Vegetables and Small Private-Sector Interests

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Vegetables and Small Private Sector Interests

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Poor farmers in developing countries need access to affordable high-quality seed of improved crop varieties to improve their incomes and reduce malnutrition. Vegetables are vital for balanced nutrition, particularly in Africa, where production has been almost static for decades, per capita consumption is very low and malnutrition is rife. Vegetables produce much greater income than staples and farmers are willing to pay substantial amounts for good seed of open-pollinated varieties they can later reproduce themselves. Small local seed firms have a competitive advantage over multinationals in supplying niche markets provided by large numbers of smallholder farmers and in dealing with complex seed distribution chains, but they need public-sector research support. AVRDC — The World Vegetable Center's vegetable breeding research and the business expertise of small private seed companies are delivering improved varieties to smallholder farmers in developing countries where there is limited public-sector plant breeding capacity. Over the last ten years AVRDC has worked closely to build partnerships with national agricultural research services and local seed companies in Tanzania to create effective national seed systems and to breed and widely distribute a series of improved tomato varieties, revolutionising East African tomato production and increasing farmer incomes by an average of 40%. Similar close cooperation is successfully commercialising improved varieties of Africa's highly nutritious indigenous vegetables — previously ignored as food for the poor. International research cooperation and public–private partnerships also are increasingly important to vegetable industries in Australasia and the Pacific as national agricultural funding priorities change, diseases become more internationalised, and quarantine alone is insufficient insurance against transmission.

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AVRDC — our expertise

Partnership is the mainstay of the research and development activities conducted at AVRDC — The World Vegetable Center. Founded as the Asian Vegetable Research and Development Center (AVRDC), but now with a global mandate, the Center has a long tradition of successful collaborations in many countries. With development being part of AVRDC's founding mandate, the Center is in a unique position — compared to most other international agricultural research centres — to adapt research for development.

Since 1971, improved vegetable varieties have been one of the major success stories of the Center's research and development program, and more than 571 000 seed samples have been distributed to the public and private sectors in more than 180 countries. Working with exotic (introduced) and indigenous vegetables, the Center has employed a participatory approach involving

farmers, national partners, the private sector and other stakeholders in the inception and execution of research projects. This partner involvement has led to great success in the implementation and utilisation of the Center's genetic resources and other technologies, thus creating impact and helping to alleviate poverty and malnutrition through improved access to appropriate seed, varieties and improved vegetable production technologies. Facilitation of the vegetable seed supply chain is vital so that vegetable farmers can have ready and timely access to new varieties and information on improved production technologies. However, not all regions and farmers have benefited equally from the Center's advanced vegetable lines, as lack of infrastructure in many developing countries and an underdeveloped seed sector, particularly in sub-Saharan Africa, have hindered accessibility.

The private sector has been, and remains, a very important partner group for AVRDC and is essential to the effective dissemination of new seeds. These partners range from large international entities to small, local entrepreneurs. AVRDC actively supports the private seed industry by providing improved inbred lines that accelerate variety development, sharing disease screening and seed production protocols, and conducting training in genetic improvement, business management and market chain issues. To increase the availability and rate of dissemination of high-quality seed, location-specific alliances need to be formed and coordinated with those companies and public-sector organisations capable of fulfilling necessary breeding, selection, varietal registration and marketing activities. The clear understanding that it takes more than just investment to create a dynamic, sustainable seed sector is paramount for a positive outcome.

Building partnerships with small vegetable seed producers

Successful partnerships depend on mutually accrued benefits. It is essential that these partnerships grow from a shared vision with well-defined and agreed goals and objectives typically captured in Memoranda of Understanding or Agreement documents between AVRDC and these partners. AVRDC traditionally has focused on the development and production of open-pollinated varieties (OPVs), which may be less commercially exploitable than hybrid seed but are favored by low-income farmers unable or reluctant to invest in higher-priced improved hybrid seed.

