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Effectiveness of Grassroots Organisations in the Dissemination of Agroforestry Innovations

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1. Introduction

Eradicating extreme poverty and hunger is the first Millennium Development Goal (MDG) for a reason: none of the other MDGs can be met without food security and economic development. Because 75 percent of the poor in developing countries live in rural areas, strengthening the agricultural sector can not only improve access to nutritious food, it does more – at least twice as much – to reduce rural poverty than investment in any other sector (FAO, 2011). The role of extension in this battle is clear; there is a great need for information, ideas and organisation in order to develop an agriculture that will meet complex demand patterns, reduce poverty, and preserve or enhance ecological resources.

Therefore in the sixties and seventies, developing-country governments invested heavily in agricultural extension. Nevertheless, as from the 1980s, support for extension declined drastically as governments undertook structural adjustments, leading to public spending cuts and a breakdown in public sector services for agriculture, but also because of disappointing performance (Anderson, 2007). The share of Official Development Assistance (ODA) to agriculture also dropped significantly, falling from a peak of 17 percent in 1979, the height of the Green Revolution, to a low of 3.5 percent in 2004. It also declined in absolute terms: from USD 8 billion in 1984 to USD 3.5 billion in 2005 (FAO, 2011).

After many years of under-investment in agriculture and particularly in extension, the tide has fortunately changed and more funding is becoming available for agricultural extension. The current interest in agricultural advisory services is emerging as part of a broader shift in thinking that focuses on enhancing the role of agriculture for pro-poor development (Birner *et al.*, 2006). For example, twenty-four African countries listed extension as one of the top agricultural priorities in their strategies for poverty reduction. With this renewed interest, there is also growing awareness that farmers get information from many sources and that public extension is one source, but not necessarily the most efficient. In most public systems, extension agents are only indirectly (if at all) accountable to their farmer-clients (Feder *et al.*, 2010). Therefore, over the last decade or so, there have been many reforms to extension and advisory services to make them more pluralistic, demand-driven, cost effective, efficient and

sustainable. However, there is limited or conflicting evidence as to their effect on productivity and poverty, as well as on financial sustainability.

While ineffective dissemination methods have contributed to low adoption of agricultural innovations in general, this is particularly true for agroforestry innovations, which are known to be complex and knowledge intensive, involving several components (crops, livestock and trees), requiring the learning of new skills, such as nursery establishment, and often providing benefits only after a long period (Franzel *et al.*, 2001). To face the challenges of inappropriate extension methods for agroforestry, the World Agroforestry Centre (ICRAF) in West and Central Africa has been experimenting with relay organisations and rural resource centres for the dissemination of agroforestry innovations and more particularly participatory tree domestication, for the last 5 years. Relay organisations refer to grassroots, local, or community-based organisations promoting the adoption of innovations. Rural resource centres are venues where new techniques are developed and demonstrated and where farmers can come for information, experimentation and training. Participatory tree domestication is a farmer-driven and market-led process matching the intraspecific diversity of locally important trees to the needs of farmers, product markets, and agricultural environments (Asaah *et al.*, 2011; Simons & Leakey, 2004; Tchoundjeu *et al.*, 2006).

The present paper first gives an overview of major challenges of agricultural extension and institutional innovations that were introduced to overcome some of these problems, with particular focus on community-based extension approaches. The third section presents the methodology including hypotheses, and descriptions of the research area, relay organisations, variables of performance and data collection tools. The results' section describes the approach involving relay organisations and rural resource centres using case studies. Then, the performance of relay organisations in terms of reaching farmers, increasing their knowledge on agroforestry and enhancing adoption of agroforestry innovations in Cameroon is evaluated and factors that affect performance are identified. The concluding section formulates implications for up-scaling of the approach.

2. Institutional innovations in agricultural extension

2.1 Challenges of agricultural extension

Governments employ hundreds of thousands of extension agents in developing countries. About 80 percent of the extension services are publicly funded and delivered by civil servants, justified by the view that many aspects of agricultural knowledge diffusion are 'public goods'. However, there is a general consensus that the performance of extension services has been disappointing (Anderson, 2007; Feder *et al.*, 2010).

According to Feder *et al.* (1999), there are eight generic challenges that make extension services difficult to finance and deliver. First there is the magnitude of the task, which can be understood in terms of numbers, distribution and diversity of staff, farmers and other clients and stakeholders, and in terms of mandate and methodology. Often the top-down managerial style, characteristic of large bureaucracies, tends not to be compatible with participatory, bottom-up approaches and often favours more responsive clients who are typically the better-off. Second, the dependence of agricultural extension on wider policy

and other agency functions may also limit the impact of extension on production. Especially the links with research, input supply systems, credit, and marketing organisations are problematic for many extension organisations. Third, inability to identify the cause and effect of extension is leading to other inherent problems, including political support, funding and accountability of extension agents to their clients. Fourth, as the extension service is the most widely distributed representative of government at grassroots level, there is always the temptation to load it with more and more functions, such as collecting statistics and various regulatory functions. This liability for other public service functions is reducing the time that extension workers can spend on the transfer of agricultural knowledge and information. Another generic problem for agricultural extension is the difficulty of cost recovery. Therefore there is a great dependence on direct public funding, making the system very vulnerable to budgetary cuts. Finally, having in mind that the most important element of extension is the quality of its message, insufficient relevant technology to improve productivity is a major constraint. Interaction with knowledge generators is often inadequate because research and extension tend to compete for power and resources and fail to see themselves as part of a broader agricultural technology system.

2.2 Institutional pluralism, empowerment and community-based extension

In an attempt to overcome these challenges, various institutional innovations have been introduced over the last 20 years, some more promising than others. Many of these approaches however stem from the notion that not all extension services need to be organised or executed by government agencies, calling for more decentralisation, institutional pluralism, empowerment and participatory approaches. Furthermore, there is a growing consensus that not all aspects of extension are pure public goods; which explains the move towards privatisation of some of its elements and fee-for-service public provision. However, fully privatised extension is not economically feasible in countries with a large base of small-scale subsistence farmers (Feder *et al.*, 1999). Overreliance on private extension risks neglect of less commercial farmers and lower-value crops. In such circumstances, public sector finance remains essential, mixed with various cost-recovery, co-financing and other transitional institutional arrangements.

Among a series of extension approaches evaluated by Feder *et al.* (1999), three seem to be most relevant for our analysis: institutional pluralism, empowerment and participatory approaches, and interconnecting people using appropriate media.

Institutional pluralism seeks to create a more comprehensive system of complementary extension services that would reach and respond to diverse farmers and farming systems. By involving a variety of stakeholders, such partnership arrangements have the potential to resolve two fundamental generic problems – linking cause and effect, and accountability or incentive to deliver quality service. This approach also recognises that to meet diverse needs and conditions in the farming sector, more investment is needed in the whole agricultural knowledge and information system, rather than in public sector extension services alone. This implies significant role changes for ministries of agriculture as they move away from service delivery toward creating an enabling policy environment, coordinating and facilitating the work of other players. NGOs are a prevalent partner in agricultural extension in developing countries and frequently focus on areas inadequately served by government.

Many NGOs strive to be participatory, democratic, responsive, cost-effective and focused on the needs of hard-to-reach target groups. However, some NGOs push their own agenda and are more accountable to external funding sources than to the clientele they aim to serve (Farrington, 1997).

Another effective way of making extension more accountable to clients has been increasing control by beneficiaries, e.g. through farmer organisations. In many parts of the world, farmer associations, organised on commodity lines have been highly successful in providing extension services to their members. However, their impact depends on how participatory the methods are. Participatory approaches overall have positive effects for most of the generic problems of extension. For example, farmer leaders with appropriate local backgrounds may be able to perform many extension agent roles in a cost effective manner, thereby solving problems of scale and coverage. Participatory approaches also improve cause-effect relationships through farmer-led experimentation, analysis and farmer feedback. Fiscal sustainability is improved through mobilising local resources. Cost-effectiveness and efficiency are achieved by using relevant methods that focus on expressed farmer needs and local people taking over many extension roles (Axinn, 1988). Interaction with knowledge generation is enhanced by combining indigenous knowledge with feedback into the agricultural knowledge system.

