2015
ANNUAL WORKPLAN

AVRDC - The World Vegetable Center

Published by
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AVRDC Publication: 15-789

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Photos: AVRDC Image Archive

Suggested citation
AVRDC. 2015. 2015 Annual Workplan. AVRDC – The World Vegetable Center. Shanhua, Taiwan. Publication 15-789. 64 p.

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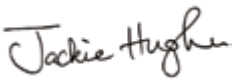
PREFACE

During the 47th Board of Directors meeting of AVRDC – The World Vegetable Center held in Arusha, Tanzania from 8-10 April 2014, concern was registered by the Program Committee that the established format of the Medium-Term Plan document (as seen in the Medium-Term Plan 2014-2016) seemed overly detailed and arduous both to prepare and read. The Board recommended changes to reduce the associated workload and improve the strategic qualities of the document, such that in 2015 and 2016 only a shorter and simpler Annual Workplan document be prepared. This would be in lieu of presenting the annual full rolling three-year MTP, but yet the Annual Workplan should be understood to link back to the 2014-2016 Medium-Term Plan document, which remains valid for the years 2014, 2015 and 2016. This shorter style of document would therefore only be required in the later two years of the three-year Medium-Term Plan and would only need to be replaced, in this case, by a 2017-2019 version of the Medium-Term Plan at the Board of Directors Meeting in 2017. This discussion is briefly summarized in the 47th Board of Directors 2014 Minutes (Page 9, Section 7, items 3 and 4).

The AVRDC Management agreed to undertake this modification in its formal documentation. At the 48th Board of Directors Meeting held at Patancheru, Telengana, India held from 22-24 April 2015, the Board passed a resolution approving this 2015 Annual Workplan document (Resolution 48/1) with the proviso that a section be added to the draft Annual Workplan prior to it becoming finalized, formally linking the research proposed in 2015 with research approved for 2015 in the 2014-2016 rolling Medium-Term Plan.

This is therefore the brief explanatory text written after the 48th Board of Director's resolution, which is designed to indicate that the Annual Workplan documents for 2015 (and later for 2016) are to be read and used within the overall context of the Board of Directors-approved Medium-Term Plan 2014-2016. In the future an Annual Workplan will be prepared for the second and third years of each Medium-Term Plan.

J.D.H. Keatinge
Director General



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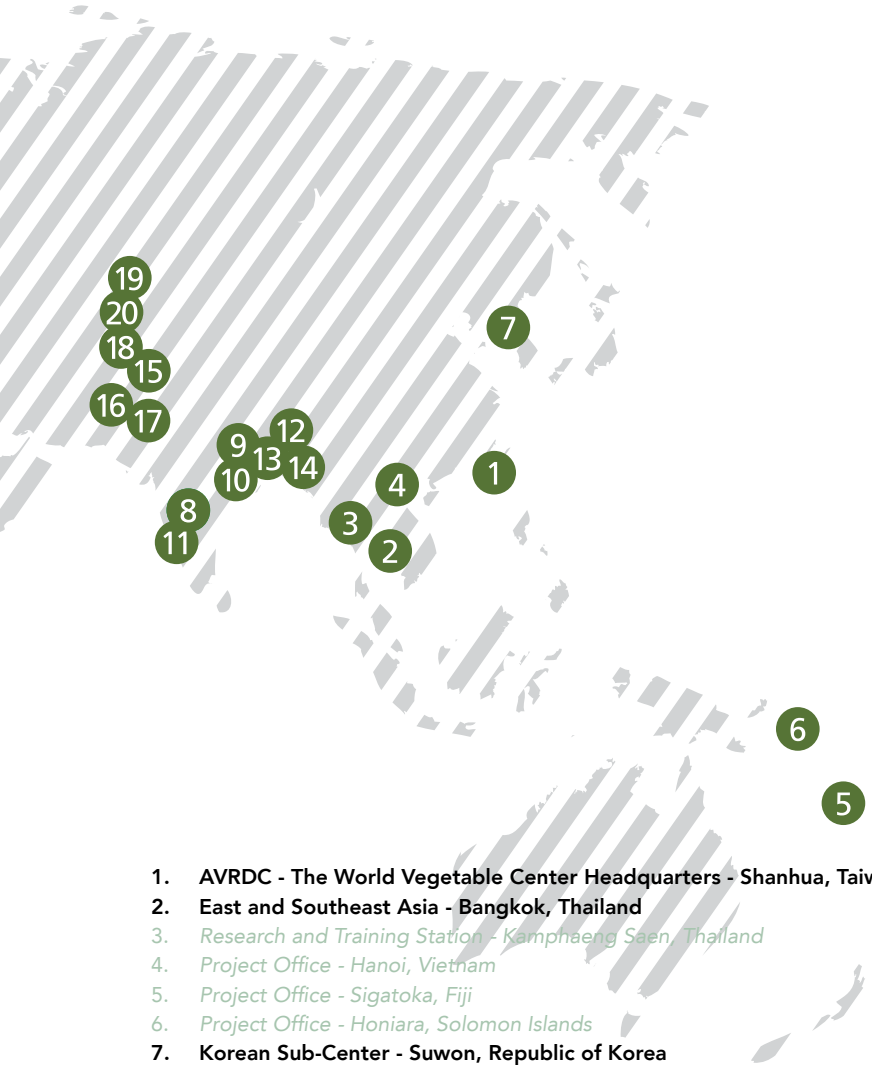
OFFICES



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REGIONAL FOCUS

AFRICA

After 20 years of operations in Africa, on 1 January 2014 the Regional Center for Africa was split into two regional offices: Eastern and Southern Africa in Arusha, Tanzania, and West and Central Africa in Bamako, Mali. The split has allowed the Center to engage better with local and regional partners, and correct regional imbalances in resource availability. Both regional offices continue to work in harmony and seek complementarity where applicable, such as in the production and scaling of seed kits or testing of starter solution technology.

EASTERN AND SOUTHERN AFRICA

Genetic resources: The regional office for Eastern and Southern Africa holds the largest seed repository of traditional and global vegetables (more than 2,500 accessions) on the continent. The repository will be expanded in 2015. A major activity will be morphological and agronomic characterization of approximately 250 accessions per year, using well-defined and harmonized standards. Accessions will be tested for drought, heat, salinity and flooding tolerance. Additional germplasm may be collected from previously uncovered areas or from biodiversity hotspots (e.g. Madagascar) to broaden the repository's genetic base.

The seed repository will continue to respond to requests for seed kits for programs providing income and nutritional benefits for poor and vulnerable communities, as well as large-scale requests for disaster relief or post-conflict recovery programs. For medium- and large-scale seed requests, the regional office combines seed kit distribution with practical and comprehensive training-of-trainers programs (community seed production, agronomy, harvest, postharvest, marketing and utilization) and follow-up visits in the field. This allows staff to track distributed seed kits for quality assurance, and to implement effective monitoring and evaluation.

AVRDC's home garden seed kits will be commercialized in the region in 2015 and beyond. At present, seed kits are not commercially available in Eastern and Southern Africa, but we envisage that market demand will be generated through a large project implemented by AVRDC and funded by the United States Agency for International Development (USAID) in Kenya, Tanzania and Uganda (as well as Liberia and Cambodia). The private sector has expressed interest in tapping the home garden market segment.

The regional office will implement database systems to help align foundation seed production with private sector demand, as well as provide market information and analytics related to vegetable supply through the value chain, ultimately benefiting smallholder farmers.

Selection and breeding: Selection from within the existing accessions will continue, prior to evaluation, testing and release by national programs and private companies in target environments of various countries in the region. Selection and breeding efforts are geared towards traditional African vegetables, with amaranth (a leafy vegetable) and African eggplant (a fruit vegetable) as the main focus; African nightshade, Ethiopian mustard, spider plant and vegetable cowpea are included based on resource availability.

Global vegetables like tomato remain very important in sub-Saharan Africa, but in the short-term their improvement will focus mainly on introduction of target populations from headquarters or mandated regional offices.

Production: Grafting technology will be introduced to expand the growing season for smallholders as well as the geographic area for tomato production, and potentially other vegetables. Grafting will boost a seedling cottage industry, an ideal opportunity for women to generate income. Proper pesticide and fertilizer application will receive greater attention. Linkages are being made with biopesticide and biofertilizer companies to research, test, adapt and implement products that enhance yield without compromising environmental sustainability.

A systems approach: There is high potential for the integration of vegetable production in staple crop, tree crop and agroforestry systems. In Eastern Africa, great potential exists for linking vegetable cowpea and pigeon pea; amaranth with maize; and African eggplant, amaranth, onion, sweet pepper and tomato as follow-up crops to irrigated rice, using residual water. Through Africa RISING and the Humidtropics program, the Center continues to strengthen integration of vegetables in staple cropping systems in Tanzania and Uganda.

Postharvest interventions: The regional office will continue to focus on postharvest handling and processing, particularly for women, with emphasis on completing physical and economic loss assessments and testing options for prolonging shelf-life and adding value. Training-of-trainer programs to disseminate technologies and encourage adoption will be conducted, as will further research on understanding and analyzing the causes of postharvest losses in vegetable value chains. The postharvest program will continue to emphasize development of low-cost cooling interventions suitable for smallholder farmers, such as zero energy cool chamber (ZECC) evaporative coolers.

Focus on market research: One of the region's largest projects, "Improving income and nutrition in Eastern and Southern Africa by enhancing vegetable-based farming and food systems in peri-urban corridors" funded by the Australian Centre for International Agricultural Research (ACIAR), is testing new modalities for scaling. At Best Practice Hubs established in Ethiopia, Malawi, Mozambique and Tanzania,

unemployed youth are trained in farm business and entrepreneurship skills. using a value chain approach that targets concrete high-value market opportunities. The regional office will actively pursue opportunities to address research gaps related to psychological, socio-cultural and economic factors affecting the demand side of vegetable consumption, and through public-private partnerships that strengthen linkages between value chain actors in promoting nutrition-sensitive interventions. More emphasis will be placed on nutritional education and social marketing promotion for behavioral change.

Expansion: Additional office space will be built at the Arusha campus during the year. Currently, the regional office hosts the International Institute for Tropical Agriculture (IITA); talks are underway to host other international organizations. In 2015, AVRDC will open an office in Kenya, to be housed at icipe. Efforts will be made to place staff in other countries (e.g. Madagascar and Zambia) for more effective implementation of activities and increased visibility in the region.

Linkages and partnerships: The regional office will continue to explore opportunities with members of the Association of International Research and Development Centers for Agriculture (AIRCA), such as the Lake Victoria Basin project, focusing on youth and women. Linkages and partnerships with national agricultural research and extension systems, nongovernmental organizations, input companies, farmer-based organizations, processing industries, and relief and rehabilitation organizations will ensure dissemination, adoption and impact.

Training: Trainer-of-trainer programs will be streamlined through harmonization and publication of manuals, so other research and development groups can benefit. The regional office will actively source for graduate students through partnerships with local universities, such as Jomo Kenyatta University of Agriculture and Technology (Kenya), Makerere University (Uganda), Nelson Mandela Institute of Science and Technology (Tanzania) and Sokoine University (Tanzania), among others.

