Small and Medium-Scale Public-Private Partnerships in Horticulture for Development

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Abstract

Affordable high quality seed of improved varieties is essential to increase crop production and to reduce poverty and malnutrition, and this is best supplied through public-private partnerships. High value horticultural crops such as vegetables produce much higher incomes than staple crops and smallholder farmers are willing to pay substantial amounts for good seed of open pollinated varieties that they can later reproduce themselves. Small and medium local seed firms have a competitive advantage over multinationals in supplying the niche markets provided by large numbers of smallholder farmers and in dealing with their complex seed distribution chains, but they need public sector research support from national and international partners. The production of quality seed requires technical knowledge of seed biology combined with skills to overcome biological restrictions—expertise often best found in the public sector. It also requires managerial skills required to run a seed business, and this is best executed by the private sector. Over the last ten years AVRDC – The World Vegetable Center has worked closely with national agricultural research services and local seed companies in East Africa to promote and distribute improved lines of exotic and indigenous vegetables. This has revolutionized East African tomato production, increasing farmer incomes by an average 39%. Such partnerships also successfully commercialized improved varieties of Africa’s highly nutritious indigenous vegetables—previously considered as food for the poor. Less extensive public-private partnerships have been successfully used to develop pheromone traps for insect management in eggplant in South Asia. Profit generation is a strong motivator for consistent and reliable partnerships. A team approach involving farmers, private and public sector institutions combining each partner’s unique strengths and expertise is required to enhance demand, increase the resilience of production systems, and improve the livelihoods of the poor.
INTRODUCTION

Public–Private Partnerships are Important for Vegetable Seeds

Successful vegetable production begins with good seed, and many farmers are prepared to pay for such a valuable input. Everything else in vegetable production is profoundly affected by the quality of the seed used, the characteristics of the variety, and the potential quantity and quality of its marketable produce. Farmers will invest in something that has such significant payoffs, and the private sector will invest in marketing such valuable commodities. Vegetable seed is one of the most valuable horticultural inputs, with seed of the most expensive European hybrid tomatoes (*Solanum lycopersicum*) selling for well over $350,000/kg (Cohen, 2007). Because of its value to all parties involved, vegetable seed production and marketing is a key area for successful public-private partnerships for development.

Open pollinated varieties (OPVs) do not command the same prices as hybrids, but their production potential is not always inferior; smallholder farmers favor OPVs because they can produce their own seed and obtain several years of cropping from one purchase. Despite this, selling OPVs can still provide a viable return for small- and medium-sized seed companies because other factors such as the ease of producing seed, purity, freedom from disease, and the reputation of the supplier prompt farmers to buy high quality seed at the right price even if in theory they could produce their own. Members of the Asia and Pacific Seed Association claim that despite the rapid adoption of some vegetable hybrids in India, the highly diverse market preferences over short distances and reasonable seed prices mean that OPVs still account for at least 30% of the vegetable seed market (Asia and Pacific Seed Association, pers. commun., 2010).

Since 1971 AVRDC – The World Vegetable Center has been working to develop high quality open pollinated vegetable lines attractive both to smallholder farmers and to small and medium seed companies. Improved vegetable varieties have been one of the major success stories of the Center’s research and development program. They have been released officially throughout the world and used in private breeding programs, resulting in thousands of new varieties available to farmers. The Center’s genebank also has distributed more than 571,000 seed samples of improved lines or unimproved germplasm to the public and private sectors in more than 180 countries. OPVs may be less commercially exploitable than hybrid seed but are preferred by the large sector of low-income farmers unable or reluctant to invest in higher priced improved hybrid seed. Many of these OPVs have been used in the production of hybrids by small- and medium-size seed companies.

The private sector is a very important partner for AVRDC. It has an essential role in effectively disseminating our new lines, but improving the whole seed chain including
selection, varietal registration, production, marketing, and creating consumer demand involves many other partners. The Center has employed a participatory approach to develop new exotic (introduced) and indigenous vegetables, involving many stakeholders including farmers and the public and private sectors. However, a lack of infrastructure in many developing countries and an underdeveloped seed sector, particularly in sub-Saharan Africa, have hindered access to improved lines.