Finally, the arrival of new information and communication technologies (ICTs) has naturally led to an interest in its potential to enhance extension delivery and in connecting people with other people (Gakiru *et al*., 2009; Zijp, 1997). Innovations in this category are most directly associated with overcoming the generic problems of scale and complexity and are most effective when considered in combination with other innovations as a 'force multiplier'. Examples are community communication centers or telecottages for local information access, communication and education in rural areas. However, radical change in perspective in favour of a pluralist, cross-sectoral, systems' perspective to harness their full potential is required. In addition, ICTs cannot replace face-to-face contact between extension agents and farmers and information alone is an insufficient condition for local change.

The analysis by Feder *et al.* (1999) suggests that in designing extension programmes, the approach is less important than its ingredients. Identifying ingredients of success and finding ways to replicate or transfer these characteristics to improve the performance of another approach seem most appropriate. The authors also argue that ingredients of a sustainable approach - instead of focusing on massive, technocratic, and sophisticated efforts as was done in the past - tend to be inherently low cost and to build relationships of mutual trust and reciprocity. From these relationships, commitment, political support, accountability, fiscal sustainability, and effective interaction with knowledge generation develop.

For example, one very popular extension and education program worldwide is the farmer field school (FFS) approach, now in place in at least 78 countries. Such schools use experiential learning and a group approach to facilitate farmers in making decisions, solving problems, and learning new techniques. Despite its popularity, up-scaling in Africa is faced with growing concerns and interest among stakeholders and donors regarding the applicability, targeting, cost-effectiveness and impact of the approach

(Davis *et al*. 2010). Other extension approaches are being tested, such as the community-based worker (CBW) systems in Uganda and Kenya (CBW, 2007). Community-based services offer the potential to reach many more people within the limited financial resources available to African governments. In addition, they allow communities to influence services to meet their own, locally-specific needs, and to monitor the performance of delivery agents. Few statistical data are available, but reported benefits of projects using the CBW approach included adoption of new technologies, replanting of trees, income from sales of seedlings, fruits and honey, improved livestock management, improved soil conservation and greater understanding of land use rights. But, with the exception of the health sector, the scale of CBW systems is small and the policy environment and coordination of these remain undeveloped. The main criticism suggested that CBWs are not always sufficiently knowledgeable and equipped to pass on information to others adequately (CBW, 2007). In their review of community-based agricultural extension approaches, Feder *et al.* (2010) concluded that communities can also fail in extension delivery. Elite capture, for example, was a major constraint, as well as limited availability of competent service providers, deep-seated cultural attitudes that prevent effective empowerment of farmers and difficulties in implementing farmers' control of service providers' contracts.

2.3 Concept of relay organisations and rural resource centres: ICRAF's experience in Cameroon

Three main research areas have been explored by researchers of the World Agroforestry Centre (ICRAF) in Cameroon for the last decade, i.e. tree improvement and integration of trees in agricultural landscapes, soil fertility management with trees and shrubs, and marketing of agroforestry tree products. Consequently, agroforestry innovations ready for dissemination include: vegetative propagation techniques (marcotting, rooting of cuttings and grafting), integration of trees through the development of multistrata agroforests, soil fertility management techniques, and improved marketing strategies for commercialisation of agroforestry tree products mainly through the organisation of group sales. To accelerate the uptake of these new agroforestry techniques by farmers in Cameroon, ICRAF established collaboration with local organisations that were already involved in agricultural extension in different areas of the country. These organisations are called "Relay Organisations".

Relay organisations (ROs) are boundary-spanning actors that link research organisations like ICRAF, and farmer communities. They join with researchers in conducting participatory technology development, implying a two-way interaction of capacity building and institutional support on the one hand and feedback on the technology development on the other hand. The ROs disseminate innovations to farmers using demonstrations, training and technical assistance, after which farmers provide feedback and by so doing, help develop the innovations further. In their respective zones of intervention, ROs identify farmer groups that are interested in working on aspects of production of agroforestry trees and commercialisation of the products. Then, with the assistance of ICRAF, they conduct a diagnosis of organisational and technical constraints to production and commercialisation of target species. Collective action is often a desired intervention, in which case ROs prepare the groups for collective action by organising a series of training sessions on group

dynamics, leadership, marketing strategies, financial management, stock management, etc. The ROs also provide technical assistance in such areas as nursery, tree planting and harvest and post-harvest techniques.

At the same time, the development of Rural Resource Centres (RRCs) has been a key element of the scaling-out strategy of the World Agroforestry Centre. Some ROs involved in the dissemination of agroforestry, but not all, use the rural resource centre in their extension approach (Box 1). Rural Resource Centres are places where agroforestry techniques are practised and where farmers can come for information, experimentation and training. A typical rural resource centre consists of the following: a tree nursery, demonstration plots, a small library, a training hall and eventually accommodation facilities. Depending on which innovations are relevant to the area, the rural resource centre may also host a unit for processing of agroforestry products and/or a seed multiplication plots. RRCs are managed by community-based organisations, which can be Non-Governmental Organisations or farmer groups; in this context also called Relay Organisations.

APADER (Association pour la Promotion des Actions de Développement Endogènes Rurales), created in 1993 and located in Bangangte (West Cameroon), is running a RRC, where agroforestry innovations are developed together with farmers and adapted to local conditions. The RRC is equipped with 2 motorbikes, a training hall, offices, computers, a printer, a generator and internet access. The centre also has a tree nursery, seed multiplication units, demonstration plots and a processing unit (dryer and grinder). Through its RRC, APADER has trained about 280 farmers and is technically supporting 28 farmer groups. APADER has also initiated a network of 23 nurseries, called UGICANE (Union des GICs des Agroforestiers du Ndé). Ten of these nurseries have developed into profitable enterprises and each generates about 500,000 FCFA (1,000 USD) a year. APADER is also providing organisational support to COFTRAKOL, a cooperative composed of 25 women, specialised in processing of karité (*Vitellaria paradoxa*) and other oleaginous products such as safou (*Dacryodes edulis*). Through its achievements, APADER has succeeded in developing strong partnerships with a number of research and development partners, such as the Ministry of Agriculture, the Institut de Recherche Agricole pour le Développement (IRAD), the Zenü Network, the University of Dschang, Peace Corps and the Programme National de Développement Participatif.

Box 1. Example of a Relay Organisation using the Rural Resource Centre approach

3. Methodology

3.1 Research framework

The methodology used to assess the performance of relay organisations in the dissemination of agroforestry innovations in Cameroon was inspired by the framework for designing and analysing agricultural advisory services, developed by Birner *et al.* (2006). This analytical framework (fig 1) "disentangles" the major characteristics of agricultural advisory services

on which policy decisions have to be made. As shown in figure 1, the performance of agricultural advisory services is explained as a function of: (1) characteristics of the advisory services and the linkages with research and education; (2) frame conditions and the "fit" of the service with those frame conditions; and (3) the ability of clients to exercise voice and hold the service providers accountable. The framework also develops an impact chain approach to analyse the performance and the impact of agricultural advisory services. In this sense, the farm households play a central role in the analytical framework as their interaction with the advisory services is critical to both performance and impact. However, Birner *et al.* (2006) recognise that the framework covers a wide range of issues and that in practice it may often not be feasible to cover all of them in a single study. Hence, in order to increase our understanding of why some ROs perform better than others and to guide reforms in agroforestry dissemination in Cameroon and beyond, the present study only focuses on some of the elements as explained below.

According to Birner *et al*. (2006), frame conditions are those variables that cannot or only indirectly be influenced from a policy perspective, yet still have an impact on the performance of agricultural advisory services. Box F in figure 1 refers to frame conditions related to *farming systems and market access*, while box C entails *community characteristics* (e.g. land size, education levels and social capital) that must be taken into account in designing agricultural advisory services. As far as characteristics of extension services providers are concerned, the present study will look at *capacity and management* (box M) which refers to the number, training levels, skills, attitudes, motivation and aspirations of staff members, as well as to the organisation's incentives, mission, orientation, professionalism, ethics and organisational culture. Management procedures applied in the organisation, such as monitoring and evaluation systems, ways of managing performance and stimulating feedback from farmers, may also determine effectiveness and will therefore be examined. Box A on the other hand, refers to *advisory methods* used by field staff in their interaction with farmers. These methods can be classified according to various aspects: number of clientele involved (individuals or groups), type of decisions on which advice is provided (types of crops or livestock, managerial decisions, group activities, etc.), and media used.

