Chapter 10
Innovative Farmers, Non-adapting Institutions: A Case Study of the Organization of Agroforestry Research in Malawi

Judith J. de Wolf

Abstract Farmer experimentation with technologies, diverting from the official recommendations, highlights a common theme in the academic literature on agricultural research and development. Local knowledge and farmer- or demand-driven research have become watchwords of international development efforts, yet remarkably little farmer experimentation has made it into the sphere of formal agricultural research. Farmer practices, interests and experimentation are not systematically analysed, nor is there any serious testing of the effectiveness of farmers' experiments and adaptations of technologies. International institutes for agricultural research – such as the members of the Consultative Group on International Agricultural Research (CGIAR) – have adopted a changed discourse on farmers' knowledge, yet their research practice appears surprisingly persistent and little influenced by farmers' agendas.

Drawing on fieldwork and studies on the adoption of agroforestry technologies in Malawi and building upon social science research into the institutional embedding of development discourses, this chapter analyses this incongruence between research discourse (farmer-oriented), and the institutional framework which continues to be geared towards the international research community. Building on the recognition that the institutional set-up and environment of agricultural research produces particular policies, discourses and outcomes, it is shown that, despite a changed discourse on research, change in organizations and research practices has been limited – with changes rarely going beyond rhetoric. Despite new development priorities, research institutes largely still speak to scientific audiences rather than with farmers. It is argued that for agricultural research institutions to adapt to the changing discourse on agricultural research, these institutions themselves need to change organizationally. The chapter critically discusses some recent organizational adaptations in agricultural research, and suggests further modifications so as to make international agricultural research more able to adapt to farmers' practices and agendas.

J.J. de Wolf (✉)
TSBF-CIAT Harare, P.O. Box MP 228, Mount Pleasant, Harare, Zimbabwe
e-mail: judith.dewolf@hetnet.nl

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Introduction

Some 20 years ago, the publication of *Farmer First: Farmer Innovation and Agricultural Research* (Chambers et al. 1989) marked a paradigm shift in thinking about agricultural research. Although conventional Transfer of Technology (ToT) approaches – underpinning industrial agriculture and the standardized green revolution packages – had been criticized since the 1970s for introducing technologies that did not fit the circumstances of resource-poor farmers in developing economies, the Farmer First approach signaled a more radical shift. Moving beyond early Farming Systems Research that sought to tailor international agricultural research to the needs of small-scale farmers through a multi-disciplinary approach (Rhoades et al. 1987), the *Farmer First* paradigm stressed the importance of local knowledge and the capacity of resource-poor farmers to innovate. The book and numerous subsequent publications made the case for agricultural research to link to farmers' agendas and knowledge (de Boef et al. 1993; Scoones and Thompson 1994). Such insights have since been commonly accepted, while the initial, rather populist *Farmer First* perspective has received considerable criticism. First, by largely ignoring power dynamics – both within rural communities and between poor farmers and outside agents – *Farmer First* methodologies have often been naively optimistic regarding the possibilities of collaboration among and between farmers and researchers. Second, the *Farmer First* paradigm suffered from a simplistic and celebratory notion of local knowledge as an environmentally well-adapted single, cohesive stock "out there", waiting to be tapped. Such a notion does not correspond with the complex and rapidly changing socio-economic and agro-ecological environments in which resource-poor farmers in the global South find themselves.

Numerous critiques and farmer participatory approaches, addressing these power/knowledge shortcomings, have since been developed (Drinkwater 1994; Long and Villareal 1994, Chapter 13), yet the challenges of farmers accessing agricultural research institutions and influencing their research agendas persist. This chapter does not focus on farmers' knowledge, its soundness or (wider) applicability, or smallholder farmers' encounters with researchers and the problems of communication that come with it. Although these are important problems which are not easily overcome, this chapter seeks to understand the problem of linking international agricultural research – as embodied by the Consultative Group on International Agricultural Research (CGIAR) – to farmers' practice from an organizational perspective. It looks at the ways in which agricultural research institutions operate. Hence, the focus is on the organization and culture of research in which both social scientists and biophysical researchers operate.

The problem addressed here is not a question of researchers' unwillingness to collaborate with farmers or their misunderstanding of farmers – although there is certainly need for improvement in this field. Rather, the chapter problematizes the current institutional environment in which agricultural researchers operate. Since institutions for agricultural research are increasingly funded by donors that set development targets, research may seem to have become more farmer-oriented. But has it? And can social scientists within international agricultural research make a difference after the adoption of the *Farmer First* paradigm? Hence, the question is: have changes in the organization of agricultural research made it more responsive to farmers' needs?

Building upon field research, literature reviews, and experiences as a social scientist working within an international research institution in the field of agroforestry,[1] the analysis presented here looks at the institutional environment – comprising both organizational and cultural aspects – in which agricultural researchers work. It shows how the organization and culture of research in one such institute – the World Agroforestry Centre (ICRAF) – has shaped the particular form farmer-oriented research in the early 2000s has taken, being focused on technology development and directed at counting technology adoption, and identifying variables influencing adoption. In so doing, this chapter seeks to elaborate why it is unlikely that agricultural researchers in international institutes – be they biophysical or social scientists – will link up with farmers and their priorities. The chapter is organized in two parts. The first part briefly describes soil fertility enhancing agroforestry technologies and the different ways which smallholder farmers in southern Malawi have adapted these technologies to fit their farming practices. It raises the question that is then addressed in the second part of this chapter, which is why such farmer adaptations (or experimentation) are not picked up by agroforestry research. The second part analyses the institutional environment and culture of research in ICRAF and how, despite changes in this environment, research has not become more farmer-oriented.

