisfactory in many countries. The exceptions are IRA, University of Zambia (U. ZAMBIA), UEM, USUTU, FAB and VELD which reported occasional interactions with forestry research establishments in their own countries. Contact between the Department of Forestry at UEM in Mozambique and the government forestry research establishment (CEF) was surprisingly infrequent. The same is true of the Institute of Resource Assessment (IRA) of the University of Dar es Salaam and TAFORI. There is also little interaction between the Biological Sciences Department of the University of Zambia (U. ZAMBIA) and the two research divisions at the government forestry department. The absence of other forestry research establishments in Swaziland and Botswana explains the occasional interactions reported by USUTU and FAB in these countries.

Of the institutions surveyed, 77.8% reported that they derive moderate benefits from interacting with national forestry and related institutions. The Faculty of Forestry at Sokoine University of Agriculture (SUA), the National Tree Seed Programme (NTSP) in Tanzania, the Biological Sciences Department at the University of Zambia, and ICFR of South Africa reported that such interactions have been very beneficial.

About 67% of the institutions had frequent interactions with other centres; this is a very positive result. Only 33% had occasional interactions, largely the result of the absence of similar national institutions with which to relate.

(b) Interactions between the institutions and national non-forestry research institutions

The interaction between the surveyed institutions and non-forestry ones within their own countries could be an important measure of the extent to which forestry research is accommodating other relevant aspects which may not be found in mainstream forestry research institutions; that is opportunities for research to ‘spillover into other research areas’. Like the preceding kind of interaction, this type of interaction may, in part, be reflected by the level of sharing research resources. TAFORI, SUA, IRA, the Department of

Biological Sciences at the University of Zimbabwe (U. ZIM), the two research divisions in the department of forestry in Zambia and USUTU have occasional interactions with other research establishments in their own countries; representing 33.3% of all institutions surveyed. The rest (66.7%) reported frequent interactions with other national research organisations. Only 27.8% reported very beneficial results from these interactions while the majority (55.6%) derived moderate benefits and 16.7% saw no real benefits from such contacts.

On the whole, there is considerable interaction between research institutions in each of the countries considered in this study. Very few institutions saw such interactions as being very beneficial and fewer still perceived no real benefits from them. The level of interaction between the institutions is indicative of the potential and extent of collaborative forestry research work in each of these countries.

(c) Interactions between the research institutions and foreign research institutions

Again Table 4 shows the frequency of interaction with foreign research institutions and the ranking of the perceived benefits. The frequency of interaction between the research institutions and their local counterparts on one hand, and between the

**Table 4**. Research interactions and their perceived value

| | Own FR | Benefit | Own NFR | Benefit | Foreign RI | Benefit |
|---|---|---|---|---|---|---|
| TAFORI | 2 | 2 | 1 | 2 | 2 | 3 |
| NTSP | 2 | 3 | 2 | 2 | 1 | 3 |
| SUA | 2 | 3 | 1 | 2 | 2 | 3 |
| IRA | 1 | 2 | 1 | 2 | 2 | 3 |
| U. ZIM | 2 | 3 | 1 | 1 | 1 | 3 |
| ZIMFC | 2 | 2 | 2 | 2 | 2 | 3 |
| ZAMBIA | 2 | 2 | 1 | 2 | 1 | 2 |
| U. ZAMBIA | 1 | 2 | 2 | 3 | 1 | 1 |
| FRIM | 2 | 2 | 2 | 2 | 2 | 3 |
| CEF | 2 | 2 | 2 | 3 | 2 | 3 |
| UEM | 1 | 2 | n.a. | n.a. | 2 | 2 |
| USUTU | 1 | 2 | 1 | 2 | 2 | 3 |
| FAB | 1 | 2 | 2 | 1 | 2 | 2 |
| VELD | 1 | 2 | 2 | 3 | 2 | 3 |
| FORSTEK | 2 | 2 | 2 | 3 | 2 | 3 |
| ICFR | 2 | 3 | 2 | 3 | 2 | 3 |
| U. STELL | 2 | 2 | 2 | 2 | 1 | 1 |
| NAMIBIA | n.a. | n.a. | 2 | 2 | 2 | 2 |
| LESOTHO | 2 | 2 | 2 | 1 | 1 | 2 |
| Sample | 18 | 18 | 18 | 18 | 19 | 19 |
| Total & Percentage | | | | | | |
| With 0 | 0 | n.a | 0 | n.a. | 0 | n.a |
| With 1 | 6(33.3) | 0 | 6(33.3) | 3(16.7) | 6(31.6) | 2(10.5) |
| With 2 | 12(66.7) | 14(77.8) | 12(66.7) | 10(55.6) | 13(68.4) | 5(26.3) |
| With 3 | n.a. | 4(22.2) | n.a. | 5(27.8) | n.a. | 12(63.2) |

Percentages are bracketed.

Note:

A. Amount of interaction:
0 = never had interactions
1 = occasional interactions
2 = frequent interactions

B: Value of benefits:
1 = no real benefit
2 = moderate benefit
3 = very beneficial

FR = Forestry Research Institution. NFR = Non-Forestry Institution.
Foreign RI = Foreign Research Institution.

institutions and foreign research institutions on the other, is more or less the same. However a majority of the institutions (63.2%) reported very beneficial interactions with foreign research institutions. In contrast, only 22.2% and 27.8% reported very beneficial interactions with local forestry research institutions and local non-forestry research institutions respectively.

Most interactions with local institutions have been moderately beneficial to the research institutions. This follows from Table 3 from which it can be seen that about half of the institutions have laboratory, library and computer facilities which are inadequate and in an unsatisfactory condition, and that some institutions lack these facilities altogether. Sharing of resources is mostly limited to those enjoying better facilities. Foreign research institutions are better placed in such exchanges. For example, they can donate literature, computer packages, give research advice, assist in arranging funding for research and to scientific meetings, as well as collaboration in research. Also foreign institutions often have improved access to donor research funds. This makes interactions with them very beneficial to the local institutions.

(d) Relative standing for each of the research interactions

The analysis was extended to how interactions reported by individual institutions (as discussed above) relate to the sample as a whole. For each institution the value for research interaction is calculated as shown in Annex 1, and its relative standing in the data set identified. This information was then graphed for each institution and is presented in Annex 3. The charts give an impression of how each institution relates to similar institutions in the region with respect to the chosen indicators.

From this second level of analysis, it would appear that with the exception of the Faculty of Forestry at Sokoine University of Agriculture (SUA) and IRA, all research-related establishments based at the Universities of Zambia, Zimbabwe, Stellenbosch and Eduardo Mondlane in Mozambique, have relatively weak contacts with related research institutions. Forestry research institutions like FRIM, CEF, TAFORI, FORESTEK, ZIMFC and ICFR show much stronger contacts with their counterparts. In general all forestry research institutions, with the exception of the two research divisions in the Department of Forestry of Zambia, report better contacts with other research institutions than the universities. This could be due to the importance of research in the teaching-research-extension mission of the universities. SUA has a relatively strong post-graduate programme which is almost twenty years old. Research for students' dissertations/theses would tend to make SUA place more emphasis on research than other institutions without a similar demand. Also the criteria for promotions at SUA and IRA is very strongly related to research results (number and quality of publications), rather than to teaching tasks; placing a further stress on research.

With the exception of FORESTEK and ICFR, both of South Africa, it would appear that the potential for forestry research capacity, as measured by the percentage of researchers with M.Sc. and Ph.D. qualifications and with over four years of experience (Figure 3), lies in the universities. This is another strong reason to enhance their role in national and regional research initiatives. As post-graduate training advances in the universities and academic career advancement puts more emphasis on research output, interactions with similar institutions is also bound to increase.

*Interactions with educational institutions.*

Again this evaluation is made at two levels; the individual institution and relative to other institutions in the sample. The first four columns of Table 5 present results for interactions between educational institutions, while the last two show the level of commitment of resources to contact with users of research results.

(a) Interactions with national educational institutions

Almost one-half of the institutions has occasional interactions with educational institutions in their own countries; while the other half has more frequent contacts. All forestry research centres in Tanzania, Zambia, Mozambique and Lesotho have occasional contacts with educational institutions in their own countries and perceive such interactions as of moderate benefit to them. Only the forestry research divisions in the department of forestry of Zambia regard those contacts as being of no real benefit.

Just 33.3% of the institutions surveyed (FORESTEK, ICFR, FRIM and FAB) regard such interactions as being very beneficial, while 44.4% perceive them as moderately beneficial and 22.2% as of no real benefit. On the whole, many research institutions consider contacts with educational establishments in their own countries as being moderately beneficial.

(b) Interactions with foreign educational institutions

With respect to contacts with foreign educational institutions, 36.8% of the national research institutions have had occasional contacts while 57.9% reported frequent interactions. Some 36.8% of these felt that they derive moderate benefits from such relationships while 52.6% considered them as being very beneficial. Only FRIM of Malawi and

FAB of Botswana consider contacts with local educational institutions as being more beneficial than those outside the country. SUA and NSTP of Tanzania, FORESTEK and ICFR of South Africa, Lesotho and Namibia reported the same value of benefits derived from national and foreign educational institutions.

On the whole, the level of contacts between national and foreign educational institutions was slightly higher (94.7%) than that between national research and educational institutions (88.8%). In addition interactions with foreign educational centres were perceived to be more beneficial (89.4%) than those derived from interacting with national institutions (77.7%). Most of the foreign contacts are related to post-graduate training of researchers in the absence of such training possibilities in national institutions.

(c) Relative standing for interactions with educational institutions

In the second level of the analysis, the quality of interaction between educational institutions is examined for each institution relative to others in

**Table 5**. Interactions with educational institutions and users of research results

| time | Own EDI | Benefit | For. EDI | Benefit | % of budget | % of staff |
|---|---|---|---|---|---|---|
| TAFORI | 1 | 2 | 1 | 3 | 10 | 10 |
| NTSP | 1 | 2 | 1 | 2 | 12 | 10 |
| SUA | 2 | 3 | 2 | 3 | 5 | 2 |
| IRA | 1 | 2 | 2 | 3 | 20 | 30 |
| U. ZIM | n.a. | n.a. | 1 | 3 | 30 | 10 |
| ZIMFC | 1 | 2 | 2 | 3 | 5 | 20 |
| ZAMBIA | 1 | 1 | 1 | 2 | 3 | 2 |
| U. ZAMBIA | 2 | 1 | 2 | 2 | 20 | 10 |
| FRIM | 2 | 3 | 2 | 2 | 20 | 30 |
| CEF | 1 | 2 | 2 | 3 | 10 | 5 |
| UEM | 1 | 2 | 2 | 3 | 15 | 15 |
| USUTU | 0 | 1 | 1 | 2 | 5 | 30 |
| FAB | 2 | 3 | 2 | 2 | 30 | 50 |
| VELD | 0 | 1 | 0 | 1 | 60 | 40 |
| FORSTEK | 2 | 3 | 2 | 3 | 7 | 7 |
| ICFR | 2 | 3 | 2 | 3 | 20 | 20 |
| U. STELL | 2 | 2 | 2 | 3 | 5 | 10 |
| NAMIBIA | 2 | 3 | 1 | 3 | n.a. | n.a. |
| LESOTHO | 1 | 2 | 1 | 2 | 1 | 20 |
| Sample | 18 | 18 | 19 | 19 | 18 | 18 |
| Totals & Percentage | | | | | | |
| With 0 | 2(11.1) | n.a. | 1(0.05) | n.a. | | |
| With 1 | 8(44.4) | 4(22.2) | 7(36.8) | 1(0.05) | | |
| With 2 | 8(44.4) | 8(44.4) | 11(57.9) | 7(36.8) | | |

In brackets are percentages

Note:
A. Interactions:
0 = never had interactions
1 = occasional interactions
2 = frequent interactions

B. Benefits:
1 = no real benefit
2 = moderate benefit
3 = very beneficial

Own EDI = Own country educational institutions
For. EDI = Foreign educational institutions.

the region. The procedure for determining the value of educational interactions is explained in Annex 1. As in the analysis of research interactions the same approach was followed in constructing charts for each of them as shown in Annex 3.

Almost the same scenario, as in (b) above, emerges. All the three institutions from South Africa (FORESTEK, ICFR and the Faculty of Forestry at the University of Stellenbosch) show relatively strong interactions with educational institutions. Those from Zambia, Botswana, and Lesotho in addition to NTSP and USUTU, have much weaker interactions. The remainder lies between these two extremes. This corresponds with the pattern described earlier with respect to research support facilities. The forestry research divisions in the Department of Forestry of Zambia, the Forestry Research Centre (CEF) of Mozambique, TAFORI, VELD and the forestry research unit of Lesotho were also observed to have satisfactory to poor library and laboratory facilities and with very limited level of sharing of research resources with other institutions. The poorly resourced units appear to be interacting less with educational institutions, which could be indicative of very little sharing of resources and low levels of research manpower for training and development.

Overall, the region has a number of universities with fairly strong capacity for forestry and related research (Figure 3). Some also offer post-graduate training and can organise other courses for researchers. There is therefore a significant potential for increased collaboration between universities and forestry research institutions which could help improve forestry research in individual countries and the region as a whole.

*Interactions with users of research results*

The last two columns of Table 5 present results on the interactions of these institutions with users of their research results. Two proxies have been used to gauge this interaction. These are the proportion of annual budget associated with technical transfer and extension (column 5) and the proportion of staff time associated with technical transfer of results and with user groups (column 6).

(a) Level of commitment of resources to user groups

From Table 5, only one centre, VELD of Botswana, devotes more that 50% of its budget to technical transfer and extension activities. This is followed by FAB of Botswana (30%) and the Department of Biological Sciences at the University of Zimbabwe (30%). Nine institutions (about 47%) use up to 10% of their budgets in these activities. The remaining seven institutions (about 37%) allocate between 10% and 50% of the budgets to user related activities.

Nine institutions (50%) allocate up to 10% of staff time to these activities, while another nine (50%) use more than 10% of their staff time. Only FAB reaches 50%, followed by VELD with 40%. Both VELD and FAB are NGOs. Such high levels of commitment, in terms of funds and staff time to user groups, are characteristic of grassroots organisations of this type. However, it is apparent that very few institutions commit significant resources, in terms of funds and staff time, to the transfer of research results. Only about 17% of those surveyed used more than 20% of their budgets in these activities, while about 28% allocated more than 20% of their staff time to extension and related activities. This is sometimes because the mandates given to these organisations are very specific about research and/or training. It could also be due to the presence of other institutions within the national systems which have been created specifically for extension purposes. Another cause may be the lag in evolution of extension work in forestry. For example, extension activities and networks are more advanced in the field of agriculture as opposed to forestry.

(b) Relative standings of individual institutions

Each of these institutions was evaluated relative to the others in the sample as explained in Annex 1, leading to the charts presented in Annex 3. The results give a scenario similar to the one described above.