Human capacity: The region has nine internationally recruited scientists, 20 nationally recruited scientists, five consultants and one person seconded from the Ministry of Agriculture, Food Security and Cooperatives, in two countries (Uganda, Tanzania). In 2015 the regional office will seek to expand its capacity to address plant health issues (both in research and extension advice), as well as funding for

WEST AND CENTRAL AFRICA

Restore feeder research capacity: To support downstream research-to-delivery processes, the regional office will need to continue to develop new technologies in the area of breeding, cropping systems, postharvest and nutrition. As most vegetable crops in the region are produced for fresh market consumption, this makes them vulnerable to spoilage if delays in reaching markets occur. These losses add to those occurring before or during harvest owing to unsuited genetics of the crops, inadequate protection of the crops against pests and diseases, and poor agronomic systems, among others. Developing options for reducing spoilage is an essential companion to research for options that increase production, and a precursor to interventions that increase and diversify processing capacities. Only in this way can additional gains and stability in income along the vegetable value chain be secured.

In 2015, the regional office will capitalize on the preliminary results from seed trials to boost breeding efforts for onion in Mali, notably with new genetic populations, while continuing to select for improved shelf-life among existing materials. The regional office will also begin regional scale evaluation of aphid-tolerant okra lines developed in Cameroon while screening for consumer-preferred mucilage content.

On-going research in crop production include participation in a global study on starter solution under the Center's newly established Innovation Fund and another multicountry initiative coordinated by German universities and German Federal Ministry for Economic Cooperation and Development (BMZ)/Gesellschaft für Internationale Zusammenarbeit (GIZ) under the UrbanFood+ initiative.

Cereal/legume/vegetable crop configuration and other system studies will constitute another dimension of crop production research, in collaboration with the International Crops Research Institute for the Semmi-Arid Tropics (ICRISAT) and International Institute for Tropical Agriculture (IITA) under the Africa RISING and the Humidtropics initiatives. Most importantly, the regional office will seek to increase capacity for crop protection research to address existing constraints to off-season (rainy season) production of vegetables and emerging threats such as the leaf miner (*Tuta absoluta*).

In 2015, the regional office will seek to expand capacity for postharvest and market research, building on the on-going seed work in Cameroon on consumer preferences in collaboration with German universities and postharvest losses in Ghana carried out as part of a Center-wide initiative.

As the region will have implemented several projects for downstream dissemination and adaptation of tested vegetable technologies, it will need to evaluate the performance of the technologies as well as that of the dissemination process to gain knowledge on 1) deployment of new varieties, 2) pesticide use, 3) barriers and incentives to adoption of new technologies and consumption of new/improved vegetables, and 4) effectiveness of the mechanism for testing, adapting and delivering research outcomes and building capacity to turn the research outcomes into profitable businesses. The regional office will seek expertise and build capacity for this in 2015.

Consolidate research and development bridges: Bridging research and practice will continue to be the Center's main thrust in the region, notably in Mali, where it is anticipated that some 45 vegetable technology immersion clusters (VTICs) linked to existing Best Practice Hubs (BPHs) will have been established by 2016 to facilitate community access to new varieties, reaching an estimated 50,000 beneficiaries.

It is projected that increased demand for quality seed will emerge as a result of the project. To sustain this, AVRDC will demonstrate, starting in 2015, protocols for efficient seed production to potential seed entrepreneurs and facilitate access to low cost seed drying equipment that can be easily constructed locally. The low cost seed dryer also can be used for drying leafy vegetables or cut pieces of fruit vegetables for preservation and future use.

Also from 2015, the regional office will help to establish low cost storage facilities at each VTIC and BPH. These low cost storage facilities will feature Zero Energy Cool Chamber (ZECC) evaporative coolers to extend shelf-life of harvested produce. The construction of the ZECC and low cost seed dryers will provide temporary employment to local artisans and likely encourage small businesses around postharvest handling of vegetable seed or produce, and possibly have applications for other commodities.

Deploy home gardening to increase regional presence: The 2014 Ebola outbreak in the West and Central Africa region exacerbated food insecurity, malnutrition, and rural poverty in the most affected countries. Agricultural interventions can boost resilience of cropping systems and populations. Reversing insufficient crop diversity—notably with fast-growing crops such as vegetables—that are available, nutritious and affordable to local populations is required to improve long-term food and nutrition security prospects. Using nutrient-dense vegetables to complement and diversify staples will result in better diet quality and contribute to combating malnutrition.

Homestead food production based on mixed cropping of vegetables with various staple and tree crops has been an integral part of the local agricultural landscape, but the vegetable varieties used currently do not have the same high yield potential,

resistance to diseases and high nutritional values as the modern improved varieties of exotic vegetables or elite traditional vegetables. Most households cultivate vegetables in backyard gardens using very low input cultural practices and poor quality seeds, resulting in low output and profitability. The deployment of good varieties and improved cultural and postharvest techniques has the potential to quickly reverse the situation.

Starting in 2015, the regional office aims, together with national agricultural research and extension systems (NARES) and communities, to introduce, evaluate and disseminate seed kits of superior lines widely consumed vegetables (chili pepper, okra, roselle, and tomato) that have been extensively tested in humid and sub-humid zones (Benin, Cameroon, Ghana and Togo) and in the Sahel (Mali, Niger, Burkina Faso and Senegal). The project will scale up and enhance widespread and rapid adoption of AVRDC's validated home garden concept and associated production and processing technologies by households, reaching an estimated 2,000 vegetable growers and ultimately 10,000 beneficiaries in each target country.

The Center's plan is to initially use existing community-based organizations for the distribution of seed kits imported from AVRDC bases in West and Central Africa, but will gradually shift to in-country production and capacity building operations to support dissemination.

To prepare for the transition to local leadership, the Center intends to train at least 50 vegetable research and extension specialists followed by in-country mentoring support. The Center also intends to identify and engage the private sector to supplying quality seed while organizing the trained growers into "accredited vegetable supply associations" under the stewardship and coordination of the NARES, as part of an exit strategy.

ASIA

Asia is the most populous continent, with 4.3 billion inhabitants accounting for 60% of the world population. Serious malnutrition problems exist in certain locations and communities. There is a major need to improve nutrition through improved household production and consumption of vegetables as well as to increase the quantity of vegetables marketed. Most vegetables are sold fresh, and only a very small proportion is processed. Postharvest losses are regularly over 25% and the value chains are often complex. High prices for consumers and low returns for farmers are blamed on a combination of poor transport, a major lack of cool storage infrastructure, and the power of middlemen. Across the region, farm sizes are small and are decreasing.

EAST AND SOUTHEAST ASIA

In 2015 AVRDC - The World Vegetable Center East and Southeast Asia will celebrate its 34th anniversary as AVRDC's first regional office established outside Taiwan. Currently, the office has 27 staff members (3 internationally recruited and 23 nationally recruited) supported by 6 temporary field laborers in Thailand, and one internationally recruited staff member located in Hanoi, Vietnam working on the CGIAR Humidtropics Central Mekong site. The gender balance is healthy, with an equal ratio of men and women.

There are 11 donor-funded projects in East and Southeast Asia. Improved lines and varieties are routinely evaluated for their suitability to growing conditions and consumer preferences, and the efficacy of pest and disease management technologies are monitored. The global crop improvement program for cucurbits, in particular bitter gourd (*Momordica*

charantia) and pumpkin (*Cucurbita moschata*), based at the Research and Training Station in Kamphaeng Saen for the past five years, continues to develop lines with desired traits. Breeding lines have been tested in Cambodia, Lao PDR, Vietnam and Tanzania and adopted by several Thailand-based seed companies and also by the public sector. Additional testing of cucurbit lines, plus tomato and pepper, is planned under new funding from the Japanese government targeting Myanmar and Vietnam in 2015-8. A monitoring and impact specialist has been recruited and is focusing on the identification, promotion and application of postharvest technologies in Cambodia, Nepal and Bangladesh.

Capacity building has been a respected and visible function of the regional center and in 2015 the International Vegetable Training Course (IVTC) will be in its 34th year. This course serves the training needs of other AVRDC regions and permits international trainees to share their diverse expertise and experiences with one another (Table 1).

The IVTC trainees form an effective network of alumni who remain in contact with each other and the Center; they often are appointed to influential positions and serve as collaborators on AVRDC research and development projects. The Economic and Social Commission for Asia and the Pacific of the United Nations (UN-ESCAP), funded by European Union (EU), selected AVRDC East and Southeast Asia to implement the SATNET Asia project in Cambodia, Indonesia, Lao PDR, Myanmar and Vietnam; this project will continue into 2015. A series of in-country and demand-driven capacity-building initiatives will be completed in 2015 (Table 2) to strengthen South–South dialogue and intra-regional learning on sustainable agriculture technologies. Postharvest training initiatives targeting Nepalese government officials and research/extension/policy representatives from countries across the region will be implemented in 2015 with support from the International Fund for Agricultural Development (IFAD), United States Agency for International Development (USAID) and the Rural Development Adminstration, South Korea.

East and Southeast Asia covers 16 countries including 10 ASEAN countries that vary in terms of their capacity for research and development and the organization of their vegetable sectors. Through SEAVEG, a biennial regional scientific symposium, the Center and its partners strengthen regional collaboration. Planning will begin for SEAVEG 2016 with the proposed host institution, the Malaysian Agricultural Research and Development Institute.

AVRDC assists with the coordination of AARNET (ASEAN-AVRDC Regional Network for Vegetable Research and Development) through the direct support of participants from seven of the 10 ASEAN countries and financial support from the Taiwan Ministry of Foreign Affairs (MOFA). AARNET facilitates the development and implementation of projects in ASEAN countries as well as information exchange, technology transfer and training on vegetable value webs. Steering Committee meetings are hosted annually and alternate between different ASEAN member countries. AVRDC organises a consecutive Expert Consultation Meeting and invites external speakers on topical areas; in 2015 in Lao PDR the consultation will focus on Mitigation and adaptation to climate change for vegetable-based systems.

Research projects are being sought to support a critical mass of core scientists in the region. For middle- to high-income countries, appropriate nutrition (to curtail obesity, diabetes and heart-related problems) and food safety are key targets for proposal development. However, for lower income countries, efforts focus on the establishment of sustainable vegetable cultivation systems. For all countries, more resilient, sustainable and diversified production systems are required; this necessitates more action to optimize natural resource management, agronomic and IPM practices, postharvest technologies and market linkages. Stronger links with international agricultural research centers, nongovernmental organizations, landscape and forestry partners, and the public and private sectors will be leveraged to increase the visibility and impact of the regional office.

Table 1. Nationality and gender of trainees who benefited from the International Vegetable Training Course (IVTC) as of the 33rd course in 2014.

REGION	COUNTRY	BATCH 33 2014	1981-2014	1981-2014 TOTAL BY REGION
East and Southeast Asia	Brunei		2	627
	Cambodia	12	74	
	China (PR)		139	
	Hongkong	2	5	
	Indonesia	11	53	
	Korea	1	18	
	Lao PDR	2	60	
	Malaysia		11	
	Myanmar	10	71	
	Philippines		23	
	Singapore		7	
	Taiwan	1	4	
	Timor Leste		3	
	Thailand	4	55	
	Vietnam		102	
South Asia	Bangladesh	8	46	119
	Bhutan		18	
	India		8	
	Nepal		9	
	Pakistan		5	
	Sri Lanka	6	33	
Africa	Burkina Faso	1	2	11
	Cameroon		1	
	Gambia		1	
	Kenya		1	
	Zambia		1	
	South Africa		1	
	Nigeria	1	1	
	Sudan	1	1	
	Swaziland	1	2	
Others	Afghanistan		24	57
	Kazakhstan		20	
	Jordan	2	2	
	Iraq	2	2	
	Netherlands		1	
	Papua New Guinea		4	
	Tuvalu	1	1	
	Nauru	1	1	
	UK		1	
	Venezuela		1	
	TOTAL	**67**	**814**	**814**
	GENDER			
	Male	46	554	68%
	Female	21	260	32%

Country	Title of Training	Participants		Total per Country		
		M	F	M	F	TOTALS
Cambodia	Postharvest technology and marketing systems for small scale farmers	19	8	41	14	55
	Vegetable genebank management and seed production systems	10	1			
	Integrated Pest Management	12	5			
Indonesia	Improving food and nutrition security through development of home gardens	10	10	44	42	86
	Postharvest technology and marketing systems for small-scale farmers	13	10			
	Vegetable Genebank Management and Seed Production Systems	7	11			
	Writeshop on translating research findings into knowledge accessible and understandable by farmers	14	11			
Lao PDR	Genebank management and seed production systems	7	8	25	19	44
	Postharvest technology and marketing systems for small-scale farmers	9	6			
	Improving food and nutrition security through development of home gardens	9	5			
Myanmar	Sustainable crop production systems for small-scale farmers	20	9	54	17	71
	Postharvest technology and marketing systems for small-scale farmers	17	7			
	Writeshop on project development for scaling up agricultural extension programs	17	1			
				164	**92**	**256**

Table 2. Titles of training courses and number of trainees facilitated by AVRDC under the SATNET project to be completed in 2015.