Farmers' Practices and Agroforestry Researchers: Some Examples

In the continuing debate on the problems of engaging farmers in agricultural research, it seems almost forgotten that agricultural research has contributed tremendously to agricultural practice and performance, both in industrial and in

[1] The World Agroforestry Centre (ICRAF until 2002) is the world's leading research institute for agroforestry research and development. Established in the 1970s, it joined the Consultative Group on International Agricultural Research (CGIAR) in 1991 (www.worldagroforestrycentre.com). The author worked as an associated social scientist for the centre, and was based at Makoka and Chitedze research stations in Malawi from 2003 to 2006. The author wishes to thank the anonymous reviewers of this chapter for valuable comments.

developing countries. Very successful, high yielding ("Green Revolution") maize varieties, fertilizer recommendations, pesticides, and herbicides have been developed without much consultation of the end-users of such technologies.[2] This chapter, which takes the example of soil-fertility improving agroforestry technologies,[3] also deals with researcher-developed technologies that have proved to be working – from a biophysical point of view. These technologies appear to be particularly well suited for resource-poor farmers, as they hold the promise of reduced dependence on agricultural input markets (for fertilizers) or the need for cattle manure to sustain yields on permanently cropped lands.

Agroforestry technologies aimed at improving soil fertility make use of the ability of certain trees to assimilate and fix atmospheric nitrogen with the aid of bacteria living in its root nodules (for a detailed description, see Giller 2001). Thus fixed nitrogen is released into the soil, where it becomes available for other crops. Hence, nitrogen-fixing trees have an additional value for soil fertility improvement, on top of the "green manure" that trees normally provide as they shed their leaves (Giller 2001; Makumba 2003; Chilimba et al. 2004).

A number of these nitrogen-fixing agroforestry technologies are particularly well-suited to situations of high population pressure on land and extreme poverty, such as those prevailing in southern Malawi. Here, population densities are among the highest in Africa – as high as 379 persons per square kilometer in some districts[4] – and leaving smallholder-farming families with an average of 0.5 ha of cultivated land by the late 1980s (NSO 2008). In the absence of substantial numbers of livestock, and with limited sources of income that can be used to purchase chemical fertilizer, soil fertility replenishment is a major problem in this region. Farmers' small plots produce hardly enough maize – the main staple food – to feed the household. And as the land needs to be cropped continuously with this relatively nitrogen-demanding crop, soils are rapidly exhausted. Consequently, agricultural productivity is very low.[5] In such circumstances, agroforestry technologies aimed at

[2] Since the 1980s, the "Green Revolution" has been critiqued, as its impact has been very uneven, and the technologies often failing to reach the poor. Additional problems include reduced and polluted groundwater supplies, agro-chemical induced health problems, reduction of bio-diversity and food quality, and increased dependency of smallholder farmers on markets (Hazell and Ramasamy 1991; Lipton and Longhurst 1989).

[3] There are a number of other agroforestry technologies, ranging from fodder banks to feed livestock, rotational woodlots, to the improvement of indigenous fruit trees (domestication, processing, marketing). Although a similar argument may be developed for these technologies, these technologies will not be discussed here.

[4] The three highest-ranking rural districts are Chiradzulu, Thyolo, and Mulanje, with population densities of 379, 343, and 256 persons per sq. km, respectively. On average, Malawi's Southern Region had some 185 persons per sq. km in 2008 (NSO 2008).

[5] For the main staple crop, maize, yields ranged between 1 and 1.2 t/ha in the early 2000s (Benson et al. 2002). To be sure, the main drivers of agricultural productivity in Africa are soil fertility *and* climate. Although rainfall can be erratic, southern Malawi can be considered suitable for crop cultivation, with average rainfall ranging from 1,000 to 1,200 mm per annum (Kanyama-Phiri et al. 2000).

Table 10.1 Soil fertility improving agroforestry technologies and their benefits (Matakala 2004)

Agroforestry technology	Trees used	Benefits under farmer conditions
Biomass transfer	*Tephrosia vogelii* *Sesbania sesban*	N_2: dependent on # seasons grown Wood harvests
Improved fallows	*Tephrosia vogelii* *Tephrosia candida* *Sesbania sesban*	Maize yields: 2.0–3.5 t/ha N_2: 70–100 kg/ha Wood harvests of up to 10 t/ha
Mixing crops with coppiced trees	*Gliricidia sepium*	Maize yields: 1.8–3.0 t/ha N_2: 60–210 kg/ha
Annual relay cropping of trees	*Sesbania sesban*[a] *Sesbania macrantha*[a] *Tephrosia vogelii*[b] *Crotolaria spp.*[b] *Cajanus cajan*[b]	Maize yields: 1.2–2.3 t/ha N_2: 50–70 kg/ha Wood harvests of up to 5 t/ha

[a] Raised in nurseries, bare-rooted seedlings are transplanted.
[b] Sown directly under a canopy of established crops.

improving soil fertility seem to be the perfect – biophysical – solution to smallholders' productivity, as they reduce the need for external inputs (manure, fertilizer).

Of the most common soil fertility improving agroforestry technologies that are briefly elaborated below, the last two are generally regarded as suitable for southern Malawi or similar situations (Table 10.1 provides an overview of these technologies and the tree species used):

1. *Biomass transfer*. This cut-and-carry system requires separate areas where nitrogen-fixing shrubs and trees are planted. Usually vegetable gardens near streams and rivers are fertilized with the biomass of these nitrogen-fixing trees that grow elsewhere. The technology is only suitable for situations in which not all land is needed for the cultivation of crops or grazing of livestock (Ajayi et al. 2008).
2. *Sequential fallow rotation or improved fallow*. In this system, nitrogen-fixing trees are planted together with maize. The maize is harvested and the (slower growing) trees remain for (usually) two agricultural seasons in which no maize is grown. In preparation for the third season, the trees are cut and the leaves and litter (biomass) incorporated into the soil. The biomass thus produced can contain to 70–100 kg/ha of nitrogen, and with the leaf biomass incorporated into the soil, maize yields of 3–5 t/ha have been reported on farmers' fields. "However, such yields depend heavily on good rainfall, the use of improved maize varieties that respond well to N fertilizer, and good management" (Akinnifesi et al. 2005, p. 2). In addition to the improvement in soil fertility, farming households also benefit from the wood harvested after the fallow that can amount to 10 t/ha (to be sold, used for fuel, or roofing beams). In southern Malawi, improved fallow is

problematic as smallholder farmers cannot afford to leave the little cropland they have fallow for some years.[6]