Obstructed by existing poor seed distribution networks, AVRDC and other public-sector institutions need to partner with small domestic seed companies that still perceive OPVs as a viable market niche and possess the marketing infrastructure and expertise to deal with a diverse distribution chain of middlemen. Vegetable seed is smaller and much more valuable than seed of grains or pulses; it is a viable commodity for small seed companies with limited storage and transport capacity that are prepared to invest in the greater complexity of vegetable seed production and distribution. Benefits to be derived by the partner seed companies include advanced knowledge of potential new varieties, their characteristics through the national testing procedure and suitable production techniques.

Although experience has shown that profit generation is a strong motivator for consistent and reliable partnerships, identifying the 'best fit' private partners in terms of size, ability, community penetration and marketing experience is essential, and should be tailored to each location. Smaller seed companies often have greater local experience than large multinationals, and can better identify and characterise niche market demands in their region.

It is vitally important to link private partners with national agricultural research and extension services (NARES) and non-governmental organisation (NGO) collaborators to strengthen national seed systems. AVRDC and our partners employ a participatory approach to variety selection and testing that involves on-station and on-farm variety evaluation with various groups (farmers, students, NARES, NGO and private-sector personnel), thus ensuring 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.

Promotional activities such as field days, seed fairs and on-farm or on-station demonstrations are undertaken across the partnership spectrum to provide farmers direct access to varieties and information on vegetable production technologies with an unbiased perspective. 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.

The inclusion of stakeholder representatives from the public sector is required to facilitate the active cooperation of public regulator agencies for variety release, registration, seed health and quarantine, and to broaden development linkages. Participation of the public sector in the ownership of the improved seed material expedites the regulatory process and minimises the time needed for variety certification and approval for release, which often can be a bureaucratic stumbling block in many countries. For example, in sub-Saharan Africa AVRDC works closely with partners such as the Tanzania Official Seed Certification Institute (TOSCI) and the Kenya Plant Health Inspectorate Service (KEPHIS) for varietal registration and certification issues, and with national agricultural research institutes such as those in Namulonge, Uganda, and the Ugandan National Agricultural Advisory Services (NAADS). These are linked to the 20 or so small private-sector companies operating in the region such as the Alpha Seed, East Africa Seed, Victoria Seed and Kibo Seed companies. These, in turn, are linked to the pro-seed activities of farmer groups, civil society organisations, church groups, women's groups and NGOs such as Farm Concern International and Catholic Relief Services who interact with and train the farming community.

Production and distribution of AVRDC tomato varieties in Africa

A partnership between AVRDC and local seed companies 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 in Tanzania. Tomato is a very important cash crop grown by small- and medium-scale farmers in large areas of mainland Tanzania. For decades Tanzanian tomato production was relatively inactive with poor-performing, old-fashioned varieties (Marglobe, Moneymaker, Cal J and Roma — some dating back to the 1920s) continuing to dominate the market. These varieties are low-yielding, mostly susceptible to pests and diseases and are easily damaged during transportation due to their thin outer skin. The high cost of seed of European hybrids put 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 outer 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.

Seed of these varieties was disseminated to small- and medium-scale farmers in all the important tomato-growing areas of the country. Horticultural researchers, in collaboration with AVRDC, the seed unit in the Ministry of Agriculture, Food Security and Cooperatives, private seed producers, and extensionists disseminated the varieties through the formation of producer and marketing groups, seed production groups, farmers' exchange visits, and multi-locational demonstration plots. They also collaborated with other elements of the private sector, seed stockists and agro-dealers to ensure the availability of high-quality seed to farmers.

Tanya became the first locally adapted processing variety suitable for year-round production. Full-fleshed, juicy and suitable for eating fresh or cooked, Tanya (short for 'Tanzania Nyanya' from the Kiswahili word for tomato) has become the country's most popular variety. Tanya provides smallholder farmers with about 36% higher yields, and better prices in the market place, compared to the best older varieties (Lyimo *et al.* 2005). Sufficient supplies of high-quality seed were critical to this success, and one key means of achieving this was through a partnership with Alpha Seed Company, a small family-owned Tanzanian business. For more than 15 years, Alpha Seed Company has worked with AVRDC and its other NARES and NGO partners to produce and market seed of new varieties. There were diverse aspects to this collaboration, including the annual provision of sufficient breeder's seed for eventual bulking into certified seed, and training Alpha 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 worked with AVRDC to help fabricate simple, farmer-friendly fruit maceration and seed separation equipment derived from AVRDC prototypes, and was supported by scien-

tists to ensure the purity and productivity of its seed production fields.