SOUTH ASIA

AVRDC's work in the region in 2015 continues its long-term focus on legume breeding and promotion in cereal systems, testing and promoting improved tomato and chili lines, and promoting home and school vegetable gardens for improved nutrition. Work in eastern India and Bangladesh is helping rice farmers to move into vegetable production. Work in Pakistan is extending low cost protected cultivation systems to provide new options for off-season production of vegetables. Research and training work on postharvest management in Bangladesh, Nepal and Pakistan is clarifying the extent of postharvest losses, identifying key intervention points and providing training for key sectors on how to reduce losses.

Legume breeding and promotion: In addition to mungbean and vegetable soybean in India, Pakistan and Bangladesh, a growing amount of work is being done in vegetable cowpea, yard-long bean and black gram. Two new projects to support regional breeding and development work on mungbean will start in 2015 and will include Myanmar and Uzbekistan.

Mungbean yellow mosaic disease devastates crops across the region, and most commercial varieties are susceptible. Bruchids are a major pest of stored grain and although India is the world's largest mungbean producer, yields are well below those in other major producing countries. There is a need to include short-season mungbean crops as a part of cereal rotations and to expand mechanical harvesting of the crop to reduce production costs.

In 2015, mungbean lines resistant to mungbean yellow mosaic disease and powdery mildew will be finalized ready for release, and experimental studies on abiotic stress tolerance (heat, salt and drought) will be continued in collaboration with three national partners in India. Experimental studies on iron uptake by different accessions across sites will be extended to assess transport and distribution patterns to select those that maximize the value of mungbean as a food to address anemia problems in women and girls. Promotion of vegetable soybean, mungbean, urdbean, vegetable cowpea and yard-long bean in Asia and sub-Saharan Africa will continue through regional testing, ensuring the

participation of women farmers. Strategic links with the private sector will expand seed production of vegetable soybean in India.

Work will continue in both Pakistan and India to promote rotation of improved varieties of mungbean in cereal systems. In Pakistan a major effort to produce more than 500 tonnes of quality mungbean seed will be undertaken. Mungbean already has been successfully demonstrated in three different cropping systems across the country, and 3500 ha of demonstration plots will be developed across 10 districts to reach 1600 new mungbean growers, and to expand farmers' access to improved varieties. Mechanical harvesting will be refined for local conditions in Islamabad and trialed in conjunction with farmers in Pothwar and Bhakkar districts. Promotion of mungbean for rainy season production in West Bengal, Jharkhand and Karnataka will continue.

Tomato and chili testing and promotion: AVRDC improved tomato lines are widely used by the regional seed industry and have been a vital source of disease resistance for over 30 years. In 2014 funding was provided by a consortium of 22 seed companies for collaborative testing across India of advanced AVRDC lines with resistance to *Tomato yellow leaf curl virus* (TYLCV). This work will continue in 2015. Advanced AVRDC tomato lines are now regularly imported into India and seed bulked up to use in regional trials and for distribution to seed companies. Testing and promotion of improved lines of both tomato and pepper is a feature of ongoing USAID-funded work in Pakistan. With the appointment of a regional seed production officer, the production of seed of elite tomato and pepper lines for local testing will continue to expand.

In Bangladesh a variety of work to promote improved tomato production is underway in a USAID-funded project. Training in summer tomato production under plastic will be expanded to the Patuakhali area in the southern coastal delta. One or two high yielding AVRDC lines with heat tolerance and resistance to TYLCV are expected to be officially released. Cherry tomatoes will be promoted in project areas in the south of the country and growers linked to supermarkets. Similar work is being done in eastern India in a project funded by the Australian Council for International Agricultural Research (ACIAR). Summer tomato production will continue to be promoted. Evaluation of elite AVRDC lines and the use of wild Solanum species as grafting rootstocks for control of soil-borne diseases such as bacterial wilt are ongoing.

An evaluation of the impact of AVRDC tomato and pepper germplasm is underway across the region, involving interviews of all major seed companies. The study already has shown that AVRDC parent material is used in up to half of the tomatoes grown in India during the rainy season. A final report is due in 2015. More comprehensive testing of improved lines for postharvest handling as well as yield and quality is being introduced through regional postharvest project work funded by USAID.

Home vegetable gardens for improved nutrition: This has been a major regional focus for AVRDC for more than 20 years, and four projects will continue to develop home and school gardening in 2015. In the flood-prone areas of Puri district in Odisha in eastern India the COFRA-funded project is promoting home gardening to women's self-help groups in collaboration with Catholic Relief Services. Women's self-help groups are being trained in improved home garden production practices like bed preparation, line sowing, staking, and staggered sowing and harvesting, seed production and seed storage. Bag gardens and floating gardens introduced from AVRDC project areas in Bangladesh are also being demonstrated and promoted as alternative vegetable production systems to cope with flooding. Women's self-help groups are being linked up with seed suppliers to provide isolated communities with sustainable access to good quality seeds.

In Nepal and Bhutan school gardens are being promoted in partnership with departments of Education, Health and Agriculture through the Swiss Agency for Development and Cooperation (SDC)-funded Vegetables Go to School project. In Bangladesh, a USAID-funded project that has already developed school gardens

involving 4400 students and recorded up to 80% increased vegetable consumption will be continued.

Helping cereal farmers start growing vegetables: This is being undertaken in three projects across the region; in Jharkhand and West Bengal in eastern India, in Karnataka in southern India and in southern Bangladesh. In eastern India farmers can make more money growing vegetables than rice or maize when monsoons are late or deposit less rain than usual. Trials and demonstrations are continuing on the intercropping of French beans in maize and in promoting trellis production of sponge gourd, bitter gourd, cucumber and pointed gourd. In both eastern India and Bangladesh tomatoes under plastic are being promoted for rainy season production. In southern India there has been good success in promoting Good Agricultural Practices (GAP) for chili farmers and connecting them to new buyers. Both Indian projects have had good adoption of mungbean in cereal rotations and uptake of improved practices such as use of new varieties and line sowing to improve weed management.

Protected cultivation: This is still relatively underdeveloped in the region. Over the last six years AVRDC refined and promoted low cost polynet houses for production of high quality tomato, cucumber, capsicum and coriander in collaboration with Punjab Agricultural University. This experience is now being extended to Pakistan, Punjab and other provinces where the use of nethouses is virtually unknown. On-station and on-farm varietal trials are being conducted in all provinces with demonstrations of protected cultivation and natural off-season production planned to involve over 600 farmers. Improved protected cultivation systems with drip irrigation and innovative practices first trialed in India will be demonstrated in five locations in Rawalpindi-ICT, Haripur, Sheikhupura, Gojra, and Faisalabad. AVRDC will demonstrate a range of low-cost nethouses in Raichur and Chickmagalur districts in Karnataka in southern India, building these in collaboration with farmers to demonstrate their use in reducing pesticide use, producing high quality produce and promoting off-season production.

Postharvest management of vegetables: This is perceived to be a chronic problem across the region, but there is a lack of supporting data and targeted training to solve problems identified. Two USAID-funded projects working across Bangladesh, Nepal, Cambodia and Pakistan are addressing postharvest concerns. The strong linkage between these projects will be strengthened in 2015 with joint training, development of fresh produce handling and processing technologies, varietal trials to test postharvest performance, completion of comparable baseline studies of postharvest losses, and identification of key intervention points in all four countries. This will involve tomato and other major crops of national importance; Bangladesh (eggplant), Nepal (cauliflower), Cambodia (brassica) and Pakistan (onion). Good postharvest management starts with the right varieties and seed supply is a chronic problem in Pakistan. Production of over 10 hectares of seed of five major vegetable crops is underway; the seed will be made available to 650 farmers for further bulking up.

CENTRAL ASIA AND THE CAUCASUS

In 2015, AVRDC in Central Asia and the Caucasus will conduct its activities within the Central Asia and the Caucasus Regional Network for Vegetable Systems Research and Development (CACVEG), which includes eight countries: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Activities will concentrate on collaborative research with partner institutes to facilitate access to new germplasm from AVRDC's genebank and advanced breeding lines; regional varietal trials; development of new vegetable crop varieties; consumption issues; tomato grafting technology adoption; promotional events (workshops, training courses, and Farmers' Days); capacity building; information exchange; and publications.

Germplasm: The regional office will arrange and coordinate activities with respect to new germplasm for regional varietal trials and requests from individual countries, introduction procedures, initiating trials, and assessment of introduced material.

Breeding: Vegetable variety trials and variety release will be analyzed and summarized. Release and commercialization of AVRDC varieties by national agricultural research and extension systems will be monitored. Seeds of new varieties will be produced in theregion.

Production: Tomato grafting technology will be continued to be promoted in selected countries. Extension and training materials will be published on various vegetable production technologies and capacity of extension staff and vegetable farmers will be strengthened through Training of Trainers courses, farmer training and field days.

Consumption: The nutritional and antidiabetic value of girasol (*Helianthus tuberosus* L.) and vegetable soybean will be evaluated in Uzbekistan and selected countries in the region. Vegetable seed kits will be distributed to home and school gardens and participatory demonstration vegetable gardens conducted in various locations. Vegetable recipes to promote school garden programs will be designed and promoted throughout Central Asia.

New projects: Activities to support the Tajikistan Nutrition-Sensitive Vegetable Technologies project funded by United States Agency for International Development (USAID) through 2016 will be conducted in 12 districts of Khatlon region of Tajikistan to improve nutrition outcomes by introducing improved production methods, including greenhouses and containerized seedling production, for extended season vegetable production.

Through the Beans with Benefits (2015-2017) project funded by the Federal Ministry for Economic Cooperation and Development (BMZ)/Gesellschaft für Internationale Zusammenarbeit Germany (GIZ), the regional office will strive to improve farmer income and increase the sustainability of dryland production systems in Uzbekistan by evaluating mungbean germplasm and selecting promising lines for resistance to viruses, bruchid pests, and environmental stress. Mungbean production technologies to increase soil fertility and crop production will be disseminated through training and publications.
The region will continue activities implementing the CGIAR Research Program on Dryland Systems jointly with the International Center for Agricultural Research in the Dry Areas (ICARDA), International Water Management Institute (IWMI), and International Center for Biosaline Agriculture (ICBA). The aim is to identify and introduce stress-tolerant, high-yielding and improved varieties of cereals, potato, vegetable, horticultural and fodder crops in pure and mixed plantations through on-farm adaptive trials, and to establish a seed system platform compatible with existing agroecological environments to supply farmers with high quality seed and planting materials.