3. *Simultaneous intercropping.* Also known as coppiced fallows, here tree seedlings are planted in between the maize ridges. Once the trees are properly established, the trees are cut back three times per year (Makumba et al. 2005). The biomass from these cuttings is then incorporated into the soil, in the ridges where maize is grown. This technology is considered to be extremely suitable for the Southern Region of Malawi, where land shortages are acute and labour is thought to be relatively abundant or cheap. Since the trees are coppiced, they do not interfere with the maize crop. The cut biomass can be used as green manure over many years. Although the commonly used *Gliricidia sepium* trees take some time to establish before they produce biomass, the nitrogen quantities generated typically range between 60 and 210 kg/ha. Depending on rainfall and soil type, maize yields under farmer conditions are said to range between 1.8 and 3.0 t/ha. Depending on the used spacing for maize, intercropping with trees may reduce the number of planting stations for maize, thus reducing maize yields per hectare (Ajayi et al. 2008).
4. *Annual relay (fallow) cropping.* Fast-growing trees or shrubs are (trans)-planted in the field after the maize crop is established. The shrubs remain in the field after the harvest of the maize crop and continue to grow. Their full canopy will only develop after the crop is harvested. When the land is prepared for the next season, the shrubs are cut and the biomass is incorporated into the soil. This technology has the advantage of no fallow periods, nor do farmers have to wait for the trees to get established (as with simultaneous intercropping). Furthermore, the results can already be seen after 1 year. However, the trees have to be replanted every year and the potential increase in yield is not as significant as in case of the other three systems as the amount of tree biomass produced in a year is smaller. Maize yields under farmer conditions typically range between 1.2 and 2.3 t/ha. Like simultaneous intercropping, this system is considered to be most suitable for Malawi's Southern Region. Although pigeon pea (*Cajanus cajan*) is one of the recommended species for this technology, the contribution of this crop to soil fertility has proved to be very limited (Chirwa et al. 2003), its impact depending on what farmers do with the crop residue after harvesting the peas. Yet farmers in southern Malawi seem to prefer the combination of maize and pigeon peas, albeit not for its effects on the soil; it gives them additional food.

From the above descriptions of the major soil fertility improving agroforestry technologies it becomes clear that these technologies not only have a number of "in-built" assumptions or blind spots regarding smallholder farming (such as cheap or abundant labour, gender neutrality, land availability), but also that "management"

[6] Biomass transfer and improved fallows are promoted in Zambia and the Central Region of Malawi, where in many areas land is relatively abundant as compared to southern Malawi.

by farmers is a crucial factor in the effectiveness of the technology. Let us therefore consider some observations from southern Malawi on farmers' management and adaptation of these technologies.[7]

Observation (1): From Mixed Cropping to Ground Leaves

Mr. Sitolo is a resource-poor farmer living not far from the main road from Zomba to Lilongwe. One day we visited his small farm in Ntubwi EPA, Machinga district in Malawi's Southern Region, an area where agroforestry has been promoted in the past. We were looking for a farm for an interested American researcher to visit. We thought of Mr. Sitolo as he was known to be an active member of the "agroforestry farmers club" right from the beginning when the technologies were introduced in this area. When we met him at his homestead, it appeared however, that Mr. Sitolo was no longer practicing the mixed intercropping with maize and *Gliricidia sepium* as "recommended". Instead, he was experimenting with applying the Gliricidia biomass to his cotton crop. And as he showed us around, he took us into one of his small houses on his homestead, where he kept his dried Gliricidia leaves. He explained that he harvested the leaves, dried them under shade to maintain the green leaf color, and then ground the leaves into a powder, which he then applied to his maize crop as if it were chemical fertilizer. He claimed that last season, his maize crop did very well after applying the Gliricidia powder in his maize field twice.

Observation (2): Different Trees in One Field, Rotating Maize and Tobacco

Although he had been practicing agroforestry since a long time, James Chikoko in Kutambala had agroforestry trees in only one of his three fields. In this field he cultivated maize and tobacco in rotation. Along the ridges he had *Gliricidia sepium* trees. "Jerejere" (*Sesbania sesban*) and "ombwe" (*Tephrosia vogelii*) had been planted together in the same field – although the "jerejere" had dried up "(that is what happens when it matures," according to Mr. Chikoko). He continued to explain that he cut the "ombwe" down when he grew tobacco in the field. The tobacco did

[7] To be sure, the case examples are not representative of all southern Malawi's farming population. However, the aim of presenting these "apt illustrations" is not to present representative cases, but to illuminate wider social patterns and processes through the study of the particular. It is our understanding of the social processes as identified in the particular situation that allow us to understand similar (or contrasting) situations (see van Donge 2006).

well with only the Gliricidia. Mr. Chikoko also applied a little fertilizer when he cultivated maize in the field with the agroforestry trees.[8] He knew it was not taught to him like that, but he decided on the fertilizer nevertheless. "The trees are only effective after two years", he explained, and when the field changed for the better, he reduced the amount of fertilizer. He did not want to try to cultivate his agroforestry field without any chemical fertilizer, because he feared he would not yield enough to feed his family. Therefore he did not want to try it without fertilizer, despite having observed others cultivating fields with agroforestry trees without any extra fertilizer. "Their harvests are not as good as his", claimed Mr. Chikoko.

