Chapter 18
Building capacity for research in agroforestry

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Abstract
This chapter discusses the key components of capacity building and the mechanisms that have been used to develop research capacity in agroforestry. These include building new expertise, developing institutions, forming networks, involving stakeholders and strengthening the links between institutions that have an interest in agroforestry research (including those in the North and the South, and those with national and international mandates). We discuss the efforts of the World Agroforestry Centre to build research capacity, including training at postgraduate level, postgraduate research, review of curricula to include agroforestry and networking between institutions. We also cover the recommendations of a 1982 conference on professional education in agroforestry and the extent to which these have been implemented, and present the results of the Centre’s graduate training programme. Finally, we outline the challenges to building capacity for agroforestry research, along with some suggested strategies and new opportunities.

Introduction
Capacity building: definitions and components
Capacity building is the structured process by which individuals, groups, organizations, institutions and societies increase their abilities to perform core functions, solve problems and define and achieve objectives, in order to understand and deal with their development needs in a broad context and in a sustainable manner. Temu and Garrity (2003) suggest that institutions with the right capacity have a good policy environment, good strategies, control capital and financial resources and have the needed expertise to successfully mobilize their capacity.

Szaro et al. (1997) define capacity building as enabling the indigenous peoples of developing countries to carry out development processes successfully by empowering them through strengthening of domestic institutions, provision of domestic markets and improvement of local government efforts to sustain infrastructures, social institutions and commercial institutions.

An effective research capacity building strategy aims to build scientific, technological and managerial abilities and capacities at the individual, institutional and organizational levels. To be successful, it should emphasize mechanisms that bring about a qualitative improvement in the way research is planned and implemented, and in the way results are disseminated.

In order to facilitate the transfer and adoption of knowledge generated, it is essential that capacity building efforts involve all stakeholders in the research process (including identification of issues, prioritisation, definition of research themes, activity monitoring...
and evaluation) and integrate traditional knowledge (Olsson 1996; Thulstrup 1996). This contributes to building capacity for the application of research findings.

Capacity building has three major components:
- strengthening institutions (legal and policy framework, support mechanisms, conducive environment);
- creating individual competence and strengthening a critical mass of human resources that is capable of planning and implementing agroforestry research projects to address the national agenda; and
- developing infrastructure (research equipment, buildings, facilities).

Temu (2003 unpublished) gives a rich illustration of the key components of capacity building. These include enabling policies, credible strategies and programmes, physical infrastructure, human resource capacity, financial resources, institutional power and voice, and networks or links with peers, clients and stakeholders (Figure 1).

Mechanisms for capacity building
The pooling of resources through networking is an essential element of any research capacity building project (Owino 1994). Networking can reduce the feeling of isolation and build critical masses of scientists within specialty groups in a virtual environment. Networking can take

Figure 1. Key components of institutional capacity.
many forms, including electronic, print or personal contact. All forms of networking should be encouraged, from local and national to regional and international. Networking ensures that neighbouring countries, and even institutions within the same country, share lessons and do not duplicate similar work. It must be pointed out, however, that networking has transaction costs such as communication and systems establishment. Well-developed scientific programmes are of little benefit if there is no participation from stakeholders and policy makers. Local input is essential to ensure the relevance of the work, and to create a sense of ownership once the science moves towards implementation in resource management and policy. Stakeholder engagement is a prerequisite for an effective capacity building strategy (Owino 1994).

The effectiveness of capacity building also depends on a step-by-step approach, beginning with existing capacity and activities. The goal is to make capacity building a unified process, within which particular activities can be organized and delivered in a logical order. Whatever the specific objectives of commitments or projects, capacity building is, above all, a long-term process that must emphasize the development of local structures and organizations.

In recent years, there has been increasing demand for research-trained manpower in key fields in many developing countries. There are several reasons for this, including global technology change towards more efficient research-based methods in both industry and agriculture, and increasing environmental concerns. The need for research-trained experts is often very specific for a given country and locality, and requires continuous production of research-trained human resources in the field (Thulstrup 1993). One primary focus of research capacity building should be to engender and encourage relationships between institutions. These should focus on the links between developed and developing-country institutions, and between institutions within developing countries. Institutions may ask themselves several questions before deciding with which institutions to collaborate; for example, which organizational structures are to be involved? What institutional relationships need to be established between them? How are these relationships to be established? Which are the most crucial institutions with which to collaborate: those with similar interests, those with complimentary interests or those with completely different interests? (Szaro et al. 1997).

Another focus for capacity building is the strengthening of institutions, not only in terms of human capacity but also in terms of research strategies, policy and legal frameworks, communication capacity and research management capacity.