With the exception of the Universities of Zimbabwe and Eduardo Mondlane, and IRA of the University of Dar es Salaam, all forestry and related establishments at universities interact weakly with users of their research results. An explanation could be related to the type of research undertaken by these institutions. Many would probably put more emphasis on basic research for their academic programmes. Also the breakdown of resources between research, extension and consultancy work may be another factor. The University of Zimbabwe is involved in a considerable amount of local community-related research which inevitably brings it into contact with its clients. The IRA at the University of Dar es Salaam spends much of its resources on consultancies and contractual research, tasks which are also client-oriented.

Institutions with a strong user contact are VELD of Botswana, ICFR and FORESTEK of South Africa, FRIM of Malawi and IRA. ICFR and FORESTEK are client-oriented research centres, whilst FRIM has significant local community-related research undertakings which bring it closer to its clients.

Generally, low interaction with users of research results would put into doubt the relevance of research undertaken by many of these institutions, as already noted in Burley *et al.* (1989). This will also raise questions on how research priorities and programmes are formulated in these countries. As research becomes more demand-driven, increased contacts with users of results will become mandatory for the survival of the forestry research establishments.

### *Internal research environment*

*Salary and related incentives*

Ideally, all disposable income of researchers in the region would come from their salaries. However, scientists from many of the institutions surveyed would find it difficult to depend solely on their salaries for survival. This is mainly due to the difficult economic climate prevailing in practically all these countries. Various measures have been designed by the institutions and individual national governments to lessen these economic hardships on their employees. It is, therefore, not surprising to find that in some institutions the remuneration of scientists from various forms of allowances and net savings on per diem allowances during travels are several times the annual salary. Table 6 summarises the results of salary and non-salary incentives available at these institutions.

From the data university staff at the institutions surveyed in Tanzania (SUA, IRA), Zambia (U. ZAMBIA) and Mozambique (UEM), have disposable incomes which are about twice the level relative to earnings of other professionals with similar qualifications in the government service outside the universities within the respective countries. Scientists at the University of Zimbabwe and ICFR of South Africa have take-home incomes which are about 50% more than that of their colleagues with equivalent qualifications, for example, in the government service. Researchers at FRIM of Malawi, CEF of Mozambique and in the two research divisions in the forestry department of Zambia appear to be earning almost half what their colleagues with similar qualifications are earning in other local organisations.

The results presented in Annex 3 should be interpreted carefully. For example, the fact that SUA, IRA, U. ZAMBIA and UEM appear in the first quartile does not mean that these institutions have the highest remuneration in comparison with the others in the sample. The researchers in these institutions have much higher disposable incomes in comparison with colleagues of similar qualifications employed in other sectors in their own countries. The researchers in the institutions in the other quartiles have smaller remuneration differentials relative to colleagues of similar qualifications employed elsewhere in their own countries. In this respect Annex

**Table 6**. Salary and non-salary incentives

| Institution | Income of researcher relative to comparable professional (+/- %) | Non-salary awards | | |
|---|---|---|---|---|
| | | Score | Max. score | % score |
| TAFORI | -70 | 19 | 36 | 52.8 |
| NTSP | -50 | 30 | 36 | 83.3 |
| SUA | 100 | 21 | 36 | 58.3 |
| IRA | 100 | 25 | 36 | 69.4 |
| U. ZIM | 50 | 20 | 27 | 74.1 |
| ZIMFC | 15 | 15 | 27 | 55.6 |
| ZAMBIA | -100 | 12 | 18 | 66.7 |
| U. ZAMBIA | 100 | 9 | 54 | 16.7 |
| FRIM | -100 | 31 | 54 | 57.4 |
| CEF | -100 | 19 | 36 | 52.8 |
| UEM | 100 | 17 | 36 | 47.2 |
| USUTU | 50 | 29 | 45 | 64.4 |
| FAB | 5 | 24 | 36 | 66.7 |
| VELD | 45 | 3 | 9 | 33.3 |
| FORESTEK | -5 | 26 | 54 | 48.1 |
| ICFR | 50 | 22 | 36 | 61.1 |
| U. STELL | -42 | 53 | 63 | 84.1 |
| NAMIBIA | n.a. | 4 | 9 | 44.4 |
| LESOTHO | n.a. | 48 | 54 | 88.9 |

3 does not provide a comparison of relative values of remuneration with respect to the sample; rather it shows how the remuneration of researchers in one country compare with those of scientists of equivalent qualifications employed in other sectors in the same country.

With the exception of institutions in South Africa, the discrepancy in salaries and related incentives between universities and forestry research institutions could be one of the factors behind better development of research capacity at the universities (see Figure 3).

The universities are in a better position to retain highly trained and experienced staff. One wonders why governments should entertain such income discrepancies, whilst cognisant that the qualifications required for the tasks at universities and research institutions are similar and that the tasks are equally challenging.

If governments are willing to give such allowances to employees, they could also legalise the total disposable incomes as being the net salaries of their employees. This would eliminate the allowances which give an impression that they are a favour from the government/institutions because, unlike salaries which are contractual by nature, several types of allowances can be reduced or eliminated even without consulting the employees. These allowances are not favours, they are earned incomes. In constant money values these salaries have been declining over time in many of these countries, reducing the purchasing power of employees. This has forced governments to make up for this loss in the form of allowances.

*Non-salary incentives*

All institutions differ in their capacity to reward their employees with benefits other than salaries. A variety of non-salary incentives were examined in terms of their frequency of use and effectiveness in stimulating research efficiency. The maximum value for each of the incentive types, as calculated following the formulas in Annex 1, is nine. In Table 6, the value for frequency and effectiveness on each incentive were added together to give a score. For example, at TAFORI, 4 incentives were used, so the maximum level of efficiency/frequency is 36. In this case the effectiveness and use was assessed at 19 for all four. These non-salary incentives included the use of non-financial awards like merit certificates, provision of housing and transport, possibilities of travel to other countries, additional research funding, professional responsibility, consultancies, sabbatical/internships/training, and career development opportunities. Not all institutions have the ability to offer all of them, so the maximum score for each institution is calculated on the basis of the type of incentives it is currently using. Table 6 presents the results.

Twelve of the nineteen institutions surveyed (about 63%) are employing 4-6 different non-salary incentives which are relatively efficient in attracting, retaining, motivating and increasing the productivity of research staff. Many of these institutions have considerable autonomy over their activities and finances. Only one organisation is using seven types of incentives and five (26%) are using 1-3 different non-salary incentives. In the majority of the institutions (74%) the incentives are moderately to greatly effective.

As research becomes more client-driven or market-oriented, the institutions will have to increase their level of autonomy without compromising national or regional research priorities. This will tend to increase their capacity to reward their staff, retain and make better use of them. In addition, it will increase the speed with which decisions are made and this can lead to overall improvement in research efficiency and reduce dependency on government funding.

Gilbert *et al.* (1994), noted that creativity is one of the ingredients of research which distinguishes it from many other occupations, particularly those in the public sector. Creativity in institutions is a product of skill levels, opportunities, low staff turnover and motivation. All these attributes are present in relatively low levels in many of the institutions surveyed. An increase in the level of institutional autonomy would most probably contribute to raising its level of creativity. The region desperately needs the creativity of its scientists in order to overcome the seemingly insurmountable problems in the shortest period possible.

*Use of formal and informal evaluations in decision making*

Evaluations of research activities could be used for justification of past expenditures, support for new funding or budget requests, guiding choice among competing research projects, and monitoring on-going research activities. Each institution was assessed in relation to these four function, all of which present possible decision-making situations relevant to management of research activities. Few institutions listed more uses. The capacity to handle such situations influences the conduct of research. The means of calculation and the limitations of the indicator are described in Annex 1. Table 7 summarises the results where a 'score' is the sum of informal and formal evaluation usage. The maximum score is based on the total types of evaluation employed.

All but three institutions evaluate their research activities to formally satisfy some or all of the four uses listed earlier. This is due to the fact that many research projects are donor funded and therefore an account of how funds are used is a requirement. The same is true for institutions which receive government funding. Justification of budgets and funding for new projects is also a donor as well as a government requirement. Many organisations have internal regulations which demand accountability as well justification for funding new projects.

**Table 7**. Use of formal and informal evaluations

| Institution | Formally used | | | Informally used | | |
|---|---|---|---|---|---|---|
| | Score | Max. score | % score | Score | Max. score | % score |
| TAFORI | 0 | 16 | 0 | 4 | 16 | 25 |
| NTSP | 12 | 16 | 75 | 1 | 16 | 6.3 |
| SUA | 19 | 20 | 95 | 0 | 16 | 0 |
| IRA | 11 | 16 | 68.8 | 4 | 16 | 25 |
| U. ZIM | 6 | 20 | 30 | 9 | 16 | 56.3 |
| ZIMFC | 12 | 16 | 75 | 9 | 16 | 56.3 |
| ZAMBIA | 8 | 16 | 50 | 1 | 16 | 6.3 |
| U. ZAMBIA | 9 | 16 | 56.3 | 9 | 16 | 56.3 |
| FRIM | 19 | 20 | 93.8 | 0 | 16 | 0 |
| CEF | 4 | 16 | 25 | 7 | 16 | 43.8 |
| UEM | 16 | 16 | 100 | 0 | 16 | 0 |
| USUTU | 12 | 16 | 75 | 4 | 16 | 25 |
| FAB | 12 | 16 | 75 | 12 | 16 | 75 |
| VELD | 12 | 16 | 75 | 0 | 16 | 0 |
| FORESTEK | 16 | 16 | 100 | 0 | 16 | 0 |
| ICFR | 14 | 16 | 87.5 | 4 | 16 | 25 |
| U. STELL | 12 | 16 | 75 | 3 | 16 | 18.8 |
| NAMIBIA | n.a | n.a | n.a. | n.a | n.a | n.a. |

Unfortunately, only four institutions have a moderately extensive use of informal evaluations, either for the four uses identified earlier or for any other purposes. A considerable amount of the information/data exists within the institutions, some of which is used for formal evaluations. Such information could be reprocessed or even be of direct internal use to improve the management of research and administration of resources. Example uses could include assessment of the degree of attainment of research objectives, efficiency (productivity) with which resources are being used, directing priority setting and reallocation of resources.

The overall impression from Table 7 is that the use of information assembled, stored and/or processed by these institutions is mainly geared towards the satisfaction of external requirements, rather than for their own internal consumption and ultimately self-improvement. Bengston *et al.* (1988) argues that the use of formal and informal evaluations is likely to be related to effective research capacity or, more specifically, to the capacity to manage research resources and administer the research process. Increased use of such evaluations may therefore be associated with the level of sophistication an institution has attained in managing research; which is also indicative of the efficiency with which research resources are being allocated and used. The broad scope of forestry research adopted by many institutions in the region is hardly commensurate with resources to carry through many of the identified research undertakings. Effective allocation management and administration of scarce resources must be a priority in practically all these institutions. The use of information already available for internal purposes will also contribute to improvements in research management and overall administration of research resources. Since effective allocation of resources is the key issue in improving the effectiveness of research, future research capacity assessments must focus on how resource allocation and research prioritisation decisions are made.

### *Technical support*

The ratio of number of technicians to number of researchers within an institution was used to gauge the level of technical support available. No attempt was made at determining the ideal ratio as this will vary by institute and research focus. However, of the eighteen institutions which responded to this nine (50 %) have less than one technician to every researcher. The indicator should be viewed with caution. For example, the two forestry research institutes in Zambia have the greatest ratio of technicians to research staff, a situation which has resulted from recent reductions in research staff numbers.

Also, almost all forestry and related establishments at universities, with the exception of that at the univer-

sity of Stellenbosch, have relatively weak technical support as compared to the research institutions. This may due to the possibility of sharing technical services with other departments/faculties at the universities; something this ratio failed to capture. Research institutions tend to have all technicians, laboratories and equipment they need, while university departments and faculties are more inclined to share some of these resources because they are centrally managed.

In comparison with LDCs in the Asia-Pacific region, Bengston *et al.* (1988) observed that technical support for research was also higher in government research institutions. Institutions with better technical support could be used for training technicians from weaker institutions.

# CONCLUSIONS AND RECOMMENDATIONS

The specific objectives of this study largely guided the structuring of the conclusions and recommendations.

## Conclusions

### *Human resources*

- About half of the forestry and related research manpower in the SADC region is trained to the level of M.Sc. and Ph.D. and has at least four years of experience after obtaining these academic qualifications. Whilst this is indicative of a fairly satisfactory number of trained and experienced forestry researchers in the region, it also implies that about half would require more training and scientific exposure.
- In Mozambique, Zimbabwe, Zambia and Tanzania, most of the qualified researchers (with the qualities mentioned above) are found in university faculties and departments. Their availability for research is limited because of commitments to other equally important activities like teaching, extension and consultancy work.
- South Africa, Botswana and Swaziland have a strong private sector forestry, which explains why most of their researchers are found in this sector as opposed to the other countries in which practically all the researchers are found in the public/government sector. There is an absence of private forestry sector research in all but these three countries.

### *Financial resources*

- There is considerable annual variation in research funding, either from external or internal sources, mainly due to political and economic externalities. This is creating serious strains on the institutions, restricting their ability to implement their research agendas, let alone safeguard their own survival. A good balance between local and foreign funding is desirable to cushion the institutions from adverse effects of externalities, like national currency devaluations which can seriously undermine the purchasing power of the institutions, reducing their ability to sustain research activities. However, such balance should be sought while, at the same time, cultivating self-financing mechanisms within the institutions.
- The absence of a strong private sector in forestry is indicative of a very poor market for research output in many of these countries (excluding South Africa), and tends to favour the continuation of government financing of forestry research until the private sector in forestry develops appreciably. Also funding of public-good research will for a long time continue to be funded by national governments and the international community as there is little financial incentive for the private sector to undertake such research.

### *Adequacy of research capacity to support decision making*

- About 17% and 28% of the institutions surveyed allocate more than 20% of their budgets and staff time, respectively, to extension activities, i.e. making contacts with users of their results. The universities are weaker in this regard compared with the other institutions, and this may be due to the teaching and consultancy commitments which are other essential tasks for university scientists. In general, low interaction with users of research results raises questions on the relevance of the research undertaken by these institutions, and how they formulate their research priorities and programmes. The economies of these countries are increasingly becoming market-oriented and with considerable involvement and promotion of the private sector. It is therefore likely that research will become demand-driven, making contacts with user groups of research results an inevitable research norm.
- There is an abundance of information in these institutions, some of which is from previous evaluations; many undertaken to satisfy external reporting requirements to governments and donors. Very few institutions use internally generated information as part of a self-improvement strategy. This is a reflection of the low level of sophistication in managing research available in many of these institutions.

### *Linkage between the research institutions and other relevant institutions*

- About two-thirds of the institutions surveyed reported frequent interactions with forestry-related

and non-forestry research institutions in their own countries. The majority of the institutions regard such interactions as being moderately beneficial. These fairly high frequencies of contact reported, accompanied by high levels of satisfaction derived from such interactions, is indicative of the current potential for collaborative research in the individual countries.