Observation (3): Not Following the Agroforestry with Hybrid Maize Recommendation

There are sound agronomic reasons to recommend soil fertility improving agroforestry technologies in combination with hybrid maize; it is more responsive to more mineralized nitrogen in the soil than local maize varieties, and perhaps many other crops. Nevertheless, in southern Malawi, resource-poor farmers are not often seen growing hybrid maize in their agroforestry fields. Local maize varieties are much more common, and very often one also observes cassava or other food crops being grown in combination with nitrogen-fixing trees. An impact assessment study of soil fertility enhancing agroforestry technologies conducted in southern Africa in 2004, also found that in southern Malawi farmers plant a variety of other crops in the agroforestry fields (Table 10.2), with positive reports:

> All the crops, when grown in agroforestry fields, they do well. All are healthy.
>
> – Mrs. Florence Kazembe, Namadidi village (2004)

> Beans, *nandolo*, soya, pumpkin, groundnuts, cucumbers, *nsama* (bambara nuts), and cassava benefit from agroforestry. Especially beans, such as *nsama*, groundnuts, pigeon peas do well.
>
> – Mrs. Loney Sinja, Namadidi village (2004)

The impact assessment study by the World Agroforestry Centre concluded, "… it appears that any crop suitable to the existing ecological conditions in the respective sites, will do well under agroforestry" (Schüller et al. 2005, p. 7). Yet, whether these alternative uses of agroforestry technologies are indeed effective and efficient is largely unknown. Study designs on the impact of nitrogen-fixing agroforestry technologies continue to consider only the effects on hybrid maize yields.

The above observations on farmer management of agroforestry technologies show the innovativeness of smallholder farmers and their capacity to adapt intro-

[8] Mr. Chikoko is not the only one. Many Malawian farmers add fertilizer to their agroforestry field if they have the means to do so. They often do not believe nitrogen-fixing agroforestry technologies can actually work on their own.

Table 10.2 Crops cultivated with soil fertility enhancing agroforestry (AF) technologies (Schüller et al. 2005)

(N = 51)	Per cent of farmers growing crop with AF (%)	Crop reacts favorably to AF (farmers' view) (%)
Maize	100	81
Bambara nuts	6	3
Beans	84	32
Cassava	74	26
Groundnuts	68	6
(Indigenous) vegetables	90	12
Millet	6	
Pigeon peas	90	29
Pumpkin	35	13
Sorghum	13	
Soy beans	16	6
Sweet potatoes	16	

duced technology packages to suit their own needs. To be sure, not all such adaptations constitute effective or efficient resource use. Yet, observations like these do provide important entry points for understanding agricultural practices and different farmers' agendas that are relevant for agroforestry research. For instance, they point to a potential inconsistency in the thinking about and evaluation of nitrogen-fixing agroforestry technologies. On the one hand they are promoted as an external input reducing – and thus, pro-poor – technology (i.e. no need to buy fertilizers), while on the other hand, agroforestry research is based on the assumption that farmers are capable and willing to purchase hybrid maize seeds. However, as observation #3 shows, for resource-poor farmers in southern Malawi, buying hybrid maize seeds each year is beyond their reach. Rather than hybrid maize, they prefer local maize varieties – an agronomically sub-optimal option – that can be kept and used the next year. It saves them not only the cost of seed, but also the cost of chemicals used to preserve the harvest, since local flint varieties[9] can be stored much longer than hybrid maize.[10] It is a moot point whether these technologies still make sense from an economic point of view when only local maize is grown.

The observations from southern Malawi further reveal how smallholder farmers who recurrently face food shortages are not merely interested in the workings of agroforestry technologies with maize, their main food crop. Cash needs and the extreme shortage of land in southern Malawi make farmers net consumers of food, affecting their decision to not simply concentrate all their agricultural efforts on (hybrid) maize production. Farmers interviewed during the impact assessment

[9] Flint varieties have kernels with a hard outer layer enclosing the soft endosperm.

[10] Furthermore, the taste of local maize is also said to be better and it is claimed there is more starch ("starch kwambiri") in local maize. Therefore, farmers claim, local maize fetches a higher prize when sold locally.

study suggest that nitrogen-fixing trees may work well with a number of crops, yet little is known scientifically about such alternative uses since researchers have not followed them up. Nor is Mr. Chikoko's practice of rotating tobacco and maize in combination with nitrogen-fixing trees taken up by researchers. Equally, smallholder farmers' use of nitrogen-fixing trees in combination with cassava signifies a need for a reliable source of food in situations of erratic rainfall and/or limited labour availability. This latter constraint runs counter to a common assumption underpinning the promotion of nitrogen-fixing agroforestry technologies: that in highly populated and impoverished areas such as southern Malawi, agricultural labour is abundant or available at very low cost.

Lastly, the observations on Mr. Chikoko and Mr. Sitolo's unusual experiments and adaptations of the agroforestry technologies are not easily captured by the quantitative surveys that are commonly used to evaluate technology adoption. Yet, they do point to the need for agroforestry researchers to consider alternative uses of technologies (in combination with other crops and other agroforestry technologies, etc.), their effectiveness and the rationale behind their emergence. Despite maize being the staple food crop in many parts of Africa, for resource-poor farmers facing recurrent food shortages it is clearly not the only crop – let alone the hybrid variety – they may want to grow in combination with nitrogen-fixing trees. So, why do these observations on smallholders' farming practices relating to agroforestry not seem to inform research on agroforestry?[11]

A Resilient Research Institution in a Changing Environment

> … farmers themselves are innovators in their use of agricultural technology and (…) their innovativeness is conditioned by their social-cultural and economic circumstances as well as their physical environment (…) Therefore, technology development should begin and end with the farmer.
>
> – Rhoades and Booth 1982, cited in Prain et al. 2006, p. 166

To understand why the above acknowledgement (which later featured so prominently in the *Farmer First* paradigm) did not result in agroforestry researchers incorporating farmers' experiences and agendas into their (participatory) research,

