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Enhancing Farmers Access to Quality Planting Materials Through Community-Based Seed and Seedling Systems: Experiences from the Western Highlands of Cameroon

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Abstract: Increasing the production and productivity in both crop and agroforestry sub-sectors is one of the measures taken to assure food security and livelihood enhancement. This improvement can only be realized if subsistence farmers have access to quality planting materials. The lack of good-quality planting material is also repeatedly identified as a major constraint to greater adoption of agroforestry innovations. The recognition of this fact has led to the development of national seed and seedling systems. However, the weak capacity of these programs, sluggish growth of the private sector and the nature of the demand of subsistent farmers obliged to seek for alternative models. This paper discusses results and experiences drawn from a community-based seed and seedling production and dissemination system in the Western Highlands of Cameroon. The system is built on the concept of Rural Resource Centre in which capacities of farmer are strengthened to multiply improved planting material of four food crops and five fruit tree species. The Rural Resource Centres are now sources of quality seeds and seedlings for farmers and institutional clients. The system has effectively improved the on-time dissemination, accessibility, affordability and availability of quality planting materials, which are obtained at affordable prices due to proximity and reduced transport and distribution costs. Income from selling improved planting material has become an incentive for Rural Resources Centres and ensures sustainability of the system. Availability of quality seeds has increased on-farm crop yields by 20-40 %, while demand for improved seedlings has surpassed supplies in participating communities. The successful dissemination of this approach requires much more than the transfer of knowledge and availability of improved germplasm; it involves supporting the capacities of the Rural Resource Centres, building partnerships with a range of stakeholders, increasing the involvement and interaction of government services, improving storage and marketing strategies and decreasing dependency on external resources. The main challenge of the future is how to make such a system sustainable. Furthermore, in addition to the challenge of projecting and meeting the quantitative demands of farmers and other stakeholders, issues of seed quality and genetic diversity still need to be addressed when designing and implementing effective seed supply strategies and policies.

Key words: Community-based · Rural Resource Centre · Planting material · Quality seeds · Germplasm

INTRODUCTION

Increasing agricultural production is one of the measures taken to assure food security and livelihood enhancement in rural areas, but this improvement can only be effective and sustainable if subsistence farmers have access to affordable quality planting materials [1]. The lack of these planting materials has also been repeatedly identified as one of the major constraints to greater adoption of agroforestry innovations. Most small-scale farmers continue to largely rely on their own materials, saved from previous seasons or obtained from neighbouring farmers [2, 3]. Improving the genetic and physical quality of planting materials can trigger yield increase up to 40% and lead to substantial improvement in the agricultural production and food security, especially if farmers continue to renew their planting materials stock [4]. In the Western Highlands of Cameroon, planting materials are from two sources: the formal and the informal systems. The formal system is

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dominantly supplied by research institutions and focused on cereals and crop seeds, while seedlings of different fruit trees species and other perennial crops are produced in government and NGO owned nurseries. The informal system on the other hand includes materials retained by the farmers from current harvest or obtained through farmer-to-farmer exchanges. Both systems have their own drawbacks. The capacity of the formal sector is too limited to supply the increasing demand, while the informal system is incapable of producing improved quality materials in the existing situation. Tree planting material systems differ from crop planting materials systems in that there are no bred varieties per se for most trees and the attendant regulations exist only in developed countries; consequently, differences between formal and informal tree seed systems are largely blurred [5]. It has been widely recognized that, more than any other input, improved planting materials hold the key to enhanced farm productivity and increased income generation [6, 7]. The recognition of this fact by the Government of Cameroon has led to the putting in place of programs in an attempt to enhance availability and wider participation of the private sector. Considerable advancements have been made and a range of regulations and policies have been adopted to protect farmers from the harmful effects of low quality materials. However, the planting materials' situation in Cameroon remains dismal. Most of the programs do not recognize the vital role that small-scale farmers could play as producers and have focused on elite farmers with no obvious commercial linkages between the two groups.