DISCUSSION

Small- and Medium-Sized Firms Can have a Competitive Advantage

Vegetables are highly diverse, and this can provide a market advantage for small- and medium-sized seed companies. In India, for instance, the preferred type of eggplant can differ within a distance of 50 km, and there are many local niche markets for different types of seed. In China, the highly diverse vegetable seed sector is dominated by the private sector (Asia and Pacific Seed Association, pers. commun., 2010). In Asia, the majority of seed companies focus on vegetables as the large seed markets for staples such as rice are often tightly regulated or government-controlled.

Partnerships between public sector institutions such as AVRDC and small- and medium-sized domestic seed companies are more likely to be effective in getting improved varieties to smallholder farmers than partnerships with large multinational seed companies. Smaller seed companies often have greater local experience than large multinationals, and can better identify and characterize niche markets and their regional demands. They are more likely to see OPVs as a viable market niche and have the marketing infrastructure and expertise to deal with a diverse distribution chain of middlemen. Large multinationals do not usually view OPVs as profitable, but they may actually possess a longer niche market life expectancy than hybrid seeds.

Because vegetable seed is smaller and much more valuable per kilogram than seed of grains or pulses, it can be an easier commodity for small seed companies with limited storage and transport capacity to handle if they are prepared to invest in the greater complexity of vegetable seed production and distribution.

Successful partnerships depend on mutually perceived and accrued benefits. While maintaining consistent profits can be a strong motivator for reliable partnerships, it is also important to identify the “best fit” private partners in terms of size, ability, community penetration, and marketing experience for each location. It is essential that these partnerships grow from a shared vision with well-defined and agreed goals and objectives typically captured formally in Memoranda of Understanding documents.

Seed companies partnering with AVRDC typically gain the benefits of advanced knowledge of potential new varieties, access to breeders’ seed, information about their
performance in national testing programs, and the provision of appropriate production and crop management techniques. In addition, AVRDC actively supports the private seed industry by sharing disease screening and seed production protocols and providing training in genetic improvement, business management, and market chain issues, particularly to small- and medium-sized enterprises.

Using Complementary Public and Private Skills to Improve Seed Systems

The production of quality seed requires mastery of two kinds of expertise: (1) knowledge of seed biology and the skills to overcome biotic and abiotic crop production constraints; and (2) managerial skills required to run a seed business. Both skills often are lacking, but the former is best found in public sector research organizations such as AVRDC – The World Vegetable Center and the national agricultural research and extension systems (NARES), and the latter is far better delivered by the private sector.

It is not enough to just work with small- and medium-sized seed companies to get improved seed into the hands of farmers—all parts of the seed value chain have to be functioning adequately. Strong and transparent national seed regulatory systems are needed to assure the availability of foundation seed to the companies. A team approach involving the unique strengths and expertise of both the public and private sectors in collaboration with farmers is required to enhance demand, increase the resilience of production systems, and improve the livelihoods of the poor.

Variety certification and approval for release often become bureaucratic stumbling blocks in many countries, causing long delays in making improved varieties available to farmers. Public sector stakeholders can help to facilitate the active cooperation of public regulatory agencies for variety release, registration, seed health and quarantine, and to broaden development linkages. When the national public sector is a part owner of the improved seed material it helps to expedite the regulatory process and minimize the time needed for variety release.

In East Africa, AVRDC works with a wide network of public, private, and community organizations to ensure that improved varieties are readily available to farmers. These include the Tanzania Official Seed Certification Institute (TOSCI) and the Kenya Plant Health Inspectorate Service (KEPHIS) for varietal registration and certification issues, in addition to national agricultural research institutes such as NARO (National Agricultural Research Organisation – Uganda) and the Ugandan National Agricultural Advisory Services (NAADS). These in turn are linked to the 20 or more small private sector companies operating in the region including the Alpha Seed Company Ltd., East African Seed Co. Ltd., Victoria Seeds Limited, and Kibo Seed Company Ltd. These are also linked to the pro-seed activities of farmer groups, civil society organizations, church groups, women’s groups, and NGOs such
as Farm Concern International and Catholic Relief Services, who interact with and train the farming community.