[11]There is an exception. One farmers' adaptation of agroforestry technology has been widely accepted by scientists: the reduction in the number of prunings of *Gliricidia sepium* in simultaneous intercropping. Initially, it was recommended that well-established *Gliricidia* trees be pruned five times a year. However, farmers appeared to be pruning only three times. Subsequent on-station trials revealed this practice to be just as effective, thus making it the official recommendation (Makumba et al. 2005). However, the most likely cause of this farmer adaptation – limited labour availability – was not taken up in further agroforestry research (see, for example, Makumba 2003).

we need to better understand the institutional environment in which agroforestry research by ICRAF in Africa takes place. But before exploring this environment, and particularly, how it changed since the early 1990s, it is useful to briefly outline the initial attempts to make agroforestry research more farmer-oriented in the mid-1990s. As before, the focus is again on soil fertility enhancing agroforestry technologies in Malawi.[12]

In Malawi, ICRAF's research on soil fertility enhancing agroforestry technologies started with on-station trials in the early 1990s. After a couple of years of exclusively on-station research, some of the trials were taken on-farm, that is, to farmers' fields (Phiri and Akinnifesi 2000; Nyirenda et al. 2001; Akinnifesi et al. forthcoming). Thus, researchers hoped to get better insight into the performance of different technologies under farmers' conditions. Four different types of on-farm experimentation were distinguished (Franzel et al. 2001; Thangata and Alavalapati 2003):

Type I: Researcher designed, researcher managed
Type II: Researcher designed, farmer managed
Type III: Farmer designed, farmer managed
Extension farmers: Spontaneously adopting farmers

By the mid-2000s most of these on-farm experiments had ceased. Only the "extension farmers" have remained, often fused with type III farmers. They continue to practice agroforestry in their fields, but devoid of scientific support. Rather than reflecting a farmer-first paradigm, the "extension farmers" position appears strikingly similar to that of "innovators" and "early adopters" in the conventional Transfer-of-Technology (ToT) model (see Rogers 1983; Leeuwis and van den Ban 2004). Typically, such farmers are also the local elites, but disconnected from agroforestry research – often under the assumption that farmers are mentored and monitored by NGOs, government extension officers, and/or Community Based Organisations (CBOs).

One important reason underpinning the demise of on-farm experimentation pertains to the organization of agricultural research. On-farm agricultural research proved to be highly labour intensive for the biophysical researchers. Researchers would have to spend much more time in the field (e.g. solving practical issues), rather than analysing and publishing the findings of experiments, their main task and performance evaluation criterion.

A second factor was the prevailing scientific culture among agroforestry researchers. Trained in predominantly biophysical scientific disciplines, and working in an international research institute geared towards the understanding of agro-ecological processes relating to nitrogen-fixation, researchers of the early 1990s were generally ill-prepared for dealing directly with farmers, let alone farmer-led experimentation. Although the participating farmers in the type II and

[12]This is not to say that soil fertility was the only problem in Malawian smallholder agriculture. Market failure is often identified as a major constraint to rural development (Dorward and Kydd 2004; van Donge 2002, 2007).

III experiments tended to be initially enthusiastic – not least because it involved receiving inputs, a harvest and compensation in case of crop failure (Akinnifesi et al. 2009) – distrust between farmers and researchers gradually developed.[13] Farmers felt their opinion did not matter (interviews by the author in Thondwe EPA), while researchers suspected farmers of tampering with the study design and the instructions (personal communication with ICRAF staff, Makoka). Not surprisingly, type II and III experiments were often considered "less scientific" by the biophysical researchers, caused by the lack of control over the research design, researchers' perceptions of farmers, and the required large investments in time (c.f. Franzel 1997).

The failure of on-farm experimentation in Malawi in the 1990s – a first attempt to re-orient agroforestry research towards farmers' circumstances and needs – may not be surprising. *Farmer First*-inspired research was highly innovative at the time, and the culture and organization of agricultural research may not yet have been ready to adapt to this new paradigm and its far-reaching consequences. Yet the institutional environment of agroforestry research, and international agricultural research at large, underwent major changes in the 1990s and early 2000s. First, the investors in agroforestry research changed the rules of the game: research became increasingly project-based and investors increasingly demanded tangible development outcomes. Second, the acknowledgement that more farmer-oriented research was needed, resulted in the hiring of more social science trained staff who could complement the biophysical oriented researchers, and provide insights to steer agroforestry research. Below, several aspects of these wider developments are discussed, showing how they interacted with each other, as well as the existing institutional environment of agroforestry research. Ironically, the analysis suggests that the changing institutional environment of agroforestry research has had little impact on the organizational culture of the World Agroforestry Centre, and is also unlikely to result in a closer collaboration between researchers and farmers.

Shift in Funding, New Goals, and a "Culture of Accountancy"

Established in 1978 to promote agroforestry research in developing countries, ICRAF joined the CGIAR in 1991. Thus ICRAF's work became linked to the goals of the CGIAR: reducing poverty, increasing food security, and improving the environment. Investors in its research, which until then had been largely focused on

[13] Besides distrust between researchers and farmers, both adopters and agroforestry technologies sometimes became the victim of distrust and jealously in the communities where on-farm trails were conducted. As participating farmers reaped benefits that others did not get, intra-community relations sometimes became strained. In a number of villages in southern Malawi where I did research in 2004, people still recounted such experiences. They saw them as a cause of non-adoption of agroforestry technologies by those who had not participated in the on-farm trials.

Africa, were thus largely national governments with an international development agenda, and development-oriented international organizations and foundations such as the EU, World Bank, and Ford Foundation.[14]

As Bellon et al. observed for CIMMYT, the "sources and nature of (CGIAR) funding have changed significantly" over the past two decades … "Core unrestricted funding has declined, leaving management increasingly dependent on special project funding to implement the research agenda" (2006, p. 134). Agroforestry research by ICRAF was no exception, although core funding declined only in relative terms (Table 10.3). The shift in funding had two important consequences. First, the increased significance of restricted funding implied greater control of investors over the channeling of funds to particular activities, and thus greater control by these investors.[15] The research agendas of CGIAR institutes thus became more donor-driven.