An alternative to fill the gaps is to strengthen the capacities of farmers and farmer organizations to produce and disseminate quality materials for both crop and tree species [8]. The advantages of farmer-based planting materials production over other approaches include sustainability, decentralization of production to cater for local supply and opportunities for linking to formal institutions [9]. Well organized smallholder producers can achieve sustainable materials supply, increased market share and greater income [10]. Several agricultural research organizations and Non-Governmental Organizations have adopted this approach. However, emerging smallholder producers face a lot of problems in conducting their activities. Difficulties range from access to basic equipment, technical and managerial skills, access to foundation materials, limited agricultural land, to lack of appropriate credits and other financial facilities necessary for developing their activities, as well as insufficient support from the public sector and policy makers.

The World Agroforestry Centre (ICRAF) through the implementation of the Agricultural and Tree Products Program developed a community-based and decentralized seed and seedling production and dissemination system to enhance the adoption and diffusion of quality planting materials, improve their availability and accessibility and create impact on the livelihood of small-scale farmers. The approach developed a sustainable system, which strengthens the informal sector and links it effectively to the existing formal sector. At the same time, it helps to build local capacity in the production and dissemination of quality materials. The main purpose of this paper is to present the system, report its progress and achievements and assess the potential of some of these farmers emerging as producers who could successfully produce and market planting materials within their respective communities. The system is reviewed in relation to seed and seedling quality, availability, affordability and delivery mechanisms. Major challenges of such system are also presented as well as key elements that ensure sustainability.

Project Implementation Strategies

Brief Description of the Project: The Agricultural and Tree Products Program implemented by the World Agroforestry Centre and partners between 2007 and 2010 in the Western Highlands of Cameroon fell within the framework of the « Food for Progress Act » between the Governments of the Republic of Cameroon and the United States of America and financed by the United States Department of Agriculture (USDA). Its principal aim was to enhance household livelihood security through the improvement of agricultural and tree crop production, marketing and competitiveness in the project area. Specific objectives included securing household revenues by improving crops, tree products and medicinal plants production, marketing and policy, promoting agri-business or agricultural enterprise (especially in the tree products and medicinal plants sub-sector) and the creation of employment opportunities. The project achieved these by developing partnerships with a wide range of stakeholders including farmers, farmer organisations, private enterprises, civil society / NGOs and government services and agencies. The main hubs of interaction for various partners were the Rural Resource Centres (RRC).

Project Site: The project was implemented in the West and North West regions of Cameroon (Fig. 1), which make up what is referred to as the "Western Highlands" owing to the huge similarities in physical, human, economic and