Performance of agricultural advisory services (box P), according to Birner *et al.* (2006), refers to the quality of the "outputs" and can be captured by the following indicators: (1) accuracy and relevance; (2) timeliness and outreach of advice, including the ability to reach women and disadvantaged groups; (3) quality of partnerships established and feed-back effects created; and (4) efficiency of service delivery and other economic performance indicators. The authors also highlight that performance indicators are more useful if they include information provided by clients, an aspect that has been taken into account in our study. Finally, the box H represents the immediate outcomes of the work of the agricultural advisory services, which are *changes in farmers' behaviour*. These changes can be measured by increased capacity of clients, adoption of innovations and change of practices whether in the domain of production, management or marketing. An important element in the framework, as shown by the arrows in figure 1, is the ability for farmer households to exercise voice and formulate demand. This ability is influenced both by characteristics of the farm households and of the advisory service. For example, a favourable advisory staff to farmer ratio and

participatory advisory methods improve the possibilities of farm households to exercise voice and hold the service providers accountable.

3.2 Variables of performance

Based on the framework described above (Birner *et al.*, 2006), the performance of relay organisations in the present study has been evaluated in terms of their effectiveness and relevance. *Effectiveness* measures the degree to which an organisation achieves its objectives (Etzioni, 1964; Heffron, 1989), while *relevance* assesses the capacity of an organisation to respond to the needs of its stakeholders and to gain their support in the present and in the future (Centre de Recherches pour le Développement International [CRDI], 2004). The following indicators were used to evaluate the performance of relay organisations: number of groups and number of farmers technically supported, diffusion and adoption rate of innovations disseminated, average nursery production of groups supported, knowledge and mastery of farmers trained, and satisfaction of farmers.

The *rate of diffusion* of agroforestry innovations was calculated by dividing the number of technologies that were received at the level of the farmers by the number recorded at the level of ROs. For example, when 8 sub-themes that are inventoried at the level of a RO are also used by the farmers supported by this RO, than the diffusion rate would be 100 %. On the other hand, the *rate of adoption* is calculated by dividing the number of farmers that use the innovation by the total number of farmers interviewed.

For the nursery production, the idea was to use data for 3 consecutive years, but due to the paucity of nursery records kept by the groups, we were unable to obtain reliable data. *Satisfaction* was assessed by simply asking farmers whether there were not satisfied at all, quite satisfied, satisfied or very satisfied with the way ROs interacted with them.

3.3 Hypotheses

Concerning factors affecting performance, the degree to which relay organisations are able to achieve their objectives and satisfy their clients was hypothesised to depend on both *internal* and *external* factors. At internal level, it was assumed that their capacity to disseminate agroforestry innovations depends on human, financial and material resources at their disposal, as well as the technical capacities of their staff, their experience with agroforestry and type and duration of their collaboration with agroforestry research. On the other hand, external factors that are likely to affect the outcome of the relay organisations' work included the need for agroforestry in the area or existence of problems that can be addressed by agroforestry, road infrastructure, market access, and farmers' experience in collective action.

It was therefore hypothesised that relay organisations in category I (favourable internal and external factors) would have the best performance, while those in category IV (unfavourable internal and external factors) would perform the least. Comparison between category II and III, both presumed to have an average performance, would inform about which set of factors (internal or external) affects the performance of relay organisations more. Because, if organisations in category II perform better than those in category III, we could conclude that internal factors influence the performance of relay organisations more than external factors and vice-versa.

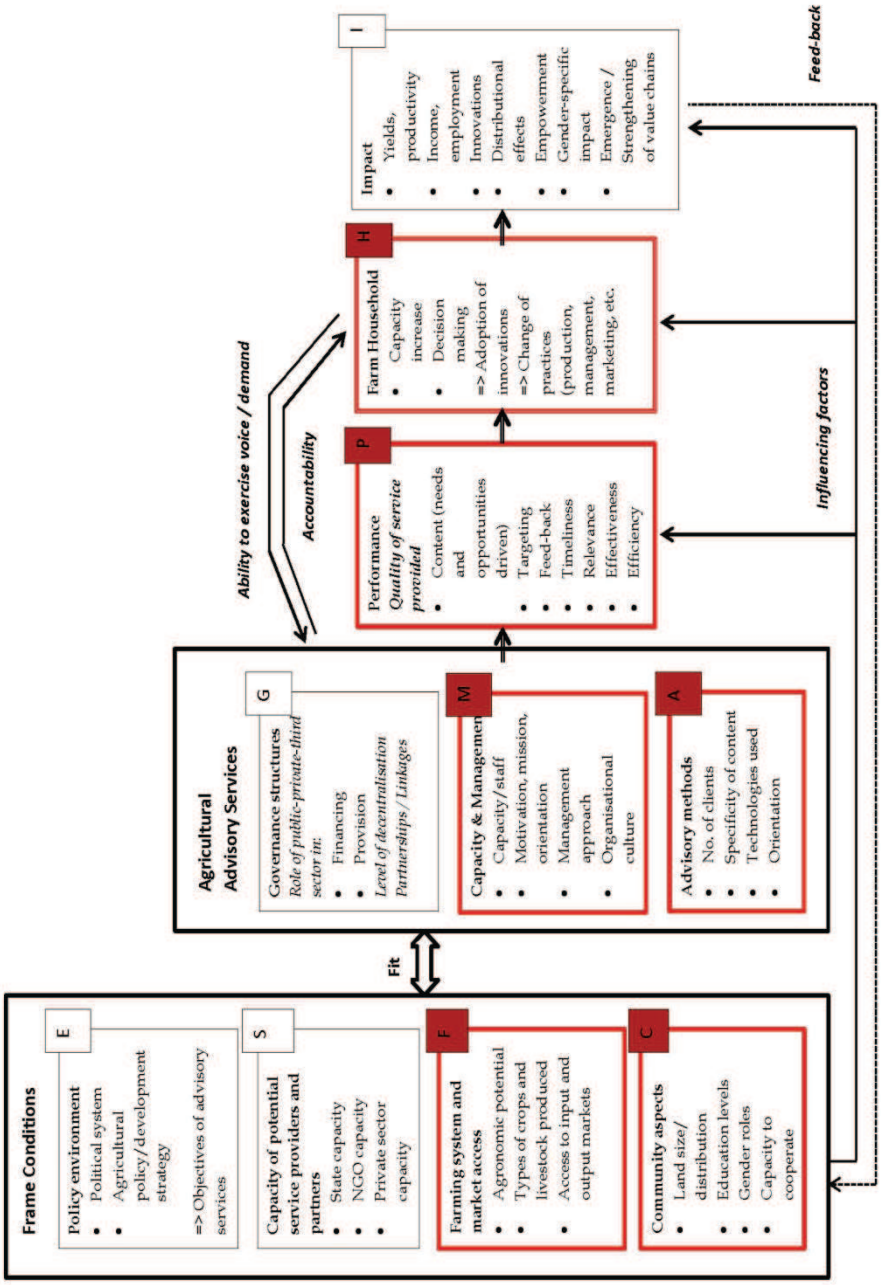


Fig. 1. Framework for designing and analysing agricultural advisory systems
Source: Birner *et al.*, 2006 (p 26)

3.4 Study area and sampling procedure

The study which involved relay organisations working in collaboration with ICRAF on agroforestry dissemination was carried out in 3 agro-ecological zones of Cameroon, i.e. the western Hauts Plateaux, the forest zone with monomodal rainfall and the forest zone with bimodal rainfall. Characteristics of the study sites are summarised in table 1.

In order to test the hypotheses laid out in 3.3 above, the 18 relay organisations were grouped in 4 categories based on whether internal and external factors were favourable or unfavourable (table 2).