Second, the shift in funding instigated an institutional reorientation. From a strict focus on research, development-oriented goals became additional objectives for CGIAR institutes. For instance, ICRAF re-organized institutionally, integrating its research and development tasks (ICRAF 2003). In order to reach the newly set development targets, more emphasis had to be placed upon research *and* extension. Strategies to get the technologies to the farmers needed to be developed. Scaling-up and scaling-out became the watchwords of this newly assumed role (Böhringer 2001). But as expertise in the field of extension within the centre was limited, the strategies developed initially had to build on the often understaffed and underfinanced

Table 10.3 Summarized overview of unrestricted and restricted funding to ICRAF 1995–2007 (Annual reports: ICRAF 1996, 2001; World Agroforestry Centre 2006, 2008)

Year	1995	2000	2005	2007
Unrestricted core funding (US $000)	8,147	7,854	9,540	9,454
Restricted funding (project funding)	8,475	14,508	21,014	22,092
Total	16,622	22,362	30,554	31,546
Unrestricted funding as percentage of total (%)	49%	35%	31%	30%

[14] See: "More than 30 years of agroforestry research and development" at: www.worldagroforestrycentre.com (Accessed 20 Feb 2009).

[15] Chambers notes that, in principle, core funding allows for greater flexibility to respond to "changing realities, perceptions and opportunities" (2006, pp. 364). He continues that "it is a sad paradox that precisely when CGIAR's mandate and context demand greater adaptability and opportunism, CGIAR's core funding should be shrinking." Barrett (2008) also argues for increased core funding to cover social science staff.

Table 10.4 Dissemination and development staff as percentage of total ICRAF-Southern Africa (Annual reports: World Agroforestry Centre 2002, 2004a, b, 2006, 2007, 2008)

Year	2001–2002	2003	2004	2005	2006	2007–2008
Researchers						
Biophysical sciences	24	24	24	14	14	10
Social scientists (incl. economists)	1	3	4	3	1	1
Research assistants and research officers	5	1	1	2	1	2
Dissemination and development facilitators (training officers)	3	7	8	6	4	3
Administrative staff	1	3	4	3	4	5
Total	34	38	37	28	24	21
Dissemination staff as percentage of total staff (%)	9%	18%	22%	21%	17%	14%

These staff numbers exclude local, non-academic staff. The 2007–2008 figures include two consultants.

national agricultural extension services in developing countries, as well as NGOs active in the field of agricultural development. Extension officers of such organizations became the recipients of training, in order for them to train farmers in agroforestry. And although the staff component dedicated to the increasingly important developmental task within the organization did increase for some years, extension did not become an important task within ICRAF. Numbers of dissemination and development officers have declined since 2004 (Table 10.4). With counter-pressure from the CGIAR, ICRAF remained a predominantly research-oriented institute, despite the important shift in its financial resources.[16]

An additional consequence of the shift towards more development-oriented project funding was the need to develop developmental impact criteria for agroforestry research and extension efforts. Development-oriented donors pressed for stricter development planning, including logical frameworks, "milestones" to be achieved, and clearly defined targets. In general these development targets got quantitatively defined. Subsequently, numbers of farmers having adopted agroforestry technologies, the number of seedlings handed-out, the amount of seed distributed to farmers, etc. became important variables in ICRAF reports and publications. Adoption figures in particular have been discovered as a powerful communication tool vis-à-vis investors in agroforestry research. For instance, in an annual report of ICRAF Southern

[16]In ICRAF Southern Africa, the indirect extension approach through training of trainers also suffered from the lack of follow-up. This was the result of limited resources available for extension as well as the persistent emphasis on research within the organization, as is evidenced by the prominence of scientific publication output in the organization's performance evaluation system.

Africa to one of its project funders, it was estimated that 55,000 farmers in the southern African region had adopted an agroforestry technology of some sort in 2001 (ICRAF 2001). By 2008, presenting adoption figures had apparently become so firmly institutionalized that researchers could now present highly precise cumulative figures: 417,503 farmers in the southern African region were reported to have adopted agroforestry technologies (e.g. Akinnifesi et al. 2008).

The development agenda of ICRAF's main investors thus gave rise to a "culture of accounting". To be sure, this is not to blame donors for the emergent preoccupation with numbers of agroforestry adopters. If donors had not pressed research institutes to become more oriented towards technology adoption, efforts to reach farmers may have been much more limited. The fact that agroforestry technology adoption has become synonymous with "counting adopters" – hence, a numerical issue – is a reflection of the specific organizational set-up of ICRAF, rather than the intrinsic merit of this approach (compare with Finnemore 1997). It is a result of the specific interpretation of donor's demands for accountability by ICRAF's predominantly biophysically, and generally quantitatively, oriented researchers.

Biophysical, Economic, and Social Scientists in Agroforestry Research: On Cultures of Research

The rise of the *Farmer First* thinking and increased (donor) stress on impact constituted important shifts in the international discourse on development. International institutes for agricultural research, faced with a shift towards restricted project funding, recognized the need to adapt organizationally and strategically (CGIAR 2000). The CGIAR institutes recognized the need for more social science researchers as well as extension-oriented staff, to take on tasks such as understanding farming practices, technology adoption, facilitating communication between researchers and farmers, assisting in effective on-farm research, etc. In other words, there was a strong push towards institutionalizing social sciences in international agricultural research (Cernea 2006). Adopting a development agenda in the late 1990s, ICRAF also sought to integrate its research and development agendas, and re-articulated its work into themes (ICRAF 2003). Yet, social science research capacity within the CGIAR decreased in the late 1990s and early 2000s, with non-economist social science researchers declining by some 24% (Kassam 2003; Cernea 2006; Chapter 12).[17] A survey (N = 356) conducted within the CGIAR in 2002 recorded a mere 11% socio-cultural scientists and 17% economists. Socio-cultural scientists were also found to be on shorter contracts than economists (Rathgeber 2006), suggesting that the latter's work is more firmly institutionalized in the CGIAR.

