Challenges of Funding Renewable Natural Resources Research and Education in Sub-Saharan Africa

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Abstract

The purpose of this paper is to encourage an intellectual debate. I have deliberately avoided the common rhetoric and poverty statistics that have recently come to characterize or accompany any statement on Africa. For so long, the rhetoric that Africa is poor and therefore incapable of spawning its own development has dominated communication and information systems that they could become "facts" in the minds of some people. If this is not nipped in the bud, especially for the youth of Africa, it will cost the continent dearly in terms of future development. The only way we can sustain development in Africa is to recognize and engage our own intellectual and physical strengths for that purpose, while tapping into our natural capital. It is argued that natural resource education, research and innovation should be funded from the very resources that we are seeking to improve. Thus the starting point is an analysis of the values we should assign to research and education.

Valuing research and education

Investing in research and education is predicated upon an appreciation of the value of knowledge. Research is a tool for producing knowledge, which can be a public or a non-public good depending on the circumstances. So there must be a quest for knowledge for research to be supported. Knowledge is generally a neutral product which can be used to the benefit or detriment of society. Unfortunately, not all knowledge from research can be applied freely. Depending on the purpose of research and the objectives of the researcher, the knowledge generated can be put into two main categories as elaborated in the Table 1, adapted from Kolliker (2004).

Non rival knowledge is like research methods. The methods can be used by anyone without being diminished. However, they can be protected by patents or intellectual property rights and thereby be restricted in use to only a few individuals or institutions. Such exclusion defines the product as a *club good*; otherwise it would be a public good. Rival knowledge or good is one that is diminished by use, such as the discovery of a use for a non-renewable natural resource. Again, depending on rights and the availability of such knowledge, it can be classified as a private or a common pool resource.

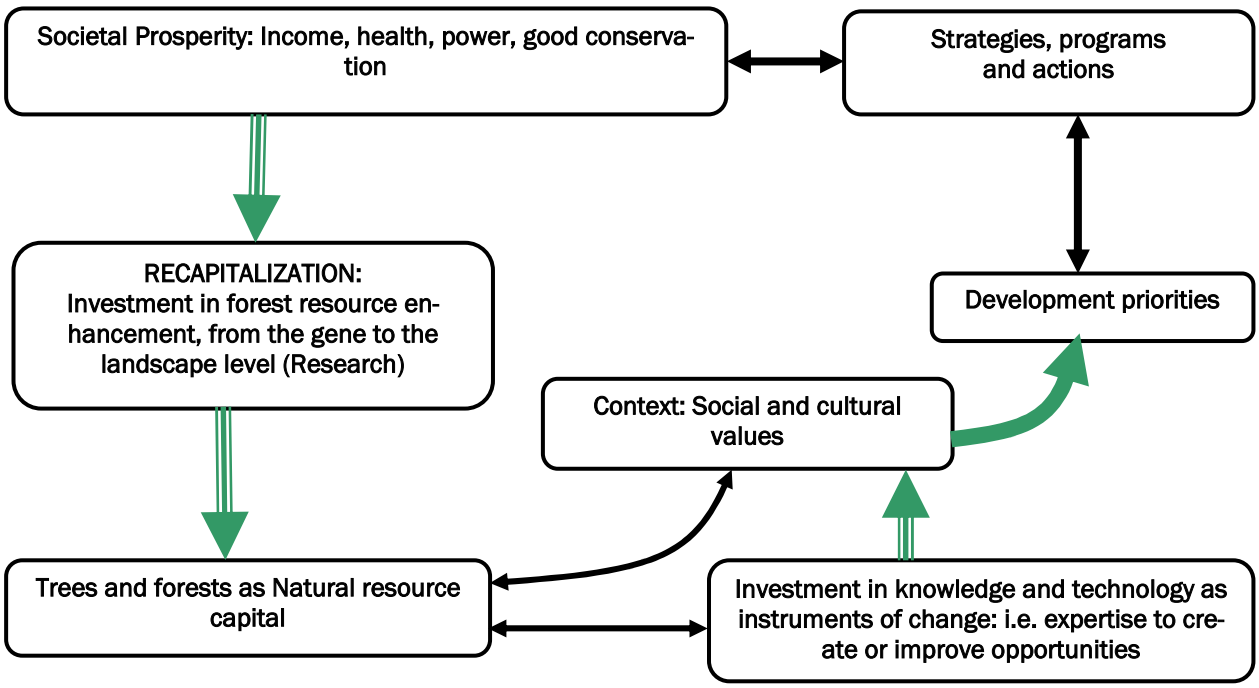
Knowledge generated from publicly funded research is not necessarily a 'public good'. In other words, the "public-ness" of a research product is not an inherent characteristic of the product itself, but depends on the producer and the purpose for which it is produced. What we can learn from Table 1 is that research has to be set up in a manner that produces a clear output, whose ownership and use can be defined by persons or the institutions involved, often called the stakeholders. Thus, research must be seen as a business that generates useful products or services, which, in terms of usage, can be restricted or made public as desired. This reasoning is important for us to determine who should invest in renewable natural resources research and why.