The World Agroforestry Centre's efforts to build research capacity
Since its inception in 1978, the Centre has built capacity in agroforestry in various ways. In the early days, capacity building took the form of preparing training materials, guiding in-house trainees, giving agroforestry lectures and contributing to seminars and world literature on agroforestry and its place in education. In 1982, the Centre held a major conference to discuss professional education in agroforestry (Zulberti 1987). The main recommendations were to: a) develop agroforestry into an experimental science that can be taught within the context of existing professional links; b) integrate agroforestry into existing courses, such as land use; c) incorporate agroforestry programmes at postgraduate level where appropriate; d) encourage short courses in agroforestry within institutions; e) develop agroforestry training materials that will be regularly updated; and f) encourage South–South and North–South collaboration between institutions. The Centre was seen as a major player in terms of supporting institutions to incorporate agroforestry and in providing material for agroforestry training.

Building expertise in agroforestry through graduate fellows
One of the main recommendations from the 1982 conference was to support postgraduate training in agroforestry through field research. This is producing new scientific knowledge about agroforestry systems in the context of agriculture, forestry and integrated management of natural resources. The knowledge is being absorbed and disseminated by teaching, learning and extension systems. It is also producing policy and technological innovations that encourage farming communities to adopt agroforestry. Collaboration between researchers, educators, development workers and farmers, and building on existing farmer knowledge/traditions is crucial in this process.

The World Agroforestry Centre has been helping to build the competence of individuals and the capacity of institutions through giving both financial and technical support. The technical support includes attaching students to Centre scientists and carrying out thesis research in Centre field sites. In the last 10 years, the Centre has supported 276 graduates at M.Sc. and Ph.D. level (the majority from Africa) to carry out field research in agroforestry (Figure 2). The highest percentage of trainees came from East and Central Africa (ECA). This is because the Centre has been
very active in ECA and has many scientists based there. There are also more institutions teaching agroforestry at postgraduate level in ECA than in other regions.

The Centre has also trained many students from Europe, Asia and Latin America. Most of these are sent by major donors and are funded by their respective projects. Out of the 276 fellows 214 have pursued Masters programmes and 62 have pursued Ph.D. programmes. It must be noted, however, that the Centre has provided financial support (especially through the regional networks) to more than the 276 fellows reported here.

The thematic areas studied in postgraduate research are very varied and include soils and water, agroforestry technologies, tree domestication, social sciences and research management (Figure 3). Research under the social sciences has focused on issues such as marketing, extension, the role of agroforestry in poverty alleviation, adoption studies and studies on indigenous agroforestry knowledge. At the 1982 workshop, it was noted that agroforestry knowledge within the social sciences was very poor. However, Figure 3 shows that we have made positive developments in this area, with 15 percent of the fellows carrying out research in the social sciences between 1993 and 2003. Research management, although important, has only been studied by nine of the 276 fellows and has focused on geographical information systems (GIS), computer modelling and the effectiveness of agroforestry research with respect to funding levels.

Gender representation, although not equal, has been very encouraging (Figure 4). Around 32 percent of M.Sc. students and 37 percent of Ph.D. students were female. This is high compared to the general percentage of women working in agricultural sciences (12–15 percent).

One of the major achievements of the graduate programme is that it has built a critical mass of agroforestry experts in national agricultural and forestry services, especially in Africa. Although we have not formally followed up on individual trainees, we believe that many of them are working in forestry and agricultural departments of research institutions or universities.

**Figure 2. Geographical distribution of World Agroforestry Centre graduate trainees (1993–2003).**

**Figure 3. Thematic areas pursued by World Agroforestry Centre degree fellows (1993–2003).**

**Figure 4. Gender balance of World Agroforestry Centre degree fellows (1993–2003).**
Postgraduate programmes in institutions of higher learning
At the time of the 1982 agroforestry conference, there were hardly any postgraduate courses in agroforestry being offered by higher learning institutions, although a few provided courses on land use. By 2003, Africa alone had 31 institutions offering agroforestry as a postgraduate course (Table 1). Many others are now teaching agroforestry as a subject within other disciplines, such as forestry, agriculture and environmental sciences. In addition, several institutions have modified their curricula to include agroforestry (Table 2). The review and incorporation of agroforestry within the curricula of national universities ensures the sustainability of these programmes and facilitates interdisciplinary interactions.

Agroforestry research and education networks
Agroforestry research networks were started in Africa in the late 1980s and form an important component of the Centre’s capacity building strategy. The networks have experimental sites in different countries in Africa, which provide excellent experimental learning for scientists from national research institutions and from the World Agroforestry Centre itself. Most of the research by the Centre’s graduate fellows (as described above) is carried out at research sites managed by the networks.