Since 2002, East Africa Seed, Kibo Seed and Multiflower/Royal Sluis Seed Companies also have been producing seeds of Tanya and Tengeru 97. The seed is produced close to AVRDC's Regional Center for Africa (RCA) at Arusha in Tanzania's dry upland area. The combined production by all the seed companies currently exceeds 15 t per year. Many young people in the region have been attracted by the income potential of tomato seed production, with some returning from jobs as labourers in the local tanzanite gem mines to become tomato contract growers.

The recent Tanzanian government evaluation of the impact of Tengeru 97 and Tanya on community livelihoods by Lyimo *et al.* (2005) showed that there had been a considerable increase in the area of tomatoes under production and in average yields in the seven years since their release, with net income gains for an average tomato producer of 21%. Six years after their introduction, more than 67% of farming households in tomato-producing districts in Tanzania grew Tanya and or Tengeru 97. The adoption intensity as measured by the proportion of the total crop area planted to the new tomato varieties in 2002–2003 was 58% and this had increased to 81% in 2003–2004. The new varieties have average yields of around 70 t ha^{-1} compared to 52 t ha^{-1} for the other older varieties. With the average variable cost of production being 17% lower, growing the new varieties produced an overall net income increase of 40%.

The new varieties are now known beyond Tanzania, as buyers come from neighboring countries to get supplies of the new seed and fresh tomatoes that possess a longer shelf life. The seeds and produce are 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 to 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, 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 varieties and are available for consumption over a longer period.

Meru, a new tomato variety bred by scientists at AVRDC and introduced into several African countries in December 2007, is rapidly becoming a favorite among Tanzanian farmers for its demonstrated resistance to late blight, a common disease that can significantly reduce tomato yields. Meru produces good yields of quality tomatoes under climatic conditions that favor development of late blight. To supplement the rising demand for late blight resistant tomatoes another new variety, Kiboko, was released in December 2008. The breeding pipeline continues to flow forward. New early-blight and late-blight resistant varieties with even greater potential than Meru and Kiboko currently are being evaluated in on-farm and multilocational trials involving all private, public and NGO/community-based organisation (CBO) sector partners.

The role of partnerships in establishing an enhanced market for indigenous vegetables

In parallel to research and development efforts with exotic vegetables such as tomatoes, the Center also works in active partnership with the private sector in Africa to develop indigenous vegetables. Most African diets are highly unbalanced, but a solution can be found in the indigenous vegetables often seen growing along roadsides and on uncultivated land. African fruit and vegetable consumption per capita is less than half the internationally recommended level and well below other developing regions of the world (Weinberger and Lumpkin 2005). Vegetables are one of the most important sources of vitamins and minerals and are a vital resource in the battle to overcome 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). African indigenous vegetables are surprisingly nutritious compared with common exotics such as white cabbage and standard red tomatoes. Researchers at AVRDC have found they contain higher levels of beta-carotene and vitamin C plus greater levels of vitamin E, folate, calcium, iron, zinc and anti-

oxidant activity (AVRDC 2004). This observation is common and germane throughout much of the developing world where malnutrition remains at crisis proportions and is particularly the case in Sahelian West Africa, the Ethiopian Highlands, the Great Lakes region and areas of southern and eastern Africa where maize is the dominant food staple.