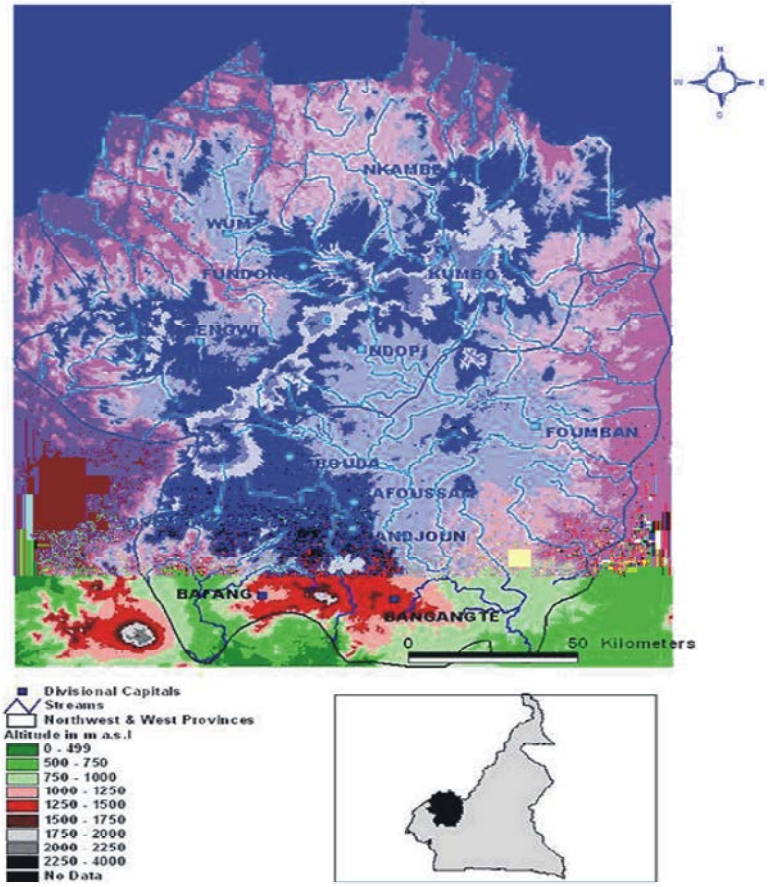

Fig. 1: Map of the project site

cultural geographies. The Western Highlands lie between latitudes 5°20' and 7° North and longitude 9°40' and 11°10' East, with a surface area covering 1/6 of the country's land area (17,910 km^2). Altitudes range from 300 to 3000 m above sea level. The annual average rainfall varies between 1300-3000 mm. Minimum and maximum temperatures have means of 15.5°C and 24.5°C, respectively. The region is dominated by high volcanic mountains with fertile soils (hydromorphic, volcanic and ferralitic) and has been traditionally the most densely populated part of the country.

The Concept of Rural Resource Centre (RRC): The main strategies for the implementation of the system were based on the concept of Rural Resource Centres (RRC) created in participating communities across the project area. These centres are community owned and managed with the support of the project. For the implementation of the seed and seedling systems, the RRC acted as an entry point for participating farmers through which foundation materials and improved germplasm were channelled as well as various technical packages. At the same time, seed multiplication farms and tree nurseries were placed under the supervision of RRCs. This innovative approach to agricultural extension focuses on building capacities to generate innovations throughout the agricultural production and marketing system. It lays emphasis on access to knowledge, interactive learning and networking - among farmers and between farmers and other stakeholders - that can help farmers improve their livelihoods. The RRCs are appropriate for promoting new technologies that are relatively 'knowledge intensive' and often require farmers to acquire new skills. This was the case for various training and technical packages concerning the production and dissemination of improved planting materials [11, 12]. In addition, RRCs also rendered key services such as information and demonstration of new technologies and innovations, access to market information, links with market actors particularly from the private sector and act as a forum for the exchange of information among farmers and between farmers and other stakeholders.

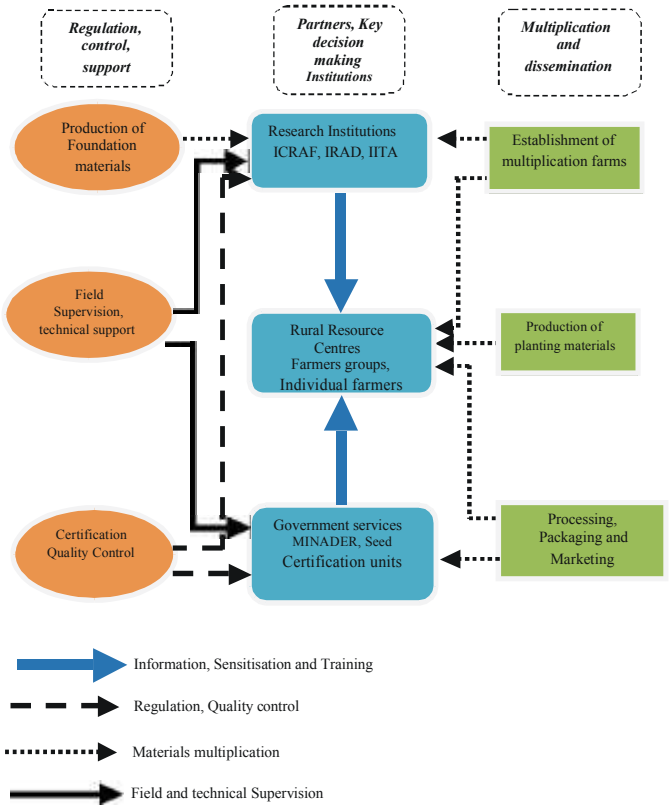

Fig. 2: Conceptual Framework of the farmers based seed and seedlings multiplication system