- Almost half of the institutions had occasional interactions with educational establishments in their own countries; while the other half had more frequent contacts. The majority of the institutions regard such interactions as being moderately beneficial. These educational institutions have some capacity for research and can provide training for staff from research organisations. However, the poorly resourced research centres, those who would benefit most, generally interact less with educational institutions. This could be indicative of a low level of research activities as well as staff training and development activities.
- The majority of the institutions reported frequent interactions with foreign institutions and viewed such contacts as being very beneficial. Benefit was greater from interacting with foreign institutions than from those within their own countries. The international bodies have more to offer and share than local ones. The level of interaction with foreign institutions may also be indicative of the scope or complexity of research undertaken by some.
- Universities appear to interact less in comparison with the other surveyed institutions. This may be due to the emphasis given to research by university establishments in their teaching-research-extension/consultancy mission as compared to the research-extension/consultancy mission of the other institutions. With the exception of South Africa, universities in the SADC countries have more qualified manpower and are better equipped with research facilities than other institutions; indicating potential for increased collaboration in research.
- Much as there are frequent and beneficial contacts between the SADC institutions, how these translate into co-ordinated collaborative activities remains unclear. SACCAR has the mandate to promote forestry-related research in the region; and hopefully it will institute a mechanism for such collaboration.

### *Adequacy of research-supporting resources*

- In about half of the institutions surveyed, laboratory and library facilities are poorly developed and equipped; in a few these facilities are completely absent.
- About two-thirds of the centres have adequate computer facilities, in the sense that the majority of their researchers have access to computers. Of this sub-sample, about two-thirds have electronic mail connections and a few have local area networks. It is unlikely that many of the institutions with poor computer facilities can use more computer equipment given the small number of their scientists and small volume of work as indicated by their budgets. For these institutions, replacement of obsolete hardware and provision of appropriate software may be more relevant.
- About two-thirds of the institutions reported a satisfactory mutual sharing of resources like laboratories, libraries and computers. However about half of the poorly resourced establishments reported very limited sharing of such resources, which could be indicative of a low volume of activities and inadequate skilled manpower.
- Almost half of the surveyed institutions have field stations/centres/zones; facilities which provide them with considerable flexibility for experimentation in the field. However, about half of these are in poor condition and without adequate infrastructure; indicating that their full research potential is being under-utilised for the activities for which they were designed.
- Several centres have a backlog of unprocessed data from field experiments and other records; sometimes stretching to over twenty years. Given that the region has considerable computing capacity, it would appear that shortage of skilled manpower and opportunities to share resources are most probably the relevant constraints; rather than inadequate computing/analytical facilities.

### *Adequacy of methodology for the study*

- The methodology chosen has a number of shortcomings, the most important being that the indicators do not encompass all factors influencing research capacity and cannot fully capture the institutional research capacity. Also much of the data relies on oral responses by the head of an institution or his/her representative to carefully explained questions, and this may expose the data to bias.
- The methodology is simple to understand, implement and interpret. It also has the merit of combining a large body of relevant information, for example in the form of a chart, thereby providing a more comprehensive overview of individual institutions relative to the sample as a whole.
- There is considerable scope for improving the methodology, for example through development of additional indicators, refinement of survey tech-

niques and improvement of data quality and analysis.

### *Main constraints to research and capacity building*

The study confirmed the continuation, in the region, of the six major constraints to effective performance and utilisation of research in Africa identified by the African Academy of Science (1994). These were:

- insufficient collaborative research. This can be discerned from the level of interactions between institutions which is especially weak among the poorly resourced centres.
- poor research and development linkages. This is indicated by low level of interactions with user groups.
- inadequate flow of information and access to scientific literature. The weak interactions between institutions, especially the poorly resourced ones, and the unsatisfactory state or absence of library facilities are factors which confirm this.
- poor research-education linkages. The study results indicate fairly weak interactions between research and educational establishments in the respective countries and the contacts were viewed as moderately beneficial.
- low sustainability of research programme support. Declining funding of research, in real terms, and especially from local sources, in addition to inadequate research manpower were observed to be constraining research development.
- lack of co-ordination with donors.

## Recommendations

### *On the results of the study*

- In view of the fact that the region has insufficient research manpower and half of that present needs more training and scientific exposure, one of the priority areas for improving research capacity in practically all SADC countries would be manpower training and development.
- As the economies of the SADC countries become more market-oriented making research increasingly demand-driven, the burden of funding research should gradually be transferred to the emerging private sector in forestry. However, public-good research should continue to be supported by governments and international organisations since this is not the domain of the private sector; at least for the foreseeable future.
- One way of dealing with the decline in real value of funding for research is for national institutions to maintain a good balance between local and foreign funding, so as to cushion themselves from the adverse effects of political and economic externalities, like devaluation of local currencies, which erode the value of their budgets, effectively constraining their capacity to sustain and/or develop new research activities.
- Much as it is advisable for national institutions to be aggressive in attracting foreign funding for research from donors and other sources, self-financing measures (in local and foreign currencies) should be vigorously pursued due to the ephemeral nature of donor funding arrangements. Reliance on a single donor makes an institute very vulnerable to changes in funding arrangements that are beyond its control.
- Institutions should adopt the concept of managing a research 'portfolio'; relatively few expensive research activities should be balanced by a greater number of cheaper ones, long-term projects balanced by short-term studies. Similarly institutes should attempt to diversify funding sources and assess their likely response to various funding scenarios during the selection of research activities.
- Library, laboratory and computer facilities should be made available where they are absent and be reinforced where they are inadequate; without them the capacity for research becomes seriously constrained, even in the presence of sufficient skilled manpower. Likewise, field stations/centres and maintenance of trial plots should be reinforced where these facilities are essential to the research agenda.
- Inadequate manpower and financial resources, coupled with paucity of research support facilities dictate that national and regional research agendas should be tailored to match available resources.
- The considerable potential for greater collaborative research activity presents an important opportunity to enhance the research capacity of individual institutions, countries and the region as a whole.

### *On the adequacy of the methodology used in the study*

- Since many factors affect the capacity to conduct research it is advisable to develop additional and more comprehensive indicators, rather than relegate many important aspects to qualitative assessment.
- It would be advisable to collect time series information for the indicators, to the extent possible, so that other analytical approaches could be used to complement the analysis made in this report.

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*ANNEX 1*

# METHODOLOGY AND INDICATORS OF RESEARCH CAPACITY

The methodology attempts to capture the most important aspects of research capacity by means of quantitative indicators or proxies. The comparison of indicators between institutions allows determination of the *relative research capacities.* It does not, however, yield optimum or absolute values. The indicators have the advantage of being simple to understand and the data required can, generally, be collected quickly and efficiently.

## SURVEY METHODOLOGY

Data collection was largely by means of structured interviews with the heads of forestry research institutes or with senior forestry-related researchers in other organisations. The interviews were conducted informally and the aims and background to the study were explained. In some institutions the full complement of data required was not readily available, e.g., financial information, publications and staff breakdowns and these were provided (in most of these cases) at a later date by mail or facsimile.

The data collected were tailored to the requirements of the methodology for quantification of the following set of indicators; additional qualitative information was captured via further discussion and visits to institute facilities and field sites. Bengston *et al.* (1988) developed a methodology which was used as the starting point for this study. Of the indicators developed by Bengston *et al*. the following have been adopted without modification:

- Salary incentives
- Non-salary incentives
- Use of evaluation; and
- Research support

These are further described below. The data resulting from the survey yielded values for indicators for each of the institutes. These were processed in a simple spreadsheet, and a graph for each institute was produced showing the standardised (to a uniform scale) quartile values for each of the indicators. The value of each indicator was then plotted against the sample quartile values, thus providing a measure of relative research capacity with respect to the indicators used.

## HUMAN RESOURCES (HR)

Effective scientific manpower is the single most important factor affecting research capacity. Most studies, including Bengston *et al*. (*op. cit.*), rely on total staff numbers to reflect the resource available. In this study an indicator that attempts to reflect staff experience and qualifications has been developed.

$$HR_i = (G_j + 2q_j) + 4E$$

where:

| | | |
|---|---|---|
| $i$ | = | $i$th research institution |
| G | = | The length of service of the $j$th staff member; 1 = less than four years, 2 = four to ten years, 3 = over ten years. |
| q | = | The highest qualification of the $j$th researcher with; 0 = B.Sc., 1 = M.Sc. and 2 = Ph.D. |
| E | = | The total number of expatriate research staff in the institute |

This expression reflects the following table whereby the relative ‘worth’ of researchers to a research institute has been arbitrarily quantified with respect to the qualifications and duration of service per researcher within the institute.

**Table A1.1** Weightings applied to human resources indicator

| Highest Qualification | Duration of Service | | |
|---|---|---|---|
| | < 4 years | 4- 10 years | > 10 years |
| Ph.D. | 5 | 6 | 7 |
| M.Sc. | 3 | 4 | 5 |
| B.Sc. | 1 | 2 | 3 |
| Expatriate | 4 | 4 | 4 |

This 'relative worth' implies several assumptions that may not adequately reflect reality:

1. New recruits to a research organisation are generally assumed to be less effective than longer-serving staff and that the effectiveness of staff increases over time irrespective of the duties performed or previous experience outside the institute.
2. Highest qualification is directly proportional to the level of competence in conducting all research-related duties.
3. The 'relative worth' of a staff member is independent of the duties performed.
4. Expatriates are assumed to have already reached their maximum potential upon entry and, since this category can have a variety of qualifications, the median 'worth' value was adopted.

## INDICATORS FOR EXTERNAL ENVIRONMENT

The three indicators that attempt to capture interactions in the external research environment have the limitation of not linking the interactions to particular beneficial outcomes, e.g., new technologies, publications, or collaborative research arrangements.

### Research Interactions (RI)

Scientific interactions with other research organisations are thought to be essential in overcoming the phenomenon of 'research isolation' and in developing and sharing research methods and findings. They are also a pre-requisite for developing national and regional research co-operation. The extent of interactions with other research institutions is quantified by the following indicator:

$$RI_i = w(aF + bM + cO)$$

where:

- $i$ = $i$th research institution
- F = frequency of interaction with other forestry research institutions in the same country
- M = frequency of interaction with non-forestry research organisations within the same country
- O = frequency of interaction with research institutions outside the country

The frequency of interaction (F, M and O) may take the following values:

0 = never interacts, 1 = interactions are occasional, 2 = interactions are frequent

a, b, and c represent the perceived benefits of the interactions defined in F, M and O respectively, and may take the following values:

1 = no real benefit, 2 = moderate benefit, 3 = high benefit

$w$ = number of research staff in the $i$th institute/mean number of research staff per institute from the sample

This indicator includes a weighting not used by Bengston *et al*. The rationale for the inclusion of a weight is that the total extent of interactions by a research institute is likely to be proportional to the number of research staff able to interact. Thus, the indicator takes into account the frequency of, and benefit derived from, various interactions adjusted by a weighting related to the number of staff in the institute.

### Educational Interactions (EI)

Interaction with educational institutions, is assumed to enhance research capacity in several ways; including training of research staff, exposure to new ideas and, perhaps, access to current literature. The interactions between the institutions surveyed and educational establishments is given by the following expression:

$$EI_i = w(dD + eQ)$$

where:

| | | |
|---|---|---|
| *i* | = | *i*th research institution |
| D | = | frequency of interaction with national educational institutions |
| Q | = | frequency of interaction with educational institutions outside the country |
| d | = | a measure of the value of the perceived benefits from the in-country educational interactions |
| e | = | a measure of the value of the perceived benefits from foreign educational interactions |
| *w* | = | number of research staff in the *i*th institute/mean number of research staff per institute from the sample |

The weighting is applied for the same reasons as in the RI indicator above.

### User Interactions (UI)

The leverage obtained from research funding is enhanced if research is 'demand-driven', i.e., a clear need is fulfilled by the research activity. The extent of interaction with users or potential users of research outputs are taken as a proxy for the extent to which research is targeted to potential users. The indicator is based on the premise that 'extent and effectiveness' of interactions can be quantified from the time and money an institute allocates to these activities:

$$UI_i = B + wT$$

where:

| | | |
|---|---|---|
| *i* | = | *i*th research institution |
| B | = | proportion, in %, of annual budget associated with technical transfer and extension of results |
| T | = | proportion, in %, of staff time associated with technical transfer and extension of results |
| *w* | = | number of research staff in the *i*th institute/mean number of research staff per institute from the sample |

One shortcoming of this indicator is the extent to which the percentage of the annual budget allocated to extension/user interactions represents 'double counting' with respect to the staff time allocation, which also features in the indicator. The staff time component has been weighted by the number of staff in the institute as a ratio of the sample mean. Again, the rationale is that total extent of 'user interaction' is the product of mean time per researcher and number of researchers in addition to the financial resources available to facilitate transfer of research results.

The indicator has a number of obvious weaknesses; it takes no account of the means by which results are transferred to users, nor does it attempt to assess the relative merit of the different approaches (e.g., workshops, demonstration trials, stakeholder participation in research design). It does not highlight the extent to which research findings may be transferred by a third party that services the research institute through extension activities, nor does it capture the extent to which user needs feature in establishing research priorities. These are all important aspects in ensuring that research outputs yield successful outcomes for the targets of research.

## INDICATORS FOR INTERNAL ENVIRONMENT

### Salary and related Incentives (SI)

Salary incentives for researchers are very important in attracting and maintaining the key research resource. The indicator captures the remuneration available to researchers relative to similarly qualified professionals in the same country:

$$SI_i = C_i$$

where:

$C_i$ is the percentage advantage (or disadvantage if negative) in the researchers' income (salaries and allowances) for the *i*th institute over that of colleagues with equivalent qualifications and experience in other sectors of the economy in the same country.

In the calculation of this index from the data, the largest negative value (-100) was added to each value for the *i* institutes to standardise the values. Relative ranking remained unaffected.

For government research organisations comparisons were made with private sector or parastatal organisations. The interpretation of the results from this indicator requires care. The indicator reflects the *within country competitiveness* of the institute in terms of salary incentives, not the total remuneration relative to the sample as a whole.

## Non-Salary Incentives (NSI)

Non-salary incentives for researchers, are considered to be very important in retaining the key resource of well qualified, highly motivated research workers. Non-salary incentives can often compensate for poor base salaries through, for example, housing and transport allowances. Inadequate non-salary incentives contribute to the likelihood of staff turnover or depletion and is defined as:

$$NSI_i = \sum r_j . R_j$$

where:

- $i$ = *i*th research institution
- R = a measure of the frequency with which the various forms of rewards are used
- r = a measure of the effectiveness of the rewards in contributing to researcher productivity
- j = types of incentives offered to researchers

The frequency of use for each of the rewards used is ranked as follows:

1 used occasionally, 2 used frequently, 3 always used (i.e. built into the system)

The effectiveness of each of the rewards in stimulating researcher productivity is ranked as:

0 not effective, 1 slightly effective, 2 moderately effective, 3 very effective

The type of incentives *j* include:

Peer recognition awards, housing and transport allowances, travel to other countries, career development (schedule of service), professional responsibility, sabbaticals/internships, consultancies/ training, and award of additional research funding.