The general purpose of research is to raise the overall amount of knowledge known about a particular subject or object, so it feeds well into educational and societal needs. In Figure 1, a conceptual model is presented, where research is part and parcel of resource development, management and utilisation. Any renewable natural resource would be valueless if it is not viewed in the context of society's social, cultural and economic needs. Research helps us to relate the physical condition of the resource with these societal values in order to articulate and prioritize strategies and interventions that bring prosperity. Again, research is necessary for us to de-

Table1. A general definition of products of research

Type of good	Limits in availability	Qualification
Non-rival (i.e. not diminished by use, e.g. research methods)	Non-excludable (everyone can access and use it)	Public good
	Excludable (e.g. through IPR or patent)	Club good
Rival (i.e. diminished by use, e.g. use for a non-renewable mineral)	Non-excludable (everyone can access and use it)	Common pool resource
	Excludable (e.g. through IPR or patent)	Private good

Figure1. Knowledge capital for forest-based development



velop recapitalization strategies that sustain both the natural resource and its contribution to prosperity.

Investing in research is similar and complementary to investing in education. The former generates knowledge whilst the latter is a tool for sharing knowledge. In an ideal situation, the two are mutually supporting. Education influences change in society, and likewise, society influences the content of education.

Good education raises the level of knowledge in specific areas, enabling society to better analyze, make choices and take appropriate actions. Likewise, the experiences of society influence institutions of learning as well as the learning experiences by putting into context what happens when certain knowledge is applied in a particular circumstance. So both education and society continue to shape each other, achieving a dynamic synergy.

This understanding makes the case for substantive investment in renewable natural resources research and education. A critical question is: How well are our research and education efforts in natural resources linked and mutually reinforcing? From available experience, it would appear that natural resources research and education are designed and managed independently. They sometimes compete for resources. Institutions of learning have great responsibility in generating, collating and sharing knowledge, yet currently they do little more than sharing knowledge, and even that, largely with students and not communities or industry.

A recent survey of forestry education in Africa and Southeast Asia (Temu et al 2005) concluded that there is an urgent need for foresters to be competent in:

linking tree and forest management to actions and strategies to achieving social and economic development goals,

managing tree and forest resources in a broader context of sustainable natural resources and environmental conservation,

innovating in the wider areas of agriculture, forestry and renewable natural resources

stimulating entrepreneurship in community and private forestry, and

strengthening linkages and synergy among natural resource sectors and between them and agriculture.

In other words, the technical substance of forestry education must be contextualized in the African situation, solving African problems and fitting the social, cultural and economic settings of Africa, while at the same time being sensitive to global society and environmental concerns. This should be true for education in other renewable natural resources.