Conceptual Framework of the Community-Based Seed and Seedling System and Functional Mechanisms: The community-based and decentralized seed and seedling system has as primary objective i.e., the increment in crop productivity through the use of quality planting materials produced by small-scale farmers themselves in their own localities and in a sustainable manner. The project achieved this by developing local capacities, motivating farmers to undertake planting materials production as a means of generating income, training farmers on production practices, post-harvest handling, quality control and basic business methods, as well as enhancing farmers' capacities to produce planting materials in sufficient quantities according to local demands and distributing this on time and at affordable prices. A number of stakeholders and partners were involved including NGOs, research institutions, extension services and government technical services.

The implementation of the system was carried out in various steps. Firstly, the project embarked on a series of sensitization meetings after which participating farmers and communities were selected. Then followed technical packages made up of various trainings and technical guidelines to facilitate the involvement of farmers. Through a participatory selection exercise, main crops and priority tree species to be integrated in the system were selected; foundation materials and improved germplasm of these species were procured and distributed to farmers for the establishment of seed multiplication farms and tree nurseries. Finally, linkages with other institutions facilitated the technical follow up, quality control and certification. The conceptual framework of the system is presented in Figure 2, showing the interactions between partners across various stages of materials' production and dissemination.

Group Strengthening and Institutional Capacity Building: The first step laid emphasis on a series of sensitization meetings to get the interest of the farmers to embark on seed and seedling production as a group activity and eventually as a lucrative business both at household and community levels. This resulted in the selection of participating farmers and groups and their organization into well-structured producers' groups placed under the supervision of RRCs. The groups were then assisted to officially register with the competent local authorities and have legal status as Common Initiative Groups (CIGs). Having a legal status empowers groups

Table 1: List of crop/tree species integrated in the system

S/N	Main crops	Fruit trees
1	*Zea mays* (Maize)	*Dacryodes edulis* (Plum)
2	*Solanum tuberosum* (potato)	*Persea americana* (pear)
3	*Musa acuminata* (plantain)	*Cola acuminata* (kola)
4	*Manihot esculenta* (Cassava)	*Mangifera indica* (Mango)
5		*Garcinia kola* (Bitter kola)

and facilitates access to local financial services for savings and access to micro credits. Social activities within groups were highly recommended to reinforce members' cohesion.

Selection of Main Crop and Priority Tree Species: Prior to the implementation of the seed and seedling system, a participatory exercise with farmers took place to select the main crops and priority tree species to be integrated in the system. This resulted in the selection of four major food crops and five-priority fruit tree species as shown in Table 1.

The selection of these species reflected their importance in the area and their contribution to income and household food security.

Capacity Building in Seed and Seedling Production: To get the initiative underway and promote the role of local farmers in the system, the project organised series of technical training sessions to strengthen farmers' capacity and knowledge regarding various aspects of planting materials production, processing, packaging, marketing and distribution systems. Topics covered for crop seeds included: selection of production sites, seed quality (genetic and physical purity, germination rate, weeds and disease management), testing, post harvest handling, seed packaging and certification. On the other hand, training subjects for tree species multiplication included tree nurseries establishment and management, germplasm collection and management, vegetative propagation techniques, mother blocks establishment and management, as well as on-farm tree management and marketing. In addition, sessions on group dynamics were organised to ensure group cohesion, good governance and transparency, book keeping and group management. Other partners, researchers and specialists from local seed inspection services participated in various training sessions either as participants or as resource persons.

