AVRDC
The World Vegetable Center

MEDIUM-TERM PLAN

2013-2015

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BRINGING PROSPERITY TO THE POOR AND HEALTH FOR ALL FOR FORTY YEARS

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CONTENTS

CONSTRUCTING A SIMPLE ZECC (ZERO ENERGY COOLING CHAMBER) TO STORE VEGETABLES AT THE POSTHARVEST TRAINING AND SERVICES CENTER (PTSC), LOCATED ON THE CAMPUS OF AVRDC'S REGIONAL CENTER FOR AFRICA IN ARUSHA, TANZANIA. THE PTSC IS A ONE-STOP SHOP WHERE GROWERS, FARMERS' ASSOCIATIONS, AND MARKETERS CAN FIND MATERIALS AND ASSISTANCE, OFFERED AT COST, FOR ALL THE STEPS THAT OCCUR FROM THE MOMENT PRODUCE IS HARVESTED TO THE MOMENT IT IS EATEN.

FOREWORD

Postharvest research: the time to invest is now

Estimates indicate that of the approximately 1.3 billion tons of food produced per year globally up to one third is lost prior to human consumption. A further unknown, but probably large amount of food, suffers loss of vitamins and micronutrients due to degradation of quality, unskilled cooking methods and lack of consumer nutritional knowledge. These problems are compounded in many developing countries by poorly developed infrastructure for the storage and processing of produce and food products. Such countries usually have a high proportion of poor people who do not have reliable domestic refrigeration and access to potable water. They thus have to shop daily, usually from local wet markets, which are often unsanitary and lack cold storage or suitable produce washing and cleaning facilities.

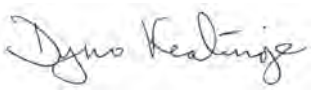
The current and future challenge to address food production and supply for the world's population not only requires investment to grow enough food to meet increasing population levels but demands a reduction in the wastage and loss of quality of the food that is currently produced, purchased, cooked and eaten. Postharvest problems for vegetables are particularly severe due to the perishable nature of fresh produce. Losses have been reported to be as high as 80% for some leafy vegetables due to poor handling, packaging and short shelf life.

Most vegetables are sold fresh and may suffer substantive losses as a result of time, heat, humidity and rough handling during transport from farm to market. The often extreme seasonality but relatively "high" market value of vegetable crops such as tomatoes may result in overproduction at specific times at a local level, forcing farmers to "dump" produce physically for a total loss, or resort to desperation sales to traders at prices below the cost of production.

Much more research is now needed to provide affordable and sustainable solutions to this myriad of problems than can be carried out by poor farmers, small entrepreneurs and low-income consumers all along the vegetable value chain, as well as policymakers and other actors influencing the value chain.

In its Medium-Term Plan 2013-2015, AVRDC seeks to expand programs on postharvest research and development aimed at these target groups. This effort builds on the Center's recent productive project experience in the Mekong Region of Southeast Asia, where suitable postharvest technologies were developed, demonstrated and adopted by vegetable producers, transporters and marketers. Simple techniques included better use of shade and low-cost cooling methods (evaporative coolers); encouraging producers to use better quality packaging; and training them on how to clean, grade and pack their vegetables suitably for transport and marketing. This has enabled a growing number of producers to improve the quality of the vegetables that are purchased by consumers and have reduced somewhat the high losses they previously experienced. Nevertheless, this research is just a start at addressing the formidable vegetable postharvest problems in developing countries and on a global scale. Much more effort of this type is required so that horticultural producers can be empowered provide good quality, nutritious and safe food to consumers.

AVRDC thanks its core donors for their continued support but calls upon all agencies to invest in productive partnerships for postharvest vegetable research. The old adage of "Waste not, want not" is particularly appropriate in the struggle to feed and nourish the world by 2050, and in the world's hopes for the attainment of Millennium Development Goal 1 (*Eradicate extreme poverty and hunger*) the deadline for which is only two years away. More investment is needed now!



J.D.H. Keatinge
Director General

STRATEGIC ORGANIZATION

FOUR THEMES

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

BREEDING

Genetic enhancement and varietal development of vegetables

Goal: Varieties with potential to expand opportunities in tropical vegetable production.

Purpose: Farmers obtain varieties and lines of major vegetables that produce high yields of nutritious and marketable food with less health risk and environmental damage.

PRODUCTION

Safe and sustainable vegetable production systems

Goal: Substantial contributions to safe and sustainable vegetable production generated.

Purpose: Increased supply of safer vegetables through adoption of profitable, environmentally sound practices by farmers leading to knowledge-based farming.

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.

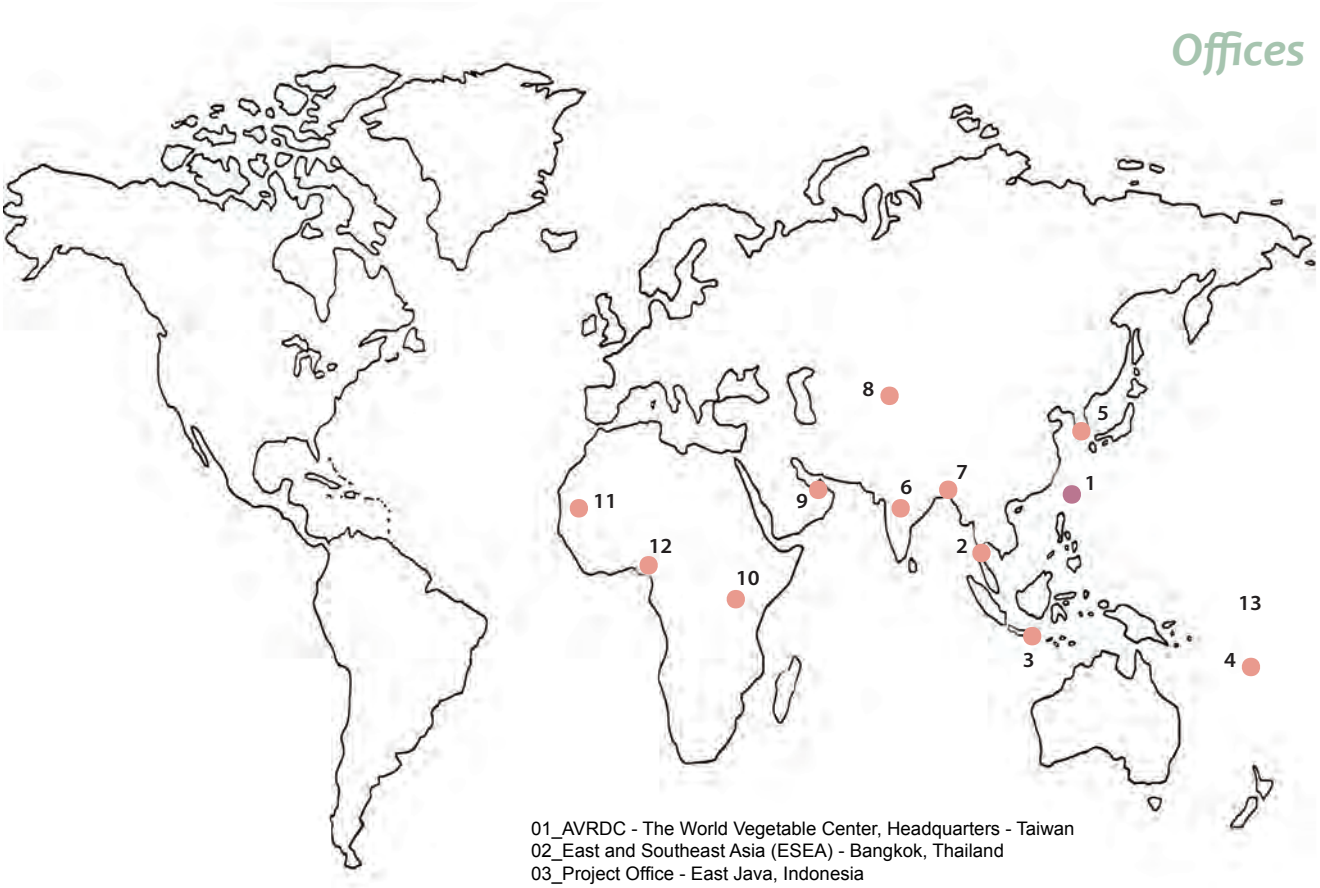
The Asian Vegetable Research and Development Center, established in 1971, formally changed its name to AVRDC – The World Vegetable Center in 2008. The name change reflects the wider geographical scope of the Center's work as it expands activities to greater parts of Asia and beyond, reaching out to sub-Saharan Africa, Oceania, and Central and West Asia and North Africa.

The Center's headquarters is located in Shanhua, Taiwan. Three regional offices are located in Bangkok, Thailand (East and Southeast Asia), Arusha, Tanzania (Regional Center for Africa), and Hyderabad, India (South Asia). Work in West Asia and North Africa, coordinated from a regional office in Dubai, United Arab Emirates, was put on hold in the second quarter of 2012. Additional offices, staff members functions and are located in Mali, Cameroon, Bangladesh, Uzbekistan, Indonesia and Fiji.

The Center's research and development activities are organized under **four separate broad themes** to encompass the vegetable value chain. The four themes are integrated in a matrix with the regional centers and headquarters. Both research and development components are built into each theme's activities. Results from adapted and applied research are used to formulate the development component of the themes to generate positive outcomes and impacts among target beneficiaries.

In 2012, the Center's activities were conducted in active partnership with the public and private sectors. Research activities involved national agricultural research systems, international organizations, private institutions and advanced education and research institutes. Emphasizing the need to ensure sustainability of development activities in targeted sites, the Center collaborated and worked within national government and nongovernmental agricultural systems, farmers' groups, women's groups and community-based organizations. All activities were conducted with a strong focus on capacity building, promotion and advocacy for improved production and enhanced consumption of vegetables. ◆

Offices



01_AVRDC - The World Vegetable Center, Headquarters - Taiwan
02_East and Southeast Asia (ESEA) - Bangkok, Thailand
03_Project Office - East Java, Indonesia
04_Project Office - Fiji
05_Korean Sub-Center - Suwon, Republic of Korea
06_South Asia (SA) - Hyderabad, India
07_Project Office - Bangladesh
08_Office for Central Asia and the Caucasus - Tashkent, Uzbekistan
09_Central and West Asia and North Africa (CWANA) - Dubai, UAE
10_Regional Center for Africa (RCA) - Arusha, Tanzania
11_Office for West and Central Africa - Bamako, Mali
12_Project Office - Yaoundé, Cameroon
13_Oceania (through Headquarters, Taiwan)

GLOBAL ACTION

Through its regional centers and project offices, AVRDC – The World Vegetable Center gains an intimate, up-to-date understanding of the economic, environmental, and social constraints faced by the rural and urban poor in developing countries. Close ties to communities, regional organizations, and national institutes ensure our global research has local impact and purpose.

Regional Center for Africa

A major priority in 2013 is to continue realignment with the major geopolitical research and development domains by splitting the region into two offices, one for Eastern and Southern Africa (ESA, based in Tanzania) and another for West and Central Africa (WCA, based in Mali). This shift would increase operational efficiencies, and make it easier for the Center to engage with partners for generation, adaptation and dissemination of impact-loaded research outcomes at the community level, notably by establishing Best Practice Demonstration and Training Hubs across countries as part of a network support strategy compatible with the small size of the team(s) in the region.

Another major priority in 2013 is that the regional center will continue to secure and facilitate access to genetic resources held at AVRDC's seed repository in Arusha, Tanzania—notably in obtaining retroactive donations of, and permission to distribute, germplasm accessions maintained by RCA from authorized sources from originating countries, particularly for the few accessions for which official transfer documentation is unavailable. This effort started in 2012 with positive and unambiguous responses from most countries contacted.

In 2014, the regional center (through both the ESA and WCA offices) will continue to work on sustainable intensification of food crop systems alongside commodity centers, notably by seeking to promote or optimize the integration of vegetables in cereal-based production systems. Testing various models of mixed or sequential vegetable cropping and associated technologies with rice, sorghum and maize will continue with AfricaRice, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and the International Institute for Tropical Agriculture (IITA), respectively. Research and development initiatives on postharvest processing and market linkages, particularly for women, will be pursued. It is anticipated that the regional center's restructuring into two distinct entities will be completed by the end of 2014.

Looking ahead to 2015, with two autonomous regions in Africa, it is thought that the ESA region will have reached full project-ready status, with functional laboratories and a diversified research team in all major disciplines. The ESA region will have further established itself as a reference center for postharvest research and development in the region and will focus on research issues surrounding norms and standards for market/export grade vegetable production and trade. The WCA region will continue to develop its human resource base while addressing issues surrounding mass supply of vegetables based on efficient seed production and delivery systems. ◆

Central & West Asia and North Africa

The Center is looking forward to revive its presence and work in North Africa and West Asia after a period of low activity after the departure of the Regional Director. Collaborative activities with the International Center for Agricultural Research in the Dry Areas (ICARDA) have been put on hold since mid-2012 as AVRDC does not have staff members in the region for active collaboration. Memoranda of Agreement have been signed with both the Sultanate of Oman and a private partner in the State of Qatar, providing a platform for the Center to strengthen its research and development activities to reach more countries in the region. The Center's assets are still located

WOMEN IN GAZAWA, CAMEROON INSTALL IRRIGATION PIPES FOR AN ONION TRIAL HOSTED IN COLLABORATION WITH PROJET D'APPUI AU DÉVELOPPEMENT DES FILIÈRES AGRICOLES (PADFA). THE CENTER BUILDS NETWORKS OF PARTNERS TO ENHANCE SKILLS AND INTRODUCE TECHNOLOGIES TO FARMING COMMUNITIES IN AFRICA.

with ICARDA in Dubai, United Arab Emirates; the possibility of establishing an office under the auspices of the International Center for Biosaline Agriculture, Dubai, is being explored. The Center hopes to have a Regional Director in place during 2013 to lead the Center's research and development activities in the region.

AVRDC facilitates germplasm exchange with the countries in Central Asia and the Caucasus. These countries have effective, structured procedures for vegetable variety release. The Center will continue to work within this framework to support the dissemination of quality vegetable lines to stakeholders in the region. The Center will continue to contribute to adaptive vegetable trials in the region – these are a major focus of the Center's research and development activities in 2013-2015. The trials will be conducted in close collaboration with local partners in Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyztan, Tajikistan, Turkmenistan and Uzbekistan.

Capacity-building activities are a vital component of the process of getting the Center's technologies accepted and adopted among smallholder farmers. Various training courses are planned in collaboration with partners, not only on breeding and effective technologies for vegetable production but also on promoting vegetable consumption for dietary diversity and good health of the local population. The training courses will initially be conducted in Uzbekistan, with the intention to scale out to other countries. Vegetable grafting techniques and intensive production systems, introduced in 2011, will be scaled up in 2014 in partnership with the Farmers Council of Uzbekistan. As part of scaling-up activities, farmer field days are planned in all eight countries of the region.

Two workshops on climate change and agriculture, and integration of education, science and agriculture, are planned in Uzbekistan. These workshops are venues for scientists and those involved in advanced education interact. The CGIAR's Program Facilitation Unit for Central Asia and the Caucasus and the National University of Uzbekistan will convene these workshops.