Information dissemination: Established demonstration plots in research institutes and farmers' fields, exhibitions, Farmers' Days, publications, newsletters, posters, leaflets, and media contacts will be used to distribute information to farmers, partners and the public.

Capacity building: Various activities will be conducted in 2015, including:

- training for young professionals on modern methods of scientific research in vegetable production;
- training for women on agricultural vegetable crops and vegetable processing;
- a seminar on "Enhancing the role of the population in food security and nutrition for a balanced diet";
- four training courses on mungbean seed production;
- four Field Days to demonstrate new vegetable varieties, strengthen collaboration with farmers on vegetable production and seed multiplication, and promote consumption of nutrient-rich vegetables;
- mentoring of postdoc students' continued research on AVRDC vegetable soybean, hot pepper, cucumber germplasm and tomato grafting technology; and
- the VIIIth Steering Committee Meeting dedicated to the 10th Anniversary of Central Asia and the Caucasus Vegetable System Research and Development Network (CACVEG) will be conducted in November 2015 in Tashkent, Uzbekistan.

OCEANIA

Develop technologies to improve nutrient use efficiency and soil sustainability: The optimum starter solution concentration for balanced fertilizer application for transplanted seedlings for Fiji was confirmed in 2014; a field trial to evaluate the effect of starter solution, balanced fertilization and legume rotation on tomato production and soil health will be conducted at Sigatoka Research Station in 2015.

Develop integrated production technologies to intensify vegetable production: Tomato grafting technology will be evaluated in Fiji to extend tomato production during rainy season. A field trial will be conducted in the Solomon Islands to evaluate the effectiveness of integrating insect exclusion nets and *Bacillus thuringiensis* (Bt) as a component of integrated pest management (IPM) on brassicas for smallholder farmers. Standard screening procedures will be used for field evaluation of improved varieties of solanaceous crops for quality and market potential, as well as the prospects for extending production seasons in Fiji and the Solomon Islands. Seed increase production plots for selected AVRDC tomato and pepper lines will be established for promotion of the improved lines in Fiji and the Solomon Islands.

Strengthen the capacity of local partners and farmers to conduct innovation processes: In 2015, training courses on good agricultural practices (GAP) will be conducted for partners and farmers, and field days and on-farm demonstrations will be used to promote adoption of improved vegetable production technologies. There will also be training and dissemination of information on tomato grafting in the Solomon Islands to interested farmers to promote the technology, which was successfully evaluated in 2014.

GENDER and IMPACT EVALUATION

GENDER

Gender research, gender mainstreaming and the empowerment of women are keys to the success of the Center's mission. The Center will continue to have greater involvement of women in disseminating its technologies and will enhance gender equality and efficiency in its vegetable production and consumption research processes.

Policy and plans: The Center will further enhance gender its strategic planning and annual workplans through periodic review and discussion in focus groups. Projects will be reviewed to incorporate possible gender mainstreaming in research components and ensure output targets that capture gender disaggregated data. Wherever the gender gap is evident from the generated data, follow-up goals will be set and monitored.

Similar to 2014, an adequate budget has been allocated for gender-related activities. This budget will be deployed to supplement gender work in donor-funded projects and to carry out smaller pilot projects exclusively focused on gender research.

Flagship projects: The Center will also conduct two to three flagship projects with a specific gender research component that could generate substantial gender research outputs in the next two to three years. The projects that are being considered are "Beans with Benefits: Integrating improved mungbean as a catch crop into the dryland systems of South and Central Asia for increased smallholder farmer income and more sustainable production systems" (Pakistan and Uzbekistan), "Improving income and nutrition in Eastern and Southern Africa by enhancing vegetable-based farming and food systems in peri-urban corridors" (VINESA: Tanzania, Ethiopia, Zambia and Mozambique), and "Improving incomes, nutrition and health in Bangladesh through potato, sweet potato and vegetables" (proposed AVRDC-International Potato Center (CIP) Phase II: Bangladesh).

Capacity development: To further strengthen the capacity of scientists and

project managers, a second gender skills course will be organized to train 20 to 25 staff members to better understand the implications and opportunities in gender-related research.

Gender Resources Toolkit: To share and enhance knowledge on gender research and mainstreaming, a resource repository platform will be put on the AVRDC intranet. Gender relevant research publications, commentaries on methodologies, questionnaires, etc. will be made available on this site. Over time it will be populated with more information from the work done at other international agricultural research and development institutions and with information generated by AVRDC and partners.

Accountability: Staff members are encouraged to include gender-related goals in their work plans and performance goals. Support will be given for implementing these goals, and appropriate rewards and recognition will be given for gender-related outputs and outcomes.

IMPACT EVALUATION

The objective of the impact evaluation group is to conduct impact evaluations of past and ongoing research and development activities at AVRDC and, through this, generate strategic information on how the organization can become more effective and more efficient at fulfilling its mission. The group works within the scope of many ongoing projects but also tries to assess the longer-term impact of activities beyond the lifetime of individual projects.

The impact evaluation team currently has two internationally recruited staff, one short-term consultant, and one vacancy that will be filled in 2015 for a Taiwan nationally recruited staff member. Consultants and local partners in project countries are also working with the group on a non-permanent basis. Three agricultural economists based in Africa also contribute to impact evaluation.

To further its aims, the impact evaluation group will provide guidance to staff on issues of monitoring and evaluation and including robust impact evaluation designs in new project proposals wherever appropriate, given project objectives. Protocols for conducting impact evaluation will be standardized and reviewed, internally or externally, before being implemented. Study protocols and data sets will be made available through AVRDC's intranet and on the external website after results have been published.

New baseline studies will be conducted to monitor progress for key AVRDC activities. In 2015, these will include two baseline studies on the introduction of mungbean as a catch crop in cropping systems for dryland areas in Uzbekistan and Pakistan, and three baseline studies on the introduction of integrated pest management in leafy brassicas and vegetable legumes in Cambodia, Laos and Vietnam. All these baseline studies will collect gender-disaggregated data for various variables and include indicators for women's empowerment and gender equality.

Studies evaluating the impact pathways and long-term impact of improved vegetable lines in East Africa (tomato and African eggplant) and South Asia (tomato and pepper) will be completed in 2015. These studies will provide important information on the extent to which AVRDC material is being used by the private sector and adopted by farmers. The studies will also provide a quantitative estimate of the economic impact of AVRDC's vegetable breeding in selected countries. The scope of these studies will be expanded to other crops and/or other regions.

Further progress can be expected in 2015 in the evaluation of home and school gardens in various countries. First, results of a randomized controlled trial of school gardens in Bhutan, Burkina Faso, Indonesia and Nepal will become available in 2015, although the study will continue to collect data until mid-2016 as it uses a two-year repeated experimental design.

An impact study evaluating the effect of training poor rural women in Bangladesh in home gardening and nutrition on their household vegetable production and consumption will be completed in 2015. This study uses baseline and endline data for a total sample of 750 women and applies a double difference method to quantify impact. The experience gained in evaluating home and school gardens will be employed in 2015 to strengthen the evaluation approach for similar interventions in other countries.

In 2015, the impact evaluation group will build further collaboration with existing networks in the field of impact evaluation, universities and other international agricultural research centers. This should allow the group to link better with the latest thinking on evaluation methods in agriculture and increase its capacity in impact evaluation.

ACTIVITIES and OUTPUT TARGETS

GERMPLASM: Germplasm conservation, evaluation and gene discovery

Goal: Biodiversity of vegetable genetic resources is preserved and its utilization for food and nutritional security is enhanced	**Purpose**: Vegetable germplasm collected, conserved and distributed; the collection evaluated to identify those accessions with desirable traits, and their genes identified, characterized, and introgressed using classical and molecular technologies
Output 1: Vegetable genetic resources (including wild relatives, breeding materials, genetic stocks and populations) collected, conserved and distributed **Outcome:** Vegetable genetic resources preserved and made available globally for crop improvement	
Activity 1.1 Collect/acquire and conserve vegetable and legume germplasm	*Output Targets 2015* • 150 accessions collected/acquired for the Center's genebank at headquarters • 100 accessions/breeding lines collected/acquired from countries in sub-Saharan Africa for safety duplication at AVRDC Eastern and Southern Africa
Activity 1.2 Maintain effective regeneration of priority vegetable germplasm	*Output Targets 2015* • 1400 accessions regenerated at the Center's headquarters • 200 accessions regenerated at AVRDC Eastern and Southern Africa • Good quality seeds produced and increased at AVRDC Eastern and Southern Africa: 10 crops for nutritional seed kits; advanced lines for multilocation and on-farm trials; maintenance of breeders' seed materials • Seeds of recommended eggplant, chili pepper, tomato and fig-leaf gourd rootstocks produced for training and/or distribution

Activity 1.3 Distribute vegetable germplasm accessions and improved lines worldwide	*Output Targets 2015* • 80% of vegetable germplasm requests served • Seed samples of 5000 accessions/ breeding lines distributed worldwide from headquarters • Seed samples of 700 accessions/ breeding lines distributed by AVRDC Eastern and Southern Africa to public and private partners
Activity 1.4 Safety duplicate AVRDC - The World Vegetable Center's germplasm in other genebanks	*Output Targets 2015* • 1500 accessions from AVRDC headquarters duplicated at the RDA genebank in Korea • 100 accessions from AVRDC Eastern and Southern Africa seed repository duplicated at Center headquarters
Activity 1.5 Systematically store information on conservation and distribution of vegetable germplasm in AVRDC - The World Vegetable Center's electronic databases	*Output Targets 2015* • 100% of acquisition and distribution data generated in 2014 entered into the Center's Vegetable Genetic Resources Information System (AVGRIS) and the Seed Distribution Database of AVRDC Eastern and Southern Africa • Characterization and evaluation data of the 2012/13 regeneration cycle made available in AVGRIS and the Seed Distribution Database of AVRDC Eastern and Southern Africa

Output 2: Germplasm characterized to enhance understanding and utilization of biodiversity in the vegetable germplasm collections **Outcome:** Genetic diversity of AVRDC – The World Vegetable Center germplasm collections determined and core collections established and validated	
Activity 2.1 Characterize morphological traits of vegetable germplasm maintained at AVRDC and its regional offices	*Output Targets 2015* • 1400 accessions at the Center's headquarters and 200 accessions at AVRDC Eastern and Southern Africa characterized, based on standard morphological descriptors • Characterization and evaluation of selected genebank accessions in Central Asia and the Caucasus region
Activity 2.2 Conduct molecular characterization, genetic relationship and diversity analysis of germplasm collection	*Output Targets 2015* • Diversity and population structure of wild tomato (*Solanum pimpinellifolium*) established using genome-wide single nucleotide polymorphic markers
Activity 2.3 Develop, characterize, and validate AVRDC germplasm core collections	*Output Targets 2015* • *Abelmoschus* core collection establishment in progress • Mungbean (*Vigna radiata*) core collection accomplished
Output 3: Trait-based characterization and screening to enhance vegetable germplasm for effective use of important horticultural traits in the development of new vegetable cultivars **Outcome:** Superior sources of genes for important horticultural traits identified	

Activity 3.1 Identify and characterize sources of resistance to viral diseases	*Output Targets 2015* • Yard-long bean (*Vigna unguiculata* subsp. *sesquipedalis*) germplasm screened for resistance to *Bean common mosaic virus* (BCMV; Potyvirus) • Cucurbits screened for resistance to *Squash leaf curl Philippine virus* (SLCPHV; Begomovirus), and study of inheritance of virus resistance in *C. moschata* continued • *Capsicum* germplasm screened for resistance to *Pepper mottle virus* (PepMoV; Potyvirus)
Activity 3.2 Identify and characterize sources of resistance to fungal and bacterial diseases	*Output Targets 2015* • Resistance to anthracnose (*Colletotrichum* spp.) in chili pepper (*Capsicum* spp.) characterized against field pathogen populations in Indonesia, Taiwan, Thailand, and India. • Resistance of S. habrochaites against field populations of tomato late blight (*Phytophthora infestans*) evaluated in Taiwan
Activity 3.3 Identify and characterize sources of resistance to insect and mite pests	*Output Targets 2015* • Mechanisms and bases of resistance to thrips (*Thrips tabaci*) in selected onion accessions characterized • Mechanisms and bases of resistance to whitefly (*Bemisia tabaci*) and red spider mite (*Tetranychus evansi*) in *S. galapagense* accessions characterized • Amaranth accessions screened for resistance to leaf webber (*Spoladea recurvalis*) and stem weevil (*Hypolixus* spp.)