Characteristics	Western Hauts Plateaux	Forest monomodal rainfall	Forest bimodal rainfall
Location	From Nde division to North-West region and part of South-West	From Littoral to South-West, and coastal area of South region	Centre, South and East regions
Coordinates	5 °00 - 7°00 N ; 9°50 – 11°15 E	4°00 – 6°30 N; 8°30 – 10°00 E	2°00 – 4°00 N; 10°31 – 16°12 E
Relief and vegetation	Mountainous areas characterised by savannah vegetation; plateaux and valleys crossed by gallery forests	Mountains with steep slopes and valleys. In the west, dominated by a volcanic chain (Mt Cameroon, Manengouba, Nlonako and Koupe)	Mid-altitude plateau (300-600 m asl.)
Soils	Young soils on slopes (Incepticols), highly weathered soils (Oxisols), soils with horizon B (Alfisols and Ultisols) and plateaux with rich volcanic soils. Organic material more than 1.5%. Moderate to high N level, high Mg level and very low K	Rich and deep Andosols in the north, supporting big industrial plantations. In the south, lowlands with sandy Ferralitic soils	Mainly Ferralitic, acid, clay soils of red or yellow colour according to the season. Low nutrient retention capacity. Rapid degradation of nutrients after cultivation, explaining the practice of shifting cultivation
Climate	Type Cameroonian of altitude with 2 seasons: dry season (mid-November to mid-March) and rainy season (mid-March – mid-November). Rainfall between 1500 and 2600 mm. Relatively low temperatures (20°C on average)	Type equatorial oceanic; hot and humid with 2 seasons: rainy season (mid-March to mid-November) and a dry season with high humidity. Rainfall of 4000 mm per year, with records of 11,000 mm on the Mt Cameroon. Stable temperatures (25°C on average)	Sub-equatorial Congo-guinea type, with 4 seasons: short rainy season (March-June), short dry spell (July-August), long rainy season (Sept-Nov), long dry season (Dec-Feb). Rainfall between 1500 and 2000 mm over 10 months. Rather constant temperatures (23° – 27°C)

Characteristics	Western Hauts Plateaux	Forest monomodal rainfall	Forest bimodal rainfall
Agro-ecological potential	Fertile soils suitable to agricultural activities, especially food crops, horticulture and arabica coffee, often in association in two cycles per year. Small livestock husbandry.	Northern part has big industrial plantations of banana, rubber, tea and oil palm. Also food crops (tubers, maize, cowpea) and horticulture. Small livestock husbandry and aquaculture	Soils suitable for cultivation of banana, plantain, cocoyam, cassava, sweet potato, yam, maize, groundnut, pineapple, cocoa, oil palm, rubber, vegetables and robusta coffee. Small livestock husbandry and aquaculture.
Socio-economic characteristics	80 % of population is involved in agriculture. 3 main areas can be distinguished with specificities in terms of agriculture: Bamoun land (moderate population density, vast spaces for livestock), Bamilike land (high population density, multistrata agricultural systems), grassfields in NW. Land is mostly inherited and agriculture is rather small-scale (1.3 ha per household)	Considered as the hub of Cameroon in terms of agro-industrial activity. Average population density: 176 inhabitants per km^2. About 40 % are immigrants from other parts of the country and abroad	Low population density, apart from areas around Yaounde and in the Lékié division. Land is mostly inherited and agriculture is small-scale, characterised by high rural exodus. Shifting cultivation is still the main agricultural practice.
ROs operating in these zones	APADER, RIBA, PIPAD	FOEPSUD	FONJAK, ADEAC, GICAL, SAGED

Table 1. Characteristics of the study sites in Cameroon
Source: Kemajou (2008); Moudingo (2007); Njessa (2007)

A stratified sampling strategy was used. First, 8 relay organisations were chosen to represent the 4 categories described above, i.e. 2 per category, represented with an asterisk (*) in table 2. The choice was guided by the duration of collaboration with ICRAF, the diversity of their activities and their geographical location (figure 2). Duration of collaboration with ICRAF has been used as a proxy for their experience in agroforestry because capacity building in agroforestry, more particularly in tree domestication in Cameroon has been mainly done by ICRAF. We deliberately choose ROs with longest experience in each of the categories in order to have a view over several years. The geographical location was closely linked to the nature of the external factors which determined the category of ROs. Second, 27 groups, one third of the total number of 86 farmer groups supported by the ROs were randomly selected and their

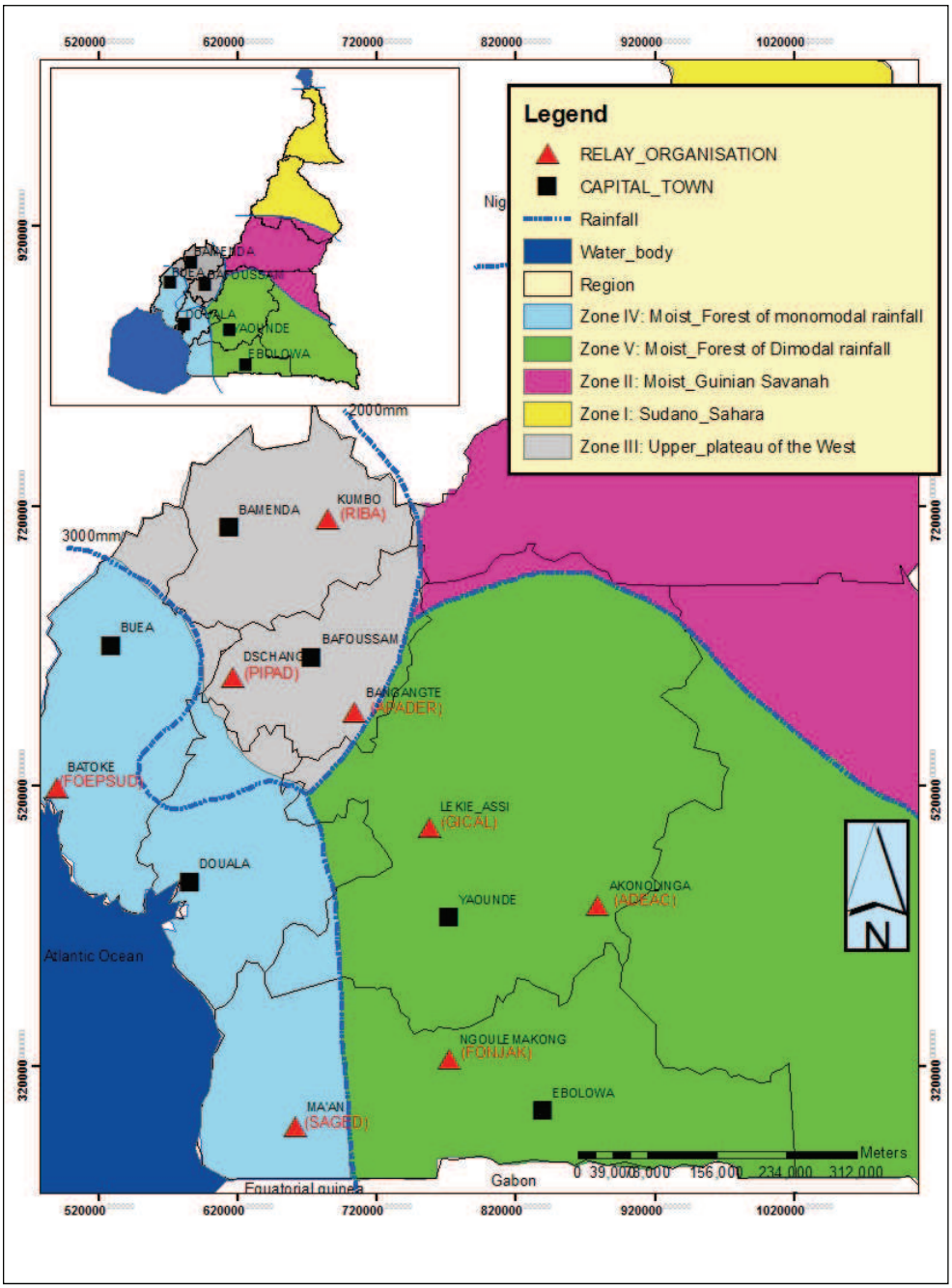


Fig. 2. Location of studied relay organisations in Cameroon
(map drawn by Ngaunkam, 2011)

leaders were interviewed to assess the performance of the ROs. Third, 30 % of individual farmers, members of the farmer groups selected in step 2, were randomly chosen for interview. It must be noted that the choice of farmer groups and group members per relay organisation was not based on duration of collaboration with the RO or on their individual experience with agroforestry. On the other hand, farmers who stopped collaboration with ROs were also interviewed wherever they were available. They were identified by the leaders of the groups interviewed.