[17]ICRAF Southern Africa experienced a short-lived increase in the number of social scientists from 2003 to 2005 (see Table 10.4).

To understand why economists' research better fits the organizational competencies and culture of research of biophysical research dominated institutes such as the CGIAR, it may help to look at two congruities between agronomic and economic research: complementarity and similarity of approach.[18] Economists' research within ICRAF, for example, has focused on identifying key socio-economic variables affecting the so-called "potential for adoption" of agroforestry technologies, looking at the feasibility, profitability, and acceptability of different agroforestry technologies (Franzel 1999; Franzel et al. 2001). Thus, economists' research complements biophysical research within the agricultural research organization, rather than co-developing technologies on the basis of understandings of farmers' practices. The assessment of "adoption potential" has become a key element of the participatory, farmer-centered model of research and development within ICRAF (Franzel 1999; Franzel et al. 2001; Franzel et al. 2004). In addition, the research approach of economists within ICRAF is similar to that of biophysical scientists. Both are characterized by a focus on the technology, which is then "tested" under different circumstances, such as different tenure regimes, population densities, household characteristics, and policy contexts (e.g. Place and deWees 1999; Franzel 1999). Alternatively, situations of successful technology adoption are analysed, singling-out the variables that contributed to success, which are then translated into generalized conditions or "essential elements for scaling up agroforestry innovations" (Cooper and Denning 2000; Denning 2001). In analogy with biophysical research aiming to understand the essential factors affecting plant growth or nitrogen-fixation, the economists' research into technology adoption thus builds on an essentially mechanistic understanding of the technology adoption process (see also Rogers 1983; Leeuwis and van den Ban 2004). Although other social science approaches may have yielded equally valuable insights into technology adoption, it is not surprising that, within agricultural research institutions such as ICRAF, the organizational workings and prevailing "culture of research" gave rise to this particular form of technology adoption studies, and that it was primarily economists who designed such studies.

A brief look at attempts to identify household and farm characteristics that influence agroforestry technology adoption yields confusing results. For example, Mkandawire found that "a person who derives most of his income from farming has a higher willingness to invest in the technologies than a person whose main source of income is non-farm" (2001, p. 13). She therefore concludes that Malawian farmers with off-farm sources of income will be less willing to adopt agroforestry technologies. Rapando – also writing on Malawian smallholders – arrives at a similar conclusion, arguing that "the incomes received from these (off-farm) activities may be used to purchase food and/or fertilizer" (2001, p. 37). However, Böhringer et al. found that

[18]Other social science methods, such as the qualitative methods deployed by anthropologists and sociologists, are less suited to the organizational requirements and cultures of research of the CGIAR. As Bellon et al. (2006) argue, biophysical scientists tend to be very skeptical about the manner in which social scientists acquire their data as well as the validity of data resulting from their qualitative methodologies.

– contrary to the commonly held assumption that agroforestry is a pro-poor technology – wealthier Malawian farmers are more likely to adopt than are resource poor farmers, possibly because "they are better able to cope with risk being introduced by testing of new technologies and innovations" (2000, p. 68). Writing about Zambia, Phiri et al. (2004) also found wealthier farmers to be more likely to adopt agroforestry technologies (improved fallows in this case) than the poorer farmers, even though poor farmers did appreciate the benefits of the technology (see also Swinkels et al. 1997; Thangata and Alavalapati 2003). These findings suggest that agroforestry adoption is not easily captured in terms of key socio-economic variables determining adoption or non-adoption. As agroforestry researchers also seem to acknowledge, such studies have often "mainly emphasized biophysical and economic analysis, and not farmer assessment" (Akinnifesi et al. 2004, p. 5).

Technology adoption is, as already suggested above, a complicated *social* process, which is not easily captured in quantitative terms. Just how problematic categorizing farmers into adopter/non-adopter classes can be became clear when I conducted a study into the process of adoption of soil fertility-enhancing agroforestry technologies in southern Malawi.[19] Focusing on areas where ICRAF or its extension partners had been working for a number of years, I often encountered farmers who had planted agroforestry trees, but were unaware of what to do with them. Although my observations were localized and not intended as a representative sample, they challenged the classification of farmers as "adopters" as had been done previously. Assessing impact becomes even more difficult when one takes into account the effects of the nitrogen-fixing agroforestry technologies on crop farming. After all, it is not merely the presence of nitrogen-fixing trees which is important; it is their use. This became most apparent when I conducted interviews in an area not far from the Makoka agricultural research station in southern Malawi. Considered as an area with high adoption rates, there were indeed numerous farmers who had substantial numbers of agroforestry trees in and around their fields. The trees were not used for soil fertility improvement, but grown for their seeds, which the farmers sold to ICRAF. This again raises the question of whether these farmers should be considered adopters of the technology.[20]

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[19]Some 70 interviews with ICRAF staff, extension officers and (predominantly) farmers currently and previously practicing agroforestry were done between March and July 2004. One of the areas covered villages in Thondwe Extension Planning Area (EPA). Here, major interventions had taken place such as Type II trials, intensive village workshops, training-of-trainers, and more, yet the fieldwork revealed very low rates of adoption. Interviews in villages (randomly sampled from lists of nurseries established) in the Chiradzulu district, where different partner organisations had been active in promoting agroforestry, revealed equally disappointing adoption rates. Finally, in Chiosya and Ntubwi, two so-called Pilot Scaling-Up Areas, there was no evidence that – besides very recently established ones – "agroforestry clubs" as mentioned in project documentation, were still active.

[20]A similar phenomenon has been described by Kiptot et al. (2007), who labelled farmers adopting agroforestry technologies for other reasons than improved farm productivity as "pseudo-adopters".