Investing in research

Currently in SSA the responsibility for research on lands, forestry, wildlife and fisheries is almost exclusively in the public domain. Private sector research initiatives are quite restricted both in scope and in space to where it makes business sense. This leads to the debate on whether research in renewable natural resources really requires special attention. The easiest response is to refer to the key role played by natural resources in the livelihoods of our people, and the current threats to the

natural resources. An even stronger argument though is to show what research is able to deliver. We can also argue for research by stating the cost of not doing it in a specific area. St. Paulia, a beautiful violet flower from the mountains of East Africa became a multi-million Euro business in Europe, completely eluding the attention of local researchers. So funding and participating in natural resource research is indeed very important. Research on St Paulia was funded by UK government (Peter Wood 2006 – personal communication).

There is a need to make natural resources in SSA work better for development, through effective research. To leverage local funding and participation in natural resource research, we have to demonstrate that renewable natural resources research really works for development. This should create the demand for research.

But some past research investments have produced disappointing results. Here is an example. In one country, research on timber utilization was carried out for over 40 years. The main focus was to investigate the potential utility of indigenous tree species, by determining their fibre characteristics and strength properties. Quite a few scientific publications were produced, but they stopped short of one critical result – helping the development of mechanisms to make better use of the timbers. In other words, they generated knowledge but could not move it into use. After 40 years of funding by government and development partners, the research support was scaled down so much that today it is practically only symbolic in terms of size and activities. So after so many years of public investment, it was still unclear what exactly the country was getting out of it, because there was an underlying assumption that the private sector would take up and use the research findings. That did not happen. The inability of research institutions to transform research results to practical applications for development is one of our main weaknesses. But this is also linked to problem diagnosis and setting the objectives of our research. All too often the end users of research results and other stakeholders are not involved.

Most renewable natural resources in SSA are under public responsibility. In such a situation, governments would be expected to generate or at least create conditions for other stakeholders to support research that generates the knowledge needed to improve benefits from our renewable natural resources. This is not happening at the expected scale, ostensibly because we are unable to generate research funds. I would argue that our natural resources can generate the funds needed for research. Nothing stops us from using our own natural resources for this purpose.

It is clear that the Consultative Group for International Agricultural Research (CGIAR) centres are able to secure funds for natural resources research because of two main advantages: First they have the critical mass of scientific knowledge and skills needed to address the research problems and second, they have the needed management and accountability capacity to deliver on their research commitments. So why is this not true for national research institutions in SSA? Literature searches on the subject show a large volume of criticisms on governments, research funding institutions and the African academia as the main culprits for failures in research in general. We can focus on what we can do to leverage and sustain funding for renewable natural resources research, by considering the following approaches:

- ⇒ building on available and locally contextualized knowledge in order to maintain relevance
- ⇒ improving institutional frameworks for research
- ⇒ strengthening human capital for research
- ⇒ rationalising research capacity and strengthening integration of research institutes and universities, and
- ⇒ enhancing coordination and regional cooperation.
- ⇒ All these ideas are quite familiar, yet they are far from being implemented.

Building on available and locally contextualized knowledge

Africa has biological wonders: The Namibian desert plant *(Welwitschia mirabilis)* that grows only two leaves and can live for over 1000 years supporting a myriad of other life forms as it switches between C_3 and C_4 states; the giant frog *Canrana goliath* in Congo which can produce several kilogrammes of meat; the rare mammalian frog in Tanzania that has intrigued scientists; and so many organisms macro– and microscopic in our rich biota remain only partially untapped to benefit Africans (Mshigeni et al 2000). Africa is quite rich, but Africans are poor. The abundance of natural resources (renewable and non-renewable) as exemplified in DRC, Angola, Sierra Leone, Sudan, Gabon, Nigeria, Liberia and most of the countries in Sub-Saharan Africa (in terms of biota) is intriguing and by far supersedes many other countries in the world that are developed or classed as transitional economies. However, our management of natural resources proves beyond doubt the adage that "possession of natural resources is in itself only an indicator of the potential for development, but does not guarantee development". And so it has remained for Africa. Serious research is needed to expand the knowledge available today and unleash the potential for improving the well-being of people. There is no shortage of exciting areas of research! But for us, exciting research must also make exciting economics!