The 6th Steering Committee Meeting on the Central Asia and the Caucasus Vegetable Research and Development Network (CACVEG) will be held in Tashkent in 2013. The forum provides an opportunity for representatives of the eight countries to exchange ideas, assess opportunities and develop annual plans for vegetable research and development activities in the region. ◆

LEARNING AT THE SOURCE: PLANT PROTECTION OFFICERS AT THE BHUPING PALACE, CHIANG MAI, THAILAND, EXPLAINED THEIR INTEGRATED SYSTEM TO CONTROL PLANT PESTS AND DISEASES TO PARTICIPANTS IN AVRDC'S INTERNATIONAL VEGETABLE TRAINING COURSE.

East and Southeast Asia

2013 will see the conduct of the 8th AARNET Steering Committee meeting in Bangkok, followed by an expert consultation on "Vegetable Research and Priorities in Southeast Asia" in March 2013. The AVRDC Board of Directors will hold its 46th Board Meeting in April 2013 in Thailand as one of the significant events of the year. In addition, the regional office will host a training of trainers course in Kamphaeng Saen on "Sustainable Vegetable Production and Consumption" in collaboration with the Food and Agriculture Organization of the United Nations for female extension workers from Afghanistan.

The International Vegetable Training Course will remain one of the regional priorities from 2013 through 2015. In-country training for technologies on sustainable production and processing technologies will be facilitated by the regional office in Cambodia, Indonesia, Laos and Myanmar in 2013 and 2014 under the innovation network for food security and poverty reduction, SATNET Asia funded by EuropeAid. The BMZ/GIZ-supported projects on Maruca vitrata and urban vegetable systems will conclude in 2013 with final project workshops being held in Thailand. A Ph.D. student from the Philippines will be based at the regional office and in collaboration with staff from headquarters and Kasetsart University conduct a three-year study on the impact of AVRDC on the vegetable seed sector in Thailand starting in May 2013.

Among other activities for the period 2013-2015, the regional office will facilitate the Southeast Asia component of the Federal Department of Foreign Affairs FDFA Swiss Agency for Development and Cooperation (SDC) supported "Vegetables Go to School" project. Collaboration will be strengthened with the WorldFish Center, particularly in the area of the CGIAR Research Program 1.3 "Harnessing the Development Potential of Aquatic Agricultural Systems for the Poor and Vulnerable." The regional office will be actively involved in preparing for the Regional Symposium on "Sustaining Small-Scale Vegetable Production and Marketing Systems

for Food and Nutrition Security" (SEAVEG 2014: Families, Farms, Food), which will be held in February 2014 in Bangkok. ◆

South Asia

In 2013 the main activities in South Asia will be to successfully initiate new projects that will be starting in India, Pakistan, Nepal and Bhutan; to expand the legume breeding program; and to extend what has been learned from the long-running Sir Ratan Tata Trust (SRTT) project to other projects and to initiate its second phase. The final evaluations of the SRTT project will be completed and research publications produced on the outcomes.

There will be a need to substantially expand staff numbers in the region over the next three years and to initiate new regional communication and planning activities such as annual regional meetings of different project teams to encourage cross-fertilization and the development of a regional project development strategy.

Initiatives to begin in 2013 will be the Australian Centre for International Agricultural Research (ACIAR)-funded project to improve livelihoods in the Eastern Uplands of India, the Swiss Agency for Development and Cooperation (SDC)-funded project to promote school gardens in Nepal and Bhutan, the COFRA funded project to promote home gardens for women's groups in flood affected Odisha, a project funded by the government of Karnataka to promote increased agricultural productivity and incomes (including vegetables) and a large United States Agency for International Development (USAID)-funded project to promote mungbean production, covered production systems and improved vegetable value chains in Pakistan.

The pursuit of other projects will continue in 2013; in particular a global project on mungbean development currently under consideration by ACIAR, and projects to expand globally the growing outputs from the legume breeding program, including joint projects with the government of India. In 2014 and 2015 the region will aim to develop a wider suite of projects with more diverse partners and a critical mass of expertise in legume breeding, home gardens and covered production systems, training and research that can be widely applicable. Further attempts will be made to develop projects in Sri Lanka and other countries beyond India.◆

SOUTH ASIA REGIONAL DIRECTOR WARWICK EASDOWN (RIGHT) MEETS PARTNERS AND FARMERS IN THE FIELD TO DISCUSS PROGRESS OF HOME GARDENS ESTABLISHED WITH AVRDC'S DISASTER RELIEF SEED KITS. THE KITS WERE DISTRIBUTED TO VILLAGERS IN THE FLOOD-AFFECTED STATE OF ODISHA, INDIA.

Oceania

In 2013-2015 the Center is planning activities to address the major challenges in Oceania of slow economic development, high rates of major non-communicable diseases and issues related to climate change. In line with the Center's Strategic Plan, the Center will introduce and evaluate elite high-value vegetable crops, evaluate management technologies to overcome major production constraints in the regular production seasons and off-seasons, and support communities to deliver adequate amounts of produce to markets. As an integral part of the activities, the Center also aims for a sustainable seed system to supply quality seed of elite vegetable lines and to enhance the capacity of the region's smallholder farmers through training on good agricultural practices, and farm and business management, specifically for those following participatory guarantee systems with hotels/ resorts.

To address the diverse needs of the region, the Center is strengthening its presence in Oceania, and strongly pursuing hosting arrangements and ensuring good working relationships with many different stakeholders with an interest in vegetable research and development, nutrition and health. The region provides unique opportunities for several research areas and the results could be applicable to other regions. For example, the subsistence production system which is, by default, nearly organic provides opportunities to select vegetable lines and varieties that respond well under low input conditions—for example, demonstrating resistance to diseases specific to the agroecosystem or better utilization of nutrients derived from organic matter.

STRONGER LINKS IN THE VEGETABLE VALUE CHAIN MEAN MORE PROFITABLE FARMS AND HAPPIER CUSTOMERS. CHEFS AT RESORT HOTELS IN FIJI EXPLAIN THEIR NEEDS TO PRODUCERS.

The rising sea level in the Pacific—a serious concern to the many small island nations in the region—provides opportunities to select for salinity tolerance among crop species and varieties. The Center hopes to take advantage of unique island agroecologies to extend the reach of its research and development activities.

Studies and lessons learned in the region on how to promote and increase vegetable consumption and its contribution to alleviate prevalence of non-communicable diseases will be shared with other populations with similar concerns.

Collective effort is required to build consensus among donors, governments, and research and development organizations on the importance of vegetable production and consumption to improve the livelihoods of smallholders, and the Center strives to strengthen linkages with various stakeholders in the region. ◆

THE CENTER'S PROJECTS

AVRDC staff have strong multidisciplinary competence and capability to implement research and development projects globally, creating significant impacts for our target beneficiaries in the developing world.

AVRDC carries out a range of research and development projects, capturing opportunities and addressing constraints of the vegetable enterprise all along the value chain. Projects are conducted around the globe and supported by traditional and non-traditional donors covering the spectrum of the research and development continuum: from advanced research to adaptation of results into basic and applied development, and to technology transfer and dissemination.

Title	Donor	Duration
Strengthening the Cambodia and Australian vegetable industries through adoption of improved production and postharvest practices	Australian Centre for International Agricultural Research, Australia	2010 - 2013
Improving vegetable production and consumption for sustainable rural livelihoods in Jharkhand and Punjab, India	Sir Ratan Tata Trust, India	2008 - 2013
Less loss, more profit, better health: reducing the losses caused by the pod borer (*Maruca vitrata*) on vegetable legumes in Southeast Asia and sub-Saharan Africa by refining component technologies of a sustainable management strategy	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Germany	2010 - 2013
Development of environmentally friendly substances to control bacterial wilt and Phytophthora late blight of tomato	Rural Development Administration, Republic of Korea	2010 - 2013
Characterize and map late blight resistance in wild tomato accessions	National Science Council, Taiwan	2010 - 2013
Screening for development of begomovirus-resistant processing tomato hybrid	Kagome, Co. Ltd., Taiwan	2010 - 2013
Exploiting bittergourd (*Momordica charantia* L.) to increase incomes, manage type 2 diabetes, and promote health in developing countries	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Germany	2011 - 2014
Mobilizing vegetable genetic resources and technologies to enhance household nutrition, income and livelihoods in Indonesia	United States Agency for International Development, USA	2010 - 2014
Enhancing horticultural productivity, incomes and livelihoods through integrated management of aphid pests on vegetables in sub-Saharan Africa.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Germany	2011 - 2014
Semillas de Esperanza: Vegetable Seeds for Sustainable Agriculture	United States Agency for International Development, Hortcultural Collaborative Research and Support Program, USA	2011 - 2013

Title	Donor	Duration
Seeds of begomovirus resistant tomato lines for evaluation	Indus Seed Pvt. Ltd., India	2011 - 2013
Strengthening Integrated Crop Management Research in The Pacific Islands in Support of Sustainable Intensification of High-Value Crop Production	Pacific Agribusiness Research for Development Initiative, Australia	2011 - 2016
Biotechnology-Assisted Development of Virus-Resistant Varieties and Populations of Squash for Climate Change Adaptation	National Science Council, Taiwan	2011 - 2014
Targeting Induced Local Lesions IN Genome (TILLING) of tomato for multiple virus resistance	National Science Council, Taiwan	2011 - 2014
Improving Vegetable Production and Consumption in Mali	United States Agency for International Development, USA	2011 - 2013
Nutritional characterization and value addition of amaranth vegetable and grain by low cost sustainable processing: towards poverty reduction, food and nutrition security in Kenya and Tanzania	Australian Agency for International Development, Australia	2011 - 2013
Safe and effective pest and crop management strategies to strengthen the vegetable value chain in the humid tropics	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Germany	2012 - 2015
Network for Knowledge Transfer on Sustainable Agricultural Technologies and Improved Market Linkages in South and Southeast Asia	EuropeAid, European Union	2012 - 2014
Screening and collection of anthracnose-resistant pepper germplasm and development of high temperature-resistant pepper lines for abnormal climate	Rural Development Administration, Republic of Korea	2012 - 2013
Beating Begomoviruses: Better livelihoods for farmers in tropical Asia with begomovirus resistant tomato, hot pepper and mungbean and integrated disease management	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Germany	2012 - 2015
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, USA	2012 - 2013
Sustainable African Indigenous Vegetable Production and Market-Chain Development for Improved Health and Nutrition and Income Generation by Smallholder Farmers in Kenya, Tanzania and Zambia	United States Agency for International Development, Hortcultural Collaborative Research and Support Program, USA	2011 - 2013

Title	Donor	Duration
Understanding Urban and Peri-urban Vegetable Production and Marketing Systems through GIS-based Community Food Mapping in Greater Bangkok	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Germany	2012 - 2013
A preliminary study to improve income and nutrition in Eastern and Southern Africa by enhancing vegetable based farming and food systems	Australian Centre for International Agricultural Research, Australia	2012 - 2013
Implementation of integrated thrips and tospovirus management strategies in smallholder vegetable cropping systems of eastern Africa	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Germany	2012 - 2015
Extension of Appropriate Postharvest Technology in sub-Saharan Africa: A Postharvest Training and Services Center	United States Agency for International Development, Hortcultural Collaborative Research and Support Program, USA	2012 - 2013
Enhanced Homestead Food Production: Tanzania	Helen Keller International, Tanzania	2012 - 2013
Fine-mapping of quantitative trait loci on tomato chromosome 6 associated with resistance to Phylotype I and II strains of *Ralstonia solanacearum*	National Science Council, Taiwan	2012 - 2013
Studies on durability of resistance trait loci against *Ralstonia solanacearum* and efficiency of marker-assisted selection	National Science Council, Taiwan	2012 - 2013
Vegetables Go to School: Improving nutrition by agricultural diversification	Swiss Agency for Development and Cooperation, Switzerland	2012 - 2013
Improving livelihoods with innovative cropping systems on the East India plateau	Australian Centre for International Agricultural Research, Australia	2012 - 2015
Vegetable seed kits for flood-affected households in Fiji	Government of Fiji	2012 - 2013
Postharvest project	United States Agency for International Development, USA	2012 - 2013
Developing an integrated participatory guarantee system in the Pacific Islands in support of sustainable production of high-value vegetable crops	Australian Centre for International Agricultural Research, Australia	2012 - 2014
Support for the implementation of the Commodity Value Chain Development Support Project's (PADFA) onion seed programme	International Foundation for Agricultural Development - PADFA , Cameroon	2012 - 2015
Overcoming conservation and germination problems of selected indigenous vegetables	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Germany	2013 - 2014

RESEARCH AND DEVELOPMENT OUTPUT TARGETS 2013-2015

AVRDC – The World Vegetable Center aims to generate positive impacts that contribute to reducing poverty and malnutrition among our beneficiaries. The Center's rigorous research contributes to new knowledge development and delivers applicable technologies. Appropriate technologies are developed, adapted and tested with partners and adopted by end users. While opportunities and needs sometimes constrain the balancing act between research and development activities, the Center nevertheless retains flexibility in its diverse project portfolio to ensure effective technology development, dissemination, and uptake.

The Center does not have a defined crop species mandate, and its target crop portfolio has changed over the years. The constant criterion is that the crops are nutritious and health-promoting vegetables. The shift of focus on our target crops may be driven by global needs, our comparative advantages and competencies, economics and/or donor priorities. Disciplinary focus and diversity of the Center's research and development work also need to be shifted and readjusted from time to time.

AVRDC – The World Vegetable Center organizes its research and development work under four global themes: Germplasm, Breeding, Production and Consumption, to address all aspects of the vegetable value chain. Currently, the Center's crop portfolio comprises tomato, sweet and chili pepper, onion, cucumber, pumpkin, some crucifers, mungbean and traditional vegetables (bitter gourd, African eggplant and nightshade, slippery cabbage, okra, amaranth, roselle, Malabar spinach and moringa, among others).

Competent teams of scientists and support staff members implement the Center's work in various parts of the world, taking into account local stakeholders' needs, resources and concerns. A diversity of disciplines, skills and ethnicity within each of the Center's geographic locations lends to the flexibility, perceptiveness and innovative strength of the research and development teams. They respond effectively to changing constraints and opportunities of vegetable production, marketing and consumption—issues that are globally important and which directly influence local circumstances, or conversely, local problems with global pertinence.

The disciplines represented in the Center's scientific teams are: plant breeding (Bulb Allium, Cucurbits, Traditional Vegetables, Legumes, Pepper and Tomato), Plant Pathology (Bacteriology, Mycology, and Virology), Entomology, Biotechnology/Molecular Breeding, Nutrition, Socioeconomics, Genetic Resources and Seed Systems, and Global Technology Dissemination. These are supported by Biometrics, Communications and Information, Intellectual Property Management, Information Technology, Grants and Partnership Development, Human Resources, Financial Services, Administration Services, Technical Services and Food and Dormitory Services.