AVRDC and its partners have developed improved lines, growing techniques and cooking methods for crops such as amaranth, spider plant, African nightshade, Ethiopian mustard and African eggplant that are fueling a resurgence in the popularity of indigenous vegetables in both rural and urban areas. Currently, producers find these crops are in high demand. The Center has been able to enhance the nutritional value of indigenous vegetables for consumers by modifying traditional recipes. Leafy vegetables are usually simply boiled or stir-fried, but researchers have demonstrated that adding oil, tomato, lemon, soybean and a combination of different indigenous vegetables can potentially increase the human bioavailability of beta-carotene by 50% and iron by over 50% (Yang and Tsou 2006; Ngegba *et al.* 2009). These recipes have been published in leaflets and distributed to farmers directly or through AVRDC's partners. In addition, researchers at AVRDC in Arusha, Tanzania and Hyderabad, India, have developed improved agronomic practices that can integrate up to 14 different kinds of vegetables in optimised home garden systems. Using these innovative cropping patterns, yields of over 80 t ha^{-1} y^{-1} can be obtained to provide a household's daily vegetable requirement year-round (Chadha and Oluoch 2003; Chadha and Oluoch 2007; AVRDC 2008a).

Home seed packs

Home garden packs containing elite lines of indigenous and exotic vegetables have been developed by the Center and widely promoted in East Africa to progressive farmers, womens groups, NGOs and schools during short-term training courses in growing, processing and preservation and cooking of vegetables. In Tanzania alone almost 8000 seed packs were distributed in 2007. In partnership with 23 seed companies in Eastern and Southern Africa, the Center is helping seed companies commercialise improved lines of African indigenous vegetables to ensure they can play their vital part in overcoming malnutrition in Africa (AVRDC 2008a).

For example, selected high yielding lines suited to local tastes are being 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 nightshade (sweeter varieties), spider plant, vegetable cowpea 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 organised in business support groups and linked to markets, sales of indigenous leafy vegetables such as giant nightshade grown with seed sold by the Simlaw Seed Company increased from 31 t in 2003 with an estimated farm gate value of USD6000 to 600 t in 2006 with an estimated farm gate value of USD142 860 in Nairobi, Kenya, alone (MATF 2007; Ngugi *et al.* 2007). The volume of sales 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.

Amaranth

Leaves of amaranth (*Amaranthus* spp.) have been a traditional food across Africa for centuries. Three improved lines introduced by AVRDC and possessing softer, sweeter leaves than the older types have created a new industry for small peri-urban farmers in East Africa. The new varieties can be harvested in just 21 to 28 days and have reduced cooking times. The nutritional value of amaranth depends on how it is cooked. Leaves plucked from traditional varieties are much tougher than the soft young whole plants harvested from the new varieties, and are usually cooked for up to 40 minutes. At AVRDC in Arusha, Tanzania, women farmers have learned recipes for the new varieties that use cooking times of as little as 10 minutes. This maximises the nutritional value of amaranth and helps save fuelwood — an added bonus in a region where wood is in short supply due to dwindling forest cover.

Seen as an inexpensive high-protein substitute for meat, the demand for this highly nutritious vegetable has contributed to the growth of a viable seed sector in East Africa. Local seed companies in Uganda 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 com-

panies, AVRDC and NARES are promoting and demonstrating these lines prior to local release.

African egg plant

In Tanzania, AVRDC has had a success story with African eggplant. For years 'garden eggs' as they are commonly known in much of Africa, were literally just that — a backyard crop ignored as a potential income earner because of low-quality varieties, a perception that it was food for the poor, and competition from exotic crops like tomatoes and the eggplant common in the rest of the world. Selection work conducted by AVRDC from 2000–2005 identified the varieties Tengeru White and the premium-priced and sweet-tasting DB3, AB2 and RW14 as having great market potential. The new lines now dominate markets around Arusha. DB3 can be harvested every week for seven months, and produces for up to 15 months if pruned back at the end of the season. Because of its scarcity and high demand, it can fetch up to three times the price of the other new variety, Tengeru White. Farmers can harvest ten to twenty 30-kg bags of African eggplant each week throughout the seven-month growing season and earn USD2500 ha^{-1} a year, which is almost twice the income possible from tomatoes (AVRDC 2008b). Today African eggplant regularly appears on the shelves in the supermarkets that cater to the region's wealthiest consumers. Local seed companies have started scaling up seed production using AVRDC protocols, but there is still a need to improve marketing channels. A recent socioeconomic impact assessment of households' participation in growing African eggplant in four villages in Arumeru district near Arusha determined the magnitude of commercialisation of African eggplant. Families growing African eggplant were found to have significantly higher values in almost all parameters of commercialisation, including time spent by household members, income levels and ownership by gender. It was ranked as the current number one cash crop (AVRDC 2008a).