There are many examples of traditional African scientific innovations. The extraction of preservatives from *Commiphora myrrha* that were used for mummification of

dead bodies is well known but poorly appreciated traditional African science. The preparation of "old man's tea" from the bark of *Prunus Africana* as prophylaxis against prostrate cancer received global attention only recently, and is currently exploited by France, importing the tree bark from Africa to extract the cancer preventing ingredients. The business they generate is based on ancient African research findings! The fields of human and animal nutrition and medicine provide thousands of examples of this kind. What is worrisome is what this generation is doing, or stated more appropriately, not doing to improve and use such knowledge. Let us steer away from 'ethno-altruism' as expounded by Lettmayer (2000), in which traditional values and approaches can be blindly glorified over foreign ones. Sinclair and Joshi (2000) explain how traditional knowledge can selectively be captured and utilised in research. Various methods exist for doing this effectively. The claim often made that we do not have enough funds to support research is inaccurate. Our greatest weaknesses today emanate much more from our own attitudinal orientation and ineffective institutional establishments, including organization, governance and integrity. There is a huge wealth on knowledge (both indigenous and external) that is poorly utilized despite strong evidence that it could play a role in driving Africa out of poverty. The starting point is to understand the demand for research.

Is there an established demand for renewable natural resources research?

The majority of SSA's rural population relies directly on agricultural production and direct extraction from natural resources to sustain livelihoods. The export trade is dominated by direct extraction and sale of natural resources and some primary processing of agricultural produce, much of it in the hands of private institutions. Thus, the region's development is heavily anchored on agriculture and natural resources. Enhancing science and technology through research in these fields is an essential lever for accelerating development in general and rural development in particular. Many ambitious commitments made by SSA countries and their development partners on raising the lot of the rural poor cannot be achieved because our investment in science and technology as the backbone for development is inadequate. So while there is a huge demand for research, scientists are not properly linked to it. There is little evidence that scientific innovation arising from our research has contributed in a significant way to development, and this may underline the reason for weak public funding for research.

Local communities have an enormous wealth of knowledge that requires some of fine tuning through research to contribute to real improvements of their lives. From the mortar that pounds the yams to the multistorey agroforestry farming systems that are so ecologically designed, we scientists have great opportunities to add value. My challenge to every one of us is to identify just one item where his/her research and innovation can make a difference. The demand for research is large, but it is currently obscured by inadequacies in policy, institutional arrangements and, most of all, attitudes of scientists.

Improving the institutional framework for research

Nyerere (1990) pointed out the weak institutional framework and investment in science and technology in The South. He counselled The South to enlarge its capacity and commitments in order to benefit effectively from science and technology (S & T). Apparently, this advice was well heeded by Asia but was largely ignored by Africa. Working S & T institutions with appropriate mandates and with long-term vision are only second to having the human capital This is currently appreciated by African leadership, and is the basis for NEPAD's efforts to promote *institutions of excellence* in Africa. This has involved the construction and equipping of laboratories as well as training of scientists. It has to be understood that excellence is attained or achieved, not constructed. It is imperative therefore that the "institutions of excellence" are conceptualized and promoted more in terms of programmes, intellectual leadership, and less in terms of physical infrastructure and facilities although these too are important. They would then be *institutions for excellence*.

A good institutional base is a fundamental requirement for research and education to thrive. Many aspects of RNR for instance forestry, soils, water and wildlife management cut across sectors. Actions taken in any of the sectors can have profound effects on the other resources. However, in many countries the sectors have separate and independent institutions in both research and education, and sometimes the communication among them is very limited. Thus beneficial synergies are foregone. Quite often we experience competition, duplication of efforts and diverging perspectives on specific approaches to RNR management. In such an environment, we are unlikely to excel.

Despite ecological similarities collaboration across countries is complicated by the high diversity of institutional structures and their parent ministries. An obvious cost in this institutional dispensation is the size of institutions. We have many small institutions whose capacity to work beyond their internal management processes is quite limited, let alone engaging in regional and international collaboration. We need multi-sectoral linkages that can improve efficiency. For this to happen it is necessary for those in academia to begin by overcoming our disciplinary barriers within departments and faculties and expand integrative education programmes (Temu 2004).