Supporting the RRCs with Foundation Materials and Improved Germplasm: After the training sessions, the project supplied 1,000 kg of potato seeds, 100 kg of maize seeds, 2500 plantain suckers and 20,000 cuttings of cassava for crops and germplasm of *Dacryodes edulis, Persea americana, Cola acuminata, Mangifera indica, Garcinia kola* for fruit trees in the forms of seeds, cuttings, marcotts and grafts obtained from specialised research organisations to multipliers as foundation materials. In addition, technical supervision that consisted of field visits, farms' and nurseries' evaluations, field discussions related to specific technical aspects, technical guidelines and on-farm training were carried out at weekly (seed farms) and monthly (tree nurseries) intervals to ensure the proper use of the materials and the application of norms and regulations that govern the production and distribution of each type of planting materials.

Establishment of Crop Seed Multiplication Farms and Tree Nurseries: The materials supplied by the project coupled with technical backstopping resulted in the establishment of 42 seed multiplication farms (10 for *Solanum tuberosum* (potato) seeds, 12 for *Manihot esculenta* (Cassava) cuttings, 20 for *Zea mays* (Maize) seeds, 18 *Musa acuminate* (plantain) plantlets multiplication units, stock plants and mother blocks as well as the establishment of 147 tree nurseries involving 2,550 farmers across the project area. Participating farmers used part of their farmland for the establishment of multiplication farms which were regularly inspected by the staff of the seed certification unit of the Ministry of Agriculture and Rural Development (MINADER) to guarantee quality. Inspection fees that range between US$10 - 20 per visit were paid by the farmers but other field research activities related to production were shared between the project and other research institutions which were interested in the on-farm performance of the materials supplied and wanted to establish sustainable linkages with the producers for future collaboration.

Linkages with Research Institutions, Government Services and Extension Systems: Strong partnerships are essential to ensure both success and sustainability of any project related to the production and distribution of planting material [2]. The role and responsibility of each of the implementing partners need to be very clear to all. Government programs, research institutions and especially NGOs have potential roles in promoting improvements in production, marketing and distribution of planting materials. Therefore, structural links through institutional arrangements were established between the project and other research institutions such as the

Institute of Agricultural Research for Development (IRAD) and the International Institute for Tropical Agriculture (IITA) in order to sustain the supply of foundation materials. These institutions also participated in the capacity building activities and took part in the technical supervision of multiplication farms to ensure that all the regulations and norms were respected.

Similar arrangements were established with government technical services such as the Ministry of Agriculture and Rural Development (MINADER) to ensure that producers were better supervised and technically assisted to produce quality materials. Local seed certification units of MINADER in each of the participating community were in charge of field supervision and certification. The quality of materials produced was therefore controlled and certified. These units then became vital partners of the system that ensured the quality and prevented fraudulent materials entering the system.

Quality Control, Regulations and Certification: Materials regulation in the system involved a range of activities from deciding which variety of crops or tree species to be multiplied, testing for purity in seed certification to regulating seed labeling and marketing. The quality control was an important part of the approach, as it intended to ensure the physical and genetic quality of planting materials supplied and to build farmers' confidence in such materials through certification tags. For the case of crops, materials certification was the "official" seal declaring that the "certified" materials had been produced from a proven, tested, improved and recognized genetic source and that it had the stipulated germination percentage, purity, health and moisture content.

Within the system, materials certification followed a kind of chain-control system, where the variety's identity and purity are checked from the very first generation through a prescribed number of generations to arrive at sufficient quantities of final materials that can be distributed to farmers. Standards for crops included for instance, the distance to neighboring fields with the same crop or to weeds that may cross with the seed crop, the number of allowable off types and so on while standards for tree species included sources of germplasm, type of pots used, type of substrate used and physical characteristics parameters such as sturdiness and shoot to root ratio. Certification also involved strict procedures for labeling and packaging.

Table 2: Evolution of the number of RRC during the project on seed production (2007-2010)

	Years			
	2007	2008	2009	2010
RRC	4	8	14	12
Affiliated groups	47	126	150	147
Farmers involved	215	1,500	2,612	2,550

Data Collection: A monitoring and evaluation system was put in place from the inception of the project to collect all available data generated during the implementation of the project. Tools made up of forms were made available at the level of each group. Data were collected on the quantity of planting materials produced, type of fruit tree propagules, number of multiplication farms, distribution and marketing of materials, number of participating farmers and multiplication farms.