AVRDC has gained a good understanding of the use and management of intellectual property by working with the private seed sector. Our experience has shown the importance of clarifying intellectual property rights (IPR) beforehand to ensure an appropriate balance is achieved between incentives for the participating company and the public interest. Protecting intellectual property rights ensures that the Center’s target clients are able to freely access the Center’s technologies they need as international public goods. All technologies, varieties, and information generated through the Center’s projects remain international public goods.

AVRDC’s strategy has been to supply national agricultural research centers and private companies with germplasm and advanced lines through Material Transfer Agreements, in which the intellectual property rights remain in the public domain. However, there is no ideal intellectual property rights system for plant breeding due to widely differing seed systems between crops and within countries.

Both public and private partners need to work closely with farmers to ensure that the whole vegetable seed value chain works effectively. This means employing a participatory approach to variety selection and testing, including on-station and on-farm variety evaluation with farmers, students, NARES, NGOs, and the private sector to build partner involvement and ownership of the results from project inception to completion. This helps ensure our vegetable breeding activities meet real market and consumer demands.

AVRDC promotes improved lines through information leaflets, distribution of seed kits for home gardens, training programs for farmers, and workshops for collaborating scientists prior to official varietal release. Promotional activities such as field days, seed fairs, and on-farm or on-station demonstrations involving a range of partners are needed to provide farmers direct access to varieties and information on vegetable production technologies.

**Working with the Private Seed Sector in Tomato Production for East Africa**

A partnership between AVRDC and local seed companies and the national public sector in Tanzania has helped make improved tomato seed available to farmers across East Africa, creating a new regional seed industry and a new source of income for highland farmers.

Tomato is a very important cash crop grown by small- and medium-scale farmers in large areas of Tanzania. For decades, Tanzanian tomato production was relatively inactive with poorly performing old varieties such as ‘Marglobe’, ‘Moneymaker’, ‘Cal J’, and ‘Roma’ (some of which dated from the 1920s) dominating the market. These varieties are low-yielding, often susceptible to pests and diseases, and are easily damaged during transportation due to their thin skins. The high cost of seed of European hybrids puts them
beyond the reach of smallholder farmers and such varieties are not necessarily well adapted to local environmental conditions.

Over the last decade, AVRDC and its NARES and NGO partners successfully developed two new tomato varieties, ‘Tanya’ (processing type) and ‘Tengeru 97’ (fresh market type), that were released by the Tanzanian Horticultural Research Institute in 1997. These varieties not only yield more than the old varieties but, due to their firmer skins, are substantially less vulnerable to pests and diseases, as well as to damage during road transportation. They are also more resistant to Tomato mosaic virus, Fusarium wilt, and root knot nematodes. The new varieties possess the advantage of longer shelf life, potentially lasting in a saleable condition for up to three weeks at room temperature.

AVRDC in collaboration with the seed unit in the Ministry of Agriculture, Food Security and Cooperatives, private seed producers, and extensionists disseminated high quality seed of these varieties to smallholder farmers across Tanzania. This was done through groups of seed producers, seed stockists, agro-dealers, farmers and marketers, farmers’ exchange visits, and multimodal demonstration plots.

‘Tanya’ (short for “Tanzania Nyanya” from the Kiswahili word for tomato) became the first locally adapted processing variety suitable for year-round production. It has become the country’s most popular variety, providing smallholders with higher yields and better prices compared to the best older varieties (Lyimo, et al. 2005). A partnership with Alpha Seed Company Ltd., a small family-owned Tanzanian business, was critical to providing sufficient supplies of high quality seed to farmers. The Alpha Seed Company has worked with AVRDC and its NARES and NGO partners for more than 15 years to produce and market seed of new varieties. Collaboration included the annual provision of sufficient breeder’s seed for bulking into certified seed, and training Alpha Seed Company employees and contract farmers in all aspects of producing high quality seed efficiently and profitably. The company was involved in demonstration trials and seed fairs to promote the new varieties. Alpha Seed Company worked with AVRDC to fabricate simple fruit maceration and seed separation equipment for smallholder farmers derived from AVRDC prototypes, and was supported by scientists to ensure the purity and productivity of its seed production fields.