The following thematic logical framework provides a detailed yet concise workplan for each theme's activities, outputs, and expected outcomes for 2013-2015 and serves as a benchmark for monitoring and evaluation. ◆

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 2013* • 150 accessions collected/acquired at the Center's headquarters • Impact of seed drying method and seed moisture content on germination rate of bitter gourd determined • 90 accessions/breeding lines collected/acquired from locations in sub-Saharan Africa for safety duplication in Regional Center for Africa *Output Targets 2014* • 150 accessions collected/acquired at the Center's headquarters • Effect of storage conditions on the germination rate of bitter gourd determined • Effect of seed priming techniques on germination rate and field establishment of stored seed of bitter gourd, okra, and water spinach determined • 90 accessions/breeding lines collected/acquired from locations in sub-Saharan Africa for safety duplication in Regional Center for Africa *Output Targets 2015* • 150 accessions collected/acquired the Center's headquarters • 90 accessions/breeding lines collected/acquired from locations in sub-Saharan Africa for safety duplication in Regional Center for Africa

Activity 1.2 Maintain effective regeneration of priority vegetable germplasm	*Output Targets 2013* • 1000 accessions regenerated at the Center's headquarters • 200 accessions regenerated at Regional Center for Africa • Production and increase of good quality seed conducted: 10 crops for nutritional seed kit; advanced lines for multi-location and on-farm trials; maintenance of breeder materials • Produce seeds of recommended eggplant, chili pepper, tomato and fig-leaf gourd rootstocks, and provide for training or distribution *Output Targets 2014* • 1000 accessions regenerated at the Center's headquarters • 200 accessions regenerated at Regional Center for Africa • Production and increase of good quality seed conducted: 10 crops for nutritional seed kit; advanced lines for multi-location and on-farm trials; maintenance of breeder materials *Output Targets 2015* • 1000 accessions regenerated at the Center's headquarters • 200 accessions regenerated at Regional Center for Africa • Production and increase of good quality seed conducted: 10 crops for nutritional seed kit; advanced lines for multi-location and on-farm trials; maintenance of breeder materials
Activity 1.3 Distribute vegetable germplasm accessions and improved lines worldwide	*Output Targets 2013* • 80% of vegetable germplasm requests served • 5,000 accessions/breeding lines distributed worldwide from headquarters • 700 accessions/breeding lines distributed by Regional Center for Africa to public and private partners *Output Targets 2014* • 80% of vegetable germplasm requests served • 5,000 accessions/breeding lines distributed worldwide from headquarters • 700 accessions/breeding lines distributed by Regional Center for Africa to public and private partners *Output Targets 2015* • 80% of vegetable germplasm requests served • 5,000 accessions/breeding lines distributed worldwide from headquarters • 700 accessions/breeding lines distributed by Regional Center for Africa to public and private partners

Activity 1.4 Safety duplicate AVRDC - The World Vegetable Center's germplasm in other genebanks	*Output Targets 2013* • 800 accessions from the Center's headquarters duplicated at National Agrobiodiversity Center, Korea and Svalbard Global Seed Vault, Norway • 150 accessions from Regional Center for Africa duplicated at the Center's headquarters and Svalbard Global Seed Vault, Norway Output Targets 2014 • 800 accessions from the Center's headquarters duplicated at National Agrobiodiversity Center, Korea and Svalbard Global Seed Vault, Norway • 150 accessions from Regional Center for Africa duplicated at the Center's headquarters and Svalbard Global Seed Vault, Norway Output Targets 2015 • 800 accessions from the Center's headquarters duplicated at National Agrobiodiversity Center, Korea and Svalbard Global Seed Vault, Norway • 150 accessions from Regional Center for Africa duplicated at the Center's headquarters and Svalbard Global Seed Vault, Norway
Activity 1.5 Systematically store information on conservation and distribution of vegetable germplasm in AVRDC - The World Vegetable Center's electronic databases	*Output Targets 2013* • 100% of acquisition and distribution data generated in 2012 entered into the Center's Vegetable Genetic Resources Inforrnation System (AVGRIS) and Regional Center for Africa's database • Characterization and evaluation data of the 2010/11 regeneration cycle made available in AVGRIS and Regional Center for Africa's database Output Targets 2014 • 100% of acquisition and distribution data generated in 2013entered into the Center's Vegetable Genetic Resources Information System (AVGRIS) and Regional Center for Africa's database • Characterization and evaluation data of the 2011/12 regeneration cycle made available in AVGRIS and Regional Center for Africa's database *Output Targets 2015* • 100% of acquisition and distribution data generated in 2014entered into the Center's Vegetable Genetic Resources Information System (AVGRIS) and Regional Center for Africa's database • Characterization and evaluation data of the 2012/13 regeneration cycle made available in AVGRIS and Regional Center for Africa's database

Activity 1.6 Develop effective seed health and quarantine program at AVRDC – The World Vegetable Center's headquarters and the regional centers	*Output Targets 2013* • All seed shipments from AVRDC - The World Vegetable Center comply with host country regulations *Output Targets 2014* • All seed shipments from AVRDC - The World Vegetable Center comply with host country regulations *Output Targets 2015* • All seed shipments from AVRDC - The World Vegetable Center comply with host country regulations
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 marker-trait associations identified	
Activity 2.1 Characterize morphological traits of vegetable germplasm maintained at AVRDC and its Regional Centers	*Output Targets 2013* • 1,000 accessions characterized at the Center's headquarters, based on standard morphological descriptors • 200 accessions characterized at Regional Center for Africa, based on standard morphological descriptors • Seed of 50 *Cucurbita moschata* genebank accessions multiplied and preliminary evaluation completed • Output Targets 2014 • 1000 accessions characterized at the Center's headquarters, based on standard morphological descriptors • 200 accessions characterized at Regional Center for Africa, based on standard morphological descriptors • Seed of 50 *C. moschata* genebank accessions multiplied and preliminary evaluation completed *Output Targets 2015* • 1,000 accessions characterized at the Center's headquarters, based on standard morphological descriptors • 200 accessions characterized at Regional Center for Africa, based on standard morphological descriptors • Seed of 50 *C. moschata* genebank accessions multiplied and preliminary evaluation completed

Activity 2.2 Conduct molecular characterization, genetic relationship and diversity analysis of germplasm collection	*Output Targets 2013* • Diversity analysis of *Abelmoschus* collection (~400 accessions) accomplished *Output Targets 2014* • Diversity of begomovirus resistance sources in pepper understood *Output Targets 2015* • Analysis of genetic diversity of sub-set of pumpkin collection accomplished at molecular level
Activity 2.3 Develop, characterize, and validate AVRDC germplasm core collections	*Output Targets 2013* • *Abelmoschus* core collection initiated at the Center's headquarters • Mungbean core collection initiated *Output Targets 2014* • *Abelmoschus* core collection accomplished • Mungbean core collection accomplished *Output Targets 2015* • Pumpkin core collection accomplished
Activity 2.4 Conduct studies to identify markers and genes linked to important agronomic traits	*Output Targets 2013* • Seed quality traits in mungbean mapped *Output Targets 2014* • Combined gene expression and quantitative trait loci analysis in biparental populations of *Solanum lycopersicum* conducted to identify genes involved in heat tolerance *Output Targets 2015* • Quantitative trait loci for heat tolerance elucidated

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 2013* • Mungbean and hot pepper germplasm screened for resistance to local begomoviruses in the field in India, Thailand and Vietnam • Inheritance of resistance to *Cucumber mosaic virus* from *Solanum habrochaites* (LA1033) determined • AVRDC isolates of *Tomato mosaic virus* (*Tobamovirus*) characterized in relation to the different *Tm-2* resistance alleles Output Targets 2014 • Mungbean and hot pepper germplasm screened for resistance to local begomoviruses in the field in India, Thailand and Vietnam • Inheritance of resistance to *Squash leaf curl Philippine virus* (*Begomovirus*) in *C. moschata* determined • Method for screening leguminous germplasm for resistance to *Bean common mosaic virus* (*Potyvirus*) developed and host range of Taiwan strain assessed Output Targets 2015 • Leafy brassica germplasm screened for resistance to *Turnip mosaic virus* (*Potyvirus*) • Inheritance of resistance to *Squash leaf curl Philippine virus* (*Begomovirus*) in *C. moschata* determined • *Capsicum* germplasm screened for resistance to *Pepper mottle virus* (*Potyvirus*)
Activity 3.2 Identify and characterize sources of resistance to fungal and bacterial diseases	*Output Targets 2013* • Resistance to late blight, early blight and black leaf mold in tomato characterized • Resistance to anthracnose in pepper characterized • Eggplant accessions screened for stable bacterial wilt resistance • Cucurbit accessions screened for downy mildew resistance Output Targets 2014 • Resistance to late blight, early blight and black leaf mold in tomato characterized • Resistance to anthracnose in pepper characterized • Resistance to *R. solanacearum* phylotype IIB-1 strains in tomato characterized *Output Targets 2015* • Resistance to late blight, early blight and black leaf mold in tomato characterized • Resistance to anthracnose in pepper characterized

Activity 3.3 Identify and characterize sources of resistance to insect pests	*Output Targets 2013* • Mechanism and basis of resistance to aphids in selected okra accessions characterized • Resistance to leafhopper confirmed in okra accessions • Onion accessions screened for resistance to thrips • Resistance to insect and mite pests confirmed in hot pepper accessions • *Solanum galapagense* accessions screened for resistance to whitefly and red spider mite *Output Targets 2014* • Mechanism and basis of resistance to leafhopper in selected okra accessions characterized • Resistance to thrips confirmed in onion accessions • Mechanism and basis of resistance to insect and mite pests in selected hot pepper accessions characterized *Output Targets 2015* • Mechanism and basis of resistance to thrips in selected onion accessions characterized • African eggplant and African nightshade accessions screened for resistance to red spider mite
Activity 3.4 Identify and characterize sources of tolerance to drought, heat, flooding and salinity stress	*Output Targets 2013* • Salt tolerance screening method for vegetable crops established *Output Targets 2014* • Germplasm sources of selected crops for salt tolerance identified *Output Targets 2015* • Flooding tolerance screening method for selected vegetable crops established

Activity 3.5 Evaluate vegetable germplasm for selected nutrition-related compounds	*Output Targets 2013* • Nutrient content analyses and LCMS profiling of 30 popular vegetables in Taiwan continued; plant and nutrition databases for the vegetables designed and developed • Target anti-diabetic compounds for mass screening of bitter gourd germplasm searched *Output Targets 2014* • Nutritional and functional values measured for target vegetable species/accessions and included in the nutrient database *Output Targets 2015* • Nutritional and functional values measured for target vegetable species/accessions and included in the nutrient database
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 for resistance to biotic stresses	*Output Targets 2013* • Tomato gene Ph_4 associated with resistance to late blight mapped • Mapping populations for begomovirus resistance mapping in mungbean and pepper made available • Begomovirus resistance loci identified and tagged with molecular markers in mungbean *Output Targets 2014* • Begomovirus resistance loci identified and mapped in pepper • Candidate resistance loci against *Zucchini yellow mosaic virus, Papaya ring spot virus - Watermelon strain* and *Squash leaf curl Philippine virus* identified in pumpkin populations *Output Targets 2015* • Markers for begomovirus resistance validated in mungbean and pepper for breeding purposes

Activity 4.2 Develop mapping populations and identify quantitative trait loci for tolerance to abiotic stresses	*Output Targets 2013* • No activities planned in 2013 *Output Targets 2014* • Mapping populations for salt tolerance developed *Output Targets 2015* • Quantitative trait loci for salt tolerance mapped
Activity 4.3 Conduct fine mapping of quantitative trait loci and develop markers for marker-assisted selection (MAS)	*Output Targets 2013* • Fine-map *Bwr-6* and *Bwr-12*, major quantitative trait loci for bacterial wilt resistance by developing near-isogenic lines *Output Targets 2014* • Fine-map *Bwr-6* and *Bwr-12*, major quantitative trait loci for bacterial wilt resistance by developing near-isogenic lines *Output Targets 2015* • Durability of *Bwr* quantitative trait loci evaluated
Activity 4.4 Assemble and develop molecular marker sets for priority vegetable crops	*Output Targets 2013* • A set of suitable markers developed for Bulked Segregant Analysis (BSA) in *C. moschata* • A bioinformatics platform for single nucleotide polymorphism (SNP) detection and genotyping for vegetable crops established • Restriction site associated DNA (RAD) sequencing to rapidly obtain markers established for vegetable crops: Method tested and applied on mungbean and tomato. *Output Targets 2014* • Molecular markers for selection for *Tomato yellow leaf curl virus*, nematode and late blight resistance in tomato validated in a breeding population • RAD sequencing established for pepper to obtain and map a large number of molecular markers in populations *Output Targets 2015* • Methods of genotyping by sequencing available for vegetable crops

Activity 4.5 Develop mapping populations and identify QTLs for high rutin content in tomato	*Output Targets 2013* • Additional markers developed between 40.0-48 cM to establish introgression length • Co-segregation of rutin with chalcone isomerase assessed • Selection and generation advance of high rutin lines to F_6 conducted
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 and pathogen-derived resistance to *Tomato yellow leaf curl virus* based on RNA interference explored	
Activity 5.1 Allele mining to identify variation conferring superior traits	*Output Targets 2013* • At least 200 M2 families of a tomato mutant population screened for putative loss of susceptibility to *Tomato yellow leaf curl virus* in ten candidate genes through next generation sequencing and TILLING *Output Targets 2014* • At least 200 M2 families of a tomato mutant population screened for putative loss of susceptibility to *Cucurbit mosaic virus* in five candidate genes through next generation sequencing and TILLING *Output Targets 2015* • Begomovirus resistance alleles of at least one resistance gene identified in mungbean • Salt tolerance genes and tolerance alleles identified
Activity 5.2 Characterize and validate candidate genes for heat and salt tolerance	*Output Targets 2013* • No activity planned in 2013 Output Targets 2014 • Salt tolerance genes identified in tomato *Output Targets 2015* • Heat tolerance genes validated in tomato and pepper

Activity 5.3 Evaluate gene function and efficacy through genetic engineering	*Output Targets 2013* • Tomato plants with bi-RNAi construct generated • Reaction of R1-R2 generation (engineered with bi-RNAi constructs) evaluated against *Tomato yellow leaf curl virus* *Output Targets 2014* • Reaction of R3-R4 generation evaluated against various *Tomato yellow leaf curl virus* strains *Output Targets 2015* • Selection and evaluation toward a potential strategy for improvement of *Tomato yellow leaf curl virus* resistance
Output 6: Intellectual Property Rights strategy on germplasm, transgenics and genes implemented **Outcome:** AVRDC – The World Vegetable Center, national agricultural research and extension systems and the private sector benefit from using the Center's germplasm accessions and improved breeding lines	
Activity 6.1 Utilize, develop or improve Material Transfer Agreements (MTAs) for genebank germplasm, breeding lines and transgenic materials that support AVRDC's interests	*Output Targets 2013* • All outgoing seed shipments comply with the Center's MTAs • Incoming seed are accompanied by MTA, germplasm acquisition agreement, or letter of donation *Output Targets 2014* • All outgoing seed shipments comply with the Center's MTAs • Incoming seed are accompanied by MTA, germplasm acquisition agreement, or letter of donation *Output Targets 2015* • All outgoing seed shipments comply with the Center's MTAs • Incoming seed are accompanied by MTA, germplasm acquisition agreement, or letter of donation
Output 7: Capacity in germplasm conservation, evaluation, characterization, and gene discovery developed **Outcome:** Skills of national agricultural research and extension systems' scientists in germplasm conservation, utilization and gene discovery enhanced	