A good working environment: This is not a new idea. All of us are looking for better physical facilities, good ex-

posure, attractive salaries and benefits. Many reports lament the poor remuneration of academics that leads to the brain drain. While that is true, we also have internal brain drain, where scientists spend a disproportionate amount of time doing private activities and consultancies that very often do not even add to their skills. This 'internal brain drain' can be substantial. Many authors recommend increases in salaries and benefits, despite the persistent evidence that this rarely happens. If countries are not investing is research, why would they invest in researchers? Again, the problem lies in the fact that we have not been able to demonstrate that our research really pays off.

Strengthening human capital for research

Human capital is central in any discussion of science, technology and development. As human beings, we are responsible for creating the right mindsets, policies, institutions (and institutional arrangements) and knowledge and innovations that improve and sustain our livelihoods. This is true at all scales, from the individual to the whole nation or humanity. Research is a very powerful tool for generating knowledge and innovation, the primary requirement for which is human capital. Education, training and exposure are essential elements that build the competence for research, as for many other competencies

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High standards, reliable scientific skills and a sustained critical mass for research are crucial. Merger of sectors as proposed above can help, complemented by synergy of research with educational programmes. The great wealth of graduate students in our universities is yet to be tapped to implement national research programmes. This is a strategic issue which is easy to tackle but often overlooked.

We have some good work such as the identification in *Thaumatococus danieli* (Nigeria's sweet berry) of proteins that have 1600 times the sweetness of sucrose (Ogunseitan 1991). We can be proud of that. We also know of the identification and cultivation of red seaweeds in Zanzibar, the biological control of water hyacinth on Lake Victoria, and the new rice "Nerica" with Vitamin A by WARDA. But we know that African scientists contribute only 0.7% of global scientific publications, a disproportional contribution considering that Africa has about 11.5% of the global population. In the area of agriculture and natural resources we are slightly better off, with about 2% of all publications, but mostly from agriculture!

In 2003, The International foundation for Science (IFS) carried out studies in East Africa that clearly demonstrated that the average age of scientists at research institutes and universities is rising sharply, due to declining interest in research and academic jobs. To build up interest we must first demonstrate that science and technology are being adequately exploited to drive development. In other words, we must attract local interest and investment in science and technology before expecting others to support us. Secondly, we must recognise and reward scientists and innovators appropriately and encourage them to move up the scientific ladder. Thirdly, we must create the right conditions for science and innovation to flourish. The best starting point is with research that relates directly to our social/cultural settings and especially with existing indigenous knowledge. Let us scientist incentivise the public by producing very useful products and innovations that will attract attention and support for our work.

Rationalising research capacity and strengthening integration of research institutes and universities

A common practice all over the world is to divide our research programmes according to the standard scientific sub-disciplines. Thus soils research is seen as soil physics, soil chemistry, soil biology, biogeochemistry, soil carbon, and so on. Most problems requiring research solutions cut across these traditional sub-divisions. In forestry we have the traditional divisions of silviculture, engineering, wood technology, social science, economics and forest management. Quite often, research programmes are developed against these academic frameworks, and understandably, donors could not fund such programmes because they are drawn from structures that do not reflect the research problems or needs. With this approach, we are quite unclear on exactly what we are marketing to the funding agencies. Thus their reaction has been justified – choosing their own priorities and requiring us to frame projects within defined limits.

A cursory examination of current forestry research trends shows a downward spiral of hard science and emergence of a myriad of survey-based data largely focused on gender and participatory philosophies and practices. There is no doubt that these are important subjects. Our concerns are that they are done at the expenses of all other prime science topics; they rarely produce tangible results that can be extrapolated beyond the local survey area/community; and by investing such a large proportion of support in this area, donors skew (probably inadvertently) the balance of Africa's forest research agenda. The trend is palpable in other natural resource sectors and agriculture

Another crucial aspect is a new drive to demand that research projects demonstrate impact on livelihoods. Many strategic research areas are unlikely to produce results that have immediate impact on livelihoods, unless a project runs for a fairly long term. Most research projects are generally for small amounts of money (<US $ 100K) and run for up to 3 years. There are challenges in making such projects respond to long term needs, so naturally they are crafted to address shorter-term needs. We therefore experience low cover-

age of certain areas as hydrology, land degradation, land use change, climate change and serious development of novel products and services from forests.