Since 2002, East African Seed Co. Ltd., Kibo Seed Company Ltd., Multiflower Ltd., and Royal Sluis Ltd. seed companies have been producing seeds of ‘Tanya’ and ‘Tengeru 97’ near AVRDC’s Regional Center for Africa at Arusha in Tanzania’s dry uplands. Total seed production in the region now exceeds 15 t per year, and the income potential of the seed industry has attracted the interest of many young people to return from jobs as laborers in the local tanzanite gem mines to become tomato seed contract growers.

In the six years following the release of ‘Tengeru 97’ and ‘Tanya,’ the total area of tomatoes in Tanzania increased along with average yields and the incomes of smallholder farmers. A Tanzanian government evaluation of the impact of these two new varieties by
Lyimo, et al. (2005) showed that by 2003/04 they occupied 81% of the tomato crop area in major production districts. A comparative financial analysis of their performance in 2003/04 showed that they yielded 18% higher than other varieties, obtained a 13% higher price in the market, and had 17% lower variable cost per kilogram of production. Farmers who adopted them obtained a 39% increase in income.

Buyers came from neighboring countries to Tanzania to get supplies of the new seed and fresh tomatoes that possessed a longer shelf life. The seeds and produce are now being marketed in more than a dozen countries including Kenya, Uganda, Democratic Republic of Congo, Zambia, Malawi, and Zimbabwe. The seed also is being exported as far as Mauritius and the Middle East.

The increased income from growing these improved varieties has made a major difference in the quality of life of farming families in tomato growing districts. In some districts in Tanzania, more than 90% of farmers have been able to build new homes, buy vehicles, open shops, and pay school fees or medical bills with the income earned from selling the fruit of these new varieties. The health of farmers and consumers has improved, because the new varieties have somewhat better nutritional value than older tomato varieties and are available for consumption over a longer period.

In 2007 the improved variety ‘Meru’ was released in Tanzania and in 2008 this was followed by the release of ‘Kiboko.’ Both have good resistance to late blight that can devastate tomato yields. The AVRDC breeding program is continuing and other new early blight and late blight resistant varieties with even greater potential than ‘Meru’ and ‘Kiboko’ are currently being evaluated in on-farm and multilocational trials in conjunction with private, public and NGO and Community-Based Organization (CBO) sector partners.

The quality of the certified seed of the varieties ‘Tanya’ and ‘Tengeru 97’ appears to have degenerated in the 13 years since they were first released. In both Tanzania and Zambia locally sourced certified seed of the two varieties is not producing the expected varietal types, which may indicate that past maintenance practices for the foundation seed by the NARES partners may have not been flawless, or that contract farmers producing certified seeds for seed companies may have not been alert to impurities in the seed stocks. It appears that for long-term maintenance of seed quality, AVRDC needs to continue to be a repository for pure stocks of breeders’ seeds for released varieties that NARES maintainers of foundation seed can access to regularly rejuvenate their stocks.

Working with the Private Seed Sector to Improve African Indigenous Vegetables

AVRDC also works in active partnership with the private sector in Africa to improve African indigenous vegetables and develop their market chains. Many African diets are imbalanced and fruit and vegetable consumption per capita is less than half the internationally recommended level and well below many other developing regions of the
world (Weinberger and Lumpkin, 2005), resulting in dietary deficiencies of vital micronutrients. A solution can be found in the indigenous vegetables often seen growing along roadsides and on uncultivated land. Vegetables are one of the most important means of overcoming deficiencies of vitamin A and iron, which are major contributors to the scourge of malnutrition in Africa (AVRDC, 2003).

Indigenous vegetables are an important source of nutrition in Africa, particularly for the poor. For example, a survey by AVRDC in rural Tanzania found that African indigenous vegetables provided up to 50% of the beta-carotene (vitamin A precursor) and 25% of the iron requirements for the poorest members of the community—far higher proportions than for wealthy local consumers (Weinberger and Msuya, 2004). Some African indigenous vegetables are surprisingly nutritious compared with common exotic vegetables such as white cabbage and standard red tomatoes, containing higher levels of beta-carotene and vitamin C plus higher levels of vitamin E, folate, calcium, iron, zinc and antioxidant activity (AVRDC, 2004). Indigenous vegetables can play a major role in reducing malnutrition across sub-Saharan Africa.