## Use of Formal and Informal Evaluations (EV)

The use of evaluation in research decision making is assumed to be linked to the capacity to effectively manage research, another important component of research capacity. An evaluation index (EV) based on formal and informal evaluations was quantified as follows:

$$EV_i = \sum U_j + V_j$$

where:

- $i$ = *i*th research institution
- U = the frequency with which a formal evaluation is used
- V = the frequency of use of informal evaluations

The frequency of use of either formal or informal evaluations U and V is ranked as:

0 never used, 1 seldom used, 2 occasionally used, 3 frequently used, 4 always used (i.e. built into the system)

- j = types of evaluation conducted: justifying past expenditure, in support of funding or budget requests, choosing among research projects, monitoring ongoing research activity

This indicator implies that formal and informal evaluation methods are of equal merit. The indicator does not attempt any standardisation in relation to the methodology or processes involved in the evaluation activities con-

sidered. Therefore, evaluations based on well-structured, relevant information, that make use of defined procedures will 'score' equally with inadequately designed and poorly implemented evaluation procedures. Also, the indicator does not capture the importance of the evaluation to the internal management of the institute, nor does it record to what extent evaluations only serve externally imposed requirements. These deficiencies were ameliorated, to some extent, by the collection of qualitative information in relation to evaluation procedures.

During data collection it became apparent that many respondents had difficulty with the classification of 'frequency of use' of evaluation procedures. Future surveys should consider the use of three categories should this indicator be used in the same form: 0 = never used, 1 = occasionally used, 3 = always used.

## TECHNICAL SUPPORT (TS)

Technical Support is also an important factor in high levels of research capacity. Provision of technical support releases more 'effective research time' for researchers. The optimum ratio of technicians to researchers will depend on the type of research being conducted.

$$TS_i = \frac{S}{P}$$

where :

$i$ = $i$th research institution
S = number of technicians in the $i$th institution
P = number of researchers in the $i$th institution

This expression implies that the higher the ratio of technicians to researchers, the better. Optimum levels for each institute are not known nor is the opportunity cost of allocating too many resources to provision of technicians. Results must therefore be carefully interpreted as the institutes that have the greatest number of technicians per researcher may be making inefficient use of research funds by allocation of excessive resources to technical support.

## RESEARCH OUTPUTS (RO)

Although research output is a retrospective indicator of research capacity, it can provide insights into the productivity of a research institute, and should be expressed in proportion to the number of research staff. The indicator used can be expressed as:

$$RO_i = \frac{(H - I + 3I)}{P} = \frac{(H + 2I)}{P}$$

where:

$i$ = $i$th research institution
H = total number of publications for the $i$th institution in the preceding year
I = total number of publications for the $i$th institution appearing in refereed journals in the preceding year
P = number of researchers in the $i$th institution

Clearly, the indicator gives an arbitrary weight in favour of published refereed papers that is three times that for unrefereed material. Although the magnitude of the weight is arbitrary the indicator implies that refereed material has greater 'value'. This is because the dissemination of refereed material is likely to be wider and the 'quality control' in the research findings more reliable. The indicator fails to address such aspects of research as: the time (scientist year equivalents) required to conduct different kinds of forestry research, e.g., tissue culture experiments versus tree provenance/site selection trials; other forms of research output/product, e.g., equipment, software, and practical techniques that are not readily described in the format of a scientific paper; all these are are excluded from the indicator and may represent major research efforts.

*ANNEX 2*

# FORESTRY RESEARCH MANPOWER IN THE SADC REGION

Research manpower data was collated during the study yielding the following figures. These data were accurate for each institute at the time of survey (June or November 1995).

**Table A2.1** Forestry research staff numbers by institute

| INSTITUTE | Ph.D. | M.Sc. | B.Sc. | Expat. | Total | % of sample total |
|---|---|---|---|---|---|---|
| FORESTEK | 19 | 22 | 9 | 3 | 53 | 19.06 |
| ICFR | 4 | 9 | 6 | 0 | 19 | 6.83 |
| U. STELL | 13 | 1 | 0 | 0 | 14 | 5.04 |
| SUA | 17 | 12 | 0 | 1 | 30 | 10.79 |
| TAFORI | 0 | 13 | 14 | 0 | 27 | 9.71 |
| IRA | 12 | 4 | 2 | 0 | 18 | 6.47 |
| NTSP | 0 | 2 | 1 | 2 | 5 | 1.80 |
| FRIM | 0 | 7 | 8 | 5 | 20 | 7.19 |
| CEF | 0 | 2 | 11 | 0 | 13 | 4.68 |
| UEM | 1 | 7 | 4 | 3 | 15 | 5.40 |
| NAMIBIA** | 2 | 4 | 4 | 5 | 15 | 5.40 |
| ZIMFC | 1 | 6 | 5 | 1 | 13 | 4.68 |
| U. ZIM | 3 | 6 | 1 | 0 | 10 | 3.60 |
| U. ZAMBIA | 4 | 2 | 1 | 1 | 8 | 2.88 |
| ZAMBIA | 0 | 3 | 2 | 0 | 5 | 1.80 |
| USUTU | 2 | 1 | 0 | 1 | 4 | 1.44 |
| VELDT | 0 | 1 | 2 | 1 | 4 | 1.44 |
| FAB | 0 | 1 | 2 | 0 | 3 | 1.08 |
| LESOTHO | 0 | 0 | 1 | 1 | 2 | 0.72 |
| TOTALS | 78 | 103 | 73 | 24 | 278 | 100 |

**Table A2.2** Forestry research staff aggregated by country

| COUNTRY | RESEARCH STAFF | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | % of sample total | Ph.D. | MSc. | B.Sc. | Expat. | Ph.D., M.Sc. >4 years |
| TANZANIA | 80 | 28.8 | 29 | 31 | 17 | 3 | 52 |
| ZIMBABWE | 23 | 8.3 | 4 | 12 | 6 | 1 | 14 |
| ZAMBIA | 13 | 4.6 | 4 | 5 | 3 | 1 | 9 |
| MALAWI | 20 | 7.3 | 0 | 7 | 8 | 5 | 7 |
| MOZAMBIQUE | 28 | 10.1 | 1 | 9 | 15 | 3 | 9 |
| SWAZILAND | 4 | 1.4 | 2 | 1 | 0 | 1 | 2 |
| LESOTHO | 2 | 0.7 | 0 | 0 | 1 | 1 | 0 |
| SOUTH AFRICA* | 86 | 30.9 | 36 | 32 | 15 | 3 | 49 |
| BOTSWANA | 7 | 2.5 | 0 | 2 | 4 | 1 | 1 |
| NAMIBIA** | 15 | 5.4 | 2 | 4 | 4 | 5 | 6 |

* Private sector research facilities (other than ICFR) were not surveyed

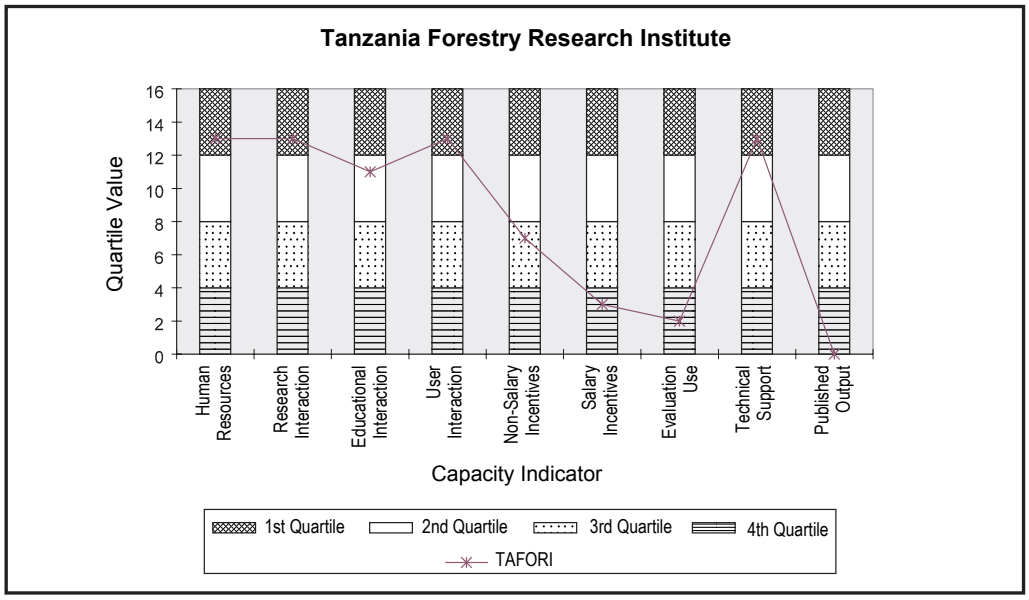
** Includes staff whose duties involve, but are not restricted to research

*ANNEX 3*

# VALUES FOR RESEARCH INDICATORS BY INSTITUTES

| | Human Resources | Research Interaction | Educational Interaction | User Interaction | Non-Salary Incentives | Salary Incentives | Evaluation Use | Technical Support | Published Output |
|---|---|---|---|---|---|---|---|---|---|
| Min | 5.00 | 1.07 | 0.00 | 0.00 | 3.00 | 0.00 | 0.00 | 0.07 | 0.00 |
| 1st Quartile | 19.00 | 4.03 | 2.01 | 13.34 | 16.00 | 51.25 | 11.25 | 0.25 | 0.00 |
| 2nd Quartile | 46.00 | 10.20 | 7.52 | 18.96 | 20.50 | 102.50 | 15.50 | 0.70 | 0.61 |
| 3rd Quartile | 77.50 | 17.45 | 9.60 | 34.73 | 25.75 | 150.00 | 18.00 | 1.60 | 2.48 |
| 4th Quartile | 234.00 | 142.28 | 42.68 | 67.11 | 53.00 | 200.00 | 24.00 | 3.60 | 6.75 |
| TAFORI | 95.00 | 21.74 | 9.06 | 36.24 | 19.00 | 30.00 | 4.00 | 1.89 | 0.00 |
| NTSP | 15.00 | 4.36 | 1.34 | 7.38 | 30.00 | 50.00 | 13.00 | 2.60 | 0.00 |
| SUA | 164.00 | 28.19 | 24.16 | 14.09 | 21.00 | 200.00 | 19.00 | 0.27 | 0.00 |
| IRA | 103.00 | 12.08 | 9.66 | 60.40 | 25.00 | 200.00 | 15.00 | 0.39 | 0.00 |
| U. ZIM | 46.00 | 6.71 | 2.01 | 26.85 | 20.00 | 150.00 | 15.00 | 0.10 | 2.40 |
| ZIMFC | 40.00 | 12.21 | 6.98 | 21.81 | 15.00 | 115.00 | 21.00 | 1.46 | 5.23 |
| ZAMBIA | 18.00 | 2.68 | 1.01 | 1.68 | 12.00 | 0.00 | 9.00 | 3.60 | 0.00 |
| FRIM | 64.00 | 18.79 | 13.42 | 67.11 | 31.00 | 0.00 | 19.00 | 2.30 | 0.00 |
| CEF | 22.00 | 13.96 | 6.98 | 13.09 | 19.00 | 0.00 | 11.00 | 0.46 | 0.54 |
| UEM | 51.00 | 2.01 | 8.05 | 30.20 | 23.00 | 200.00 | 16.00 | 0.20 | 0.33 |
| USUTU | 20.00 | 3.76 | 0.27 | 9.40 | 29.00 | 150.00 | 16.00 | 0.75 | 4.75 |
| FAB | 8.00 | 2.01 | 2.01 | 16.11 | 24.00 | 105.00 | 24.00 | 1.00 | 1.00 |
| VELD | 9.00 | 10.20 | 0.00 | 26.85 | 3.00 | 55.00 | 12.00 | 0.25 | 2.50 |
| FORESTEK | 234.00 | 142.28 | 42.68 | 49.80 | 26.00 | 95.00 | 16.00 | 1.64 | 6.75 |
| ICFR | 66.00 | 53.56 | 15.30 | 51.01 | 19.00 | 150.00 | 18.00 | 1.00 | 0.68 |
| U. STELL | 89.00 | 7.52 | 9.40 | 14.09 | 53.00 | 100.00 | 11.00 | 0.64 | 5.71 |
| U. ZAMBIA | 45.00 | 4.30 | 3.22 | 16.11 | 9.00 | 200.00 | 18.00 | 0.25 | 1.50 |
| NAMIBIA | 54.00 | 16.11 | 8.05 | 0.00 | 4.00 | 100.00 | 0.00 | 0.07 | 0.00 |
| LESOTHO | 5.00 | 1.07 | 0.54 | 2.82 | 48.00 | 100.00 | 20.00 | 0.67 | 0.00 |