Activity 3.4 Identify and characterize sources of tolerance to drought, heat, flooding and salinity stress	*Output Targets 2015* • Establish a mungbean germplasm subset enriched with salt tolerant accessions • Evaluate mungbean germplasm subset under salt stress • Flooding tolerance screening method for tomato established • Solanaceaous germplasm accessions with tolerance to salt stress identified for use as potential rootstocks for tomato and sweet pepper production
Activity 3.5 Evaluate vegetable germplasm for selected nutrition-related compounds	*Output Targets 2015* • Nutrient database of vegetables in Burkina Faso, Nepal, Bhutan, Tanzania, and Indonesia further developed • Data collection from selected fruit and vegetables, commonly consumed in Taiwan, continued and input into the Center's phytochemical database • Evaluation of nutritional quality of amaranth germplasm initiated
Output 4: Specialized genetic materials, molecular tools, and methods developed to enhance the creation of new varieties **Outcome:** Genes conferring improved horticultural traits introgressed, genetically mapped, and DNA markers developed for marker-assisted selection	

Activity 4.1 Develop mapping populations and identify quantitative trait loci (QTLs) for resistance to biotic stresses	*Output Targets 2015* • Markers for begomovirus resistance in mungbean and hot pepper (*Capsicum annum*) breeding populations validated for breeding purposes • Interspecific population produced for use as mapping populations for locating QTLs for resistance to tomato late blight
Activity 4.2 Develop mapping populations and identify QTLs for tolerance to abiotic stresses	*Output Targets 2015* • Mapping populations derived from new resistance sources established to mobilize new heat stress tolerance traits in tomato • QTLs for heat tolerance elucidated
Activity 4.3 Conduct fine mapping of QTLs and develop markers for marker-assisted selection (MAS)	*Output Targets 2015* • Effect of different sections of the *Bwr6* QTL on Phylotype I and II strains of *Ralstonia solanacearum* tested
Activity 4.4 Assemble and develop molecular marker sets for priority vegetable crops	*Output Targets 2015* • Methods of genotyping by sequencing available for AVRDC priority vegetable crops, including for polyploid species (pepper, pumpkin and African traditional vegetables: okra, spider plant)
Output 5: Genes affecting important horticultural traits isolated, validated, and functionally analyzed using genomics and molecular technologies **Outcome:** Gene markers associated with important horticultural traits developed-	
Activity 5.1 Allele mining to identify variation conferring superior traits in mungbean and pepper	*Output Targets 2015* • Begomovirus resistance alleles of at least one resistance gene in mungbean identified

Activity 5.2	*Output Targets 2015*
Characterize and validate candidate genes for heat and salt tolerance	• Heat tolerance genes validated in tomato
Output 6: Capacity in germplasm conservation, evaluation, characterization, and gene discovery developed **Outcome:** Skills of national agricultural research and extension systems' women and men scientists in germplasm conservation, utilization and gene discovery enhanced	
Activity 6.1	*Output Targets 2015*
Train human resources, ensuring women enrollment, in vegetable genetic resources conservation, management, and evaluation using conventional and advanced techniques	• Training courses conducted, encouraging the participation of women, on germplasm conservation and management, and use of molecular tools for biodiversity analysis and germplasm evaluation • Various vegetable accessions/ lines, production technologies and nutritional information displayed in the Demonstration Garden at headquarters and at AVRDC's regional offices for information dissemination to at least 750 visitors, and shared through community education for men and women • AVRDC's germplasm and technologies showcased in Taiwan's annual Seeds and Seedling Festival and other events • Next generation sequencing training course held for young scientists from Vietnam and Thailand

BREEDING: Genetic enhancement and varietal development of vegetables

Goal: Varieties with potential to expand opportunities in tropical vegetable production	**Purpose:** Farmers obtain vegetable varieties that produce high yields of nutritious and marketable food with less risk to health and the environment
Output 1: Cultivars and lines of vegetables with improved disease resistance, stress tolerance, quality and nutritional traits developed **Outcome:** Lines adopted directly as cultivars or used in public/private sector breeding programs	
Activity 1.1 Develop heat tolerant and disease-resistant tropical tomato (*Solanum lycopersicum* L.) with desirable horticultural and quality traits	*Output Targets 2015* • 3-5 late blight (caused by *Phytophthora infestans*) resistant and tomato yellow leaf curl-resistant F7 lines developed and evaluated for horticultural traits • 3-5 tomato yellow leaf curl-resistant Taiwan fresh market fruit type hybrids tested in replicated trials • Crosses created to introgress whitefly resistance from *S. galapagense* and *S. pimpinellifolium* into cultivated tomato
Activity 1.2 Develop and distribute disease-resistant chili pepper (*Capsicum annuum*) cultivars (targeting anthracnose (caused by *Colletotrichum* sp.), Phytophthora blight (caused by *Phytophthora capsici*), bacterial wilt (caused by *Ralstonia solanacearum*), *Cucumber mosaic virus, Chili veinal mottle virus*, and/or begomoviruses), aphids (*Myzus persicae*) and mites (*Tetranychus urticae*)	*Output Targets 2015* • 150 F5 RILs segregating for leaf curl disease and insect tolerance advanced to F_6 generation • At least 50 segregating generations screened for multiple disease reactions and advanced aphid/mite resistant/tolerant lines identified for seed increase

Activity 1.3 Develop heat and disease tolerant tropical sweet pepper (*Capsicum annuum*) (targeting *Potato virus Y*, *Chili veinal mottle virus*, bacterial wilt and Phytophthora blight	*Output Targets 2015* • 5-8 sweet pepper hybrids and inbred lines made available to collaborators from headquarters • 3-4 lines combining heat tolerance and one or two diseases developed
Activity 1.4 Develop short-day red and yellow onions (*Allium cepa*) for improved yield and extended shelf-life	*Output Targets 2015* • Breeders' seed of at least three AVRDC elite lines and five local purified selections from Mali local onion populations produced • Bulk crosses developed for recombination of major horticultural traits (high yielding, high dry matter content, early maturity, storability) of the best local purified selections from Mali local onion populations
Activity 1.5 Develop and distribute heat-tolerant broccoli (*Brassica oleracea* var. *italica*) and Chinese cabbage (*Brassica rapa* L. *ssp. pekinensis*) varieties	*Output Targets 2015* • Seed of six broccoli hybrids and their respective parental lines increased by honeybee-assisted nethouse pollination at headquarters to ensure appropriate female-male parental plant ratios • Seed of two Chinese cabbage hybrids and respective parental lines increased by honeybee-assisted nethouse pollination at headquarters to ensure appropriate female-male parental plant ratios

Activity 1.6 Develop improved vegetable soybean and mungbean with improved stress tolerance and nutritional and flavor qualities	*Output Targets 2015* • Mungbean lines resistant to Mungbean yellow mosaic disease, Cercospora leaf spot (caused by (*Cercospora* sp.) or powdery mildew (caused by *Erysiphe* sp.) developed in India • 22 crosses created for bruchid (*Callosobruchus maculatus*) resistance in mungbean; 18 F_1, 16 F_2 populations and 8 F_3 families evaluated for bruchid resistance and advanced at the National Agricultural Research Center (NARC), Pakistan
Activity 1.7 Develop cucumber (*Cucumis sativis*) lines for improved horticultural traits, disease resistance, good fruit quality, and high gynoecy	*Output Target 2015* • Preliminary yield trial of selected Japanese type (market type popular in Southeast Asia and Africa) cucumber conducted at AVRDC Taiwan
Activity 1.8 Develop disease resistant and high quality pumpkins (*Cucurbita moschata*)	*Output Targets 2015* • Seed increase and international distribution from AVRDC Taiwan of 4-6 small fruit type inbred lines completed • 4-6 hybrid combinations evaluated for yield, fruit quality and virus resistance conducted at AVRDC Taiwan
Activity 1.9 Develop bitter gourd (*Momordica charantia*) possessing improved yield, earliness, good fruit quality and resistance to diseases/ insects	*Output Targets 2015* • 10-15 advanced breeding lines evaluated for yield, fruit quality, and nutritional traits (ascorbic acid, carotenoids and saponins) at AVRDC East and Southeast Asia • Recurrent selection cycles 2 and 3 completed at AVRDC East and Southeast Asia emphasizing selection for yield, early fruit maturity, fruit quality and resistance to mildews

Activity 1.10 Develop traditional vegetables with superior horticultural traits	*Output Targets 2015* • Second year of the summer Malabar spinach (*Basella alba*) assessment trial at headquarters completed, manuscript for publication completed, and 3-5 superior Malabar spinach accessions selected for international distribution and promotion • 3-5 promising advanced lines identified each of amaranth (*Amaranthus cruentus*) , nightshade (*Solanum scabrum*), spider plant (*Cleome gynandra*) and cowpea (*Vigna unguiculata* ssp. *unguiculata*) and tested in multilocation (two locations: one on-farm and one on-station) trials in Eastern and Southern Africa • Parental lines identified and crossing program initiated in two African eggplant (*Solanum aethiopicum, S. macrocarpon*) populations for fruit shape, size and yield
Activity 1.11 Develop okra (*Abelmoschus esculentus* and *A. caillei)* lines for improved yield, resistance to diseases (*Okra leaf curl virus* and *Okra yellow vein mosaic virus*) and pests and with good horticultural traits	*Output Targets for 2015* • 3-5 F_1 *A. esculentus* and *A. caillei* populations with resistance to aphids, *Okra leaf curl virus* and *Okra yellow vein mosaic virus* developed • 3-5 BC_2 F_1 and F_2 populations developed for *both A. esculentus* and *A. caillei* and screened for resistance to *Okra leaf curl virus, Okra yellow vein mosaic virus* and aphids

Output 2: Vegetable variety testing networks and improved seed systems developed **Outcome:** Improved distribution, evaluation, release, and seed production of AVRDC-bred varieties leading to (1) better understanding of genotype-environment interactions, (2) trait priorities for particular agroecosytems and markets, (3) streamlined variety release procedures, and (4) more efficient vegetable seed production	
Activity 2.1 Assemble and internationally distribute elite vegetable lines	*Output Targets 2015* • Global distribution and international collaborator testing of AVRDC chili pepper, sweet pepper, tomato, vegetable soybean, mungbean, African nightshade, spider plant, vegetable cowpea, and other AVRDC-developed lines • Seeds of 10 local purified selections from Mali local onion populations and 15 AVRDC elite lines produced for multilocation regional trials in West, Central and Eastern Africa • Vegetable soybean and mungbean lines promoted in Asia and sub-Saharan Africa through regional testing, ensuring participation of women farmers
Activity 2.2 Analyze and review data from multi-environment testing of AVRDC-improved germplasm	*Output Targets 2015* • Vegetable variety trials analyzed and published; implications for breeding and variety release assessed
Activity 2.3 Develop on-line seed catalog to facilitate seed requests for AVRDC-improved vegetables	*Output Targets 2015* • On-line seed catalogs developed or updated for tomato, pepper, soybean, leafy brassica (*Brassica rapa* cvg *parachinensis*, *B. oleraceae* Alboglabra Group), Chinese cabbage, shallot (*Allium cepa* var. *aggregatum*, bitter gourd, onion, cucumber and pumpkin and elite lines of African traditional vegetables