Activity 7.1

Train human resources in vegetable genetic resources conservation, management, and evaluation using conventional and advanced techniques

Output Targets 2013

- Training courses on germplasm conservation and management conducted
- Training courses on use of molecular tools for biodiversity analysis and germplasm evaluation conducted
- Various vegetable accessions/lines, production technologies and vegetable nutritional information displayed in the demonstration garden for information dissemination to at least 300 visitors
- Exhibit AVRDC's germplasm and technologies in Taiwan's annual Seed and Seedling Festival and other events

Output Targets 2014

- Training courses on germplasm conservation and management conducted
- Training courses on use of molecular tools for biodiversity analysis and germplasm evaluation conducted
- Various vegetable accessions/lines, production technologies and the vegetables nutritional information displayed in the demonstration garden for information dissemination to at least 300 visitors
- Exhibit AVRDC's germplasm and technologies in Taiwan's annual Seed and Seedling Festival and other events

Output Targets 2015

- Training courses on germplasm conservation and management conducted
- Training courses on use of molecular tools for biodiversity analysis and germplasm evaluation conducted
- Various vegetable accessions/lines, production technologies and the vegetables nutritional information displayed in the demonstration garden for information dissemination to at least 300 visitors
- Exhibit AVRDC's germplasm and technologies in Taiwan's annual Seed and Seedling Festival and other events

BREEDING: *Genetic enhancement and varietal development of vegetables*

Goal: Varieties with potential to expand opportunities in tropical vegetable production	**Purpose:** Farmers obtain varieties and lines of major vegetables that produce high yields of nutritious and marketable food with less health risk and environmental damage
Output 1: Varieties and lines of vegetables with improved disease resistance, stress tolerance, quality and nutritional traits developed **Outcome:** Lines adopted directly as varieties or used in public/private sector breeding programs	
Activity 1.1 Develop heat tolerant and disease-resistant tropical tomato with desirable horticultural and quality traits	*Output Targets 2013* • 10-15 F7 fresh market/dual purpose lines with multiple begomovirus resistance genes, bacterial wilt, early blight and good horticultural traits evaluated in replicated yield trial, and seed multiplied for international distribution • High carotenoid (high pigment and crimson gene) lines advanced to F6 • High flavonoid tomato lines selected for good horticultural traits and advanced to the F6 • Seeds of 2-3 improved tomato varieties multiplied in Regional Center for Africa for distribution to partners *Output Targets 2014* • Marker-assisted selection in BC_1F_1 to combine acylsugar insect resistance and *Ty-5* begomovirus resistance and generation advance to BC_1F_2 • Marker-assisted selection to develop lines combining *Ph-2+Ph-3+ph-4* late blight resistance genes • Three lines combining tomato yellow leaf curl disease resistance, heat tolerance, high yield and good fruit quality identified in Tanzania • At least one long shelf life tomato line with other desirable horticultural traits identified in Tanzania *Output Targets 2015* • Indeterminate fresh market lines with combinations of *Ty-3a, Ty-5, Ty-2* advanced to the F6 generation • Crosses created at Regional Center for Africa to combine long shelf life tomato genes with other desirable traits

Activity 1.2 Develop and distribute disease-resistant chili and sweet pepper varieties (targeting anthracnose, Phytophthora, bacterial wilt, *Cucumber mosaic virus, Chili veinal mottle virus*, and/or begomoviruses)	*Output Targets 2013* • 10-20 AVRDC improved pepper lines/ germplasm accessions systematically screened for begomovirus resistance in Taiwan and other locations • Sources of anthracnose resistance assessed by field and micro-injection and spray inoculation techniques and new crosses created using resistant lines • Seed of 7-12 new multiple disease resistant lines distributed to collaborators and 5-10 promising pepper lines increased for international distribution *Output Targets 2014* • Crosses made to study inheritance of begomovirus resistance • Inheritance of anthracnose in new sources of resistance studied and selection, and generation advance made in segregating populations • Aphid/mite resistance inheritance study completed and 2-3 resistant/tolerant progeny identified for use in breeding *Output Targets 2015* • Inheritance of begomovirus resistance studied and segregating generation advanced for further selection • Seeds of 8-10 pepper lines increased and made available for distribution in the International Chili Pepper Nursery and the International Sweet Pepper Nursery • Seeds of aphid/mite resistance/tolerant lines increased for international distribution
Activity 1.3 Develop heat tolerant tropical sweet pepper	*Output Targets 2013* • 5-10 promising heat tolerant pepper inbred lines and hybrids tested on-farm in Taiwan and selected inbred lines directly released to international collaborators • Crosses made to develop inbred lines combining heat tolerance and two or more disease resistances *Output Targets 2014* • Populations segregating for heat tolerance and disease resistance developed and progenies selected and advanced • Seeds of 4-5 heat tolerant inbred lines and their hybrids increased and made available for on-farm testing in Taiwan *Output Targets 2015* • Sweet pepper hybrids and inbred lines released for Taiwanese seed companies and other cooperators around the world. • 3-4 lines combining heat tolerance and multiple disease resistances developed

Activity 1.4 Develop short-day red onions and yellow onions for improved yield and extended shelf-life	*Output Targets 2013* • Selected open pollinated onion lines introduced from Taiwan and evaluated for adaptation in Mali • 500 g each of 3-5 purified selections from local varieties and AVRDC elite lines multiplied for regional trials • Regional allium network established and multilocation trials conducted *Output Targets 2014* • Multilocation trials in West Africa conducted of 5-10 best local populations and 3-5 AVRDC open pollinated lines • Mother bulbs of purified selections and AVRDC elite lines produced for regional trials • Cold storage facility for onion seed established in Mali *Output Targets 2015* • Breeder seed produced from 3-5 elite lines • Multilocation regional trials conducted
Activity 1.5 Develop and distribute heat-tolerant broccoli and Chinese cabbage varieties	*Output Targets 2013* • New broccoli hybrid combinations tested and promising lines evaluated and multiplied • New Chinese cabbage hybrid combinations tested and promising lines evaluated and multiplied *Output Targets 2014* • Seed of 2-5 broccoli hybrids, and 1-3 inbred lines increased for use in breeding or for international distribution and testing • Seed of 5-10 Chinese cabbage lines and 1-3 Chinese cabbage hybrids increased for use in breeding or for international distribution and testing
Activity 1.6 Develop improved vegetable soybean and mungbean with improved nutritional and flavor qualities	*Output Targets 2013* • 10 elite mungbean lines promoted in sub-Saharan Africa, and 10-15 vegetable soybean lines in South Asia and sub-Saharan Africa • Improved mungbean lines for methionine content confirmed by HPLC • Markers for *Mungbean yellow mosaic virus* resistance in mungbean developed *Output Targets 2014* • Vegetable soybean lines promoted in South Asia and sub-Saharan Africa • Bruchid resistant mungbean lines developed using resistant mungbean accessions V2709 and V2802 *Output Targets 2015* • Vegetable soybean lines promoted in South Asia and sub-Saharan Africa • Mungbean lines with *Mungbean yellow mosaic virus* resistance developed. • Mungbean lines resistant to Cercospora leaf spot and powdery mildew developed

Activity 1.7 Develop cucumber lines for improved horticultural traits, disease resistance, good fruit quality, and high gynoecy	*Output Target 2013* • 10-15 F_7 entries evaluated in replicated trial and characterized for key horticultural traits and disease resistance • 20-30 hybrid combinations of South and Southeast Asian types evaluated for key horticultural traits in targeted countries along with 5-8 improved lines *Output Target 2014* • Seed increase and international distribution of 3-5 F_7 cucumber lines identified from the 2013 replicated trial completed
Activity 1.8 Develop disease resistant and high quality pumpkins (*Cucurbita moschata*)	*Output Targets 2013* • 15-20 F_7 entries evaluated in preliminary yield trial and characterized for key horticultural traits and nutritional components and field resistance to diseases • 20-30 F_1 hybrids developed using *Zucchini yellow mosaic virus* resistant lines and high quality F_8 lines derived from elite hybrids • 20-30 F_5 families derived from elite hybrids evaluated and advanced to F_6 and 15-20 F_6 lines evaluated and advanced *Output Targets 2013* • Multilocation trial of 8-10 F_8 lines and 4-6 F_1 hybrids conducted • 10-15 F_7 lines evaluated *Output Targets 2015* • Seed increase and international distribution of 5-8 inbred lines completed • Multilocation trial of 5-8 F_8 lines conducted
Activity 1.9 Develop bitter gourd possessing improved yield, earliness, good fruit quality and resistance to diseases/insects	*Output Targets 2013* • 20-30 F_6 lines derived from elite hybrids evaluated and advanced and a set of 15-20 F_7 lines evaluated in preliminary yield trial • Multi-location trial of commercial lines in India conducted to evaluate environment, ripening stage, influence of local postharvest management on level of nutrients • Anti-diabetic compounds in commercial lines of bitter gourd in India investigated *Output Targets 2014* • Multilocation trials of selective F_7 lines conducted *Output Targets 2015* • Seed increase and international distribution of 6-8 lines completed

Output 2: Indigenous vegetables improved for productivity, quality, and nutrient content

Outcome: Lines potentially beneficial to farmers and consumers

Activity 2.1 Develop indigenous vegetables with superior horticultural traits	*Output Targets 2013* • 97 Malabar spinach genebank accessions evaluated for horticultural traits and seeds of 50 accessions multiplied for yield and flood tolerance trials. • Priority set leading to selection of 1-2 African indigenous vegetable crops for improvement at the Regional Center for Africa • 30 amaranth pure lines developed at the Regional Center for Africa from landrace accessions *Output Targets 2014* • 20 Malabar spinach accessions assessed in a replicated trial for field flood tolerance, yield, nutritional, and anti-nutritional trials. • 1-2 high yielding grain/dual type amaranth elite lines identified from multi-location tests for further evaluation in Tanzania • Promising nightshade, spider plant and cowpea lines with desirable horticultural traits identified for further testing *Output Targets 2015* • Ten elite Malabar spinach accessions evaluated for flood tolerance at several plant stages. • Five superior Malabar spinach accessions identified for international distribution and promotion. • Promising advanced lines of nightshade, spider plant and cowpea identified in on-farm participatory varietal selection in Tanzania
Activity 2.2 Evaluation, seed multiplication, and distribution of elite indigenous vegetables	*Output Targets 2013* • Elite indigenous vegetables evaluated for horticultural, nutritional, and anti-nutritional traits and seed of selected lines/accessions increased for international distribution • At least 5 elite lines and improved varieties of each of nightshade, amaranth, spider plant and cowpea increased at RCA *Output Targets 2014* • Selected elite indigenous vegetables lines/accessions increased for international distribution • Breeder and pre-basic seeds of major improved varieties of African indigenous vegetables increased, and elite lines and breeding lines maintained at the Regional Center for Africa

Output 3: 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 3.1 Assemble and internationally distribute elite vegetable lines	*Output Targets 2013* • Global distribution and testing of AVRDC chili pepper, sweet pepper, tomato, vegetable soybean, mungbean and other AVRDC-developed lines conducted *Output Targets 2014* • Global distribution and testing of AVRDC chili pepper, sweet pepper, tomato, vegetable soybean, mungbean and other AVRDC-developed lines conducted *Output Targets 2015* • Global distribution and testing of AVRDC chili pepper, sweet pepper, tomato, vegetable soybean, mungbean and other AVRDC-developed lines
Activity 3.2 Analyze and review of multi-environment testing of AVRDC-improved germplasm	*Output Targets 2013* • Vegetable variety trials and implications for breeding and variety release analyzed and summarized *Output Targets 2014* • Vegetable variety trials and implications for breeding and variety release analyzed and summarized *Output Targets 2015* • Vegetable variety trials and implications for breeding and variety release analyzed and summarized
Activity 3.3 Develop on-line seed catalog to facilitate seed requests for AVRDC-improved vegetables	*Output Targets 2013* • On-line seed catalogs for tomato, pepper, soybean and leafy Brassica updated • On-line seed catalogs for Chinese cabbage, shallot, root stocks, elite African indigenous vegetables and cucumber developed *Output Targets 2014* • On-line seed catalogs for tomato, pepper, soybean, leafy brassica, Chinese cabbage, shallot, root stocks, African indigenous vegetables and cucumber updated • On-line seed catalog for pumpkin developed *Output Targets 2015* • On-line seed catalogs for tomato, pepper, soybean, leafy brassica, Chinese cabbage, shallot, root stocks, African indigenous vegetables, cucumber and pumpkin updated

Activity 3.4 Monitor and assess variety release, commercialization and adoption of AVRDC-bred lines	*Output Targets 2013* • Release and commercialization of AVRDC varieties by NARES and seed companies in Africa, Asia, and Central America monitored • Breeder seed produced of released AVRDC lines at AVRDC-Taiwan and Regional Centers *Output Targets 2014* • Release and commercialization of AVRDC varieties by NARES and seed companies in Africa, Asia, and Central America monitored • Breeder seed produced of released AVRDC lines at AVRDC-Taiwan and Regional Centers *Output Targets 2015* • Release and commercialization of AVRDC varieties by NARES and seed companies in Africa, Asia, and Central America monitored • Breeder seed produced of released AVRDC lines at AVRDC-Taiwan and Regional Centers
Activity 3.5 Use male sterility to improve the efficiency of hybrid vegetable seed production	*Output Targets 2013* • Advance of BC_1F_3 generations segregating for fertility restoration using molecular marker-assisted selection • Crosses developed to evaluate efficacy of sweet pepper restorer lines possessing *Rf* gene from hot peppers • Seeds of available CMS chili pepper increased under net house and role of bumblebees to facilitate cross pollination examined *Output Targets 2014* • Design and implement impact assessment of AVRDC CMS pepper lines in improving access to improved varieties. • Sweet pepper CMS based crosses raised and evaluated for fertility restoration and potential sweet pepper restorer lines identified. • Seeds of chili pepper CMS line made available for the cooperators *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

PRODUCTION: *Safe and sustainable vegetable production systems*

Goal: Substantial contributions to safer and sustainable vegetable production generated	**Purpose:** Increased supply of safer vegetables through adoption of profitable, environmentally sound practices by farmers leading to knowledge-based farming
Output 1: Integrated pest management technologies developed/validated **Outcome:** Integrated pest management technologies and related information to manage major vegetable pests ready to be disseminated to national agricultural research and extension systems, nongovernmental organizations, and small-scale farmers	
Activity 1.1 Diagnose and characterize major insect pests	*Output Targets 2013* • Most common species of aphids associated with okra (*Abelmoschus* spp.) in Cameroon catalogued • Major whitefly species or cryptic species associated with tomato, pepper and mungbean in Southeast Asia characterized *Output Targets 2014* • Major whitefly and thrips species or cryptic species associated with major vegetables in Bangladesh characterized *Output Targets 2015* • Most common species of aphid, thrips and defoliators on leafy brassicas, and aphid, thrips and pod borers on yard-long bean in Cambodia, Lao PDR and Vietnam catalogued
Activity 1.2 Develop integrated pest management technologies for major insect pests	*Output Targets 2013* • Efficacy of an integrated pest management strategy for legume pod borer, eggplant fruit and shoot borer and aphids on okra validated in Southeast Asia, South Asia (Nepal) and sub-Saharan Africa (Cameroon) • Efficacy of an integrated pest management strategy to manage major insect pests on vegetable brassicas determined in lowlands of Bangladesh and Taiwan *Output Targets 2014* • Efficacy of an integrated pest management strategy for whitefly determined in India, Thailand, Taiwan and Vietnam • An integrated pest management strategy to manage insect pests on summer tomato developed for Bangladesh • Efficacy of an integrated pest management strategy for legume pod borer on country bean validated in Bangladesh *Output Targets 2015* • Efficacy of integrated pest management practices to manage major pests on vegetable legumes and leafy brassicas determined in Southeast Asia • Integrated pest management strategy developed for insect and mite pests on amaranth and African nightshade in sub-Saharan Africa • Epidemiology of thrips vectors transmitting tospoviruses in vegetable cropping systems established