KEY: **CEF** = Centro de Experimentacao Florestal, Mozambique, **FAB** = Forestry Association of Botswana, **FORESTEK** = Division of Forest Science and Technology S. Africa, **FRIM** = Forestry Research Institute of Malawi, **ICFR** = Institute for Commercial Forestry Research S. Africa, **IRA** = Institute of Resource Assessment University of Dar es Salaam Tanzania, **LESOTHO** = Forestry Division, Ministry of Agriculture Lesotho, **NAMIBIA** = Directorate of Forestry, Ministry of Environment and Tourism Namibia, **NTSP** = National Tree Seed Programme Tanzania, **SUA** = Sokoine University of Agriculture (Faculty of Forestry) Tanzania, **TAFORI** = Tanzania Forestry Research Institute, **UEM** = Universidade Eduardo Mondlane (Department of Forestry) Mozambique, **U. STELL** = University of Stellenbosch (Faculty of Forestry) S. Africa, **USUTU** = Usutu Pulp Company Ltd. Swaziland, **U. ZAMBIA** = University of Zambia (Biological Sciences Department), **U. ZIM** = University of Zimbabwe (Biological Sciences Department), **VELD** = Veld Products Research Botswana, **ZAMBIA** = Division of Forest Research & Division of Forest Products Research Department of Forestry Zambia, **ZIMFC** = The Forestry Commission Research Centre Zimbabwe.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Human Resources
Research Interaction
Educational Interaction
User Interaction
Non-Salary Incentives
Salary Incentives
Evaluation Use
Technical Support
Published Output
Capacity Indicator
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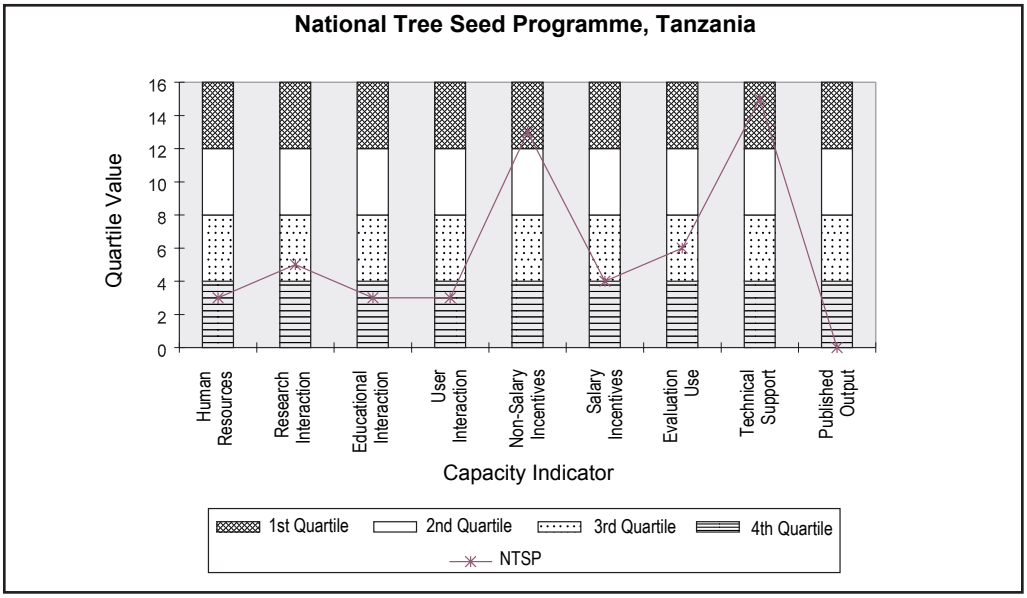