3.5 Data collection methods

Information was collected in July-August 2010 at 5 different levels. Four ICRAF staff members were interviewed as resource persons to inventory agroforestry innovations developed with ROs and to identify criteria for selection and evaluation of ROs. The second category of respondents was composed of leaders of the 8 ROs selected for this study. Information collected at this level included general information about the ROs, their human, financial and material resources and their involvement in the participatory development of agroforestry innovations. Semi-structured interviews were then held with the leaders of 27 farmer groups in order to identify innovations received at group level, dissemination approaches used by the ROs and group achievements in terms of agroforestry.

		External factors	
		Favourable	Unfavourable
Internal factors	Favourable	PROAGRO (2000) **RIBA (2002)*** **APADER (2004)*** MIFACIG (1998)	**FONJAK (2000)*** **ADEAC (2003)*** CAMECO (2005)
	Unfavourable	RAGAF (2008) **PIPAD (2008)*** AJPCEDES (2008) **FOEPSUD (2005)*** CIMAR (2009) FEPROFCAO (2009)	**GICAL (2000)*** APED (2008) **SAGED (2008)*** CAFT (2004) CANADEL (2010)

Table 2. Categorisation of relay organisations according to internal and external factors likely to affect performance
[In brackets: year of start of collaboration with ICRAF;
* Relay Organisation selected for the study]

At the level of individual farmers, 76 group members (35 women) and 7 farmers (all male) who stopped collaboration with the ROs were interviewed to record which of the agroforestry innovations they had adopted and whether they were satisfied with the support given by the ROs. The opinion of those who stopped collaboration was sought with a view of identifying strengths and weaknesses of the ROs and reasons for stopping collaboration. We also wanted to find out whether they were still using some of the agroforestry techniques they had learnt from the ROs.

Data were entered and analysed in Excel and SPSS using Multivariate Analysis of Variation and Multiple Component Analysis.

4. Results and discussion

4.1 Presentation of relay organisations and their functioning

It must first be noted that all ROs studied already existed before they started working with ICRAF. Four of the eight ROs (APADER, RIBA, ADEAC, FONJAK) had been collaborating with ICRAF for more than 6 years, suggesting a great experience in the domain of agroforestry. GICAL, as a farmer group, had been collaborating with ICRAF on tree nursery management for about 10 years but was only promoted to relay organisation in 2009, which explains its uncontested expertise in tree propagation but much less so in other domains. PIPAD and SAGED joined ICRAF's network of partners only 2 years ago, and were therefore put in category III and IV respectively. It is worthwhile noting that the ROs in the West and Northwest regions of Cameroon, known as highly hierarchical societies with strong traditions of associations, all had endogenous origin. This is in contrast with ADEAC, FONJAK and SAGED from the Centre and South regions which had been created under impulse from the outside.

Nevertheless, all ROs had more or less the same objectives, i.e. diffusing agroforestry technologies developed in collaboration with ICRAF (100 %) and improving local people's livelihoods in general (62 %). The following activities were mentioned by all relay organisations: tree domestication, tree planting, establishment of demonstration plots and organisation of study and exchange visits for farmers. Seventy-five percent of the ROs were involved in soil fertility management and half of them accompanied their groups in collective action for marketing of agroforestry products. For the achievement of their objectives, relay organisations developed partnerships with international, national and local organisations, governmental bodies and projects. However, less than half of the ROs studied collaborated with governmental institutions or programmes such as the Ministry of Agriculture and Rural Development (MINADER), Ministry of Forests and Fauna (MINFOF), Institute of Agricultural Research for Development (IRAD), National Programme for Participatory Development (PNDP) or CAPLANDE. It has also been noted that the longer ROs had been active in agroforestry, the greater their expertise and the greater the demand for their expertise. In this sense, 7 out of 8 ROs noted that MINADER had solicited their expertise at least once.

All relay organisations in this study got part of their financial resources from ICRAF support, revenues from the nursery and through service provision (e.g. training). Contributions from members constituted a source of income for one third of the ROs, while the sales of livestock and agricultural products were used to finance day-to-day operations of one RO each. This suggests a genuine effort from ROs to become financially autonomous.

In terms of qualified staff, we noticed big differences between the ROs (Table 3). Logically, category I and II (favourable internal factors) disposed of the most experienced staff, while category III and IV were less well endowed with qualified staff. However, the person in charge of agroforestry within the ROs had in three-quarters of the cases appropriate qualifications, such as agroforestry technician or agricultural engineer. Unfortunately, only 2 staff members had received specific training in gender issues. Likewise, category I and II were better equipped with office furniture and transport facilities than category III and IV (Table 4). GICAL and SAGED (category IV) did not dispose of any means of transportation

of their own, which seriously constrains the diffusion of innovations, especially because road infrastructure in their zone of intervention is not good.

Category	RO	Total number of staff	Number trained in farmer organisation	Highest qualification of agroforestry staff	Staff trained in gender issues
Cat I	APADER	7	4	MSc agribusiness	No
	RIBA	3	3	Agric technician	No
Cat II	ADEAC	6	6	Agric technician	No
	FONJAK	8	6	Agric engineer	Yes
Cat III	FOEPSUD	5	5	Agric technician	No
	PIPAD	18	2	Agric technician	No
Cat IV	GICAL	1	1	Secondary School	No
	SAGED	6	3	Secondary School	Yes

Table 3. Human resources of ROs

Category	RO	offices	library	meeting room	computer	printer	internet key	motorbike	vehicle
Cat I	APADER	2	1	1	4	2	2	2	0
	RIBA	14	1	1	2	1	1	1	1
Cat II	ADEAC	5	0	1	2	1	1	1	0
	FONJAK	6	0	1	6	1	0	1	3
Cat III	FOEPSUD	1	0	0	0	0	0	0	0
	PIPAD	9	1	2	3	1	1	1	3
Cat IV	GICAL	0	0	0	0	0	0	0	0
	SAGED	1	0	1	1	1	0	0	0

Table 4. Material resources of ROs

4.2 Role of ROs in development and dissemination of agroforestry innovations

Interactions between ROs and ICRAF formally took place during planning and evaluation meetings twice a year. In addition, ICRAF staff carried out regular field visits to assess progress of activities, hand out nursery material and provide technical assistance whenever required. Another means of communication between ROs and ICRAF were the technical reports. In general, 75 % of staff of ROs seemed to be satisfied or very satisfied with the interactions they had with ICRAF. Even though all ROs recognised that their feedback on the agroforestry technologies disseminated was valued by ICRAF and taken into account in the further development of the innovations, only 25 % identified their active involvement in participatory research as a distinctive role, in addition to dissemination of innovations. Participation of the ROs in the development of the innovations seemed to be facilitated by the presence of rural resource centres, where focus is put on interactive learning and farmer experimentation. Ways to enhance the contribution of ROs in technology development suggested by ROs were increasing the number of formal meetings (75 %), providing a

framework for technology evaluation (25 %), and organising workshops where specific technologies are reviewed (13 %).

Three main categories of agroforestry innovations have been recorded at the level of ICRAF staff, relay organisations and farmers: (i) tree propagation and integration in farmers' fields, (ii) soil fertility improvement with trees and (iii) marketing strategies for agroforestry tree products. The rate of diffusion and adoption of these innovations have been evaluated by dividing these categories into 14 sub-themes or knowledge domains, as will be demonstrated in the next session on performance of ROs.