Activity 2.4 Monitor and assess variety release, commercialization and adoption of AVRDC-bred lines	*Output Targets 2015* • Release and commercialization of AVRDC varieties by national agricultural research and extension systems, and seed companies in Africa, Asia, and Central America monitored and information entered into AVRDC's variety release database • Breeders' seed produced of released and elite AVRDC lines to catalyze large-scale testing, scaling up commercial seed production and promotion
Activity 2.5 Use male sterility to improve the efficiency of hybrid vegetable seed production	*Output Targets 2015* • Seeds of potential sweet pepper restorer lines increased for international distribution • Initial cross to isolate alloplasmic cytoplasm developed or feasible use of nuclear male sterility in hybrid seed production examined
Activity 2.6 Efficiency and effectiveness of national seed supply systems improved for production of high quality seed of improved varieties.	*Output Targets 2015* • Major constraints on vegetable seed production identified (in Pakistan), seed production sites identified and partnerships created to overcome the constraints • 20 tonnes of good quality mungbean seed produced in Pakistan to facilitate expansion of mungbean cultivation
Output 3: Enhanced seed company capacity in vegetable breeding research, design and application of efficient seed systems, and delivering development outcomes **Outcome:** Seed companies improved for capacity in vegetable breeding, seed production, or delivering technical advice and promotional messages	

Activity 3.1 Train seed company staff (ensuring participation of both men and women) in design and application of molecular markers in breeding	*Output Targets 2015* • Molecular markers for hybrid detection or disease resistance implemented by at least one seed company in Asia
Activity 3.2 Collaboration with seed companies to understand key traits for design of improved breeding strategies	*Output Targets 2015* • A set of AVRDC tomato lines carrying different combinations of *Ty*-genes conferring resistance to tomato yellow leaf curl assessed for resistance against the locally prevalent leaf curl viruses in seed company-managed field sites in India, Thailand, the Philippines, and Indonesia
Activity 3.3 Equipping seed companies to promote nutrition and other development messages to men and women farmers through farmer field days	*Output Targets 2015* • Effectiveness of Lal Teer's (a Bangladesh seed company that works closely with AVRDC) nutrition promotion in Bangladesh, and interventions to improve Lal Teer nutrition messages determined • Discern key "lessons learned" from the Lal Teer case study to identify opportunities in Africa/Southeast Asia to promote nutrition messages through seed companies

PRODUCTION: Safer and sustainable vegetable production systems

Goal: Sustainable livelihoods of smallholder vegetable growers and a secure supply of safer and affordable vegetables	**Purpose:** Smallholder vegetable growers (in target regions) adopt sustainable integrated production practices that are profitable and safer for the environment, growers and vegetable consumers

Output 1: Novel information generated for integrated crop management, including pest, disease, and soil fertility management, for sustainable vegetable production

Outcome: Information used by national agricultural research systems and other organizations to develop effective methods to manage major vegetable production constraints

Activity 1.1 Detect, characterize and explore integrated management strategies for major insect and mite pests	*Output Targets 2015* • Most common insect pests of leafy brassicas (*Brassica* spp.) and yard-long bean (*Vigna unguiculata* subsp. *sesquipedalis*) in Cambodia, Lao PDR and Vietnam catalogued • Major natural enemies of key insect pests (e.g. *Spoladea recurvalis, Pieris rapae* and *Aphis craccivora*) on amaranth, brassicas and legume vegetables identified in Southeast Asia and parasitism of major parasitoids on target pests assessed • Efficacy of bio-pesticides against *P. rapae, Phyllotreta striolata, A. craccivora* and thrips (*Megalurothrips* spp.) determined in Southeast Asia

Activity 1.2 Detect, characterize and explore integrated management strategies for major fungal and bacterial diseases	*Output Targets 2015* • Molecular protocols using paper-based DNA extraction methods for diagnosing tomato foliar diseases validated in Vietnam and Fiji • Variables affecting the growth and survival of phylotype IIB-1 strains of *Ralstonia solanacearum* , the causal agent of bacterial wilt, under tropical lowland conditions determined • Populations of *Ralstonia solanacearum* and *Phytophthora infestans*, the causal agent of bacterial wilt and late blight, associated with tomato (*Solanum lycopersicum*) in Southeast and East Asia characterized • Control efficacy of plant activators or other materials, such as biocontrol agents, in enhancing resistance to seedling diseases of tomato and pepper (*Capsicum annuum*) determined
Activity 1.3 Detect, characterize and explore integrated management strategies for major viral diseases	*Output Targets 2015* • The important viruses, especially begomoviruses, and virus-like agents prevalent or emerging in vegetable crops in Asia and Africa identified and monitored • The identity determined and genetic diversity assessed of selected viruses and virus-like agents affecting vegetable crops in Asia and/or Africa • The ecology/epidemiology of selected viruses and/or virus-like agents affecting vegetable crops in Asia and/or Africa studied for the better design of integrated disease management strategies

Activity 1.4	*Output Targets 2015*
Develop technologies to improve soil nutrient use efficiency and soil sustainability	• Effect of starter solution and legume rotation on tomato production and soil health confirmed in Fiji and impact of starter solution on fertilizer utilization in chili pepper verified through multilocation trials • Soil properties assessed and soil management programs developed for sustainable cropping systems to produce quality vegetables in Eastern and Southern Africa • Protocols for evaluating compatibility of scions and rootstocks for tomato developed
Output 2: Sustainable vegetable production practices developed/validated for targeted agro-ecosystems **Outcome**: Integrated production technologies and related information to enhance and sustain vegetable productivity ready to be disseminated to national agricultural research and extension systems, nongovernmental organizations, input suppliers, and small-scale farmers	
Activity 2.1	*Output Targets 2015*
Develop and adapt gender-sensitive integrated production technologies for intensive production systems (cultivation using high amounts of inputs, e.g. labor, capital, pesticides, fertilizers, relative to land area)	• Integrated crop management technologies for tomato, pepper, and eggplant (*Solanum melongena*) validated in open field and adapted in South Pacific (Fiji, Solomon Islands) and Central Asia (Uzbekistan and Armenia) • Integrated pest management packages for eggplant, summer tomato, vegetable brassicas, vegetable legumes, and other crops validated and adapted in Southeast Asia (Vietnam) and South Asia (Bangladesh) and Eastern and Southern Africa • Vegetable production under protective structures in Pakistan improved through adapting IPM practices, new crops, and other integrated crop management practices

Activity 2.2 Develop and adapt gender-sensitive integrated production technologies for extensive production systems (cultivation using lower amounts of inputs relative to land area)	*Output Targets 2015* • Vegetable production options after the direct seeded rice crop in Jharkhand, India developed • Home vegetable garden options (suitable crop/cultivar and crop sequence/management) considering for the flood prone target area of Odisha, India developed • Mungbean production as part of the rice-wheat cropping system, double cropping in wheat-fallow system areas and integrated pest management (IPM) practices improved in Pakistan
Output 3: Innovative dissemination processes on vegetable production technologies initiated and outcomes assessed **Outcome:** Smallholder vegetable farmers adopt new innovations with the support of input suppliers, marketing agents, and policy makers, and this improves farm productivity and sustainability, strengthens the role of women, and enhances livelihoods	
Activity 3.1 Identify and establish gender-sensitive and effective knowledge and innovation systems	*Output Targets 2015* • Data collected from men and women farmer respondents on farm-level constraints and opportunities to IPM adoption for vegetable legumes and leafy brassicas in Cambodia, Lao PDR and Vietnam • Needs for mungbean IPM practices and opportunities for their introduction or promotion in Pakistan identified, and baseline data including gender data collected on mungbean production in Uzbekistan and Pakistan • Options for livelihood improvement for communities in aquatic agriculture systems in Solomon Islands through vegetable production identified • Innovation platforms on vegetable production for market sales and home consumption established and maintained in Vietnam and Thailand

Activity 3.2 Strengthen the capacity of local partners and farmers to facilitate and conduct innovation processes	*Output Targets 2015* • Extension and training materials published on various vegetable production technologies, distributed to men and women farmers • Capacity of nursery operators, extension staff, vegetable farmers and researchers (men and women) in Thailand and Indonesia strengthened through business skills, home gardening and grafting training activities, and in South Asia (Bangladesh, India, Pakistan), Oceania (Fiji and Solomon Islands), Central Asia and the Caucasus, Eastern and Southern Africa, and West and Central (Mali) strengthened through Training of Trainers courses, farmer training, Farmer Field Schools or field days • Follow-up on Participatory Action Plans of onion production Training of Trainers course participants in Northern Cameroon
Activity 3.3 Identify challenges and opportunities to innovation adoption and evaluate outcome generated	*Output Targets 2015* • Results documented and published on the impact evaluation of off-season tomato production in Bangladesh • Data collected for the impact evaluation of eggplant and cucurbit IPM in Bangladesh

CONSUMPTION: Balanced diets through increased access to and utilization of nutritious vegetables

Goal*:* Consumer health improved by increased consumption of nutritious vegetables for a balanced diet.	**Purpose***:* Increased public awareness, accessibility and utilization of nutritious and diverse vegetables.
Output 1: Knowledge of consumer behavior and nutritional properties of vegetables enhanced	
Outcome: Research communities become aware and better understand consumers' attitude towards health, food safety and vegetable consumption as well as the nutritional and functional values of vegetables.	
Activity 1.1 Assess consumption and nutrition related outcomes of vegetable producers and consumers in Asia and sub-Saharan Africa	*Output Targets 2015* • Outcomes of vegetable consumption promotion in south Bangladesh on targeted male and female consumers' knowledge and attitudes, and their behavioral change evaluated • Baseline study on food habits and dietary diversity of urban and rural households in Cameroon, Ethiopia, north Thailand and Vietnam documented • Baseline study to understand male and female consumer preferences and determine quality standards to provide new market outlets for vegetable products from peri-urban farm enterprises in Ethiopia, Tanzania, Malawi and Mozambique documented • Rapid assessment on priority and potential lines of traditional and global vegetables most widely demanded for home garden scaling in Cambodia, Liberia, Kenya, Tanzania and Uganda conducted

Activity 1.2 Study nutritional and functional values and benefits of vegetables from sub-Saharan Africa and Asia	*Output Targets 2015* • Nutritional and functional properties of selected indigenous vegetables from Africa and Asia evaluated • Phytochemical contents of selected common traditional vegetables in Bangladesh and Mali measured • Nutrient contents of *Amaranthus* spp. germplasm lines measured
Output 2: Dietary strategies and food based intervention packages developed **Outcome:** AVRDC – The World Vegetable Center, national agricultural research and extension systems and nongovernmental organizations promote home, school and community gardening, distribute seed kits to disaster affected areas, and advocate more nutritionally effective use of vegetables.	
Activity 2.1 Develop home, school and community garden packages for poor households in Asia and sub-Saharan Africa for technology adaptation and adoption, and increased access to vegetables	*Output Targets 2015* • Case study on the roles of school vegetable gardens in food systems, nutrition and health in 1-2 selected countries in Asia and Africa conducted; data analyzed • Effect of home vegetable gardens on income and food consumption, especially among women and children in Barisal, Bangladesh documented • Preliminary results about the effect of school vegetable gardens on dietary patterns and dietary awareness of students in Burkina Faso, Bhutan, Nepal and Tanzania made available • Specifically targeting women and children, over 10,000 nutritional vegetable seed kits distributed for home garden scaling, school gardens and participatory demonstration vegetable gardens in Bhutan, Burkina Faso, Cambodia, Kenya, Liberia, Nepal, Tanzania, Uganda and Uzbekistan.