Activity 1.3 Diagnose and characterize major bacterial and fungal pathogens	*Output Targets 2013* • Survival capacity of phylotype IIB-1 strains of *Ralstonia solanacearum* in lowland tropics determined • *R. solanacearum* attacking tomato in Eastern Africa and attacking pepper and eggplant in Taiwan characterized • *Colletotrichum* species associated with chili pepper anthracnose in Oceania identified and application of the FTA® card in molecular diagnosis evaluated • Pathotypes of cucurbit downy mildew in Taiwan identified *Output Targets 2014* • Protocol on the use of FTA® card for distant diagnose of vegetable diseases developed • Effect of temperature on the growth and survival of phylotype IIB-1 strains of *R. solanacearum* determined • Effect of bacteriophage on survival of phylotype IIB-1 strains of *R. solanacearum* determined *Output Targets 2015* • Effect of rice rotation in tomato cropping system on survival of phylotype IIB-1 strains of *R. solanacearum* determined
Activity 1.4 Develop and validate integrated disease management technologies for major bacterial and fungal diseases	*Output Targets 2013* • Control efficacy of plant activators on tomato and pepper foliar diseases evaluated • Effect of biochar as an amendment in potting mixture on plant growth and induced resistance in tomato evaluated • Rootstock varieties with good compatibility and flooding tolerance for sweet pepper production in hot-wet season identified *Output Targets 2014* • Control efficacy of plant activators on tomato and pepper diseases evaluated • Effect of biochar as an amendment in potting mixture on plant growth and induced resistance in pepper evaluated • Rootstock varieties with good compatibility and flooding tolerance for tomato and sweet pepper production in hot-wet season identified *Output Targets 2015* • Control efficacy of plant activators on tomato and pepper diseases evaluated • Effect of biochar as an amendment in potting mixture on plant growth and induced resistance in pepper evaluated • Rootstock varieties with good compatibility and flooding tolerance for tomato and sweet pepper production in hot-wet season identified

Activity 1.5 Detect, characterize and explore integrated management strategies for major viral diseases	*Output Targets 2013* • The important viruses, especially begomoviruses, infecting or emerging in vegetable crops in Asia and Africa identified and monitored • Genetic diversity of Solanaceae-infecting begomoviruses in Indonesia studied • An infectious clone of a cucurbit-infecting begomovirus from Taiwan developed *Output Targets 2014* • The important viruses, especially begomoviruses, infecting or emerging in vegetable crops in Asia and Africa identified and monitored • Genetic diversity of begomoviruses infecting tomato, chili and/or mungbean in India, Thailand and/or Vietnam studied • Field response of tomato lines carrying different combinations of *Ty* genes to local begomoviruses in India, Thailand and Vietnam assessed *Output Targets 2015* • The important viruses, especially begomoviruses, infecting or emerging in vegetable crops in Asia and Africa identified and monitored • Genetic diversity of begomoviruses (and their whitefly vectors) infecting tomato, chili and/or mungbean in India, Thailand and/or Vietnam studied • Integrated disease management package for begomovirus on hot pepper, tomato and mungbean developed
Output 2: Integrated crop and soil fertility management technologies developed/validated **Outcome**: Integrated crop and soil fertility management technologies and related information to enhance and sustain vegetable productivity ready to be disseminated to NARES, NGOs, and small-scale farmers	
Activity 2.1 Develop technologies to improve soil nutrient use efficiency and soil sustainability	*Output Targets 2013* • Guidelines of soil health assessment suitable for smallholder vegetable production in Oceania developed • Components of biochar briquette and its effects in soil studied • Major soil constraints identified and long term trials to determine the benefits of soil management designed and started *Output Targets 2014* • Guidelines of soil health assessment suitable for smallholder vegetable production in Solomon Islands developed • Effects of biochar briquette on selected vegetables evaluated • Long-term trials to determine the benefits of soil management continued in Oceania
Output 3: Improved vegetable production technologies integrated, disseminated, and impact assessed **Outcome:** Farmers adopt new technologies that result in improved farm productivity and sustainability, incomes, and farm livelihoods	

Activity 3.1 Identify major constraints and determine site-specific dissemination strategies in targeted regions	*Output Targets 2013* • Participatory appraisals of vegetable farming conducted in targeted countries and dissemination strategies determined for integrated crop management technologies *Output Targets 2014* • Participatory appraisals of vegetable farming conducted in targeted countries and dissemination strategies determined for integrated crop management technologies *Output Targets 2015* • Participatory appraisals of vegetable farming conducted in targeted countries, and dissemination strategies determined for integrated crop management technologies
Activity 3.2 Adapt integrated production technologies for targeted systems or regions	*Output Targets 2013* • Integrated crop management technologies for tomato, pepper, and brassicas adapted in Indonesia, Oceania and in Uzbekistan • Effect of rain shelter and eggplant rootstocks on summer tomato yield and quality determined • Appropriate vegetable crops, varieties, and their cultural practices identified for Tanzania, for direct seeded rice system and flood-prone areas in India *Output Targets 2014* • Integrated crop management technologies for tomato, pepper, and brassicas adapted in Oceania and in Uzbekistan • Appropriate vegetable crops, varieties and production practices identified following direct seeded rice and for flood-prone areas in India • Integrated pest management packages for yard-long bean adapted in Cambodia and Lao PDR *Output Targets 2015* • Production packages of vegetables and legumes following direct seeded rice in India developed • Home vegetable garden options for the flood prone target area in India developed • Integrated pest management packages for eggplant, summer tomato, and vegetable brassicas adapted in Bangladesh

Activity 3.3 Strengthen capacity of local partners and farmers to promote technology adoption	*Output Targets 2013* • Extension and training materials published on various vegetable production technologies • Capacity of extension staffs, female nursery operators and vegetable farmers in Indonesia, Bangladesh, India, Oceania, Central Asia, Cameroon, and Tanzania strengthened through Training of Trainers, Farmer Field Schools, field days or group discussions • Four issues of *Feedback from the Field* published and mature technologies database updated *Output Targets 2014* • Extension and training materials published on various vegetable production technologies • Capacity of extension staffs, female nursery operators and vegetable farmers in Indonesia, Bangladesh, India, Oceania, Central Asia, and Cameroon strengthened through Training of Trainers, Farmer Field Schools, field days, or group discussions • Four issues of *Feedback from the Field* published and mature technologies database updated *Output Targets 2015* • Extension and training materials published on various vegetable production technologies • Capacity of extension staffs, female nursery operators and vegetable farmers in Indonesia, Bangladesh, India, Oceania, Central Asia, and Cameroon strengthened through Training of Trainers, Farmer Field Schools, field days or group discussions • Four issues of *Feedback from the Field* published and mature technologies database updated
Activity 3.4 Understand farmers' behavior, cost-benefit, and constraints/opportunities of technology adoption	*Output Targets 2013* • Economic costs and benefits of integrated crop management technologies in Thailand, Vietnam, Indonesia, Bangladesh and Oceania analyzed and documented • Farm-level opportunities and constraints in the adoption of integrated pest management methods for *Maruca vitrata* and vector control for mungbean, tomato and chili documented for India, Thailand and Vietnam *Output Targets 2014* • Economic costs and benefits of integrated crop management technologies in Thailand, Vietnam, and Oceania analyzed and documented • Farm-level constraints and opportunities to IPM adoption identified for vegetable legumes and leafy brassicas in Cambodia, Lao PDR, and Vietnam • Baseline studies on the biophysical and biological environments for effective crop management and crop protection technologies and practices conducted in Tanzania, Ethiopia, Mozambique and Malawi. *Output Targets 2015* • Policy-level constraints and opportunities to integrated pest management adoption identified for Cambodia, Lao PDR, and Vietnam)

Activity 3.5

Understand the impact of improved technologies on production systems and livelihoods

Output Targets 2013

- Impact of AVRDC's tomato grafting in Vietnam documented
- Data collected for the outcome evaluation of summer tomato production in Bangladesh analyzed
- Impact of AVRDC project on vegetable production in Punjab and Jharkhand, India documented

Output Targets 2014

- The outcomes of summer tomato production in Bangladesh analyzed and documented
- Data collected to assess impact of AVRDC germplasm on vegetable production in Thailand

Output Targets 2015

- Collected data analyzed and published on impact of AVRDC germplasm on vegetable production in Thailand
- Costs and returns documented for farmers adopting integrated pest management methods in vegetable legumes and brassicas in Laos, Cambodia and Vietnam

CONSUMPTION: *Balanced diets through increase 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 nutrition related outcomes of vegetable gardeners and consumers in Asia and sub-Saharan Africa	*Output Targets 2013* • Study on production, consumption and marketing of bitter gourd and ex-ante analysis of its use in managing type 2 diabetes in India and Tanzania documented conducted • Baseline yield gap, diagnostic and consumption patterns survey of intensified rice-vegetable systems in Tanzania and Ghana conducted • Household survey conducted and data analyzed for food and nutrition gap in target areas of Sikasso region in Mali • Interactive GIS-based platform established for data exchange and visualization urban and periurban vegetable production, consumption and marketing in Greater Bangkok, Thailand *Output Targets 2014* • Ex-ante analysis of increased production and consumption of bitter gourd in India and Tanzania documented • Field surveys conducted in Ethiopia, Tanzania and Malawi conducted to understand consumer preferences and determine quality standards for new outlets for vegetable products from peri-urban farm enterprises *Output Targets 2015* • Outcomes of vegetable consumption promotion in south Bangladesh evaluated on targeted consumers' knowledge, attitude and behavior change • Understanding of consumer preferences and determination of quality standards in Ethiopia, Tanzania, Malawi and Mozambique documented for new outlets of vegetable products from peri-urban farm enterprises
Activity 1.2 Study nutritional and functional values and benefits of vegetables from sub-Saharan Africa and Asia	*Output Targets 2013* • Anti-hyperglycemic effect of bitter gourd validated in insulin-resistant patients in India and Tanzania • Phytochemical and nutrient databases of common vegetables designed *Output Targets 2014* • Phytochemical and nutrient databases of common vegetables developed *Output Targets 2015* • Nutritional and functional properties of selected indigenous vegetables from Africa and Asia evaluated

Output 2. Dietary strategies and food based interventions developed, validated and implemented

Outcome: AVRDC – The World Vegetable Center, national agricultural research and extension system and non-governmental 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

Design, validate and implement home, school and community garden interventions for enhanced access to and consumption of vegetables by poor household, especially women and children in Asia and sub-Saharan Africa

Output Targets 2013

- School and community gardens in target locations in Indonesia and Cameroon established and functional with appropriate cropping schedule/ sequence, pilot schemes in sub-Saharan Africa and Asia explored
- Protocols for collecting baseline and follow-up data on 30 school vegetable gardens in Bhutan, Burkina Faso, Indonesia, Nepal, Philippines and Tanzania; and for home vegetable gardens in Bangladesh developed; baseline data collected.
- Training of Trainers workshop for establishing school vegetable gardens in Bhutan, Burkina Faso, Nepal and Tanzania conducted.
- Data on the outcomes/impact of home gardens on poverty and food consumption in Jharkhand, India analyzed and documented.

Output Targets 2014

- Case study on roles of school vegetable gardens in food systems, nutrition and health carried out in 1-2 selected countries in Asia and Africa
- Post-intervention data on the effect of home vegetable gardens on food consumption in Barisal, Bangladesh households collected and analyzed; and baseline and follow-up data on dietary patterns and awareness of students in selected schools in Bhutan, Burkina Faso, Nepal and Tanzania collected and analyzed.
- Nutritional seed kits distributed to home and school gardens and participatory demonstration vegetables gardens conducted in selected location of Central Asia
- Publication on the effect of home gardens on poverty and food consumption in Jharkhand, India made available

Output Targets in 2015

- Case study on the roles of school vegetable gardens in food systems, nutrition and health conducted and data analyzed in 1-2 selected countries in Asia and Africa
- 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
- Nutritional seed kits distributed to home and school gardens and participatory demonstration vegetable gardens established in selected locations of Central Asia

Activity 2.2 Develop and distribute nutritious vegetable seed kits as disaster response and to other vulnerable groups in tropical and sub-Saharan Africa and Asia	*Output Targets 2013* • Existing seed stocks in Taiwan, India, Tanzania and Mali made available for distribution in response to future disasters in sub-Saharan Africa, Asia and Pacific in exchange for funding to replenish seed stocks • Easy-to-understand instructions on cultivation, field management and food preparation in various languages prepared, published and disseminated to vulnerable groups or possibly as disaster response in sub-Saharan Africa, Asia and Pacific *Output Targets 2014* • Existing seed stocks in Taiwan, India, Tanzania and Mali made available for distribution in response to future disasters in sub-Saharan Africa and Asia, in exchange for funding to replenish seed stocks Easy-to-understand instructions on cultivation, field management, and food preparation in various local languages prepared, published and disseminated to vulnerable groups or possibly as disaster response in sub-Saharan Africa, Asia and Pacific *Output Targets 2015* • Existing seed stocks in Taiwan, India, Tanzania and Mali made available for distribution in response to future disasters in sub-Saharan Africa and Asia, in exchange for funding to replenish seed stocks • Easy-to-understand instructions on cultivation, field management, and food preparation in various local languages prepared, published and disseminated to vulnerable groups or possibly as disaster response in sub-Saharan Africa, Asia and Pacific
Activity 2.3 Develop dietary strategies, nutrition-improved recipes and food preparation methods based on traditional diet and food practices for increased consumption of vegetables and nutritious/healthy diets by poor households in Asia and sub-Saharan Africa	*Output Targets 2013* • Dietary strategies for bitter gourd consumption for low income and high diabetic prevalent regions in India and Tanzania developed • Dietary options identified and strategies developed using locally available vegetables for promotion in target areas in south Bangladesh, Cameroon, selected areas of Mali and Central Asia distributed to target beneficiaries • Recipes designed for promotion in school garden program in Mali, Cameroon and selected regions in Central Asia *Output Targets 2014* • Dietary strategies for bitter gourd consumption for low income and high diabetic prevalent regions in India and Tanzania promoted and publication disseminated • Nutrition-improved preparation and preservation techniques studied in Mali to enhance micro-nutrient bioavailability and vitamin retention in indigenous vegetables • Recipes disseminated for promotion in school garden program in Mali, Cameroon and selected regions in Central Asia *Output Targets 2015* • Nutrition-improved preparation and preservation techniques that enhance micro-nutrient bioavailability and vitamin retention in indigenous vegetables for Mali documented • Recipes disseminated for promotion in school garden program in Mali, Cameroon and selected regions in Central Asia

Activity 2.4 Develop, validate and implement promotion strategies for increased consumption of vegetables and nutritious/diverse diets by poor households emphasizing on women and children in Asia and sub-Saharan Africa	*Output Target 2013* • Innovative multiple communication tools developed and tested to promote good nutritional practices and increased vegetable consumption in rural and urban areas of selected areas of Mali • Approaches on effective communication and dissemination strategies tested for promoting indigenous vegetable nutrition and utilization in Central Asia, Bangladesh and Cameroon • Community-based promotion campaigns conducted for enhanced vegetable consumption in south Bangladesh *Output Target 2014* • Effective communication and dissemination option scaled up for promoting indigenous vegetable nutrition and utilization in Central Asia, Bangladesh and Cameroon • Effect of nutrition-sensitive agricultural promotion by seed companies on nutritional knowledge and intention for behavior changes studied • Community-based promotion campaigns conducted for enhanced vegetable consumption conducted in south Bangladesh • Promotion strategies developed involving integration of vegetable gardening, livestock, food and nutrition components for enhanced vegetable consumption and good nutrition practices for rural and urban families in selected areas of Mali *Output Targets 2015* • Nutrition leaflets, posters, booklets and recipes books for Central Asia developed, printed and distributed • Promotion of vegetable recipes for school and community garden programs in Mali, Cameroon and selected regions in Central Asia conducted and vegetable consumption and nutritious diets in Bangladesh promoted via participatory approaches

Output 3: Approaches to enhanced market efficiency and access developed, post-harvest losses minimized and vegetable supply chains strengthened

Outcome: Small-scale farmers and other actors in Africa, Asia and the Pacific benefit from improved market coordination along vegetable supply chains, improved postharvest practices as well as from enhanced research capacities and networks.