All 8 ROs studied used a combination of approaches to disseminate agroforestry, namely theoretical and practical training of farmers, open-door events to sensitise and demonstrate new technologies to a wide public and establishment of demonstration plots showing the benefits of agroforestry innovations. In addition, two of the ROs (APADER and RIBA, belonging to category I) operated a Rural Resource Centre, which is equipped with a nursery, experimental and demonstration plots, a training hall and accommodation amenities. Rural Resource Centres are assumed to facilitate the diffusion of technologies to farmers because they encourage continuous interaction between farmers, relay organisations and research, making the technologies more relevant and acceptable; and increase farmers' access to information, skills and planting material.

4.3 Performance of relay organisations

Performance of relay organisations was assessed in terms of number of groups supported and farmers trained, technical knowledge on and mastery of agroforestry techniques by farmers trained, diffusion and adoption rates of innovations disseminated, and farmers' satisfaction.

Number of groups supported and farmers reached

Figure 3 shows the number of farmer groups and group members who received technical assistance from the relay organisations studied. We noticed that ROs of category I provided assistance to the highest number of groups, though ROs of category II and III reached more farmers overall. This can be explained by the bigger size of farmer groups supported by the latter. In terms of gender, all ROs taken together, 46 % of the farmers reached were women. This proportion is high, relative to many development interventions, and is a combined result of deliberate efforts to bring women to training sessions and the targeting of women's groups for particular agroforestry technologies, such as soil fertility improvement and commercialisation of agroforestry tree products that traditionally belong to the women's domain (e.g. *Irvingia gabonensis* and *Ricinodendron heudelotii* nuts for spices and *Gnetum africanum* leaves for consumption as a vegetable). The proportion of female farmers trained was particularly high for RIBA (67 %), which mainly disseminates soil fertility improving techniques, and ADEAC (67 %) which is predominantly promoting post-harvest and group marketing of *Ricinodendron heudelotii* nuts. On the contrary, the proportion of women in groups supported by GICAL was the lowest (18 %) which can be explained by the strong focus on vegetative propagation. Overall, 36 % of the farmers trained by the ROs studied were younger than 35 years old. There was no clear relationship between the number of youths reached and the category to which a RO belongs. FONJAK however was standing out with 61 % of its farmers being less than 35 years old, followed by RIBA (46 %).

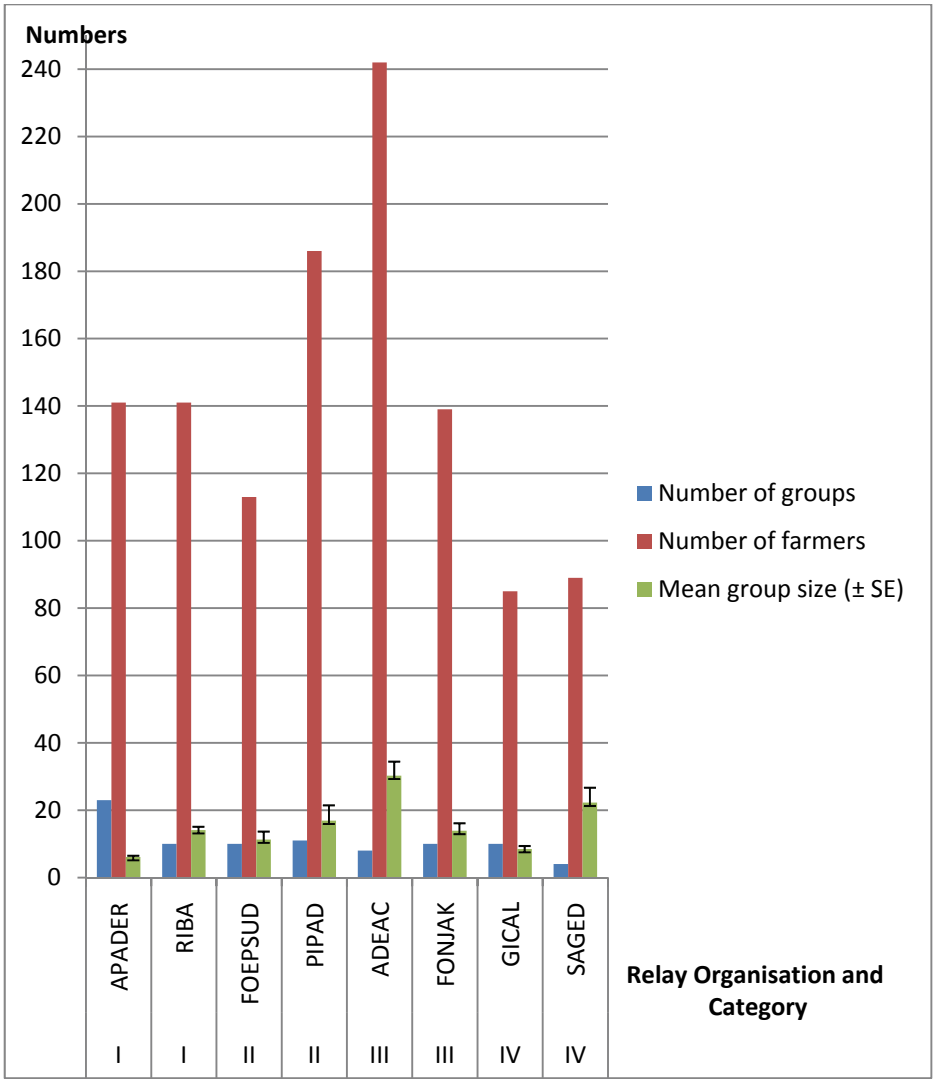


Fig. 3. Number of groups and farmers supported by ROs and mean group size

Knowledge and mastery of agroforestry techniques

Farmers' knowledge on agroforestry technologies was assessed by asking group members whether they had no knowledge, basic knowledge, good mastery or whether they could actually teach other farmers on the different topics taught by ROs. The farmers interviewed could have participated in training sessions or have learned the techniques through their group leaders. In total, 14 knowledge domains were identified in the field (Fig 4). However, the maximum number of topics taught by any one RO was 11 and the minimum 7. Overall, 44 % of the respondents had basic knowledge on all technologies, 14 % said to have mastery

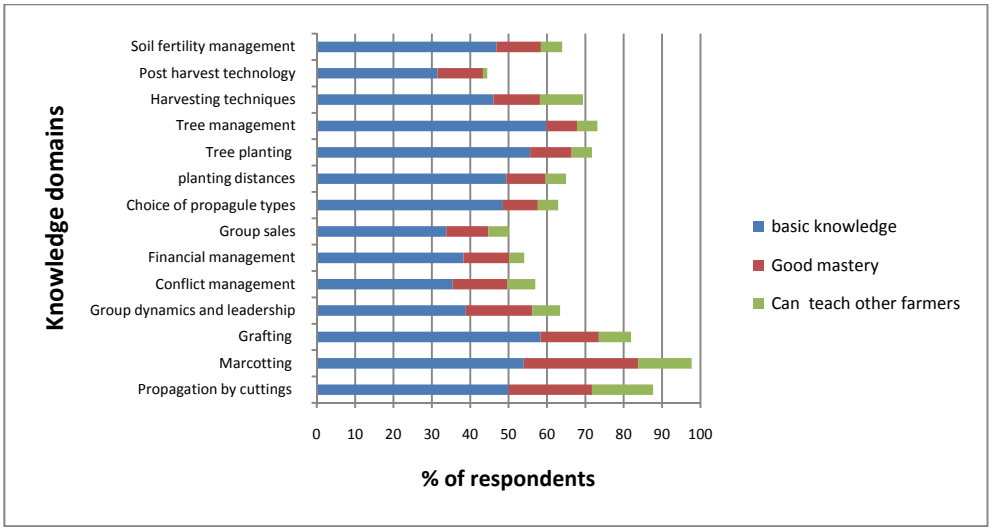
of the technology and 6 % could also teach other farmers on the topic, irrespective of knowledge domain or relay organisation considered. Knowledge domains that were best acquired by farmers included rooting of cuttings and tree spacing, while topics less mastered were post-harvest technologies, group sales and conflict management, all related to developing marketing strategies for agroforestry products. This is related to the fact that ROs had been introduced to tree propagation earlier than to marketing-related aspects and were therefore able to gain more expertise on tree propagation issues. Looking at differences per category of ROs, we noticed that the proportion of farmers who had no knowledge on agroforestry innovations was much higher for ROs from category IV (49 %) than from category I (21 %), while the opposite was true for farmers who could teach others (Fig 4).