There are now three main agroforestry education networks: the African Network for Agroforestry Education (ANAFE), the Southeast Asian Network for Agroforestry Education (SEANAFE) and the Latin American Agroforestry Network (LANAFE). These are described by Rudebjer et al. in Chapter 17 of this volume. In addition to these regional networks, many countries have also formed national agroforestry networks.

### Issues and challenges in building capacity for agroforestry research
Agroforestry has come a long way since it was originally recognized as a simple extension of forestry. It was categorized in this way because the idea of planting trees appeared to fit best with the forestry profession, and foresters saw agroforestry as a way of helping farmers to produce their own tree products and reduce their dependency on natural forests. By and large, the early proponents of agroforestry were foresters (Temu, unpublished).

Agroforestry is now seen as a science that is of increasing interest to a wide variety of disciplines. Perspectives are changing and many new agroforestry programmes are being developed within agriculture, forestry, environmental education and other land-use programmes. Agroforestry is currently considered as an important entry point for holistic natural resources management studies within educational institutions. Temu and Garrity (2003) observe that agroforestry also provides an entry point for biodiversity education. Despite viewing agroforestry as a broad-based discipline touching on various sectors, most national agricultural institutes and university faculties still remain very sector-based with separate institutions for agriculture, forestry, wildlife, livestock, etc. Integrating the agroforestry agenda therefore represents a significant challenge, especially in cases where there is no institutional collabora-

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**Table 1. Postgraduate education in agroforestry.**

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of universities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>31</td>
</tr>
<tr>
<td>Australasia</td>
<td>4</td>
</tr>
<tr>
<td>Central and South America</td>
<td>3¹</td>
</tr>
<tr>
<td>Eastern Europe and China</td>
<td>?¹</td>
</tr>
<tr>
<td>North America</td>
<td>20</td>
</tr>
<tr>
<td>Western Europe</td>
<td>41</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>15</td>
</tr>
<tr>
<td>South Asia</td>
<td>?¹</td>
</tr>
</tbody>
</table>

¹ Information not complete

**Table 2. Number of curricula reviewed to incorporate agroforestry in Africa (1993–2002).**

<table>
<thead>
<tr>
<th>Discipline/level</th>
<th>Certificate</th>
<th>Diploma</th>
<th>First degree</th>
<th>Postgraduate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>2</td>
<td>4</td>
<td>15</td>
<td>2</td>
<td>23</td>
</tr>
<tr>
<td>Forestry</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>2</td>
<td>23</td>
</tr>
<tr>
<td>Other (e.g. rural development, horticulture)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>New agroforestry programmes</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>18</strong></td>
<td><strong>29</strong></td>
<td><strong>10</strong></td>
<td><strong>67</strong></td>
</tr>
</tbody>
</table>

The sectoral nature of institutions, ministries and faculties brings new challenges within national programmes in terms of coordinating agroforestry activities. Despite recommendations at the conference in 1982 for more integration, this has not happened in most countries. In institutions of higher learning that do not offer postgraduate courses in agroforestry, students wishing to carry out their research in agroforestry have to find their own points of integration.

Funding constraints often prevent national agricultural research organizations (NAROs) and public universities retaining well-trained agroforestry staff. Once they become skilled, staff may move to the private sector, international research organizations or non-governmental organizations (NGOs), or go out of the region on teaching or research assignments. Although they may contribute in one way or another to research efforts in their home countries or regions, the high turnover presents a challenge for the national programmes. This problem is not specific to agroforestry and is linked to the more general ‘brain drain’ of expertise from the South to the North and, within countries, from the public to the private sector. For those that remain in the national programmes, regular salaries tend to be insufficient for sustaining an acceptable standard of living and a second income is often a necessity. Only rarely are second jobs conducive to research activities; usually they will take time away from research and (graduate) education. Lack of time and incentive for research therefore presents a serious problem for many developing-country research programmes.

Mainstreaming agroforestry into national programmes has been successful to a certain extent. In institutions of higher learning, agroforestry has become an area of study, even at graduate level, implying major policy changes in the recognition of agroforestry by universities. However, most of the agroforestry activities conducted in NAROs are donor funded and agroforestry has not become part and parcel of their core programmes and priorities. This is due mainly to persisting sectoral orientation.

Effective communication and sharing of information across sectoral barriers remains a daunting challenge at both local and national level. However, these problems are only part of the broader global capacity building challenge to promote, legitimize and institutionalize effective sharing of ideas and information across sectoral, national, cultural, linguistic and socioeconomic barriers. The increasing importance of electronic communication has often made matters worse for developing-country researchers, since the required facilities may not be available. In the long term, however, electronic communication is likely to become a valuable tool, helping developing-country researchers to overcome the long distances between them and other researchers in their fields.