Lessons learned

Quality seed is an essential input for the production of vegetable crops needed to balance the world's nutritional requirements. Promoting the use of improved seeds and suitable crop husbandry techniques are of particular importance for poverty alleviation. A united team approach involving private- and public-sector institutions and farmers that combines 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. The production of quality seed requires mastery of two kinds of expertise:

- technical knowledge of seed biology combined with skills to overcome biological restrictions
- managerial skills required to run a seed business.

Both skills often are lacking, but the former is best found in public-sector research organisations such as AVRDC and the NARS, and the latter is far better executed by the private sector. In addition it is important to have strong and transparent national seed regulatory systems in place to assure the availability of foundation seed to the companies. Only by working in coordinated public–private partnerships can we hope to strengthen the seed systems in Africa and ensure easy access by farmers to locally adapted, affordable seed.

AVRDC's strategy for vegetable improvement has been to supply national agricultural research centres and private companies with germplasm and semi-finished varieties through material transfer agreements in which the intellectual property rights remain, where possible, fully in the public domain. Although not perceived as profitable by large multinationals, OPVs continue to be widely planted and may actually possess longer projected niche market life expectancy than hybrid seeds. Working in partnership with the private sector has provided AVRDC with a good understanding of the use and management of intellectual assets, of intellectual property rights and how to protect these rights to ensure the Center's target clients are able to access the technologies they need from the Center. However, there is no ideal intellectual property rights (IPR) system for plant breeding due to widely differing seed systems between crops and among and within countries. Our experience in working jointly with private and public partners and negotiating agreements has further underscored the importance of clarifying intellectual property rights beforehand to ensure an appropriate balance is achieved between public interest and incentives for the participating company. Information and varieties generated through AVRDC's projects will remain international public goods.

Future role of AVRDC

Improved performance of the smaller seed companies fosters a competitive seed sector and helps to make access to locally adapted seeds affordable to smallholder farmers; this in turn will lead to increased productivity. AVRDC is committed to continuing to support local seed companies with variety testing and seed multiplication of breeders' seed. Training and assistance in the development of realistic and practical business plans as well as seed marketing and dissemination strategies are also provided. AVRDC will continue to facilitate the training of NARES and NGOs in production technologies, and foster vegetable production and consumption by building networks that ensure all public- and private-sector stakeholders are well linked and understand their respective strengths, roles and common goals. Malnutrition also will be targeted by fortifying partnerships with NARES and NGOs to disseminate improved production technologies and establish linkages with institutions promoting community health.

Although the development of small seed companies is being fostered through the establishment and or improvement of seed distribution channels, a balance between profitability and sustainability is necessary. It would appear that small- to medium-sized seed companies at present have a potential competitive advantage in meeting the needs of farmers in sub-Saharan Africa due to their flexibility and niche market orientation. Their participation is essential in addressing food security, malnutrition and poverty reduction issues within economically disadvantaged rural communities. However, due to their small size, it is unlikely that they would develop in-house breeding capacity for a wide range of crops. Investing in public-sector breeding research and ensuring research outputs reach the private sector in a functional and timely manner is a major way in which all partners can contribute to the food and nutritional security of the poor.

It is an inescapable fact that funding for public-sector research, particularly for long-term efforts such as plant breeding, has diminished drastically over the last decade. This trend runs strongly counter to national and regional interests and to the likelihood of achieving the Millennium Development Goals. Enhanced future investment in agricultural 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.

Why is this paper of importance to Australian donors and to vegetable research in Australia?