4th Quartile
TAFORI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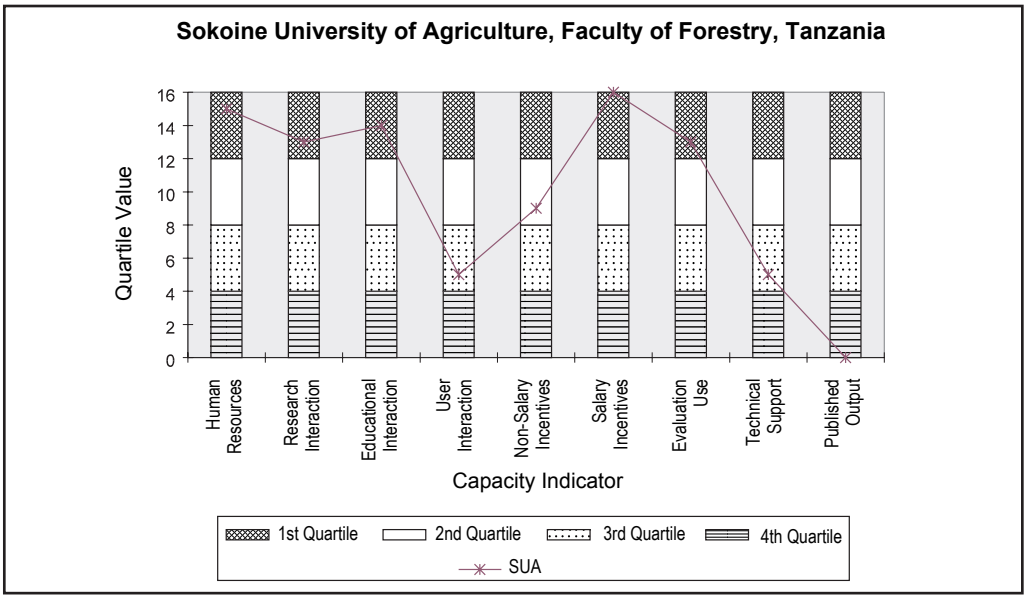
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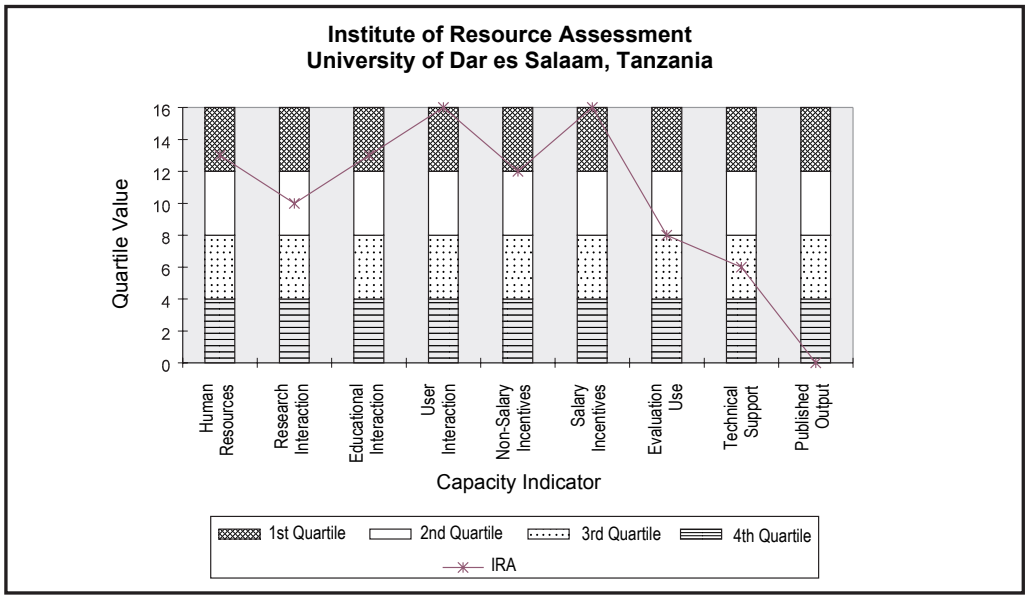
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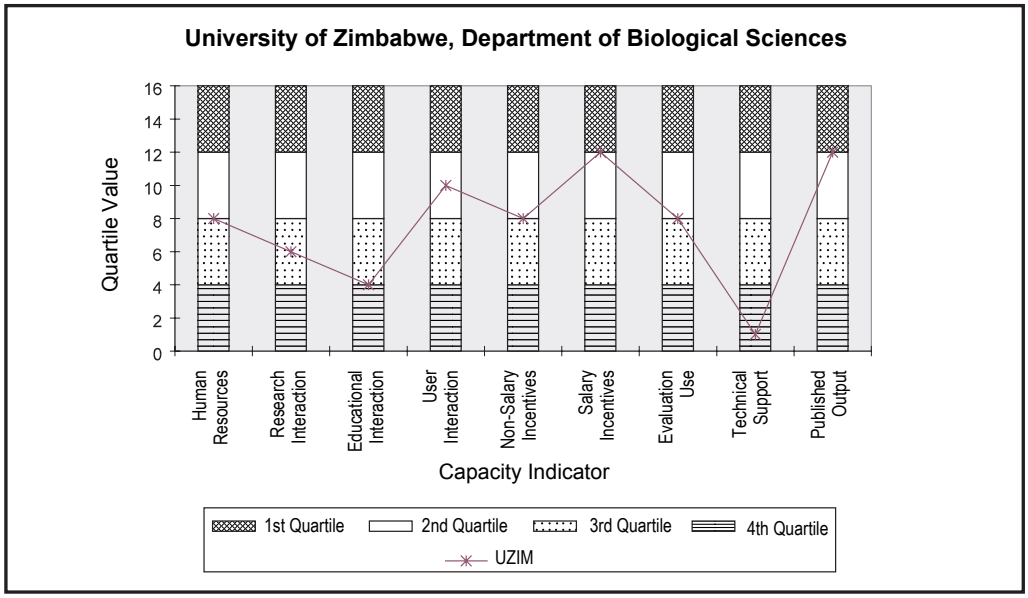
4th Quartile
IRA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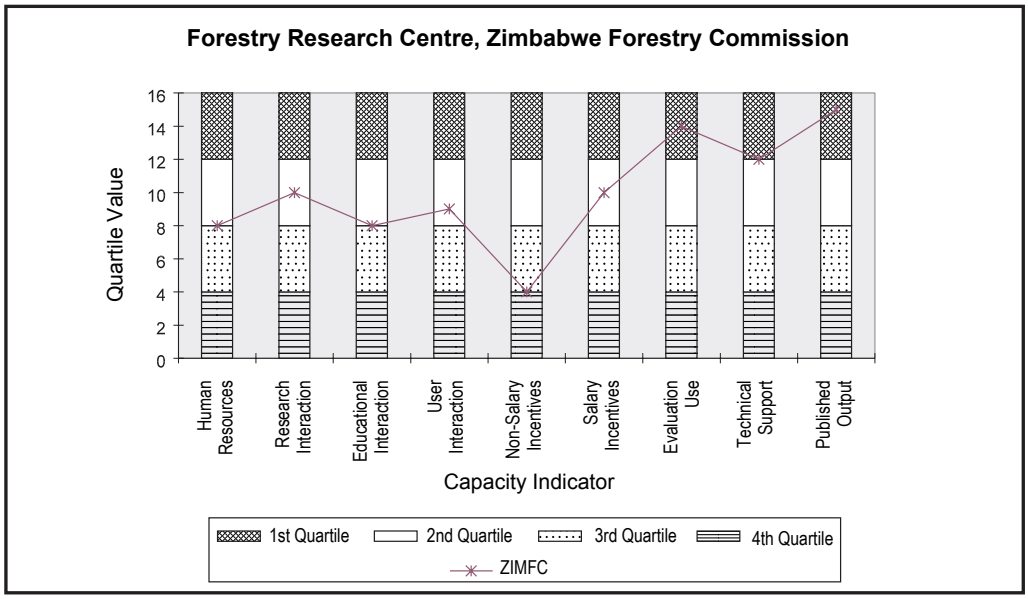
3rd Quartile
4th Quartile
UZIM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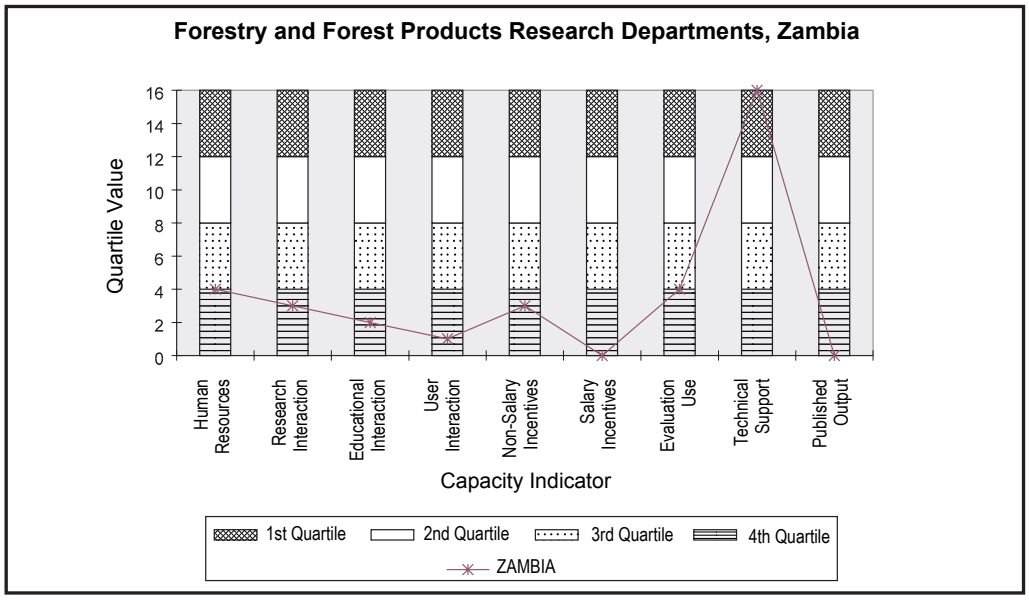
ZIMFC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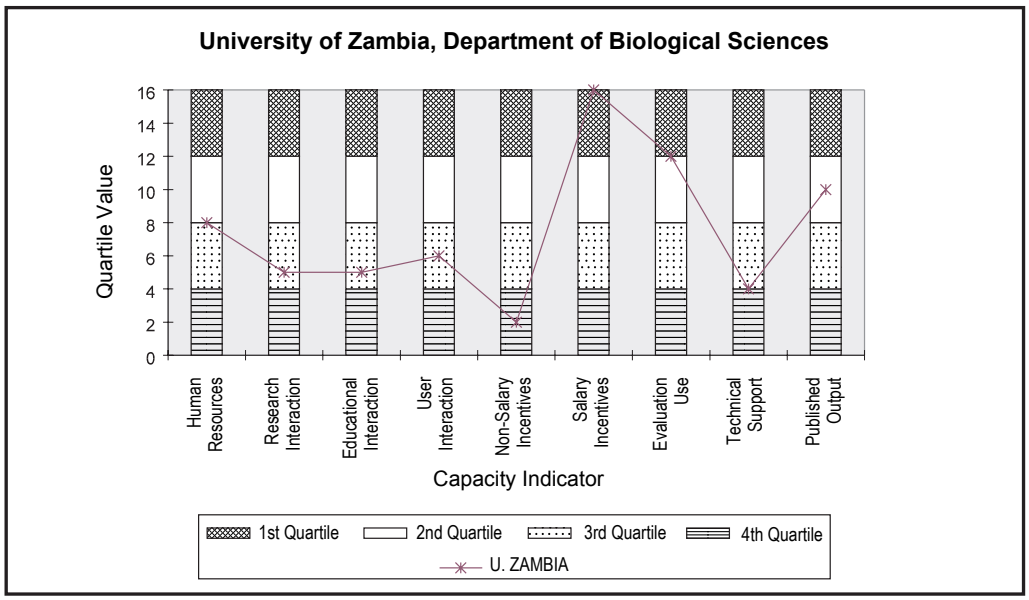
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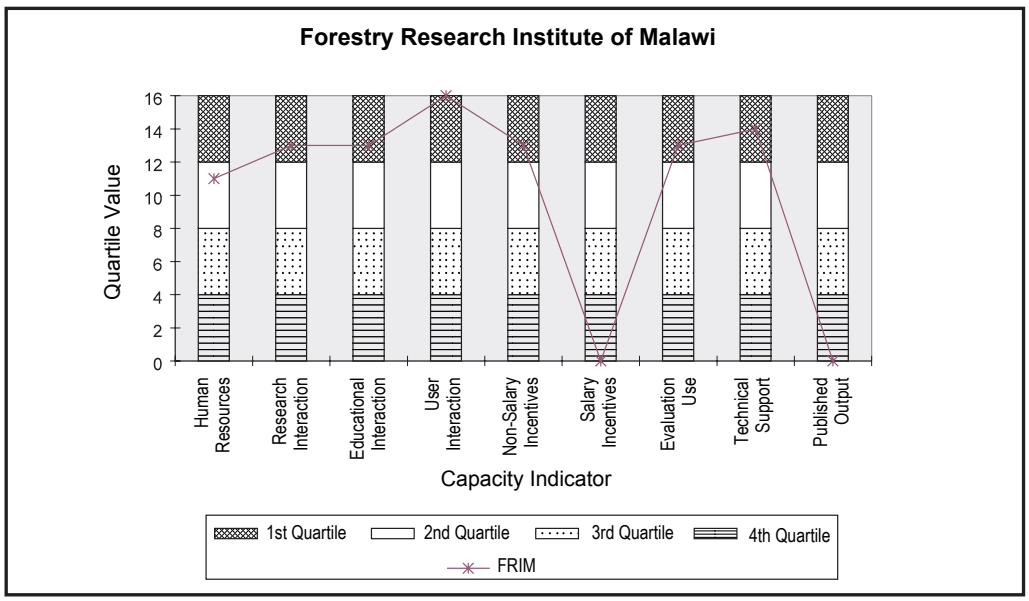
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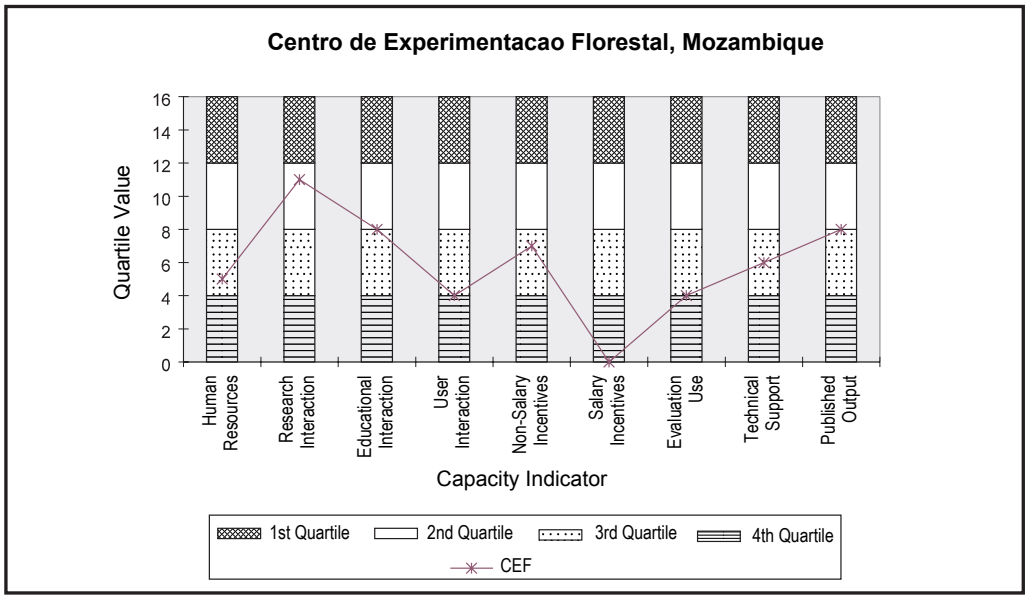
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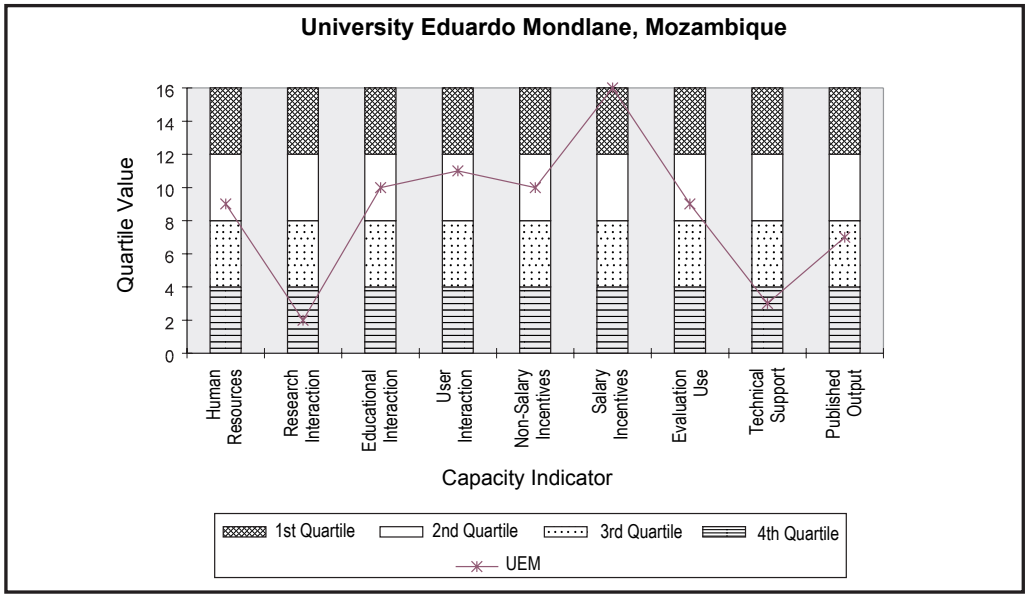
CEF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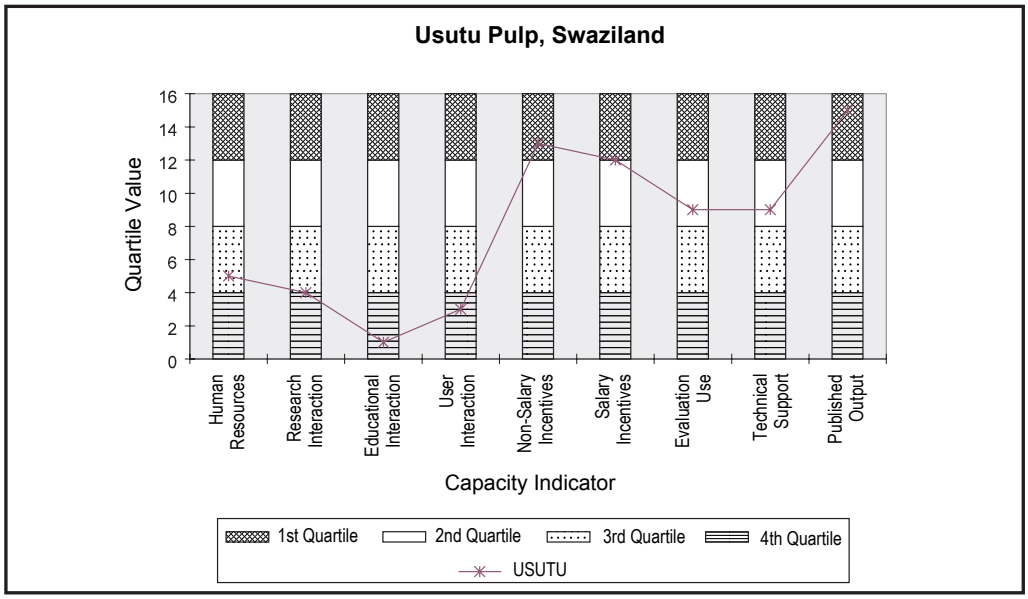
UEM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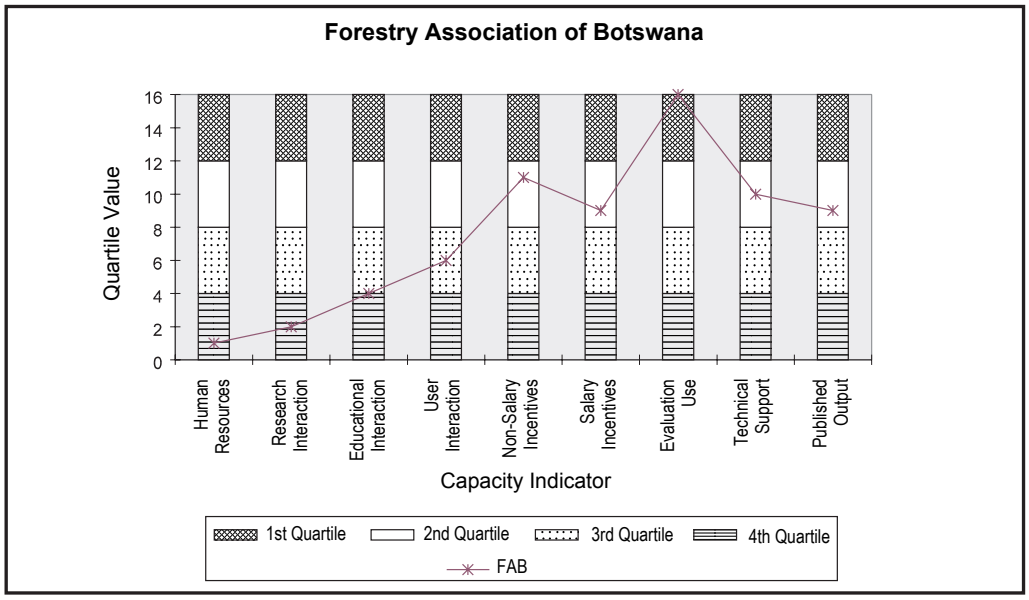
USUTU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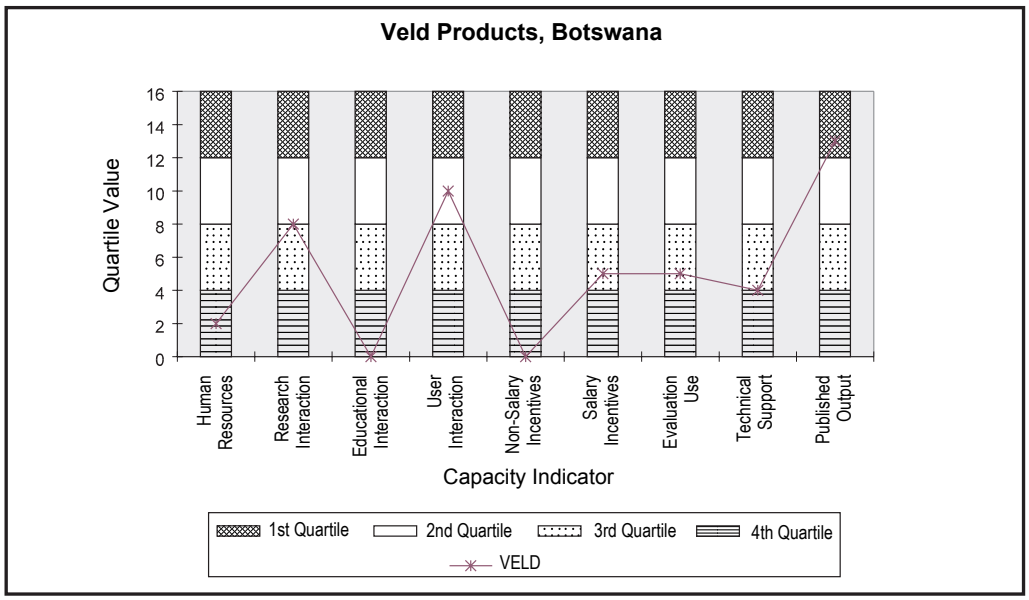
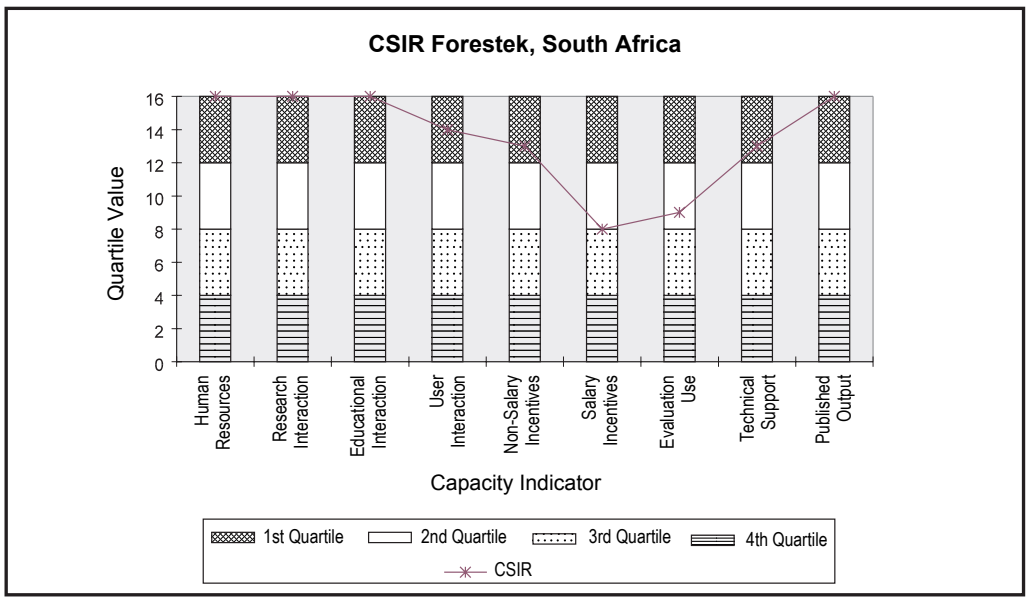
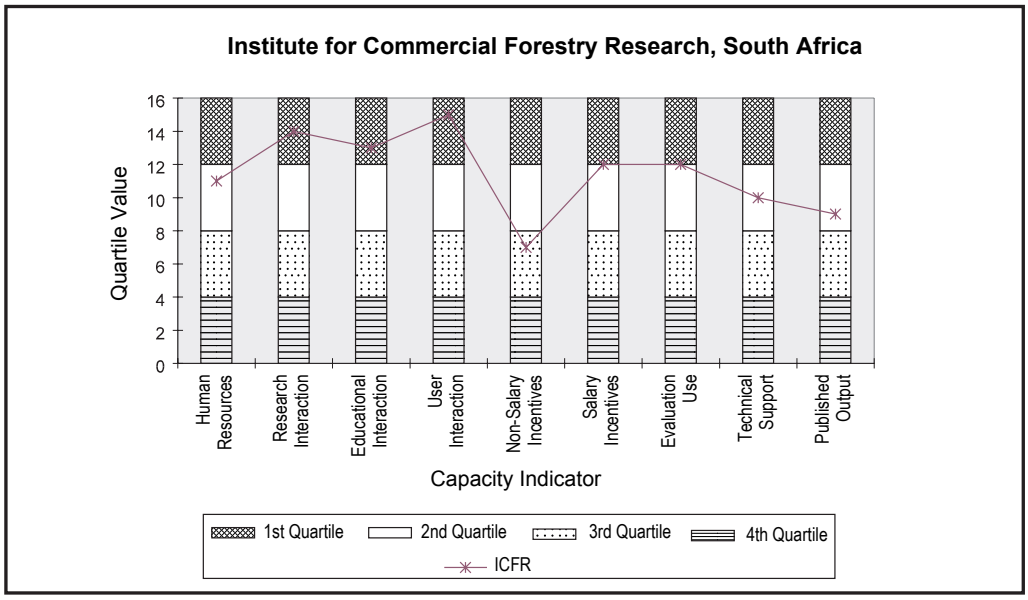
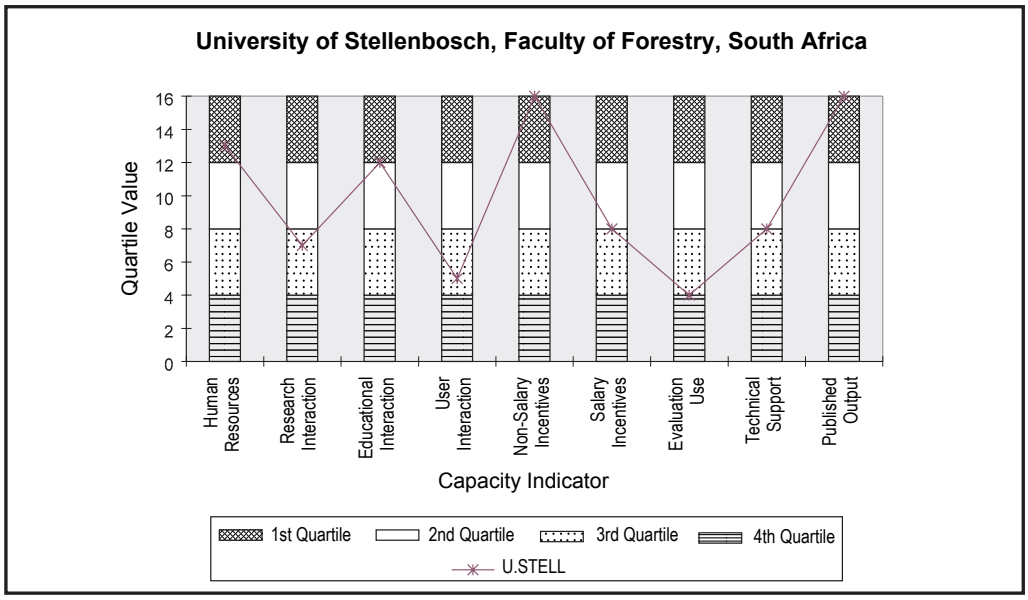
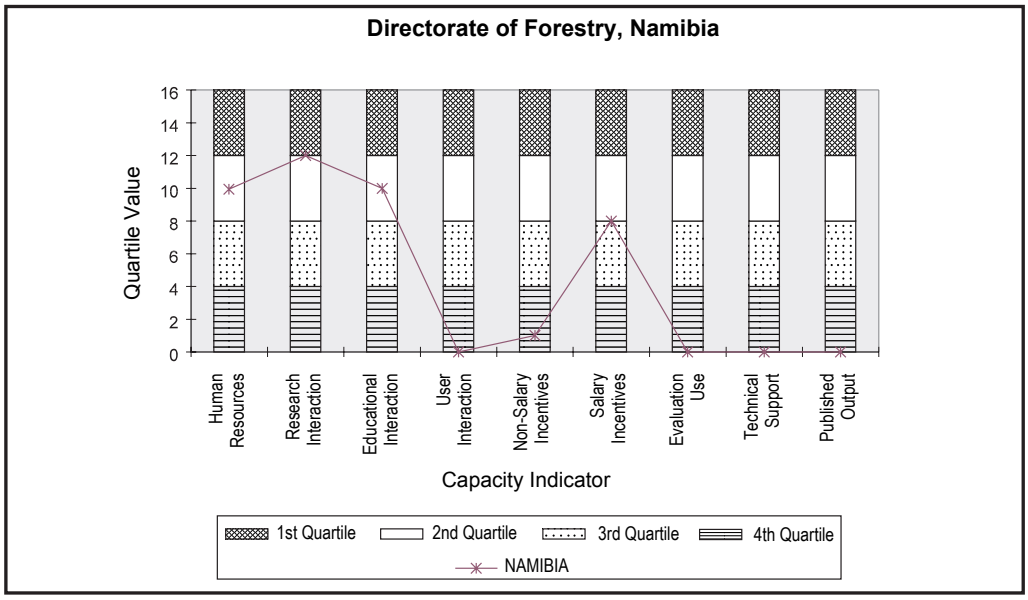
Research Interaction
Educational Interaction
User Interaction
Non-Salary Incentives
Salary Incentives
Evaluation Use
Technical Support
Published Output
Capacity Indicator
1st Quartile
2nd Quartile
3rd Quartile
4th Quartile
FAB