Activity 3.1

Analyze components of supply chains, marketing systems and post-harvest handling of vegetables in sub-Saharan Africa, Asia and Pacific

Output Targets 2013

- Needs assessment of vegetable postharvest handling and storage in Bangladesh and Mali; and study on postharvest losses assessment in Tanzania, Kenya and Ghana conducted
- Stakeholder consultation workshops conducted to understand local needs, constraints and opportunities of postharvest management in Ghana, Kenya and Tanzania
- Market survey conducted in Tanzania among growers and consumers of indigenous vegetables and their demand for seed and for produce
- Results of vegetable value chain and market opportunities study in East Java and Bali, Indonesia documented

Output Targets 2014

- Needs and loss assessment surveys on vegetable post-harvest handling conducted in selected regions in Cambodia and Ethiopia
- Marketing systems of indigenous vegetables in Tanzania documented
- Opportunities for improving vegetable marketing value chain performance in Ethiopia, Tanzania, Malawi and Mozambique indentified through field surveys and multi-stakeholder platforms

Output Targets 2015

- Nutritional content of selected vegetables monitored following application of validated innovative post-harvest handling technologies along various points of the supply chain in target countries in sub-Saharan Africa and Asia
- Feasibility studies on minimal processing and processing technologies as an alternative market in Ethiopia, Tanzania, Malawi and Mozambique conducted

Activity 3.2

Facilitate the establishment of enhanced market coordination mechanisms for vegetable supply in sub-Saharan Africa, Asia and Pacific

Output Targets 2013

- Value chain groups based on the participatory market chain approach established for summer and winter tomato production systems in Bangladesh
- Pilot Participatory Guarantee System for high value vegetable crops in Fiji and Solomon Islands developed and monitored.
- Linkages and value chain enhancing activities forged between indigenous vegetable seed and produce growers and private seed companies in Tanzania
- Evaluation and promotion of improved vegetable packaging materials conducted via on-farm demonstrations in Tanzania
- Effective linkages along vegetable value chains enhanced through demand creation activities in Tanzania, selected areas of Mali and Cameroon

Output Targets 2014

- Effective linkages along vegetable value chains enhanced through demand creation activities in Tanzania, selected areas of Mali and Cameroon enhanced through various demand creation activities
- Existing extension training approaches reviewed and strategic options developed to improve training course curricula with Participatory Guarantee System, post-harvest handling and produce quality management components in the Solomon and Fiji Islands
- Results of research trials on use of evaporative coolers for short term vegetable storage validated and disseminated in Tanzania

Output Targets 2015

- Techniques for improved vegetable packaging materials disseminated via multi-stakeholder platforms in Tanzania
- Awareness raising activities conducted to enhance adoption of new postharvest technologies by beneficiaries in Africa and Asia
- Identified options for improving vegetable marketing value chain performance in Ethiopia, Tanzania, Malawi and Mozambique promoted via multi-stakeholder platforms

Activity 3.3 Develop and enhance training curricula and materials on proper post-harvest management and marketing skills for trainers in Asia, sub-Saharan Africa and Pacific	*Output Targets 2013* • Curricula and training materials reviewed and updated annually for the International Vegetable Training Course held in Thailand, and for Onion Production, Storage and Marketing Training Course in Cameroon • Training materials developed and related standard operating procedures completed for use at Postharvest Training and Services Center in Tanzania for capacity building programs • Training materials translated into local languages of selected countries in sub-Saharan Africa, Asia and Oceania and adapted for dissemination to beneficiaries in targeted locations *Output Targets 2014* • Curricula and training materials reviewed and updated annually for the International Vegetable Training Course in Thailand • Translated training materials updated annually and disseminated to program beneficiaries in targeted locations in sub-Saharan Africa, Asia and Oceania *Output Targets 2015* • Curricula and training materials reviewed and updated annually for the International Vegetable Training Course in Thailand • Translated training materials updated annually and disseminated to program beneficiaries in targeted locations in sub-Saharan Africa, Asia and Oceania • Training materials developed and capacity building programs conducted to reinforce linkages between producers and processor in Bangladesh and Tanzania
Activity 3.4 Strengthen postharvest research capacity of national partners through trainings and awareness raising on post harvest loses and post harvest research in national and regional level in Asia, Africa and the Pacific	*Output Targets 2013* • At least 25 participants from Asia trained on vegetable production, postharvest and marketing • At least 20 participants from northern Cameroon trained on onion production, storage and marketing • At least 250 participants for the Training of Trainers and farmer training courses from Tanzania and Bangladesh trained in postharvest handling practices *Output Targets 2014* • At least 1,000 participants for the Training of Trainers and farmer training courses from Tanzania and Bangladesh trained in postharvest handling practices • Participatory training workshop in postharvest handling conducted in Bangladesh *Output Targets 2015* • At least 1,000 participants for the Training of Trainers and farmer training courses from Tanzania and Bangladesh trained in postharvest handling practices

Activity 3.5

Adapting available technologies and developing new technologies to meet the needs of the target value chain actors and stakeholders in selected countries in Asia, Africa

Output Targets 2013

- Research trials conducted on use of evaporative coolers for short term vegetable storage to reduce postharvest losses in Tanzania
- Preliminary evaluation of packing crates for tomato transportation conducted
- Evaluation of the shelf-life performance conducted of newly introduced vegetable varieties in Bangladesh

Output Targets 2014

- Evaluation of the shelf-life performance conducted for elite AVRDC tomato varieties and advanced lines
- Preliminary evaluation of the use of ice packs to reduce deterioration of leafy vegetables during transportation and marketing conducted
- On-station field trials to determine cost benefit analysis of the use of packaging liners and use of chlorinated water for washing produce after harvest conducted in Tanzania
- Appropriate postharvest handling technologies for selected vegetables tested in Ethiopia, Tanzania, Malawi and Mozambique

Output Targets 2015

- Detailed evaluation conducted of the use of ice packs to reduce deterioration of leafy vegetables during transportation and marketing
- Participatory market trials conducted to determine cost benefit analysis of the use of packaging liners and use of chlorinated water for washing produce after harvest in Tanzania
- On-field participatory market trials conducted to determine cost benefit analysis of the use of chlorinated water for washing produce after harvest in Tanzania

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 other capacity building and knowledge sharing platforms to increase awareness and capacity of vegetable value chain actors and stakeholders to increase production, utilization and consumption of nutrient-rich vegetables in Asia, sub-Saharan Africa and Pacific

Output Targets 2013

- Senior government staff from Bhutan, Burkina Faso, Indonesia, Nepal, Philippines and Tanzania trained in design and implementation of vegetable school garden programs via workshops
- 3-5 day training courses on vegetable production, processing, consumption and conservation delivered to 15-20 target youth and women groups in Tanzania
- 1-2 farmer field days in Central Asia and the Caucasus and Cameroon conducted to promote increased production and consumption of vegetables
- Multi-stakeholder platforms established for intensified rice-vegetable production systems in Tanzania and Ghana

Output Targets 2014

- 3-5 day training courses on vegetable production, processing, consumption and conservation delivered to 30 individuals from target youth and women groups in Tanzania
- Selected farmer training programs in sub-Saharan Africa evaluated and analyzed, and report on lessons learnt made available for reviewing and conceptualizing future training programs
- 1-2 farmer field days conducted in Central Asia and the Caucasus to promote increased production and consumption of vegetables

Output Targets 2015

- 1-2 farmer field days conducted in Central Asia and the Caucasus to promote increased production and consumption of vegetables
- Policy-makers and other stakeholders of school vegetable gardens in Bhutan, Burkina Faso, Indonesia, Nepal, Philippines and Tanzania received feedback on the awareness and nutrition outcomes of vegetable consumption for school girls and boys and their households

Activity 4.2

Develop data collection protocols and policy briefs on outcome and impact assessment of program interventions in sub-Saharan Africa, Asia

Output Targets 2013

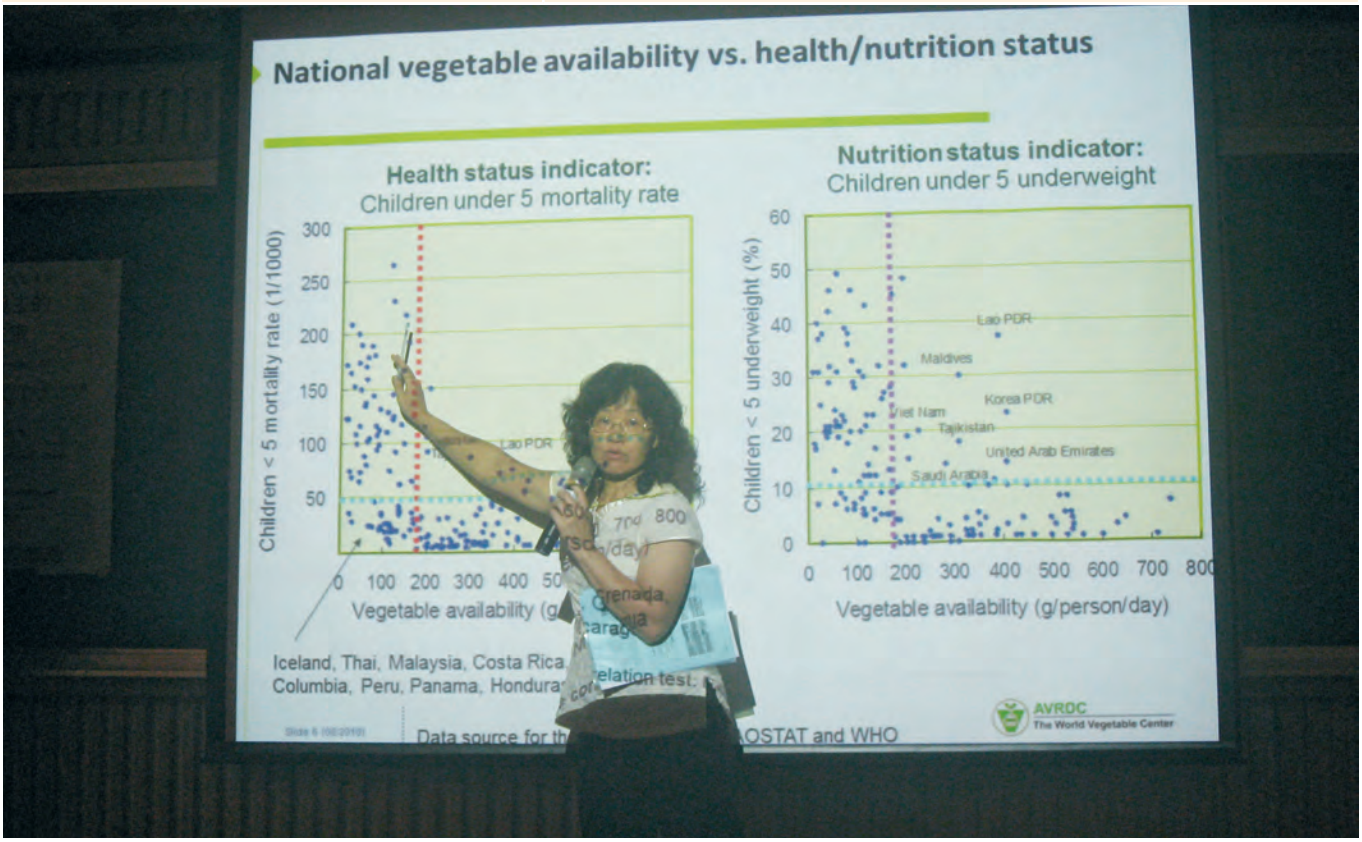
- Generic monitoring and evaluation framework and scaling-up strategy of technology dissemination for the Center published
- At least one policy brief on impact assessment of tomato grafting technology in Vietnam and on economic cost quantification of postharvest losses in sub-Saharan Africa and Asia published for dissemination
- Framework for centralized monitoring and evaluation data collection tools and databases for Center developed

Output Targets 2014

- Generic framework for monitoring, evaluation, and technology dissemination for the Center updated annually
- Centralized monitoring and evaluation data collection tools and databases for Center updated and finalized
- At least one policy brief to promote uptake of grafting technology in three selected Asian countries prepared

Output Targets 2015

- Generic framework for monitoring, evaluation, and technology dissemination for the Center updated annually
- Policy brief on the opportunities and constraints of school vegetable gardens in various countries, together with strategies for out-scaling finalized and disseminated
- Centralized monitoring and evaluation data collection tools and databases for the Center updated annually



GLOBAL SUPPORT

AVRDC's professional staff addresses the needs of a diverse and dispersed global research center in administration, finance, internal audit, human resources, communications, library, IT, data management, partnership development and technology dissemination.

Office of the Deputy Director General - Research

The Deputy Director General for Research will continue to lead and have oversight of the Center's global thematic research and development activities. The Center has four Global Themes: Germplasm, Breeding, Production and Consumption, each led by a Theme Leader (three are based at Headquarters while one is based at the Regional Center for Africa) who reports to the Deputy Director General for Research. The regional offices have geographical oversight, also reporting to the Deputy Director General for Research and forming a matrix with the four Themes. The Regional Offices cover East and Southeast Asia, South Asia, Africa, Central & West Asia and North Africa, and Oceania. In 2013 and beyond, the Center's capacity will be strengthened in the Central & West Asia and North Africa and Oceania through better hosting arrangements and strengthened collaboration with partners.