Australia's vegetable research programs are superficially collaborative, with shared funding between government and industry through Horticulture Australia. In reality, the division of interests between commodity focus groups, grower groups dominated by recent immigrant communities, a lack of industrial levy funding for major national crops like tomatoes, competition between state research organisations and the evaporation of their longer-term funding support has considerably weakened the vegetable sector and its potential future development.

In an open and developed economy, local seed companies have to survive in a climate of international competition. By world standards, the Australian vegetable industry is relatively small, with many players and diverse environments over wide agro-ecological zones. Given the size of the local market, it has therefore been difficult for local vegetable seed industries to survive. As a consequence, virtually all major Australian seed companies are now internationally owned. Fewer than ten small- or medium-sized local vegetable seed companies produce specialist lines, and these receive little breeding support from government. To a large extent, Australian vegetable growers rely on imported varieties, as international companies have scanned the world and know what to breed for if the market is large enough and can pay. Australian government breeding programs provide some locally adapted germplasm for larger vegetable industries such as tomatoes, brassicas, sweet corn and capsicums, but much more investment has been made in working with seed companies in the much larger pasture and field crop industries.

The recent epidemic of tomato yellow leaf curl virus in Queensland's winter-season tomato industry surely demonstrates that effective research investment would have helped in reducing the current risk to this major national industry. Australia's reliance on international seed companies can lead to considerable problems when new disease races or pests appear and there is no public breeding program to provide sources of resistance. Although this devastating disease has not been found in this region previously, its profligate global expansion should have been sufficient warning that palliative investment in

international agricultural research efforts to achieve resistant germplasm would have been a good national insurance policy. That this lesson is neither unique nor probably the last such experience to occur in Australia, irrespective of stringent quarantine laws (N.B. the devastation of *Ascochyta* blight in chickpeas in Western Australia in the last decade) should alert public-sector investors to the need for supporting suitable international agricultural research. Moreover, they also need to ensure that the domestic plant breeding sector is maintained and the pipeline of young Australian plant breeders, pathologists, entomologists and other agricultural professionals from universities continues to flow. At present, national underinvestment severely threatens this outcome.

When there is an imbalance between the contributions of the public and private sectors, marketing can by default shape what farmers grow more than agronomic suitability. Varieties often are commercially successful because large companies have the marketing presence to advance specific lines, despite their agronomic limitations. 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 no longer has the capacity to carry out the work. The public sector needs the private sector, as varieties produced in public programs usually have no easy path to commercialisation unless the program is funded by, or aligned with, a large international company with the means to distribute and market seed. The private sector needs the public sector to provide the best-adapted germplasm for locally important industries that may not be globally significant.

Active government research breeding programs and collaboration with local seed companies can create whole new industries to benefit local farmers and create export opportunities. For three decades the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and state Departments of Primary Industry in Queensland and New South Wales led plant breeding efforts to produce locally-adapted mungbean varieties using AVRDC-derived germplasm, working in close collaboration with local seed companies and the industry association. This created the Australian mungbean industry, and the crop is now the country's most important tropical grain legume.

Government support for the development of Australia's native foods through the Rural Industries Research and Development Corporation (RIRDC) has encouraged the rapid development of the industry, as evidenced by the recent formation of an industry peak body, Australian Native Food Industry Limited. Without government support, indigenous crops would not have developed into viable mainstream industries or potential sources of income for indigenous communities, and knowledge of their value and cultivation may have been lost. International agricultural research organisations such as AVRDC are doing the same for indigenous vegetables worldwide.

The current Australia – New Zealand 'Vital Vegetables' initiative is an excellent example of the benefits of combining government research and development efforts with the expertise of smaller private companies to bring improved, nutritionally enhanced vegetables to market to benefit local consumers and to help local vegetable industries maintain a competitive export edge in a global marketplace.

Safe vegetable production is one of the most effective ways of creating prosperity in the developing world. International agricultural research organisations such as AVRDC — The World Vegetable Center have an important role in working with small private companies to build national vegetable industries in countries where governments do not have the expertise and quality vegetable seed production and marketing are poorly developed.

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