Measuring the impact of capacity building efforts presents another challenge. There are various ways to do it, but each method has its own shortcomings. As with any impact assessment, issues of cause and effect will arise. A ‘with and without’ analysis suffers from bias, since the very effort that went into identifying target institutions would make any comparison suspect. A ‘before and after’ comparison assumes that over that same time period, there were no activities or initiatives affecting the institution other than the particular research capacity building efforts for which impact is being measured. Individual institutions therefore need to develop a combination of measures that will give the best results based on the objectives of their capacity building efforts. Examples of aspects that can be measured include:

- The number of people that have been trained (critical mass of expertise within organizations). This is really a measure of building research competence rather than research capacity.
- The number of publications produced by trainees. This approach has distinct limitations in that not all the good research is published, and there may be good reasons why some people do not or cannot publish their research results. Some work may be more effectively disseminated by means other than publishing in peer-reviewed journals. In many cases, there is a considerable time lag between the research results and publication.
- The funding attracted by researchers who have benefited from the capacity building effort. This has limitations, however, as comparisons may not be valid. Different institutions, especially in different countries, may attract different levels of funding based on their relations with donors. And this only measures researchers’ ability to attract funding, not the impact of their research on the end user, i.e. farmers and the poor.
- The networks built by the institution. This measures the extent to which increasing the capacity of an institution increases its ability to establish partnerships with other international, regional and national organizations. While this is a good measure of the institutional growth as a result of the built capacity, it does not address issues of impact on the other institutions nor on the end users of the institutions’ research products.
- Inclusion of agroforestry in national programmes is another measure of
impact that evaluates the extent of institutionalization of agroforestry within an institution's or a country's programmes. This can be measured in various ways including the evaluation of policy documents to assess whether and how agroforestry is articulated in these policy documents, the perceptions of key policy makers on the role of agroforestry, changes in practice, etc.

This kind of impact assessment and evaluation may be internal or external or a combination of both. There are advantages and disadvantages in internal and external evaluations and the two should be combined in order to reap maximum benefit from their advantages. While an internal evaluation allows and encourages learning, corrective measures and improvements, it may be subjective, since actors may fail to highlight weaknesses and concentrate on positive aspects. Building capacity in evaluation for learning and change can, however, reduce this risk. External evaluations may provide a more objective view of the strengths and weakness of an institution and the recommendations should be used to make improvements.

Conclusions and recommendations

Capacity building in agroforestry has come a long way since the 1982 agroforestry education conference. Most of the major recommendations from that conference have been implemented and the World Agroforestry Centre has played a leading role. However, significant challenges remain. The sectoral nature of research, education and administration has affected the institutionalization of agroforestry. Lack of funding and loss of staff to better-paying jobs also limits the effectiveness of capacity building efforts. In the institutions of higher learning that do not offer agroforestry as a full postgraduate course, it is still left to students of agriculture and forestry to integrate the two if they want to pursue research in agroforestry. Measuring the impact of capacity building efforts also presents a challenge.

New opportunities for capacity building in agroforestry are presented by forming links with sub-regional and regional organizations, such as the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) and the Forum for Agricultural Research in Africa (FARA). The World Agroforestry Centre forms a central point for linking educational institutions, NAROs, NGOs, donors and regional organizations (Figure 5). In the past, links between educational institutions and research institutions have been weak and have failed to address issues of strategy, such as joint research and education programmes involving different types of institutions. While links between research and extension have improved, there is still a gap between research and education. In most cases, the only points of contact are university students, who attend research institutions for experiential learning and to carry out their thesis research, and research staff, who attend university courses. These links need to be strengthened to promote sharing of information and development of coordinated agroforestry programmes.

A good model for improving the coordination of agroforestry education is the formation of a national agroforestry coordination committee. This would include representatives from different ministries or departments, universities, national agricultural and forestry research institutions, NGOs, the private sector and international agricultural research centres that are engaged in or have an interest in agroforestry. The World Agroforestry Centre is well placed to support the development of such committees.

![Figure 5. Institutional links in agroforestry.](image-url)
The Centre has already been successful in creating national and regional partnerships and networks in developing countries. The next step will be to strengthen the links between them and agroforestry institutions in the North. The issues to consider when forming new types of partnerships are: a) the organizational structures that need to be involved; b) the institutional relationships that need to be established; c) the comparative advantage that each institution brings; and d) how to establish the relationships, including the sharing of credit/authorships and issues of intellectual property rights.

Relationships with institutions in the North would provide several benefits, including opportunities for overseas studies, joint review of agroforestry curricula, scientist exchange programmes, information sharing and improved communication technology, joint research and publications and access/training in new research methods and tools.

References