This cross-cutting matrix of thematic and regional research and development is supported by Grants and Partnership Development, Intellectual Property, Biometrics, Communications and Information, Information Technology and Global Technology Dissemination. This complex inter-relationship requires judicious balancing of resources against global opportunities and challenges, and careful balancing of research and development components within the Center's portfolio of activities.

The Deputy Director General for Research leads interactions with donors and partners to source funding for projects on vegetable research and development. This requires close contact with some donors and may require rapid turnaround of concept notes and proposals with the Grants and Partnerships Development team and Financial Services to assure project funding meets the project's objectives and the Center's requirements. The quality of project proposals will be monitored to ensure proposals are in line with the Center's mission as well as the requirements of the donors. The restricted project focus will be on larger projects rather than having a large number of smaller projects.

The Center is currently developing an on-line mechanism to record the indicators and targets of the Center's activities, both as a means to monitor the Center's performance and to be able to respond to donor's requirements for data. The Center's agreements, contracts and Memoranda of Understanding or Agreement will be monitored and pass through rigorous checking by our Intellectual Property lawyer and internal processes before approval

NANCY HASELOW (RIGHT), REPRESENTING NGO HELEN KELLER INTERNATIONAL, EXCHANGES IDEAS AND INFORMATION WITH DEPUTY DIRECTOR GENERAL - RESEARCH JACKIE HUGHES.

to commit the Center to any course of action is given. This is particularly important as the Center increases its interactions with the private sector, where the intellectual property requirements require attention to ensure the Center's freedom to operate is retained.

Assuring the quality of the Center's documentation is also under the purview of the Deputy Director General for Research and includes processes for internal peer-review and quality control. The Center's 'Writing Week' that was initiated in 2012 was a success, allowing the Center's staff to focus on writing up research and development results and has contributed to the Center's publications record. This success means the 'Writing Week' will become an annual event. The Center's production of other publications such as conference papers and posters, media relations documentation, institutional documentation such as the *Year in Review, Medium-Term Plan* and *Annual Report*, press releases and extension documents will continue.

The Deputy Director General for Research will continue to chair the Institutional Biosafety and Ethics Committee, the Institutional Research and Development Committee and will chair the Center's Assets Committee. The Institutional Biosafety and Ethics Committee has a mandate to ensure that the Center's activities involving genetically modified organisms and any research involving animal or human trials follow all necessary protocols and procedures to minimize any risk to the Center. The Institutional Research and Development Committee, comprising the Global Theme Leaders and the Regional Directors, has oversight of the Center's research and development activities by providing advice, insight and guidance. The Center's Assets Committee gives direction and oversight to the Center's capital purchases, taking into account need, cost, depreciation, maintenance and other considerations before purchases are approved.

The Deputy Director General for Research works closely with the Director General, the Deputy Director General for Administration & Services, the Director of Finance and the Director of Human Resources, as well as the Regional Directors, as part of the Center's management team. ◆

Office of the Deputy Director General - Administration & Services

Administration and Services provides support for purchasing, travel arrangements, human resources, technical services, food and accommodation, risk management and host country liaison.

In the coming mid-term period, Administration and Services will recruit competent staff, promote staff morale, raise operational efficiency, and maintain awareness and preparedness for risk management.

Saving energy and reducing carbon emissions will be emphasized and closely monitored to save costs and protect the environment. Technical Services facilitates energy saving by maintaining farm machinery and rebuilding facilities such as a steam sterilizer and water pumping system in greenhouses. The purchase of new energy-efficient vehicles is being considered. Construction of new irrigation and drainage ditches will be continued as necessary.

To enhance energy conservation, Food and Dormitory Services plans to replace old kitchen and lodging equipment, install a waterproof layer on the floor of the main service building, replace drinking water fountains, air conditioners and bedding in the training hostel. The chef crew will participate in training courses to enhance their capacity in preparing international cuisine for the Center's multicultural staff and visitors.

Purchasing and travel office staff are encouraged to find the best prices available in the market for the Center' purchasing needs. They gather and compare on-line price information to assist with cost-effective procurement of equipment and materials.

Administration and Services will continue strengthening support for risk management to anticipate responses to natural disasters, extreme weather, or political unrest

in developing countries where the Center's activities may be affected. For environmental protection and the health of personnel, the storage of pesticides and toxic chemicals at headquarters and regional offices will be closely monitored and necessary adjustments taken. Fire drills, earthquake and natural disaster response, and cardiopulmonary resuscitation training for headquarters and regional centers will be regularly conducted. The Center will pursue the possibility of including the South Asia office in the evacuation plan of the International Crops Research Institute for the Semi Arid Tropics.

ADMINISTRATION & SERVICES LIASES WITH HOST COUNTRY TAIWAN ON ACTIVITIES SUCH AS OPEN DAY AT AVRDC HEADQUARTERS.

Starting in 2013 by resolution of Taiwan's Legislative Yuan, part of the host country's core contribution has been moved to special projects to strengthen collaboration between the Center and Council of Agriculture-affiliated institutions. This is hoped to enhance the development and capacity building of Taiwan's vegetable industry. The special project activities shall be mutually agreed upon by the Center and the Council of Agriculture's Science and Technology Department. These activities include development of energy- and water-saving year-round vegetable production facilities and organic vegetable cultivation systems, incorporating training of young farmers. For 2013, the budget size provided is NT$10-15 million (ca. US$500,000). A project proposal has been developed and a project report is required to be submitted at the end of the year. Additionally, special project funding also may be granted to the Center for up to US$500,000 from the Taiwan Ministry of Foreign Affairs in 2013. The Center will rely on strong support from the Council of Agriculture to encourage the Legislative Yuan Budget Committee to rescind their ruling on standing funds in the middle of the year. The Center will continue the effort to undertake new research areas and to strengthen existing ones using the special project funding provided by the Council of Agriculture. ◆

Financial Services

The Center's Strategic Plan includes substantial budget growth and funding diversity as its main financial objective. This requires maintaining the level of financial discipline that was attained over the past several years. Financial Services will continue to collaborate closely with the Grants and Partnership Development team to ensure proper and timely reporting to the donors on their investments in the Center and to help ensure that the Center pursues only projects and funding sources that are viable and in line with the Center's Strategic Plan. There is increased emphasis from donors regarding financial health and impact from their investments; concerted efforts will continue to improve the Center's financial health indicators to match the growth in activities. Maintaining cost control and efficient operation of service units remain key areas.

Progress will be made in updating the user documentation for the Enterprise Resource Planning system, Maconomy and ensuring it is more user-friendly and useful. The Center's administrative Standard Operating Procedures will continue to be updated to bring them in line with Maconomy. ◆

Internal Audit

Many documents produced from routine tasks are being stored online in the Maconomy Enterprise Resources Planning system. To avoid errors and incorrect data in the system, a cross-check function must be implemented routinely. In addition to the checks performed by Center staff, Internal Audit will double-check different areas as and when necessary. To safeguard the Center's interests, Internal Audit will monitor the property management function in relevant audit tasks and ensure that property custodians at the Center understand their responsibilities.

Sound project management allows the Center to implement research and development activities effectively and efficiently according to the commitments made to donors. Internal Audit supports the Center's research and development portfolio to ensure project management processes are implemented in compliance with the Center's regulations.

In 2013-2015, Internal Audit will continue working on the planned audits of Food and Dormitory Services, Grants and Partnership Development, control of toxic chemicals, travel process, and regional office activities and financial operations. Besides the functional audits, Internal Audit will make efforts to reinforce the Center's current systems and processes to assure proper functioning and delivery of targeted outputs. ◆

Human Resources

Activities for 2013-2015 will aim at leveraging the talent for innovation and a performance- and impact-oriented culture, besides continuing efforts to build competencies and further staff engagement.

The Center's funding diversity and multi-regional projects with a variety of partners demand clear impact goals, efficient execution and accurate measurement of results. This requires skills in project management, networking and use of measurement tools. While a number of scientists and research staff have been trained recently in project monitoring and evaluation, further intense training will be organized for regional staff from project conceptualization to execution. Staff members/ teams will be encouraged to set individual performance goals in line with Center-wide performance indicators. To that effect staff will be trained in setting and negotiating goals as well as skills in providing mutual feedback.

Teamwork, especially multidisciplinary teamworking, will provide mutual learning opportunities, an inclusive work environment and greater staff satisfaction. Interventions to improve team work through formal training and mentoring will be provided for micro and large teams. The Center is also exploring information technology-enabled social processes that could help team members to collaborate virtually, share their achievements and enhance learning. A trial initiative will be implemented in

2013 at headquarters and scaled up in the subsequent years.

Enhancing staff engagement, strengthening communication and awareness about the Center's research and development activities, especially among national staff, will continue to be a top priority. The "Line-of-Sight" training events that help staff to discover meaning and relevance of their job activities/ contributions to the goals and and mission of the Center will be conducted at multiple locations. A new short session—"Know your Center"— will be organized at HQ and in the regions for the benefit of national staff.

Following the success of the Role and Leadership Workshop held for the combined group of management, theme and regional leadership in 2012, Leadership 2.0, a new development event focused to enhance leadership skills among scientists and managers, will be conducted in 2013 and 2014.

Staff optimization through needs analysis, cross deployment and relocation of activities closer to the beneficiaries will be pursued to optimize costs and improve efficiency.

The Center continues its trend of having a good degree of diversity in its staffing. Efforts will continue to sustain and improve this trend, as well as harness the diverse perspectives for developing creative solutions for Center's goals.

Special events for staff as part of the 40th Anniversary celebrations of the Center will be also undertaken during 2013. ◆

FROM STRATEGIC PLANNING SESSIONS LED BY DIRECTOR GENERAL DYNO KEATINGE TO FIRE-FIGHTING DRILLS CONDUCTED FOR THE CENTER BY THE LOCAL FIRE BRIGADE, AVRDC STAFF ENGAGE IN ACTIVITIES TO STRENGTHEN THE SKILLS AND KNOWLEDGE VITAL TO CARRYING OUT THE CENTER'S MISSION.

Communications and Information

Communications and Information provides editorial, media and public awareness, library, graphic design, photography, visitor, and corporate marketing support to Center staff. Activities that will engage the group over the next three years:

- 2013: The Center will celebrate its 40th anniversary of service to tropical agriculture this year. The Communications group prepared a 2013 calendar combining historic and current photos; designed a distinctive commemorative logo; and set up an alumni registry on the website, which is attracting testimonials from former staff. Anniversary festivities will include an Open Day in May, a symposium in October, and other activities. The Center's photographer is evaluating software for an online photo archive accessible to all regional offices. Efforts to expand the Center's media reach will continue through targeted placement of news releases and closer collaboration with reporters, commentators, bloggers, and partners.
- 2014: Priorities will include standardizing electronic archiving practices; updating and redesigning the lobby displays in the Laboratory Building and Genebank to enhance their educational value for visitors; and promoting greater user of video and mobile technologies for extension information dissemination, surveys, and documentation.
- 2015: Communications and Information will focus on strengthening the Center's local presence and refining its global image through staff training in media relations and integration in daily activities. ◆

Information Technology Services

Information Technology Services has commissioned new network-attached storage devices that will provide extended capacity for general-purpose and group storage at headquarters. This will help in sharing large files among users, while lessening the load of having to use email and internet bandwidth for this purpose. The general-purpose storage space, known as the "T-drive," is a storage location available on the network for all users at headquarters, allowing them to share files and folders across the different groups in the Center. Group storage, known as the "U-drive," is private storage space that is visible and accessible only to scientists and staff members belonging to particular groups.

Information Technology Services is planning to upgrade file server storage capacities for routine, automatic onsite-based backups for users at headquarters, while leveraging cloud-based storage facilities for Center-wide off-site backups.

As information technology devices—such as smart phones and tablets—become ubiquitous, we need to be prepared to counter the threat to our information-based systems. Information technology policies and standard operating procedures will be reviewed, simplified and enabled Center-wide. Backup, disaster recovery and business continuity planning are critical areas that will be looked into and implemented.

Information Technology Services is also exploring video-conferencing options that would help the Center reduce travel costs. Adopting network-based phone systems or web-based communication software to make international calls (combining audio, video and data transmission and keeping bandwidth limitations in mind) across AVRDC offices around the world is also being explored—this will help reduce telephone and travel costs.

The Center maintains various information databases that can be integrated into a common pool. With indicators for projects also put into the mix, being able to not only access, but also combine data and correlate it with other databases will add value to the Center's work. Having such a platform introduces data warehousing and data mining concepts that need to be deployed, and allows tools to bring analytics and business intelligence to the forefront and help the Center with quantitative and trend-based decision support services. ◆

Global Technology Dissemination

The Global Technology Dissemination (GTD) group conducts a range of activities in capacity building, technology dissemination and agricultural development. GTD is responsible for innovating the processes and strategies for the Center's development-oriented projects to maximize impact at the farmer level.

The group actively disseminates technologies across all four of AVRDC's research and development (R&D) Themes. GTD plays a vital role in the Center's donor-funded projects; it leads a 4-year R&D project in Indonesia and provides a supporting role in a number of projects in Asia and Africa. Thousands of farmers will receive training in vegetable technologies in Indonesia and Bangladesh in 2013-2015.

GTD manages the Demonstration Garden at headquarters, which showcases the Center's technologies to visitors and trainees, including 50-100 crop species or varieties year-round. GTD staff will continue to provide tours of the Garden to the hundreds of visitors to come to the Center annually.

Global Technology Dissemination publishes Feedback from the Field, a quarterly bulletin that communicates technology applications and urgent issues from the field to its readers. This publication will continue to be disseminated via the AVRDC website, email and Facebook. In collaboration with the breeding groups, GTD maintains and updates a web-based seed catalog, which greatly facilitates germplasm transfer. The group will continue to update the AVRDC website to promote new AVRDC-improved lines, integrated pest management and other technologies. GTD compiles information on the Center's mature technologies into a database, as part of AVRDC's intellectual asset management. The database is used to enable efficient dissemination of technologies via the AVRDC website, projects and workshops. GTD will collaborate with other groups at the Center to develop videos, training manuals and extension publications that transfer the Center's technologies in ways that enable adaptation by end users.

GTD will work on showcasing and developing new technologies, such as greenhouse fertigation for vegetable crops. The group also multiplies rootstock germplasm to facilitate dissemination of flood- and disease-resistant lines. GTD's pro-poor approach is oriented towards meeting local stakeholders' needs and maximizing impact, directly in line with the Center's mission. Often this will involve a participatory approach, which is one of the group's areas of expertise. GTD provides

TECHNOLOGY DISSEMINATION SPECIALIST GREG LUTHER (LEFT) DISCUSSES SAFE AND SUSTAINABLE PRODUCTION METHODS WITH VEGETABLE GROWERS IN INDONESIA.

participatory training activities on grafting and other technologies. GTD also coordinates and organizes exhibitions, field days and training workshops.

GTD is coordinating a group of 34 AVRDC scientists worldwide who work on technology dissemination and capacity building, to provide a more unified and coherent effort to create outcomes and impacts. GTD gathers data worldwide for the Center's accomplishments and performance indicators in capacity building and technology dissemination.