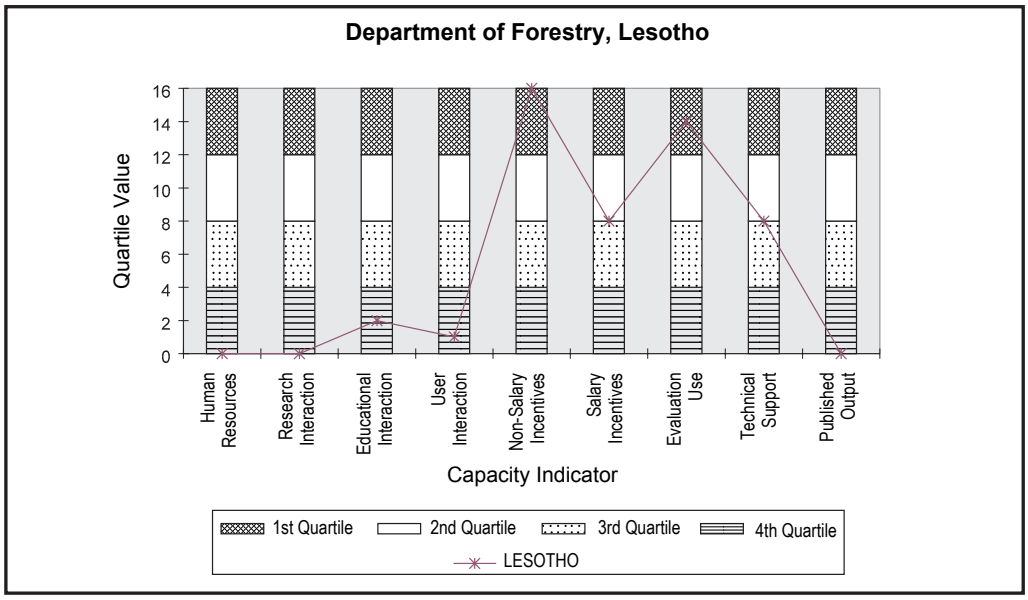

Veld Products, Botswana
Quartile Value
16
14
12
10
8
6
4
2
0
Human Resources
Research Interaction
Educational Interaction
User Interaction
Non-Salary Incentives
Salary Incentives
Evaluation Use
Technical Support
Published Output
Capacity Indicator
1st Quartile
2nd Quartile
3rd Quartile
4th Quartile
VELD


CSIR Forestek, South Africa
Quartile Value
16
14
12
10
8
6
4
2
0
Human Resources
Research Interaction
Educational Interaction
User Interaction
Non-Salary Incentives
Salary Incentives
Evaluation Use
Technical Support
Published Output
Capacity Indicator
1st Quartile
2nd Quartile
3rd Quartile
4th Quartile
CSIR


Institute for Commercial Forestry Research, South Africa
Quartile Value
16
14
12
10
8
6
4
2
0
Human Resources
Research Interaction
Educational Interaction
User Interaction
Non-Salary Incentives
Salary Incentives
Evaluation Use
Technical Support
Published Output
Capacity Indicator
1st Quartile
2nd Quartile
3rd Quartile
4th Quartile
ICFR

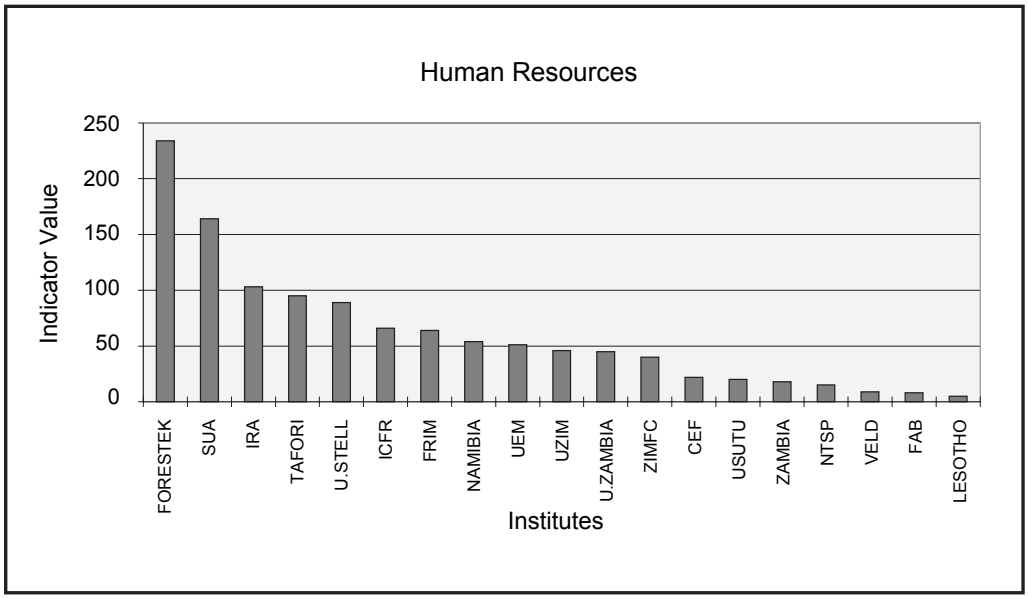

University of Stellenbosch, Faculty of Forestry, South Africa
Quartile Value
16
14
12
10
8
6
4
2
0
Human Resources
Research Interaction
Educational Interaction
User Interaction
Non-Salary Incentives
Salary Incentives
Evaluation Use
Technical Support
Published Output
Capacity Indicator
1st Quartile
2nd Quartile
3rd Quartile
4th Quartile
U.STELL

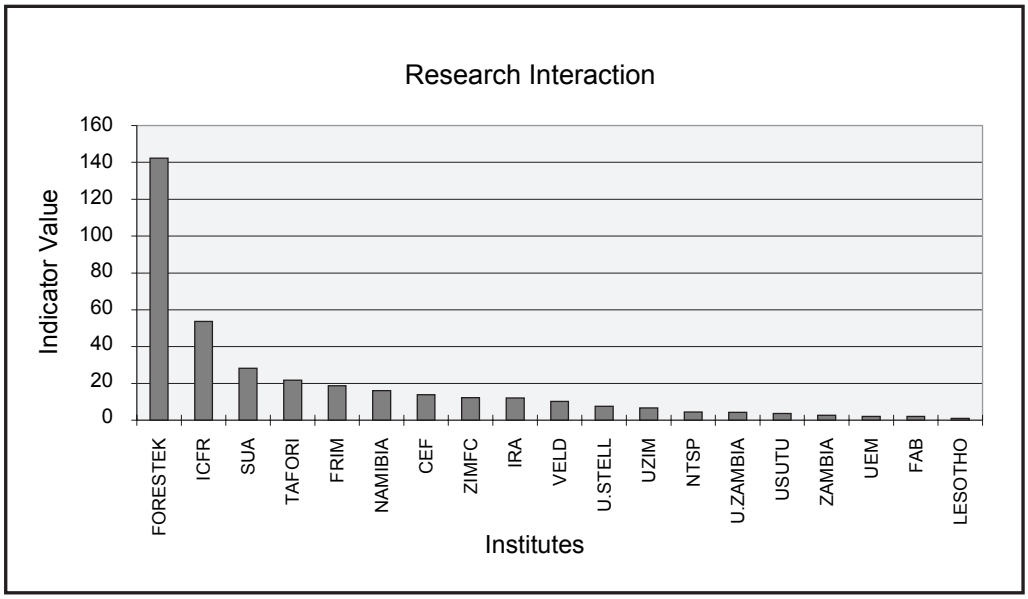

Directorate of Forestry, Namibia
Quartile Value
16
14
12
10
8
6
4
2
0
Human Resources
Research Interaction
Educational Interaction
User Interaction
Non-Salary Incentives
Salary Incentives
Evaluation Use
Technical Support
Published Output
Capacity Indicator
1st Quartile
2nd Quartile
3rd Quartile
4th Quartile
NAMIBIA

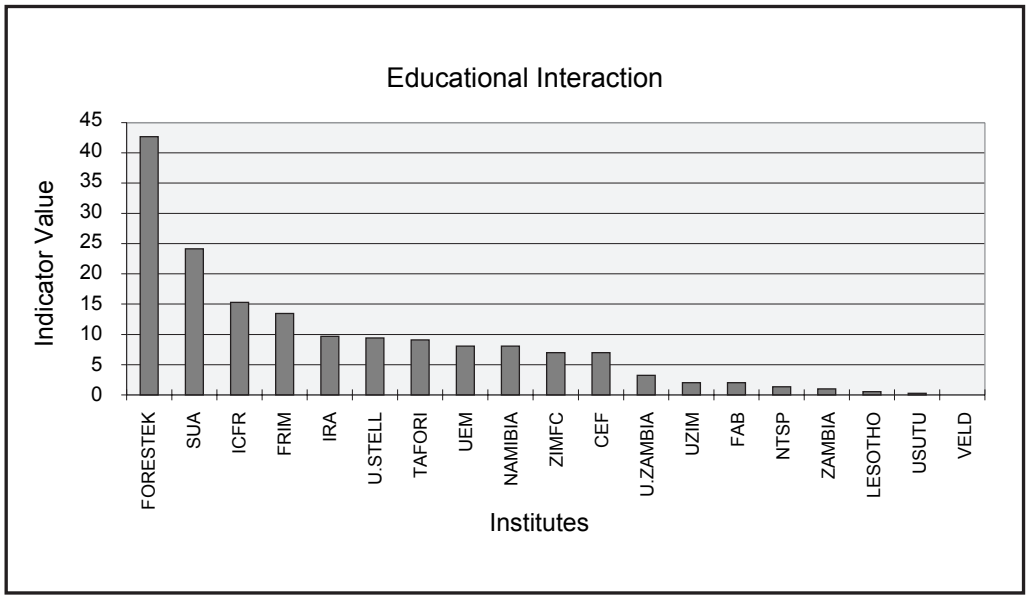

Department of Forestry, Lesotho
Quartile Value
16
14
12
10
8
6
4
2
0
Human Resources
Research Interaction
Educational Interaction
User Interaction
Non-Salary Incentives
Salary Incentives
Evaluation Use
Technical Support
Published Output
Capacity Indicator
1st Quartile
2nd Quartile
3rd Quartile
4th Quartile
LESOTHO