Activity 2.2 Develop nutritious vegetable seed kits for disaster relief in tropical and sub-Saharan Africa and Asia	*Output Targets 2015* • Existing seed stocks in Taiwan, India, Tanzania and Mali of vegetable lines suited for inclusion in seed kits made available for distribution in response to future disasters in exchange for funding to replenish seed stocks • Easy-to-understand instructions on cultivation, field management, and food preparation in various local languages prepared for publication and disseminated in disaster-affected areas
Activity 2.3 Develop dietary strategies, nutrition-improved recipes and food preparation methods based on traditional diet and food practices for promotion of vegetables and nutrition to household women in Asia and sub-Saharan Africa	*Output Targets 2015* • Nutrition-improved preparation and preservation techniques that enhance micronutrient bioavailability and vitamin retention of traditional vegetables in Mali documented • Customized cooking recipes for enhancing vegetable appeal and increased consumption promoted via school garden programs in Burkina Faso, Tanzania and selected regions in Central Asia • Nutrition-related training materials for Mali produced and distributed to over 20 extension workers

Activity 2.4 Develop, validate and implement promotion strategies for increased consumption of vegetables and nutritious/ diverse diets by poor households, emphasizing the needs and opportunities for women and children, in Asia and sub-Saharan Africa	*Output Targets 2015* • Nutritional education leaflets, posters, booklets and recipe books emphasizing the nutritional importance of vegetables, updated, printed and distributed to target men and women in Central Asia • Vegetable recipes for school and community garden programs in Mali, Cameroon and selected regions in Central Asia promoted • Vegetable consumption and nutritious diets in Bangladesh promoted to men, women and children via participatory approaches • Farmer field days conducted in Central Asia and the Caucasus to promote increased production and consumption of vegetables, ensuring participation of both men and women
Output 3:	Approaches to enhanced market efficiency and access developed, postharvest losses minimized and vegetable supply chains strengthened
Outcome:	Small-scale farmers and other value chain actors in Africa, Asia and the Oceania benefit from improved market coordination along vegetable supply chains, improved postharvest practices as well as from enhanced research capacities and networks.

Activity 3.1	*Output Targets 2015*
Analyze components of supply chains, marketing systems and postharvest handling of vegetables in sub-Saharan Africa, Asia and Oceania	• Nutrient contents of selected vegetables following application of validated innovative postharvest handling technologies for in selected countries in sub-Saharan Africa and Asia monitored • Feasibility studies on minimal processing and processing technologies as an alternative market in Ethiopia, Tanzania, Malawi and Mozambique conducted • Value chain surveys on postharvest handling and storage for vegetable crops in selected regions of Cambodia, Myanmar, Nepal and Tajikistan conducted among men and women • Value chains for at least two vegetable crops in Pakistan mapped and bottlenecks aimed at strengthening their value chains by reducing handling cost addressed for at least one crop in one province

Activity 3.2	*Output Targets 2015*
Facilitate the establishment of enhanced market coordination mechanisms for vegetable supply in sub-Saharan Africa, Asia and Oceania	• Awareness raising activities to encourage adoption of recommended postharvest handling practices and technologies by men and women beneficiaries in Africa and Asia conducted via workshops and multi-stakeholder platforms • Techniques for using improved vegetable packaging materials disseminated via on-farm demonstrations in Babati, Tanzania to men and women farmers • Identified options for improving vegetable marketing value chain performance in Ethiopia, Tanzania, Malawi and Mozambique promoted via multi-stakeholder platforms and community-based Best Practice Hubs

Activity 3.3 Develop and enhance training curricula and materials on proper postharvest management and marketing skills for trainers in Asia, sub-Saharan Africa and Oceania	*Output Targets 2015* • International Vegetable Training Course curricula and lecture/ training materials on vegetable postharvest handling, marketing and nutrition at AVRDC East and Southeast Asia reviewed and updated annually • Translated training materials in marketing and postharvest handling activities revised and disseminated to men and women in target locations in Africa, Asia and Oceania updated annually and disseminated • Training materials developed and capacity building programs for farmers and other value chain actors conducted, ensuring involvement of men and women, to reinforce linkages between producers and processors in Bangladesh and Tanzania • Model farmers' packhouse in one target site in Bangladesh, Nepal and Cambodia developed for demonstration purposes and use by beneficiaries
Activity 3.4 Strengthen postharvest research capacity of national partners through training courses and raising awareness on postharvest losses and postharvest research at the national and regional level in Asia, Africa and Oceania	*Output Targets 2015* • At least 1000 male and female participants from Ghana, Kenya, Tanzania, Bangladesh, Cambodia and Nepal trained in postharvest handling practices through Training of Trainers courses and direct farmer training activities • Postharvest research laboratories of project partners in Bangladesh, Cambodia and Nepal upgraded • Regional postharvest training programs at the Horticulture Innovation Lab - Kasetsart University, Thailand conducted

Activity 3.5	*Output Targets 2015*
Adapting available technologies and developing new technologies to meet the needs of the target value chain actors and stakeholders in selected countries in Asia and Africa	• Shelf-life performance of selected elite AVRDC-developed vegetable varieties (e.g., tomato) for desirable postharvest traits evaluated • Appropriate postharvest handling technologies for selected vegetables to reduce losses and improve physical and nutritional quality in Burkina Faso, Cameroon, Ghana, Ethiopia, Malawi, Mozambique, Pakistan and Tanzania tested and validated in the field with male and female beneficiaries • Results of research trials on use of evaporative coolers for short term storage of vegetable crops to reduce postharvest losses in Tanzania validated, documented and disseminated among men and women target beneficiaries • Field trials and desktop analysis to determine the economic costs and potential benefits of selected postharvest technologies of priority vegetables in Tanzania, Bangladesh, Cambodia, Pakistan and Nepal conducted
Output 4:	Policy recommendations with an aim to increase vegetable consumption developed, capacity strengthened and technology and knowledge disseminated
Outcome:	Consumers are aware of the health-promoting benefits of increased utilization of vegetables through better access to nutritional education information, enhanced capacities of national agricultural research and extension systems and non-governmental organizations, and improved policy support.

Activity 4.1 Conduct training courses and promotion campaigns to increase production, utilization and consumption of nutrient-rich vegetables in Asia, Africa and Oceania	*Output Targets 2015* • 1-2 farmer field days conducted in Central Asia and the Caucasus to promote increased production and consumption of vegetables • Short (3-5 days) and targeted training courses on production of vegetables and vegetable seed, and processing, preservation and consumption of vegetables delivered to 60-100 target male and female beneficiaries in Cameroon, Ethiopia, Ghana, Malawi, Mozambique and Tanzania
Activity 4.2 Develop data collection protocols and policy briefs on outcome and impact assessment of program interventions in Africa and Asia	*Output Targets 2015* • Generic framework for monitoring, evaluation, and technology dissemination for the Center updated annually • Outcome evaluation study of the contribution of improved (elite) vegetable varieties to household income and nutritional outcomes via introduced school garden programs in East Java and Bali, Indonesia documented • Evaluation of preliminary behavioral change outcomes among men, women and children of radio programing on production and consumption decisions of men and women growing traditional vegetables in Tanzania documented

2015 PROJECTS

Project Title	Donor Name	Duration	Project life budget (US$)
Multi-location evaluation of tomato lines carrying different combinations of *Ty* genes for resistance against begomovirus infection	Asia and Pacific Seed Association	2014-2016	278,263
Strengthening Integrated Crop Management Research in The Pacific Islands in Support of Sustainable Intensification of High-Value Crop Production	Australian Centre for International Agricultural Research	2011-2016	906,484
Improving livelihoods with innovative cropping systems on the East India plateau	Australian Centre for International Agricultural Research	2012-2015	97,577
Increasing productivity of allium and solanaceous vegetable crops in Indonesia and sub-tropical Australia	Australian Centre for International Agricultural Research	2013-2015	53,133
Improving income and nutrition in Eastern and Southern Africa by enhancing vegetable-based farming and food systems in peri-urban corridors	Australian Centre for International Agricultural Research	2013-2016	2,147,145
Promoting traditional vegetable production and consumption for improved livelihoods in Papua New Guinea and Northern Australia	Australian Centre for International Agricultural Research	2014-2018	137,475
Case Study on enhanced nutritional outcomes of populations through nutrition-sensitive agricultural promotion by a vegetable seed company in Bangladesh	CGIAR	2013-2015	100,000
Research Program for Aquatic Agricultural Systems	CGIAR	2014-2015	30,000
Integrated Systems for the Humidtropics	CGIAR	2015-2016	1,400,000

Strengthening the Capacity of Vulnerable Communities to Prepare for the Recovery from Floods in India	COFRA Foundation, India	2013-2015	108,634
Strengthening the cooperation between AVRDC - The World Vegetable Center and Taiwan research institutes on vegetable research and development	Council of Agriculture, Taiwan	2015-2016	451,523
Network for Knowledge Transfer on Sustainable Agricultural Technologies and Improved Market Linkages in South and Southeast Asia	European Commission	2012-2015	388,991
Local Focus: safe and effective pest and crop management strategies to strengthen the vegetable value chain in the humid tropics	Federal Ministry for Economic Cooperation and Development-Gesellschaft für Internationale Zusammenarbeit, Germany	2012-2015	132,927
Beating Begomoviruses: Better livelihoods for farmers in tropical Asia with begomovirus resistant tomato, hot pepper and mungbean and integrated disease management	Federal Ministry for Economic Cooperation and Development-Gesellschaft für Internationale Zusammenarbeit, Germany	2012-2015	1,463,415
Implementation of integrated thrips and tospovirus management strategies in smallholder vegetable cropping systems of eastern Africa	Federal Ministry for Economic Cooperation and Development-Gesellschaft für Internationale Zusammenarbeit, Germany	2012-2015	92,804
GlobE UrbanFoodPlus; Controlled central factorial experiments for participatory development, evaluation and demonstration of improved nutrient and water management strategies	Federal Ministry for Economic Cooperation and Development-Gesellschaft für Internationale Zusammenarbeit, Germany	2013-2016	136,463
Horticultural Innovations and Learning for Improved Nutrition And Livelihood in East Africa	Federal Ministry for Economic Cooperation and Development-Gesellschaft für Internationale Zusammenarbeit, Germany	2013-2016	243,902
Vegetable cucurbits for nutrition-sensitive home and school gardens in Southeast Asia	Federal Ministry for Economic Cooperation and Development-Gesellschaft für Internationale Zusammenarbeit, Germany	2014-2015	73,171