A stable (but not static), relevance research programme, with mechanisms to support dissemination of research findings is needed. It is fair to say that many national institutions have gone through participatory processes that led to the development of research programmes. However, the outcomes ought to be put into meaningful development context. For instance, it is helpful to express research programmes in the context of local and national poverty reduction strategies and Millennium Development goals (MDG). This helps us to demonstrate the contribution of the RNR sectors to real development, and that can attract local funding for research. Enabling scientists to work directly with communities and institutions that are experiencing the problems will improve context and eliminate the need to have additional personnel and structures for the dissemination of research findings. A good research strategy should be based on three key and interlinked domains: natural resource content, societal demand for products and services and ecosystem functionality (Hollier et al 2005).

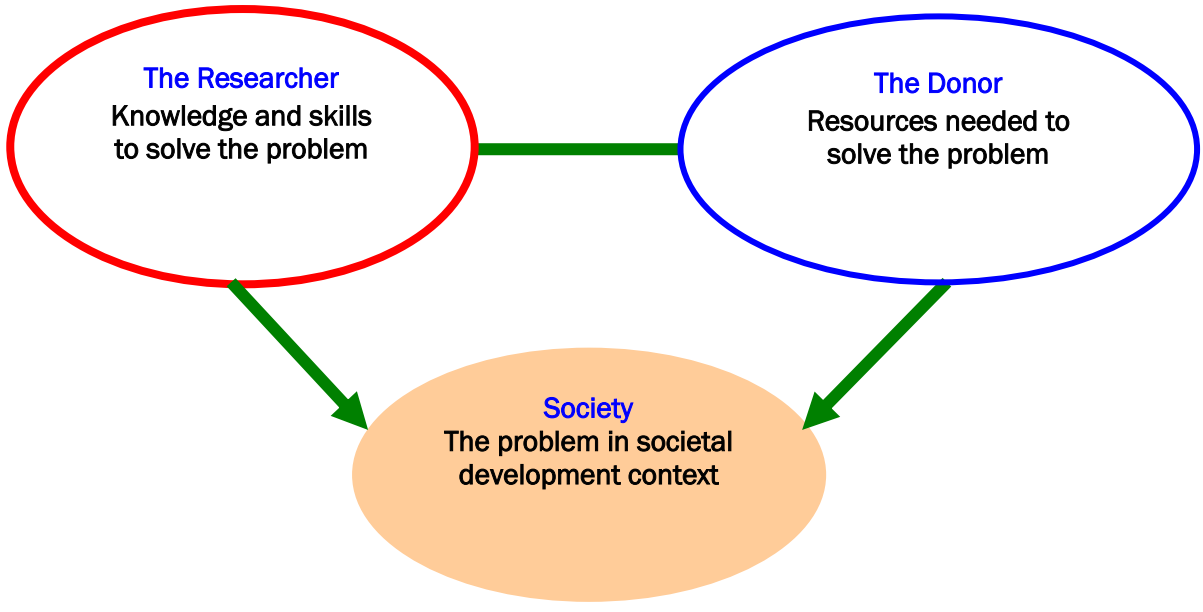
A research funding organization is much like a co-investor with the scientist. The funding agency has money and wants a solution to a specific problem. The scientist has knowledge and skills which can be used to resolve the problem, but s/he lacks the resources to carry out the research. Thus what we need is a research partnership, not a donor-recipient relationship. Unfortunately the latter has become so much the reality that scientists now accommodate donor demands, and are busy with project proposal writing protocols, funding restrictions and evaluations. They do not question the relevant or rationale of donor choices of research priorities, countries, institutions or individuals. All too often they accept donor conditions as givens, while the scientist practically cannot create conditions for the application on his/her knowledge and skills. This must be reviewed, and universities should lead that change, because they operate from a position of relatively higher freedom. What is needed is real partnership as depicted in Figure 2 and fair recognition of inputs by all parties, and not a one-sided dictation of conditions.