Project Achievements

Participating Farmers: The community-based and decentralized seed and seedling system concept was initiated, implemented and accepted as part of the activities of the Rural Resource Centres and the project contributed in establishing several of such centres in participating communities. During the three years of its implementation (2007-2010), 12 RRC were established or revitalized to support a total of 147 farming groups with a membership estimated at 2,550 farmers with 40% being women (Table 2). It is noteworthy that, contrary to most smallholder projects where the lifetime of the groups is usually equal to that of the project duration, 80% of the RRC consolidated their activities and are still continuing to produce planting materials in 2012.

Strengthening Capacities of Farmers and Other Stakeholders: A total of 64 multipliers received practical training on seed production, harvesting and post-harvest operations, conditioning, storage and marketing of crop materials. Meanwhile, 120 tree nursery operators, staff of relay organizations and government services received training on germplasm collection, tree nursery establishment and management, vegetative propagation techniques, tree integration, marketing of seedlings and tree products. Farmers showed willingness to produce improved materials and followed the necessary multiplication regulations and standards.

Production and Dissemination of Improved Planting Materials: In 2010, total seed produced was estimated at 22 tons for maize, 20 tons for potato, 18,000 plantain

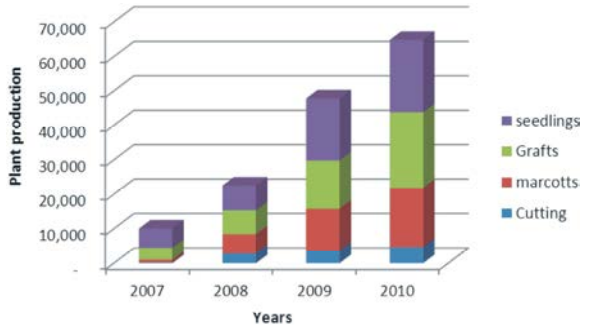

Fig. 3: Yearly production of improved tree planting materials by groups

suckers, 40, 000 cassava cuttings. For the five tree species integrated in the system, a total of 186,646 improved seedlings were produced in various types of propagules; 35,900 marcotts, 11,100 cuttings, 46,323 grafted plants and 93,323 seedlings (Fig. 3). Materials dissemination was coordinated through linkages with relevant government institutions such as MINADER and other development organisations. Part of the planting materials produced in the system (60%) was sold to generate income, while 25% was used to establish new multiplication farms and 15% was distributed free-of-charge to various group members to boost crop and tree production.

Minader through its numerous agricultural projects also promoted the commercialization by creating links between producers and users.

Contribution to Food Security and Poverty Alleviation: At the end of the project, participating farmers stressed that the business is profitable and has helped to diversify their activities, increase their income and achieve a higher living standard. For instance, total revenues generated from the sales of planting materials in 2010 were estimated at US$ 65,000 for improved seedlings and US$ 17,000 for crop seeds. These incomes generated by RRC and farming groups have become an incentive for promoting the community-based system. If the current prices are maintained or increased, more farmers will engage in the production of improved planting material as lucrative activities.

Effects on Food Production and Productivity: The use of quality planting materials by farmers already led to increased yields in demonstration farms owned by participating farmers across the project area. For the case of maize, farmers normally obtain 0.5-1.1 t ha^{-1} with farmer-saved seed, but with the use of improved seed and good farming practices, up to 1.8-2 t ha^{-1} have been achieved averagely in 12 demonstration farms (Table 3). The same tendencies were observed with potato on 6 demonstration farms, plantain on 5 demonstration farms and cassava on 8 demonstration farms with an increase in yield ranging between 20-40%. This is a tremendous productivity gain in the area and calls for an increased investment in the use of good quality planting materials.