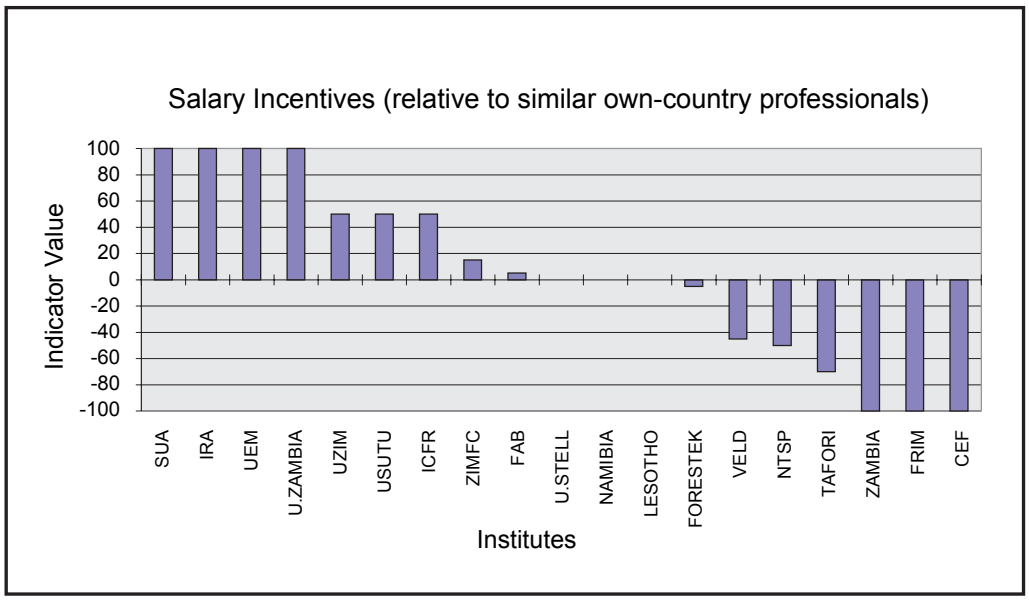
*ANNEX 4*

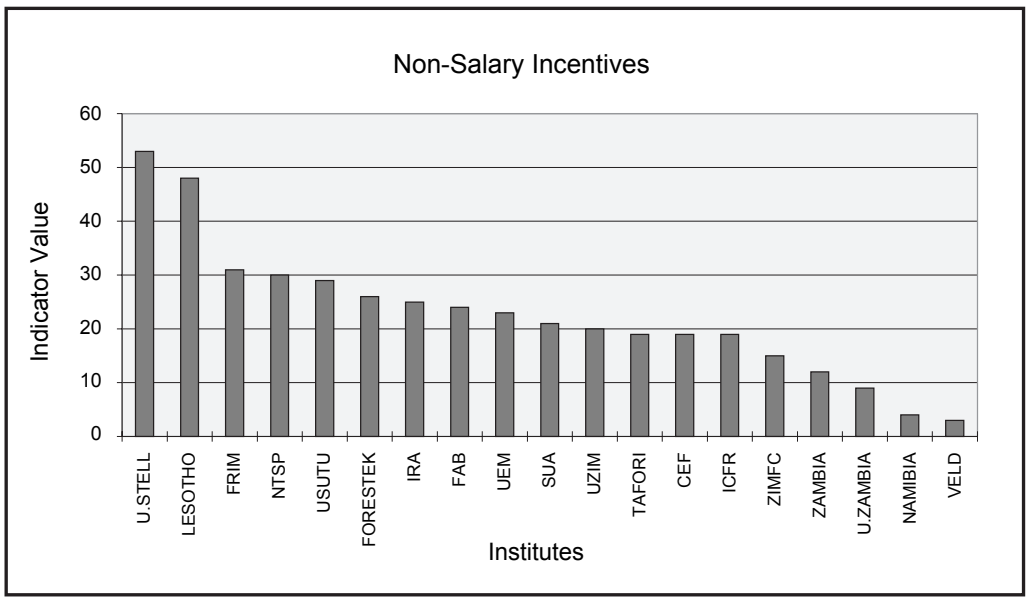
# INSTITUTES BY RESEARCH CAPACITY INDICATORS

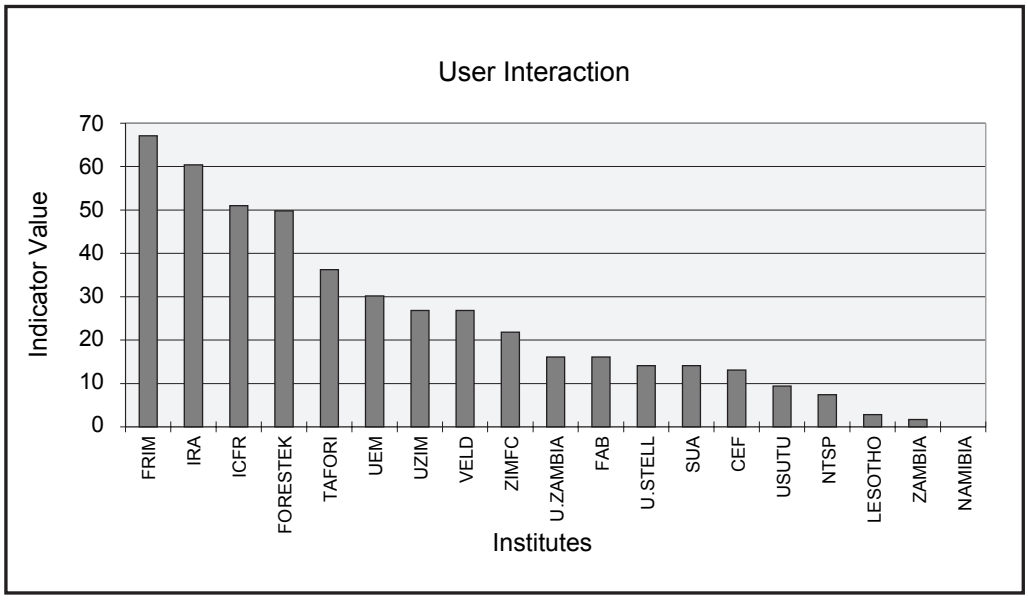


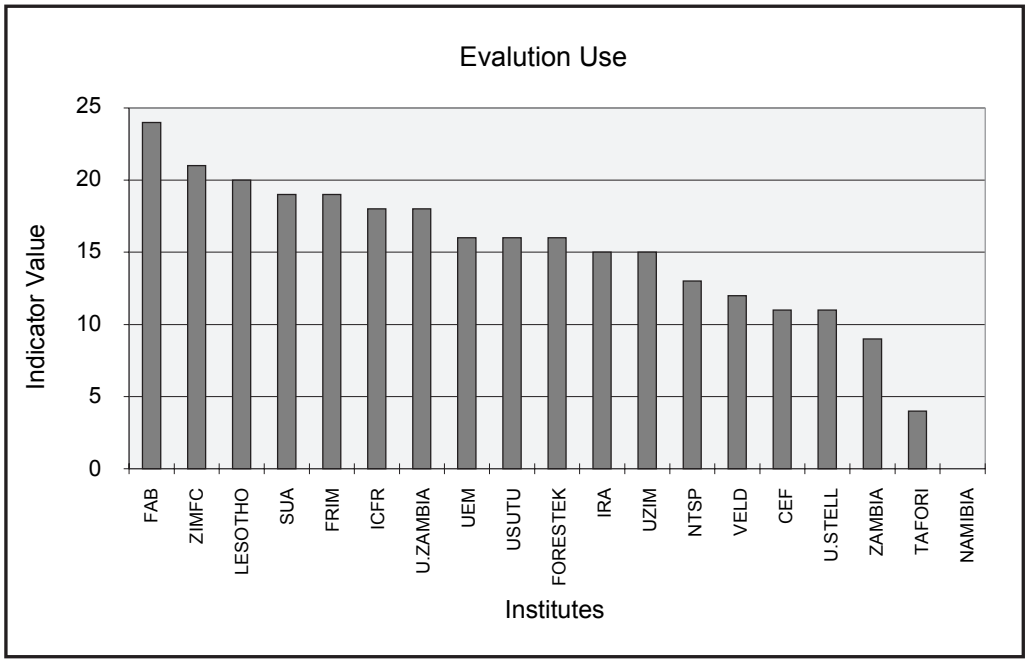




Educational Interaction
Indicator Value
45
40
35
30
25
20
15
10
5
0
FORESTEK
SUA
ICFR
FRIM
IRA
U.STELL
TAFORI
UEM
NAMIBIA
ZIMFC
CEF
U.ZAMBIA
UZIM
FAB
NTSP
ZAMBIA
LESOTHO
USUTU
VELD
Institutes


Salary Incentives (relative to similar own-country professionals)
Indicator Value
100
80
60
40
20
0
-20
-40
-60
-80
-100
SUA
IRA
UEM
U.ZAMBIA
UZIM
USUTU
ICFR
ZIMFC
FAB
U.STELL
NAMIBIA
LESOTHO
FORESTEK
VELD
NTSP
TAFORI
ZAMBIA
FRIM
CEF
Institutes


Non-Salary Incentives
Indicator Value
60
50
40
30
20
10
0
U.STELL
LESOTHO
FRIM
NTSP
USUTU
FORESTEK
IRA
FAB
UEM
SUA
UZIM
TAFORI
CEF
ICFR
ZIMFC
ZAMBIA
U.ZAMBIA
NAMIBIA
VELD
Institutes


User Interaction
Indicator Value
70
60
50
40
30
20
10
0
FRIM
IRA
ICFR
FORESTEK
TAFORI
UEM
UZIM
VELD
ZIMFC
U.ZAMBIA
FAB
U.STELL
SUA
CEF
USUTU
NTSP
LESOTHO
ZAMBIA
NAMIBIA
Institutes


Evalution Use
Indicator Value
25
20
15
10
5
0
FAB
ZIMFC
LESOTHO
SUA
FRIM
ICFR
U.ZAMBIA
UEM
USUTU
FORESTEK
IRA
UZIM
NTSP
VELD
CEF
U.STELL
ZAMBIA
TAFORI
NAMIBIA
Institutes

*ANNEX 5*

# OVERVIEW OF PHYSICAL RESOURCES BY INSTITUTION

| Institution | Laboratories | Libraries | Field Stations | Computers | Sharing of Resources | Other Observations |
|---|---|---|---|---|---|---|
| 1 SUA | Four. All in good condition & fairly well equipped | One central for university. More literature within faculty. Well equipped | Five. Two without supporting infra-structure | Seventeen faculty computers. Have e-mail facilities | Library, labs, & computers are shared across faculties and with other institutions | Buildings & other facilities are good physical condition. |
| 2 TAFORI | Limited lab. facilities. Poorly equipped | Limited library facilities. Poorly equipped | Seven centres. All with poor supporting facilities. Only threecentres haveequipment | Three with nine more expected. No e-mail facilities | Slight sharing with other institutions | Physical state of buildings & equipment at centres is very bad. No radio call facilities with centres. Backlog of unanalysed data for over 20 years. |
| 3 NTSP | Four. All in good condition and equipped | One small library at headquarters | Three zones, each with a lab. for seed testing | Twelve. Each zone has one. No e-mail facilities | Occasionally share resources with other institutions | Buildings and other facilities are in good physical condition |
| 4 IRA | One remote sensing lab., a printing section and other facilities. All well equipped | One central for university. One within theInstitute. Well equipped | None | About 15 within the Institute. Has e-mail facilities | Library, labs and computers are shared across faculties and with other Institutions | Physical state of all facilities is good |

| Institution | Laboratories | Libraries | Field Stations | Computers | Sharing of Resources | Other Observations |
|---|---|---|---|---|---|---|
| 5 U. ZIM | Several, adequate and in good state | One of the best in the region | None | About 80% of scientists have computers. There are computer labs for students. Has e-mail facilities | Sharing among university faculties only | Good physical state of facilities. |
| 6 ZIMFC | One well equipped and another poorly equipped at head-quarters | Well equipped library | Three, each with a lab. & supporting infrastructure | Has an interactive network with field stations | Shares resources with other institutions, especially labs. | Good physical condition of facilities |
| 7 ZAMBIA | Three poorly equipped labs | Two ill equipped libraries. Not receiving journals since 1988 | Three, and are poorly equipped | Five. No e-mail facilities | Benefits from other institutions | Good physical condition tion of buildings but not equipment |
| 8 U. ZAMBIA | Good lab. facilities | Fairly well equipped library | None | None | Shares facilities with other faculties in the university | Buildings and equip-ment in good physical condition |
| 9 FRIM | Four and fairly well equipped & in good physical condition | A good library | Seven | Ten. No e-mail facilities | Loans and shares resources with ICRAF and university | Good physical condition of buildings and equipment |
| 10 CEF | Three labs, two in poor condition | None | One, currently being refurbished | Two. Has e-mail through university | No sharing reported | The Centre will move to another location with new buildings for staff and labs |
| 11 UEM | Three labs, two of which are poorly equipped | Shares library with rest faculty. Well equipped | One, with adequate supporting facilities | Nine. Has e-mail | Shares resources with rest of faculty and the Forestry Research Centre | Buildings and equip-ment in a satisfactory condition |

| Institution | Laboratories | Libraries | Field Stations | Computers | Sharing of Resources | Other Observations |
|---|---|---|---|---|---|---|
| 12 USUTU | Inadequate, mostly externally sourced | Moderate facilities, has good external links, for example with ICFR | None | Good computer facilities | Benefits from others in terms of library and lab. facilities | Buildings and equipment are in good condition |
| 13 FAB | | | | | No sharing of resources reported | Housed in rented buildings |
| 14 VELD | Poorly developed | None | None, but has a good nursery | Few. No e-mail | Benefits from sharing of facilities like labs with other institutions | Housed in rented buildings |
| 15 FORESTEK | Good and equipped | Good. Have access to CD-ROM | Has several field bases with supporting infrastructure | Every scientist has a computer and on LAN. Has e-mail facilities | Shares on contractual basis its resources | Good physical condition of buildings and equipment |
| 16 ICFR | Several well equipped labs. | Has a very well resourced library | Has nurseries. Has two regional offices | Has a very powerful LAN with 54 terminals | Industry uses ICFR's resources and ICFR uses industry's labs | Good physical condition of buildings and equipment |
| 17 U. STELL | Well equipped labs. though some with fairly old equipment | Very good library facilities | None | Very well equipped and a LAN exists. Has e-mail facilities | Shares resources with other institutions | Buildings and other facilities are in good condition |
| 18 NAMIBIA | None | Poor | Has field trials in fairly good condition | Good. Has e-mail facilities | No sharing reported | |
| 19 LESOTHO | Poor | Fairly good | In fairly good condition | Poor | Limited sharing of resources | Buildings in good condition |

*ANNEX 6*

# INSTITUTIONS VISITED AND THOSE WHICH MAILED INFORMATION

### A: Botswana

1. Forestry Association of Botswana
2. Veld Products Research
3. Forestry Division, Ministry of Agriculture
4. University of Botswana (Faculty of Agriculture)
5. Southern African Centre for Cooperation in Agricultural Research and Training

### B : Namibia

6. Directorate of Forestry, Ministry of Environment and Tourism

### C: South Africa

7. University of Stellenbosch (Faculty of Forestry)
8. Institute for Commercial Forestry Research
9. Division of Forest Science and Technology (FORESTEK), CSIR.

### D: Lesotho

10. Forestry Division, Ministry of Agriculture

### E: Swaziland

11. University of Swaziland (Faculty of Agriculture)
12. Usutu Pulp Company Limited
13. Forestry Section, Ministry of Agriculture and Cooperatives
14. Energy Section, Ministry of Natural Resources

### F: Mozambique

15. Forestry Research Centre, Ministry of Agriculture.
16. Eduardo Mondlane University (Department of Forestry)

### G: Zimbabwe

17. The Forestry Commission
18. University of Zimbabwe (Department of Biological Sciences)

### H: Zambia

19. Forest Research Division, Department of Forestry
20. University of Zambia ( Department of Biological Sciences)

### I: Malawi

21. Forestry Research Institute of Malawi
22. University of Malawi (Centre for Social Research & Bunda College of Agriculture)
23. Department of Energy, Ministry of Energy and Mining
25. National Herbarium and Botanic Gardens of Malawi
26. SADC Forestry Sector Technical Co-ordination Unit

### J: Tanzania

27. Tanzania Forestry Research Institute
28. National Tree Seed Programme
29. Sokoine University of Agriculture (Faculty of Forestry)
30. University of Dar es Salaam (Institute of Resource Assessment)