Diffusion and adoption of innovations

In terms of adoption, farmers interviewed mainly applied the following agroforestry techniques: marcotting, rooting of cuttings, grafting, soil fertility management and use of njansang cracking machine (post-harvest technique). Average rates of adoption varied from 52 % for farmers trained by ROs of category III to 61 % for those backstopped by ROs from category I. However, adoption was very variable according to the techniques, as is demonstrated in figure 5. Nevertheless, highest rate of adoption was recorded for the marcotting technique and the lowest for soil fertility improvement. This can be explained by the fact that marcotting is a dividable technique (can be done on a single tree), applicable to many different species independently of ecological zones and does not need much equipment. On the other hand, soil fertility management is a technology that requires land tenure security and a higher upfront investment in planting a large number of trees or shrubs, and therefore is more difficult to adopt. It was interesting to note that, of the respondents who stopped collaboration and left the farmer groups, 65% continued to practice marcotting, 43% continued rooting of cuttings and 43% continued grafting. On the other hand, only 14 % were still using trees and shrubs for soil fertility management after they left the farmer groups. Reasons for leaving the group were both personal (illness, absence, etc.) as well as related to the way in which the group was managed (problems with use of nursery material and sharing of benefits). Nobody actually mentioned that they left the group because the agroforestry practices offered by the ROs were not useful.

Farmers' perception of performance

Finally, farmers' overall level of satisfaction of ROs was assessed by asking respondents whether they were very satisfied, satisfied, a bit satisfied or not satisfied at all with the way their ROs interacted with them. All ROs taken together, respectively 11 % of the farmers interviewed were very satisfied and 67% satisfied with the performance of the ROs. In fact, 78 % of the respondents mentioned good technical support as one of the strong points of the work by ROs, followed by regular follow-up of group activities (reported by 39 %) and contact with a range of other partners through the ROs (26 %). Most respondents also felt that the language used by ROs was adapted to the target population. Moreover, staff of ROs were said to be patient and tolerant, and the techniques disseminated were relevant to farmers' needs. Only 10 % expressed that they were not satisfied at all with the performance of the ROs. The major points of dissatisfaction among respondents who were not satisfied were failure to find buyers for their products (86 %), delays in implementation of activities (70 %), absence of financial assistance (69 %) and non-respect of appointments (56 %).



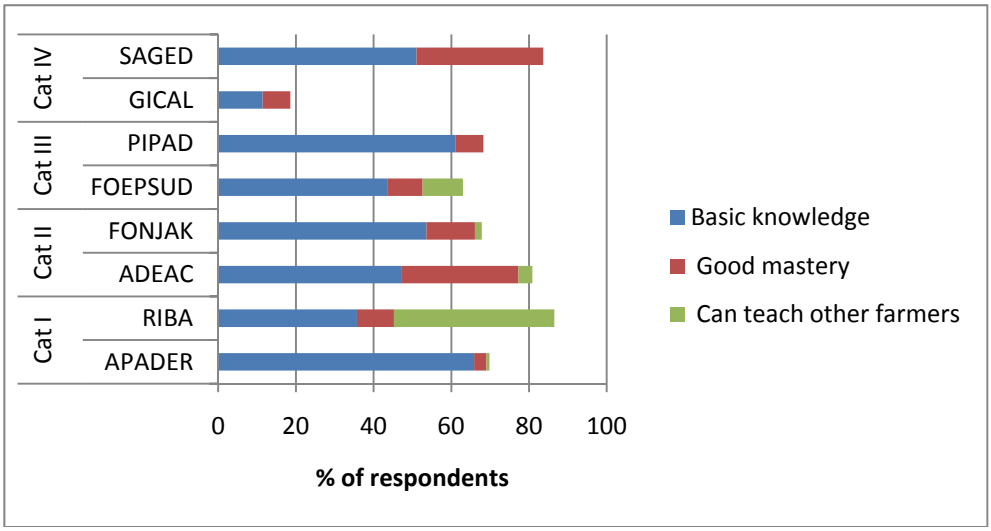


Fig. 4. Knowledge and mastery of agroforestry techniques, by technique (a) and by relay organisation (b)

4.4 Analysis of effect of internal and external factors on performance of relay organisations

As demonstrated above, the relay organisations studied were successfully diffusing agroforestry innovations to farmer groups overall. Nevertheless, differences have been observed between categories of relay organisations for a number of performance indicators, as shown in table 5. Though differences were not statistically significant, results suggest that relay organisations which operate under favourable internal and external factors (Cat I)

perform best for most of the performance indicators. Also, the study puts forward that external factors such as existing opportunities for agroforestry, strong farmer associations and good road and communication networks (Cat III), might affect the effectiveness of relay organisations more than their internal capacity, reflected by their human, material and financial resources (Cat II). However, this needs further investigation.

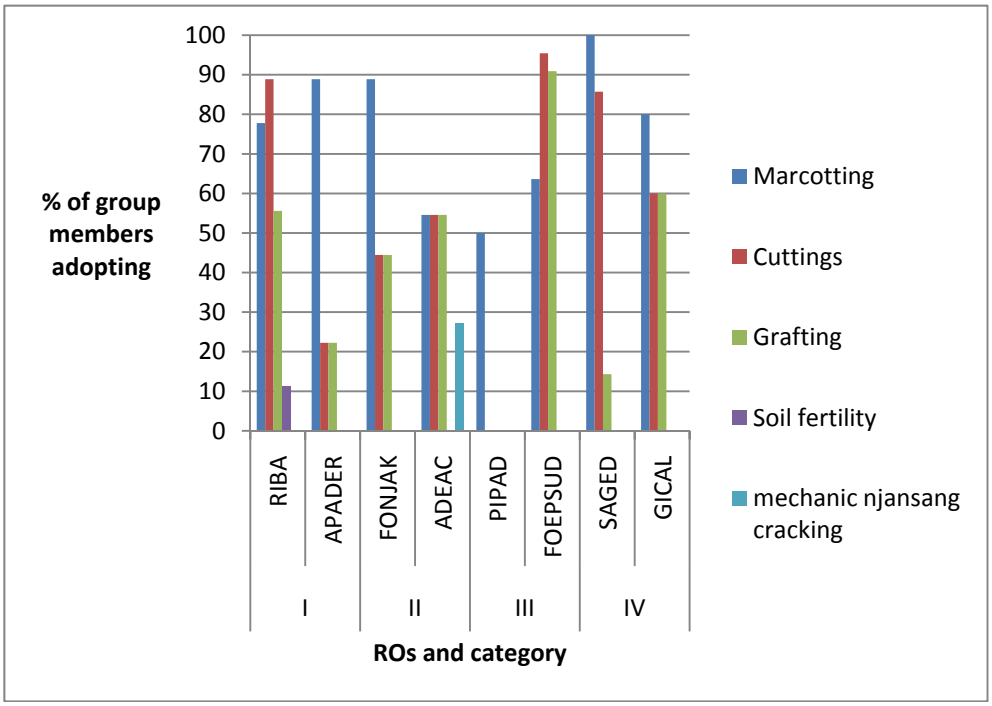


Fig. 5. Adoption rate of agroforestry innovations per RO and category

Since analyses above did not find any significant differences between the performances of different categories of relay organisations, a Multiple Component Analysis was done. Figure 6 shows the distribution of the 8 relay organisations studied, following performance indicators. From this, three groups can be distinguished. First, APADER stands on its own in terms of highest average nursery production and most groups supported. This can be explained by appropriate qualification and experience of its staff and the presence of a resource centre. Second, GICAL, also standing on its own, obtained a high proportion of satisfied farmers and the highest adoption rate but for a limited number of techniques. On the other hand, GICAL also had the highest percentage of farmers with no knowledge at all on several domains, which can be justified by the fact that GICAL only has 1 resource person to do extension. At last, there seems to exist a strong correlation between the following relay organisations: PIPAD, FONJAK, FOEPSUD, ADEAC, RIBA and SAGED, meaning that results obtained by these organisations, in terms of diffusion rate, number of farmers trained, % of farmers with basic knowledge, mastery and who can teach others, varied little.