A fragmented approach to RNR research is a critical weakness in Africa. Research funding organizations develop their own research support strategies and programmes with very limited coordination. Due to inadequate local research support, our national research institutions, set aside their own research strategies and programmes, and bend over backwards to receive limited research support that diverts their time to issues outside their priorities. It is hard to sell full programmes to donors, who tend only to support projects that contribute to their own specific priorities. This approach scuttles the national research strategies and programmes and also undermines the scientific knowledge and skills of national scientists, as they often find themselves responding to international calls for research support in areas marginally related to their specific competencies. The result is – yes, we have RNR research taking place, but it is poorly articulated to provide the answers to the right questions.

Enhancing coordination and regional cooperation

An aspect related to rationalization is the need to achieve some sort of harmony among the natural resource disciplines, improve collaboration across institutions and countries and improve collaborative bargaining. Agriculture has achieved funding success by form-

Figure 2. Partnership to solve problems through research



ing the sub-regional networks (ASARECA, CORAF and SADC-FANR) and a regional research network (FARA). They all have partnerships with the CGIAR system. RNR institutions are lamentably far behind in this approach. AFORNET and FORNESSA are good initiatives in forestry but are still in a nascent stage.

One of the ways we can promote regional cooperation in RNR education and research is through ecosystem-based assessment of education, training and research needs. From the start, we can recognize the main ecological settings such as dry lands, sub-humid, humid, mountain and coastal systems and these can be further categorised according to land use (agriculture, forestry, marine, wildlife conservation etc). Adding the socio-political and economic parameters would give us a sufficient base for putting together the cross-border research and education programmes that are collaborative and fundable as independent entities. Such an arrangement also has the potential to avert conflicts on natural resources. In short, we need better coordination and cooperation.

Byron and Turnbull (1998) pointed out some challenges in forestry research

Current forestry institutional structures are unsuitable for proper integration of disciplines

Forestry objectives are still primarily focused on public service, while policies have shifted to private and community arrangements. This causes confusion.

Current funding for forestry (education and research) is still weak

These observations are relevant to other areas of renewable natural resources and education.

CONCLUSIONS

Research generates knowledge while education organizes and shares it, so the two are very closely linked. They should be treated as such in terms of policy and institutional arrangements. Supporting research is a reflection of a societal demand for knowledge. In renewable natural resources the demand is obscured by the inadequate policy, institutional arrangements and attitude of scientists. Current research suffers from among other problems, poor links with national development needs, and the lack of systematic and usable methods for qualitative assessment of natural resources; narrow focus of current projects and activities and strong dependency on external funding sources. Renewable natural resources in SSA are capable of funding research if the policy would allow it. What is needed is a clear vision of the benefits of research and serious commitment to fund and implement research from using a small portion of the renewable natural resources. The following recommendations are worth considering:

Renewable natural resources research policies and institutions should be re-designed to respond more directly to development needs such as addressing food and nutritional security, poverty and incomes, agricultural sustainability and conservation;

There is a need to create stronger vertical and lateral integration of disciplines and sectors to enhance synergy and efficiency;

Policies should be amended to encourage the use of renewable natural resources to fund research and education programmes:

A dedicated human resource development and sustenance is needed to achieve high standard of scientific and management skills needed (this includes improved working environment);

Effective mechanisms are needed to support dissemination of research findings and securing feedback from end users;

There is a need to promote eco-regional approaches as a way of achieving regional coordination as well as building adequate capacity for research investment and improving regional cooperation.

Globalization and opening up to private sector opportunities has hit the natural resources sector through intensified harvesting of raw materials, but not at all in research or education. This observation requires follow up. Finally, without attitudinal changes within the forestry and other natural resource sectors and serious efforts to sell research in development lexicon, it is highly unlikely that there will be a change in RNR research investment.

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