AVRDC and its partners have developed improved lines, growing techniques, and cooking methods for indigenous vegetables such as amaranth (Amaranthus spp.), spider plant (Cleome gynandra), African nightshade (Solanum scabrum), Ethiopian mustard (Brassica carinata) and African eggplant (Solanum aethiopicum) that are fueling a resurgence in the popularity of these crops in both rural and urban areas.

Popularization in East Africa has been assisted by the widespread distribution of home garden packs developed by AVRDC that contain elite lines of indigenous and exotic vegetables. These have been provided to progressive farmers, women’s groups, NGOs, and schools during short term training courses in growing, processing, and cooking of vegetables. In Tanzania alone almost 8000 seed packs were distributed in 2007.

In partnership with more than 20 seed companies in Eastern and Southern Africa, the Center is helping commercialize improved lines of African indigenous vegetables so that they are available to even more farmers (AVRDC, 2008). Local seed companies in Uganda have released new amaranth varieties such as ‘White Elma’ and ‘Green Gina’ and sales have expanded as consumer awareness of the nutritional value of these traditional vegetables has grown. In Tanzania and Kenya, other seed companies, AVRDC, and NARES are promoting and demonstrating these lines prior to local release.

Selected high yielding lines of leafy indigenous vegetables are promoted to farmers in East Africa with the help of local NARES, the private sector and NGO partners. In partnership with local seed companies and the NGO Farm Concern International, AVRDC’s Regional Center for Africa has introduced improved lines of African nightshade (sweeter varieties), spider plant, vegetable cowpea (Vigna unguiculata), and African eggplant in Kenya and Tanzania. Supermarket displays and innovative promotions in formal and informal
markets have raised urban consumer awareness of these indigenous vegetables. Working with more than 900 farmers organized in business support groups and linked to markets in Nairobi, Kenya, sales of indigenous leafy vegetables such as giant African nightshade grown with seed sold by the Simlaw Seeds Company Ltd. increased from 31 t in 2003 with an estimated farm gate value of USD 6,000 to 600 t in 2006 with an estimated value of about USD 142,800 (MATF 2007; Ngugi et al. 2007). The volume of sales in Nairobi has apparently continued to rise, particularly in supermarkets such as Pricerite and Uchumi in Kenya and in the informal rural and urban markets of Tanzania and Kenya.

**Working with the Private Sector to Develop IPM Technologies**

Public/private partnerships have been essential to the widespread adoption of seed of improved OPVs, but they also can be important to the production of vegetable crops. In South Asia such partnerships have been vital to the success of an integrated pest management (IPM) system to control one of South Asia’s most important pests, the eggplant fruit and shoot borer (*Leucinodes orbonalis*) (EFSB). South Asia grows almost half of the world’s area of eggplant (*Solanum melongena*), and during the wet season it is one of the only vegetables affordable to poor communities. Smallholder farmers spend around a third of their production costs in applying more than 80 applications of pesticides to control damage by EFSB larvae (Alam et al. 2006; Baral et al. 2006). This can have severe impacts on their health and that of consumers and the environment.

Starting in 2000, as part a project to develop an integrated pest management strategy to reduce pesticide use in Bangladesh, India, and Sri Lanka, AVRDC researchers and partners developed an inexpensive, environmentally safe sex pheromone trap to lure ESFB moths (Alam et al., 2006). Farmers tried the trap; it worked. They told other farmers, who then wanted more traps. Small-scale entrepreneurs near the EFSB pilot project sites saw a business opportunity and began making traps to sell to local farmers. Agricultural input dealers were encouraged to add the traps to their stock.

Five years later, nine companies were making a variety of traps and the price had dropped from US $1 to US $0.10 per trap. Thousands of farmers were then able to afford to use more traps more often, which reduced pesticide applications, and improved harvests, the health of farmers and consumers, household incomes, and local economies.