Attraction in Action: Using pheromones and other safe and sustainable management strategies to reduce losses from insect pests and plant diseases on vegetable legumes and leafy brassicas in Southeast Asia	Federal Ministry for Economic Cooperation and Development-Gesellschaft für Internationale Zusammenarbeit, Germany	2014-2017	1,463,415
Enhancing the Livelihood Opportunities of Smallholder African Indigenous Vegetable Producers through the Development and Implementation of IPM Measures for Arthropod and Nematode Pests	Federal Ministry for Economic Cooperation and Development-Gesellschaft für Internationale Zusammenarbeit, Germany	2014-2016	203,946
Beans with Benefits: Integrating improved mungbean as a catch crop into the dryland systems of South and Central Asia for increased smallholder farmer income and more sustainable production systems	Federal Ministry for Economic Cooperation and Development-Gesellschaft für Internationale Zusammenarbeit, Germany	2015-2018	1,275,720
RegenIntro: Introduction of accessions from the regeneration initiative into the international collections held by AVRDC	Global Crop Diversity Trust	2013-2015	59,451
Improving Rural Livelihoods through Innovative Scaling-up of Science-led Participatory Research for Development in Karnataka	Government of Karnataka, India	2013-2017	70,000
Screening for development of begomovirus-resistant processing tomato hybrid	Kagome Co. Ltd., Taiwan	2010-2015	88,328
Sustainable Actions for Edible Gardens	Milan Municipality, Italy	2014-2015	12,195
Mobilize resistance genes from wild tomato for breeding salt tolerant tomato cultivars	Ministry of Science and Technology Taiwan	2014-2016	79,401
Local adaptation of *Ralstonia solanacearum* phylotype IIB sequevar 1 strains in Taiwan and identification of their resistance sources in tomato	National Science Council, Taiwan	2013-2015	59,905
Support for the implementation of PADFA's onion seed programme	The Commodity Value-Chain Development Support Project (PADFA), Cameroon	2012-2015	194,845

The supply of services pursuant to request of supplying Seed Kits and Training	Project Concern International - Tanzania	2015	9,584
Development of Breeding Techniques and Selection of Virus Resistant Germplasm in Pepper and Tomato	Rural Development Administration, Korea	2013-2015	120,000
Development of Breeding Techniques and Selection of Disease Resistant Germplasm in Cucurbits	Rural Development Administration, Korea	2014-2016	120,000
Postharvest program for RDA seconded scientist	Rural Development Administration, Korea	2014-2015	120,000
Vegetables Go to School: Improving Nutrition through Agricultural Diversification	Swiss Agency for Development and Cooperation	2013-2015	3,530,303
Cambodia horticulture project for income and nutrition	Swiss Agency for Development and Cooperation	2015-2017	515,509
Evaluation and Screening of Syngenta Maize and Vegetable Hybrids for Adaptation in Nigeria And Skills Development Program for Syngenta Staff	Syngenta Crop Protection AG	2014-2017	42,000
Utilizing the genome of the vegetable *Cleome gynandra* for the development of improved cultivars for the West and East African markets	The Netherlands Organization for Scientific Research	2015-2017	5,847
Mobilizing vegetable genetic resources and technologies to enhance household nutrition, income and livelihoods in Indonesia	United States Agency for International Development	2010-2015	1,439,784
Postharvest Program	United States Agency for International Development	2012-2017	5,000,000
Promoting Science and Innovation in Agriculture in Pakistan - Agricultural Innovation Program	United States Agency for International Development	2013-2017	3,000,000
Deploying Improved Vegetable Technologies to Overcome Malnutrition and Poverty in Mali	United States Agency for International Development	2014-2017	3,200,000
Nutrition Sensitive Vegetable Technologies in Tajikistan	United States Agency for International Development	2014-2016	591,147

Deploying Vegetable Seed Kits to Tackle Malnutrition In Cambodia, Kenya, Liberia, Tanzania and Uganda	United States Agency for International Development	2014-2017	6,000,421
Enhancing partnership among Africa RISING, NAFAKA and TUBORESHE CHAKULA Programs for fast-tracking delivery and scaling of agricultural technologies in Tanzania	United States Agency for International Development	2014-2015	199,018
Africa RISING: Enhancing vegetable value chains in rice-based and sole crop production systems to improve farm household income and consumer access to safer vegetables in Morogoro, Tanzania	United States Agency for International Development	2012-2015	344,700
Cereal-based Systems of West Africa: Vegetables and associated best management practices in cereal-based crop production systems to improve income and diets of rural and urban households in Northern Ghana and Southern Mali	United States Agency for International Development	2012-2015	618,600
Urbanisation and its Impacts on the use of Natural Resources in Africa	Volkswagen Stiftung, Germany	2014-2015	69,024
Enhancing Productivity, Competitiveness and Marketing of Traditional African (Leafy) Vegetables for Improved Income and Nutrition in West and Central Africa	West and Central African Council for Agricultural Research and Development	2013-2016	433,608

The Center is in good financial health thanks to proper financial planning, resource allocation, monitoring and reporting. A significant and increasing portion of the Center's revenue comes from (restricted) project financing. The Center includes in all project proposals the full cost of the proposed actions to guarantee long-term financial sustainability.

Finances 2015

	AVRDC	CGIAR** recommended range
Cash management on restricted operations*	0.4	less than 1
Adequacy of reserves	126 days	75-90 days
Short-term solvency	171 days	90-120 days

The Center has strengthened its financial reserves as part of its risk management strategy. Reserves have been set aside to provide a cushion against unexpected setbacks; to carry out necessary capital investment replacements; and to pursue innovative research ideas through the Innovations Fund.

Table 1. 2014 Revenues (in '000 USD)

Unrestricted grants	8,817	46%
Restricted grants	10,268	53%
Other revenues	259	1%
Total	**19,344**	100%

Unrestricted Grants	
Republic of China (ROC)	4,714
UK Department for International Development (UK/DFID)	2,479
United States Agency for International Development (USAID)	1,000
Germany	313
Thailand	148
The Philippines	100
Korea	50
Japan	13
Sub-total	***8,817***
Other revenues	259
Total	**9,076**

Restricted Grants	
United States Agency for International Development (USAID)	4,343
Republic of Germany / BMZ / GIZ	1,617
Australia/Australian Centre for International Agricultrual Research (ACIAR)	1,048
Consultative Group on International Agricultural Research (CGIAR)	852
Swiss Development Cooperation (SDC)	579
Republic of China / Council of Agriculture	390
Republic of China / Ministry of Foreign Affairs	303
European Union	184
West and Central African Council for Agricultural Research and Development (CORAF/WECARD)	179
Korea/Rural Development Administration (RDA)	123
Republic of China / Ministry of Science and Technology (MOST)	95
COFRA Foundation	75
Asia and Pacific Seed Association (APSA)	73
Government of Karnataka	61
Alliance for Green Revolution in Africa (AGRA)	57
Volkswagen Stiftung Foundation	37
Kagome Co., Ltd.	25
Others	226
Sub-total	***10,268***

Table 2. 2015 Final budget estimate (USD '000)

			2015 Estimate		2014 Actual	
Revenues			**19,468**		**19,344**	
Budget Allocations by Objects						
	Personnel					
		- International	5,820	30%	5,281	29%
		- Local	5,263	27%	5,156	28%
	Operations					
		- Operational expenses, services	6,063	31%	5,760	32%
		- Travel costs	1,178	6%	1,013	6%
		- Training, Workshops and Meetings	672	3%	638	4%
		- Equipment (Depreciation costs)	369	2%	298	2%
		- Overhead Charge	1,382	7%	1,329	7%
	Contingency		100	1%		
Sub-total			**20,847**	107%	**19,476**	107%
	Indirect cost recovery (overhead)		(1,382)	-7%	(1,357)	-7%
Total			**19,465**	100%	**18,119**	100%
Changes in net assets			**3**		**1,225**	
Net assets at the beginning			6,416		5,714	
Change in net assets			3		1,225	
Net change in Capital Replacement Fund					(429)	
Net change in Innovations Fund					(90)	
Net change in Self-sustaining Operating Fund					(3)	
Carried over / forward			6,419		6,416	
** Net Assets as of 31 December 2014:*						
	Working Capital Fund				*2,000*	
	Accumulated Fund				*2,114*	
	Capital Replacement Fund				*634*	
	Innovations Fund				*797*	
	Fixed Asset Fund				*259*	
	Self-sustaining Operating Fund				*612*	
Budget allocations by Themes						
	I.	***Strategy Themes***				
	I-1	*Germplasm: Germplasm conservation, evaluation and gene discovery*	*1,377*	*7%*	*1,639*	*9%*
	I-2	*Breeding: Genetic enhancement and varietal development of vegetables*	*2,471*	*12%*	*3,294*	*18%*
	I-3	*Production: Safe and sustainable vegetable production systems*	*5,127*	*25%*	*5,208*	*29%*
	I-4	*Consumption: Balanced diets through increased access to and utilization of nutritious vegetables*	*5,077*	*24%*	*4,969*	*27%*
	II.	***Administration and Services***	*6,795*	*33%*	*3,009*	*17%*
Total *			***20,847***	100%	***18,119***	100%

Table 3 - Breakdown of Y2015 Estimated Revenues

	Donor	2015 Estimate		2014 Actual	
Unrestricted Funding					
	Republic of China (ROC)	4,528		4,714	
	UK Department for International Development (UK/DFID)	2,130		2,479	
	United States Agency for International Development (USAID)	1,000		1,000	
	Germany	283		313	
	Thailand	144		148	
	Philippines	50		100	
	Korea	50		50	
	Japan	13		13	
	Sub-total	8,198		8,817	
	Other revenues	200		259	
	Total	**8,398**	***43%***	**9,076**	***47%***
Restricted Funding *					
	USAID	4,255		4,343	
	Republic of China (ROC-COA/MOST/MOFA)	1,281		788	
	Republic of Germany/BMZ/GIZ	1,265		1,617	
	Swiss Agency for Development and Cooperation (SDC)	1,225		579	
	Australia/Australian Centre for International Agricultural Research (ACIAR)	1,088		1,048	
	Consortium of International Agricultural Research Centers (CGIAR)	262		852	
	CORAF / WECARD	184		179	
	EU / UNESCAP			184	
	Others	1,510		678	
	Sub-total	**11,070**	***57%***	**10,268**	***53%***
	Total Revenues	**19,468**	***100%***	**19,344**	***100%***

* Contribution less than US$ 150,000 grouped under “Others”

Acronyms & Abbreviations

AARNET	ASEAN-AVRDC Regional Network
ACIAR	Australian Centre for International Agricultural Research
AIRCA	Association of International Research and Development Centers for Agriculture
ASEAN	Association of Southeast Asian Nations
AVGRIS	AVRDC Vegetable Genetic Resources Information System
BCMV	*Bean common mosaic virus*
BMZ	Federal Ministry for Economic Cooperation and Development/Society for International Cooperation
BPH	Best Practice Hub
CACVEG	Central Asia and the Caucasus Regional Network for Vegetable Systems Research and Development
CGIAR	Consultative Group on International Agricultural Research
COA	Taiwan Council of Agriculture
EU	European Union
GIZ	Gesellschaft für Internationale Zusammenarbeit
GRSU	Genetic Resources and Seed Unit
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IITA	International Institute for Tropical Agriculture
IPM	Integrated pest management
IVTC	International Vegetable Training Course
MOFA	Taiwan Ministry of Foreign Affairs
NARES	National agricultural research and extension systems
PepMoV	*Pepper mottle virus*
QTL	Quantitative trait loci
SDC	Swiss Agency for Development and Cooperation
SLCPHV	*Squash leaf curl Philippines virus*
TYLCV	*Tomato leaf curl virus*
UN-ESCAP	Economic and Social Commission for Asia and the Pacific of the United Nations
USAID	United States Agency for International Development
VTIC	Vegetable technology immersion clusters
ZECC	Zero energy cooling chamber