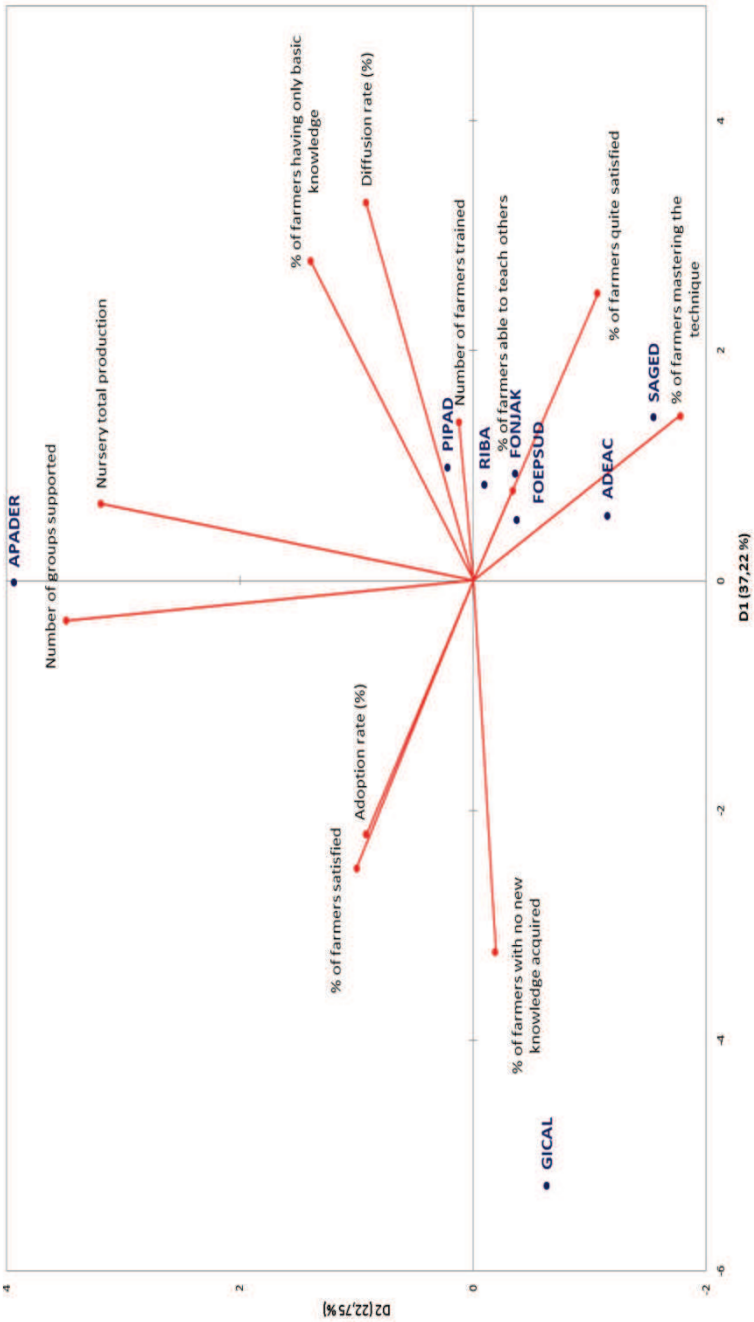


Fig. 6. Categorisation of relay organisations according to performance indicators

Indicators	Cat I	Cat II	Cat III	Cat IV	Std Error	Sign.
1. Number of groups supported	17.00	10.50	9.00	7.00	3.40	**0.319**
2. Number of farmers trained	141.00	149.50	190.50	87.00	31.58	**0.284**
3. Diffusion rate	91.00	83.50	81.00	66.00	11.64	**0.551**
4. % of farmers without knowledge on techniques	21.00	36.00	32.50	49.00	18.77	**0.775**
5. % of farmers having basic knowledge	51.00	45.50	50.00	34.50	15.63	**0.869**
6. % of farmers mastering techniques	6.50	17.00	9.00	16.00	7.00	**0.676**
7. % of farmers able to teach other farmers	21.50	1.50	8.50	0.00	10.50	**0.525**
8. Adoption rate	61.00	53.00	54.50	56.00	7.52	**0.883**
9. % of farmers very satisfied	16.50	41.00	45.50	14.50	10.15	**0.195**
10. % of farmers satisfied	61.00	52.00	53.50	85.50	16.65	0.528

Table 5. Comparison between categories using performance indicators

5. Conclusion

In the light of renewed interest in agricultural extension worldwide, this paper reviewed some of the major challenges and institutional innovations that were introduced to overcome these problems. One of such innovations, under testing for the last 5 years in Cameroon, is involving community-based organisations, called relay organisations, in the dissemination of agroforestry innovations. Their performances in terms of reaching farmers, increasing farmers' knowledge on agroforestry and enhancing adoption of agroforestry innovations were evaluated and factors that affect performances were investigated.

Results show that, overall, the relay organisations studied were successfully diffusing agroforestry innovations to farmer groups. On the other hand, differences in performances of relay organisations could not easily be explained by either external or internal factors. Nevertheless, the fact that relay organisations that operate in areas with relatively good road and communication networks and opportunities for agroforestry, and also have adequate internal human, material and financial capacity seemingly performed better, provides us with some indications of support that might be required to further strengthen these relay organisations and increase their extension capacity. The findings nevertheless call for in-depth studies involving more relay organisations to increase our understanding of what factors affect performance of organisations in disseminating agricultural innovations.

Definitely, the involvement of grassroots organisations in the extension of agroforestry has increased the relevance of the techniques and the quality of services rendered to the beneficiaries, as can be seen from the relatively high level of satisfied farmers. Already, farmer-led experimentation and adaptation is common in the rural resource centres and farmers are encouraged to provide feedback about the new techniques to research via the relay organisations. The approach has also succeeded in reaching a relatively high number of women and youths, often overlooked in 'traditional' extension systems. One challenge though in this approach remains the technical expertise of RO staff. For example, our study has shown

that organisations with few people doing all the work are limited in the range of innovations they can deliver to farmer groups. Another aspect related to this is the quality of the messages delivered. This calls for continuous training, coaching and upgrading of extension staff.

One of the criticisms of more 'top-down' and bureaucratic extension systems is the insufficient links with other stakeholders, such as research, input supply, credit and marketing actors. In the case of the rural resource centres, creating linkages and networking should become easier; though so far concrete linkages have been established with research and in some cases with traders. It is expected, however, that more opportunities for linking with other stakeholders will develop with time.

Last but not least, one of the generic problems of agricultural extension, namely the difficulty of cost recovery, has not been addressed in the current study. It is expected that community-based extension would be more cost efficient compared to other approaches. However, our current understanding of the sustainability and financial viability of the approach is not sufficient to draw any conclusions and more research is required in this domain.

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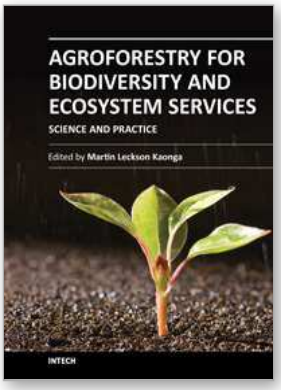

Agroforestry for Biodiversity and Ecosystem Services - Science and Practice

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Agroforestry has great potential for reducing deforestation and forest degradation, providing rural livelihoods and habitats for species outside formally protected land, and alleviating resource-use pressure on conservation areas. However, widespread adoption of agroforestry innovations is still constrained by a myriad of factors including design features of candidate agroforestry innovations, perceived needs, policies, availability and distribution of factors of production, and perception of risks. Understanding the science, and factors that regulate the adoption, of agroforestry and how they impact the implementation of agroforestry is vitally important. Agroforestry for Biodiversity and Ecosystem Services: Science and Practice examines design features and management practices of some agroforestry practices and their impact on biodiversity and the ecosystem services it delivers. It also identifies policy issues for facilitating adoption of desirable agroforestry practices and gradual diminution of undesirable policies.

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