Table 10.5 Definition for "use" and two levels of "adoption" of different agroforestry technologies, defined for the implementation of the Zambezi Basin Agroforestry Project, March 2004 (Schüller 2004)

Technology	Definition of use	Definition of adoption
Improved fallows	Planted for the first time at the farm	- Medium adoption: Replanted improved fallows on less than a fifth of the farm for a consecutive second time - Full adoption: Replanted improved fallows on more than a fifth of the farm for a consecutive second time
Intercropping	Practiced intercropping for the first time on at least a fifth of the farm	- Medium adoption: Continue to use intercropping for at least 3 years - Full adoption: Continue to use intercropping for at least 3 years and expanded area under intercropping at least once
Relay cropping	Practiced intercropping for the first time at the farm	- Medium adoption: Continue to use intercropping on less than a fifth of the farm for a consecutive second time - Full adoption: Continue to use intercropping on more than a fifth of the farm for a consecutive second time

However difficult it may be, agroforestry researchers felt compelled to develop criteria to assess agroforestry technology adoption. In 2004, ICRAF Southern Africa agreed upon definitions of technology "use" and "adoption" (Schüller 2004) to be used in counting households "reached" by soil fertility enhancing agroforestry technologies (Table 10.5). The establishment of these definitions of agroforestry adoption neither resulted from, nor did they lead to, a better understanding of farmers' practices and the processes of adoption. They also did not meaningfully reorient research towards a better understanding of such practices and processes. Like the extension of agroforestry technologies, the counting of "adopters" had largely become a task of ICRAF's partners – national extension agencies and NGOs working with farmers.

Concluding Remarks: Farmer-First and the Resilient Organization

In 2006, Cernea and Kassam published a collection of studies taking stock of social science research within the CGIAR, describing it as "an uphill battle". The studies revealed that, whereas the strategic re-orientation of the CGIAR in the early 2000s implied a much greater role for social science research within the institutes, social science research capacity tended to decline rather than to increase (see also Chapter 12).

Thus, the book argued: "Within CGIAR's total program, intensified social research on farmers' needs and their capacities to use and manage natural resources in a sustainable manner must be placed in its mainstream" (Cernea 2006, p. 26).

This chapter, which focused on this changing research agenda in one CGIAR institute, addressed how this mainstreaming of social science research has taken shape within ICRAF Southern Africa. It has shown how changing funding gave rise to a "culture of accountancy" and, as agricultural research remained technology-defined and scientific publication oriented, resulted in farmer-oriented research being defined as studies into technology adoption. In such studies, technology adoption is not analysed as a *social* process that must be understood from a farmer's position and perspective, but as a mechanistic process comprising of general variables such as tenure, gender, wealth, etc. that are understood as determinants of technology adoption. "Farmers' needs and capacities to use and manage natural resources", have largely disappeared from view (cf. Cernea 2006, p. 26).

The strategic reorientation of the CGIAR and ICRAF's policies of the early 2000s, intended to steer agricultural research towards farmers' needs, thus seems to have stumbled on the institutes' own resilient organizations and culture of research. This resilience in agricultural research institutes' functioning, combined with changes in funding, has resulted in a development discourse in which "technology adoption rates" and "scaling-out/up of technologies" take centre stage. Ironically, in practice this has meant not a bridging of the gap between researchers' and farmers' agendas as envisaged in the *Farmer-First* paradigm, but a widening of that gap. With social science in agricultural research institutes like ICRAF being technology-defined, the early twenty-first century has witnessed an increased disconnect between research and farmer practice (see Fig. 10.1).

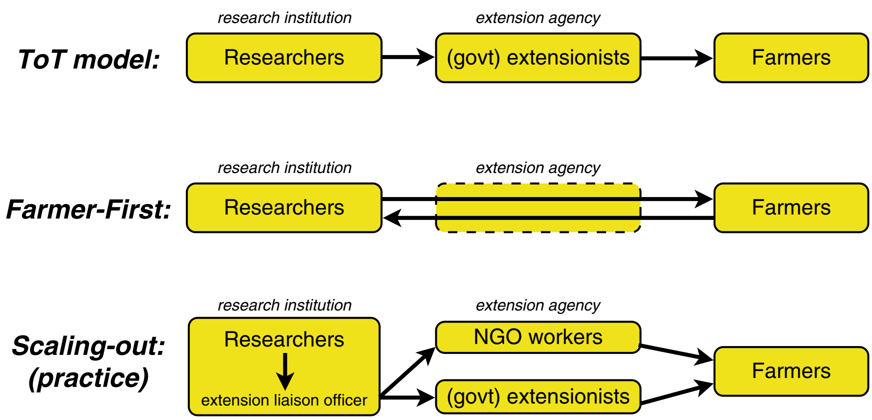

Fig. 10.1 In the conventional Transfer-of-Technology (ToT) model, arrows represent a unidirectional flow of communication and new technologies (see Leeuwis and van den Ban 2004). Central to the Farmer First model is a direct link between research and farmer agendas (see Chambers et al. 1989). "Scaling-out" has increased the number of agencies and the organizational complexity of extension, and enlarged the distance between research and farmers' practice.

While agroforestry researchers need to consider alternative uses of technologies, their effectiveness and the rationale behind their emergence, to connect or re-connect agricultural research to farmers' needs and capacities by recommending new farmer-oriented research methodologies is in part missing the point. Simply appointing (a few) more social scientists within agricultural research institutes is a recommendation that is, on its own, not likely to change the culture of research. In order to alter agricultural research practices, a more fundamental change in the organizations and culture of research within these institutes is required. Such change may be brought about by reorientations from within these institutions; yet, as this chapter has revealed, the international discourse on development and the demands of funding agencies are more likely to be critical in shaping the future of both agricultural research institutes and their research practices. Donors and research managers must proactively explore how to foster institutional cultures in research that place farmers' needs and rationales more squarely in the forefront.

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