These increase in yield observed in various demonstration plots is as a result of the use of improved planting materials by farmers. Yields on the same plots prior to the implementation of the project were lower than the present figures. In addition to improved planting materials, the project also encouraged farmers to use sustainable agricultural and agroforestry practices such as the use of various types of manure. This could also have enhanced land productivity and consequently have contributed to the yield increase observed on demonstration plots.

Sustainability of the System and Lessons Learnt: Despite the above-mentioned achievements, sustainability remained a major preoccupation. To help sustain the community-based and decentralized seed and seedling system put in place by the Agricultural and Tree Crop Programme in the Western highlands of Cameroon, the required technical skills need to be present at individual, community and national levels, because producing improved planting materials requires a range of technical capacities. Continue improving farmers' skills and knowledge at various stages of production could enhance uptake, improved practices and keep the system commercially viable. From the results, it is clear that reinforcing the interaction between farmers, research institutions and government technical services, coupled with financial and technical support from extension services is essential during the early stages of development of such a system. However, the duration of projects, particularly those related to agroforestry practices, often compromises the sustainability of such initiatives. This was the case for the Agricultural and Tree Crop Programme that lasted just for three years. The same tendency is reported in Malawi [5] where most funded agroforestry programs usually have duration of less than 5 years, which may be too short to really establish and operationalize tree planting materials systems. There is need for government and development partners to develop and implement seed and seedling supply systems as separate entities rather than bunch them together with other development programs that may have short implementation periods.

Table 3: Average yield increase as a result of using improved seeds of major crops

Crops	Yield obtained in 2007 (ton/ha)	Yield obtained in 2010 (ton/ha)	Yield Increase (%)
Zea mays	1.17	1.80	35
Solanum tuberosum	6.60	11.00	40
Musa acuminata	10.11	12.80	21
Manihot esculenta	7.84	10.60	26

Challenges and Opportunities: The venture has of course faced several challenges - a number of which still have to be overcome. First, there is the perception amongst potential local buyers that the quality of materials produced by farmer multipliers is not of the same high grade as that from Research Institutions. Local farmers sometimes judge the materials by their appearance and are therefore unwilling to pay the price asked by the producers. Consequently, producers had sometimes accepted lower prices - and will have to continue to do so until they have improved their packaging and marketing strategies. This situation has also been reported in Malawi where most small-scale farmers are unwilling to pay premium price to their neighbors for seeds obtained from their own harvests [2].

There have also been challenges with the marketing of surplus materials outside the immediate locality. Again it is a question of confidence in the materials - which will be difficult to overcome until the quality of presentation of these materials has been improved. To increase the sales of materials produced by farmers, promotion activities should be conducted to raise awareness of farmers in participating communities under smallholder planting materials programs [13]. Steps are currently being taken to strengthen links between producers, agricultural research institutions and MINADER to tackle the problem of materials presentation. Also, a monitoring and evaluation system has to be put in place to provide multipliers with the technical back up required to ensure long term sustainability of their activities.

CONCLUSION

This experience in the Western Highlands of Cameroon has shown that it is possible to fill the gaps left by government and private sectors in the supply of improved planting materials. Supporting the establishment and development of community-based and decentralized systems remains a vital alternative. The success of the model described in this paper is attributed to the good partnership with public and private institutions. However, there is need for policy reforms in order to strengthen, streamline and develop the sector, as also suggested by [14, 15]. However, much still has to be done in the area of tree planting materials. There have been a lot of improvements in terms of physical quality but not much progress has been made as far as genetic quality is concerned. There is need to continually reinforce the technical know-how of farmers on issues of quality tree planting materials. In terms of impact, the model has not only produced tons of quality seeds and thousands of improved seedlings that are important for national food security and landscape protection but it has also contributed to an improvement of the livelihoods of farmers. However, the agricultural extension system has to continue sensitizing farmers on the importance of these materials in order to increase demand. The government should continue to support the planting materials sector and ensure that capacity building, particularly in production and marketing is assured. The Western Highlands model is a success story that can be adapted to similar conditions in other countries where the production of improved planting materials is at the emergence stage.

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