The simple IPM strategy that researchers developed was based on keeping fields free of old eggplant stalks; regular pruning and disposing of EFSB-damaged shoots with larvae inside; sex pheromone traps to attract and kill EFSB adult males; and refraining from pesticide use for as long as possible to allow native natural enemies of EFSB to thrive. It has helped farmers overcome the vicious cycle of pesticide misuse, which led to spiraling production costs, environmental pollution, human health hazards, the destruction of natural enemies of EFSB, and the development of pesticide resistance in EFSB.
In addition to hosting field days, NGOs and extension agencies convinced vegetable growers in the pilot project areas to adopt the IPM strategy through puppet shows, wall paintings, and a TV documentary. Local media were actively engaged at press conferences, which led to feature stories, editorials, interviews, and talk shows. Thousands of ESFB brochures were sent by post directly to Bangladeshi and Indian farmers.

Without a ready supply of low-cost pheromone traps provided by private sector partners at an affordable cost, the IPM strategy could not have been successful. The new IPM technology developed and promoted through public/private partnerships reduced pesticide use by 65–75% in Bangladesh and India. Farmers adopting the IPM strategy reduced their cost of production by around 30%—and increased their net income by about 60%.

Maintaining the Right Balance so that Poor Farmers Continue to Benefit

Effective profit generation may be a strong motivator for maintaining successful public/private partnerships, but in the long term it can change the dynamics of the partnership so that smallholder farmers may no longer be its major beneficiaries. This is particularly the case in partnerships to develop new vegetable varieties.

Successful public/private partnerships and establishing or improving seed distribution channels can boost economic development, improve incomes for farmers and help to grow small- and medium-sized seed companies. Public sector partnerships with small local companies can help them to prosper. But, as successful small companies grow or are taken over by larger corporations, it is important that the public sector does not withdraw and become less involved. Large seed companies with their own in-house breeding capacity are not effective substitutes for public breeding efforts. As the economic power of the participants in a successful partnership change, it is important to maintain a balance of contributions to ensure poor smallholder farmers will not lose out from its success.

Small- and medium-sized companies currently have a competitive advantage in complex and diversely segmented markets such as those serving smallholder farmers in sub-Saharan Africa. Their participation is essential to improve food security, and to reduce poverty and malnutrition in economically disadvantaged rural communities. However, due to their small size, it is unlikely that they would be able to develop in-house breeding capacity for a wide range of crops. As the smaller companies grow this becomes more attractive and more likely, but if this becomes a rationalization for cutting back public sector commitments to plant breeding research, the needs of smaller market segments may be lost. It is important to ensure research outputs of the public sector reach the private sector in a functional and timely manner so that all partners can contribute to the food and nutritional security of the poor.

When there is an imbalance between the contributions of the public and private sectors and large companies come to dominate vegetable varietal development, marketing can
by default determine what farmers grow more than agronomic suitability and local niche needs. Varieties often are commercially successful because large companies have the marketing presence to distribute and promote specific lines despite their agronomic or other limitations. For instance, increased pesticide spraying of a less well-adapted but widely marketed variety may become the default response to a new pest or disease problem because it is uneconomic for the private sector to develop a resistant variety for a small market, and the public sector may no longer have the capacity to carry out the work. This change in practice and imbalance in public and private contributions biases against the most economically disadvantaged farmers and niche markets.

The public sector needs the private sector, as varieties produced in public programs usually require commercial support to multiply, distribute, and market seed. The private sector needs the public sector to provide the best adapted germplasm for locally important niche markets that may not be regionally or globally significant and to maintain stocks of pure breeder’s seed. If they are to benefit, poor smallholder farmers need a balanced input that builds on the different strengths of both public and private partners.

Funding for public sector research, particularly for long-term efforts such as plant breeding, has diminished drastically over the last decade to the detriment of smallholder farmers, making achievement of the Millennium Development Goals less likely. Expanding future investment in agricultural and horticultural research remains a sensible strategy both nationally and internationally, and good public-private partnerships with small companies remain a vital component in ensuring this investment is fruitful.

**Literature Cited**