The group also coordinates the Center's Disaster Response Program, which features seed production and distribution of hardy, fast-growing and nutritious vegetable crops to disaster survivors. In addition, Global Technology Dissemination provides an important service role by facilitating administrative issues and logistics for trainees coming to headquarters for capacity building activities across a range of disciplines. ◆

Biometrics

The benefits of the Biometrics resource at AVRDC are reflected in the high quality of research output of AVRDC. Sound biometrical methods and access to statistical information and techniques used in research are important in achieving scientifically reliable and high quality research output.

AVRDC's Biometrics resource covers all biometrics-related aspects of experimentation from experimental design, field plot techniques, plot sampling techniques, remedial measures for problem data, statistical analysis of data, to presentation and interpretation of results. Quality of all scientific manuscripts is ensured through comprehensive statistical review of reports to ensure and maintain AVRDC credibility among our donors, clients, and the scientific community.

The Biometrics Office will continue to provide the following biometrics consulting services to Center research scientists and staff: 1) statistical review of reports / proposals /abstracts / scientific papers and posters for publication, 2) evaluation of experimental/sampling plans, 3) statistical analysis of data, 4) capacity building through training programs on experimental design, data management and analysis, interpretation/presentation of results to improve and enhance the skills of staff and the national agricultural research system collaborators in conducting research, and 5) advice on how to use statistical software available at AVRDC.

Generally, the outputs of the Biometrics Office are: 1) advisory support – provide consulting services or general help in designing experiments, dealing with data, or other statistical issues, 2) training - in-country and in-house, aimed at improving the skills and understanding of researchers and NARS collaborators, and scientists, who may be infrequent users of statistics, 3) assurance of high quality data - a measure is put in place to assure quality of research outputs right from the start—at the planning stage, through detailed evaluation of experimental plans which also assure proper recording and archiving of procedures used in each experiment, and 4) statistically reviewed reports, proposals, scientific manuscripts submitted for publications in international peer-reviewed journals. Specific outputs are analyses of agricultural and meteorological data to highlight the effects of climate on rural smallholder agricultural systems to minimize risk and maximize productivity. ◆

Grants & Partnership Development

The overall goal for Grants and Partnership Development is to be an effective and efficient institutional support function for the research and development agenda of AVRDC in terms of resource mobilisation and project management/administration. This is realised mainly through quality review, facilitation and coordination and in doing so acting as a focal point for grants (proposals and projects) and partnership development at the Center.

The Grants & Partnership Development work is mainly in three areas:

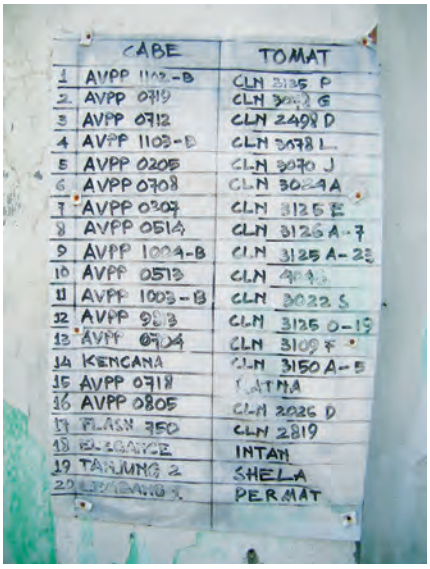
(1) Facilitate, coordinate and support resource mobilisation efforts: donor intelligence and priorities; review, edit and submission of concept notes and proposals; development of partnerships.
(2) Monitor and support project management/ administration: negotiate, draft, review and edit agreements; review, edit and submission of reports; a multitude of other project specific issues.
(3) Development and management of tools for resource mobilisation and project management/administration.

The processes and procedures for resource mobilisation and project management/administration will be reviewed for effectiveness and efficiency and adjusted accordingly. Focus in 2013 will be to (i) analyse and, if need be, suggest and implement changes; (ii) enable a deeper involvement of Global Theme Leaders and Regional Directors in ensuring the technical content and quality of proposals; (iii) create a more systematic flow of information on resource mobilisation and project management/administration issues to Global Theme Leaders and Regional Directors.

Efforts to enhance staff skills in proposal development and review will be made. Efforts will also continue to contribute to a better understanding within the Center of the 'why and how' of full-cost recovery from projects, as well as ensuring it is incorporated as much as possible in each proposal.

The Grants and Partnership Development group will continue to ensure that the Deputy Director General for Research receives relevant information in a systematic manner as well as populate Maconomy with the Center's concept notes/proposals, project data and agreements and improve its functionality in regard to resource mobilisation and project management/administration.

The main work of Grants and Partnership Development will continue to be to ensure the quality of the Center's concept notes, proposals and reports and support negotiations; prepare, review and edit agreements; and monitor project implementation. ◆



Introducing AIRCA

The **Association of International Research and Development Centers for Agriculture (AIRCA)** was formalized in March 2012 at a meeting at FAO, Rome and launched at the GCARD 2 meeting in Punta del Este, Uruguay in October 2012 to make a vigorous, combined impact on the attainment of the Millennium Development Goals to eliminate global poverty and malnutrition. The nine research and development centers in the partnership include AVRDC, CABI, Tropical Agriculture Research and Higher Education Center (CATIE), Crops for the Future (CFF), International Center for Biosaline Agriculture (ICBA), the International Center for Integrated Mountain Development (ICIMOD), Africa Insect Science for Food and Health (icipe), IFDC, and the International Network for Bamboo and Rattan (INBAR).

When acting together, these institutions have substantive global reach through their well-developed networks of country partners in the Americas, Africa and the Asia-Pacific Region. They have particular strengths in helping countries in the developing world build their own research and development capacity to address agricultural and health related issues. All have an established, historical track record of successful research outcomes that have been scaled up to development impact at landscape and regional levels.

AIRCA's expertise compliments that of FAO and the CGIAR, as well as national programs with respect to staple crops. AIRCA members add further competence in crops with high economic, social, nutritional and ecological value. They have long experience in helping farmers overcome the difficulties they experience at field level in troublesome niche environments and can provide supporting germplasm and diagnostic skills in the front line trenches in the battle against environmental and biological forces which poor farmers face on a daily basis.

AIRCA
Association of International Research and Development Centers for Agriculture

Linkage with strong regional networks ensures AIRCA members have the capacity necessary to plan, develop and execute scientific endeavors with strong local support and a high probability of attaining sustainable development outcomes. These local networks are further complimented by their relative diversity, as the AIRCA's specific expertise is attractive to both public and private sector actors within the development community.

Being strongly oriented towards problem solving at a systems, rather than at a single commodity, level helps the research and development actions of AIRCA members be better grounded in the day-to-day problems experienced and articulated by poor farming communities in the developing world. Addressing complex and rapidly evolving problems such as global climatic uncertainty and widespread malnutrition can be done in a confident manner as AIRCA is supported by world-scale high-quality knowledge and germplasm banks, from which material is made available to partners as freely and effectively as possible. Thus, the design of realistic climate-smart landscapes is an achievable output which will substantively contribute to the intensified, sustainable development outcome presently sought by the global community.

The demonstrated ability to respond quickly and efficiently to agricultural problems, relatively small size and uncomplicated governance and management structures of AIRCA's members enables them to combine and re-combine simply and as necessary with a wide diversity of partners, and to offer alternative types of expertise required to provide solutions to development problems. Working relationships with other major players such as FAO, the CGIAR Centers, the academic community and the private sector worldwide are in place and are used as required. AIRCA recognizes that we are all players on the same team and that each can contribute expertise as and where necessary in the services of assisting the poor and disadvantaged.

Addressing the ever-present global dangers of flooding, drought, salinity, soil infertility, pests and diseases and their consequent agricultural impact on human diets, health and prosperity is AIRCA's call to action. All AIRCA members seek to contribute to a world in which the Millennium Development Goals can be made redundant as quickly as possible and they pledge their renewed efforts with donors and partners to actively support this desired state. ◆

KEY STAFF

Staff Name	Position Title	Location	Nationality
Afari-Sefa, Victor	Scientist - Socioeconomics and Global Theme Leader - Consumption	Arusha, Tanzania	Ghana
Ahmad, Shahabuddin	Vegetable Sector Leader (Bangladesh)	Dhaka, Bangladesh	Bangladesh
Chagomoka, Takemore	Liaison Officer for Cameroon and Seed Business Specialist	Yaoundé, Cameroon	Zimbabwe
Chang, Jan	Postdoctoral Fellow - Molecular Entomology	Shanhua, Taiwan	Taiwan
Chang, Yin-Fu	Deputy Director General - Administration & Services	Shanhua, Taiwan	Taiwan
Chen, Huei-Mei	Associate Specialist, Biotechnology/Molecular Breeding	Shanhua, Taiwan	Taiwan
Chen, Willie	Assistant Specialist, Global Technology Dissemination	Shanhua, Taiwan	Taiwan
Cho, Myeong-Cheoul	Scientist - Pepper Breeding	Shanhua, Taiwan	Korea
Dhillon, Narinder	Vegetable Breeder - Cucurbits	Bangkok, Thailand	India
Dinssa, Fekadu Fufa	Vegetable Breeder	Arusha, Tanzania	Ethiopia
Easdown, Warwick	Regional Director, South Asia	Hyderabad, India	Australia
Ebert, Andreas	Genebank Manager and Global Theme Leader - Germplasm	Shanhua, Taiwan	Germany
Endres, Theresa	Community Development Specialist (Nutrition)	Bamako, Mali	Germany
Habicht, Sandra	Postdoctoral Fellow - Biochemical Nutrition	Shanhua, Taiwan	Germany
Hanson, Peter	Plant Breeder (Tomato and Indigenous Vegetable Research) and Global Theme Leader for Breeding	Shanhua, Taiwan	USA
Holmer, Robert	Regional Director, East and Southeast Asia	Bangkok, Thailand	Germany
Hsu, Sylvia	Manager - Food and Dormitory Services	Shanhua, Taiwan	Taiwan
Hughes, Jacqueline d'Arros	Deputy Director General - Research	Shanhua, Taiwan	United Kingdom
Inukonda, Nagaraj	Director of Human Resources	Shanhua, Taiwan	India
Keatinge, J.D.H.	Director General	Shanhua, Taiwan	Ireland
Kenyon, Lawrence	Plant Virologist	Shanhua, Taiwan	United Kingdom
Krishnan, Bharath	Manager - Information Technology Services	Shanhua, Taiwan	India
Kumar, Sanjeet	Scientist - Pepper Breeding	Shanhua, Taiwan	India
Kwazi, Nadine	Executive Assistant to the Director, Regional Center for Africa	Arusha, Tanzania	Zambia
Ledesma, Dolores	Board Secretary and Biometrician	Shanhua, Taiwan	Philippines
Lin, Chih-Hung	Associate Specialist, Bacteriology	Shanhua, Taiwan	Taiwan
Lu, Vincent	Internal Auditor	Shanhua, Taiwan	Taiwan
Luther, Greg	Technology Dissemination Specialist	Shanhua, Taiwan	USA
Luther, Kartini	Assistant to Deputy Director General - Research	Shanhua, Taiwan	USA
Ma, Chin-Hua	Associate Specialist, Bacteriology	Shanhua, Taiwan	Taiwan
Mak, Adrienne	Manager - Management Support & Human Resources Services	Shanhua, Taiwan	Taiwan
Manickam, Ravishankar	Research Site Coordinator	Jharkhand, India	India

Staff Name	Position Title	Location	Nationality
Mariyono, Joko	Project Site Coordinator (Indonesia)	Jawa Timur, Indonesia	Indonesia
Mavlyanova, Ravza	Regional Coordinator for Central Asia and the Caucasus	Tashkent, Uzbekistan	Uzbekistan
Mecozzi, Maureen	Head of Communications and Information	Shanhua, Taiwan	USA
Nair, Ramakrishnan	Vegetable Breeder - Legumes	Hyderabad, India	India
Nenguwo, Ngoni	Postharvest Specialist	Arusha, Tanzania	Zimbabwe
Öberg, Annelie	Manager - Grants and Partnership Development	Shanhua, Taiwan	Sweden
Overweg, Dirk	Director of Finance	Shanhua, Taiwan	The Netherlands
Rajendran, Srinivasulu	Post Doctoral Scientist - Agricultural Economics	Arusha, Tanzania	India
Ramasamy, Srinivasan	Entomologist	Shanhua, Taiwan	India
Rouamba, Albert	Vegetable (Onion) Breeder	Bamako, Mali	Burkina Faso
Schafleitner, Roland	Head - Molecular Genetics	Shanhua, Taiwan	Austria
Schreinemachers, Pepijn	Agricultural Economist	Shanhua, Taiwan	The Netherlands
Stoilova, Tsvetelina	Scientist - Genetic Resources	Arusha, Tanzania	Bulgaria
Tenkouano, Abdou	Regional Director, Africa	Bamako, Mali	Burkina Faso
Tsai, Wen-Shi	Associate Specialist, Virology	Shanhua, Taiwan	Taiwan
Wang, Jaw-fen	Plant Pathologist and Global Theme Leader - Production	Shanhua, Taiwan	Taiwan
Yang, Ray-yu	Nutritionist	Shanhua, Taiwan	Taiwan

BUDGET

The following tables show the trend of the Center's revenues and expenditures covering the period from 2012 to 2015 along with sources of funding and allocation of finances to thematic research and development activities.

Table 1 shows the details of the 2012 actual outcome along with the budget.

Table 2 shows how the estimated 2013 budget compares to 2012 actual along with thematic allocation.

Table 3 details the main sources of revenue for 2012 and 2013.

Table 4 shows the expected budgets for 2013-2015 and provides indications of the spending per theme.

TABLE 1. FINANCIAL ACTIVITIES FOR THE YEAR 2012

	2012 Actual						2012 Budget	
	Unrestricted		**Restricted**		**Total**	%	**Total**	%
Revenues								
Unrestricted grants	8,732,776				8,732,776	66%	9,773,968	63%
Restricted grants			4,313,052		4,313,052	33%	5,474,123	36%
Other revenues	198,694				198,694	2%	150,000	1%
Total	**8,931,470**	67%	**4,313,052**	33%	**13,244,521**	100%	**15,398,091**	100%
Expenditures								
Personnel								
- International	2,874,454		1,076,750		3,951,204	32%	4,741,556	31%
- Local	4,041,616		492,640		4,534,256	37%	4,997,249	33%
Operating expenses								
- Field labor	0		196,719		196,719	2%	200,000	1%
- Supplies and services	881,508		1,117,186		1,998,694	16%	2,582,279	17%
- Travel	243,044		383,914		626,958	5%	609,294	4%
- Training and workshops	120,836		292,966		413,801	3%	300,000	2%
- General expenses	248,355		634,260		882,615	7%	1,000,000	7%
Contract outreach research	0		31,629		31,629	0%	600,000	4%
Contingency							905,000	6%
Depreciation/special project assets	74,740		86,989		161,728	1%	262,175	2%
Sub-total	**8,484,552**		**4,313,052**		**12,797,604**	105%	**16,197,552**	106%
Indirect cost recovery (overhead)	(586,778)				(586,778)	-5%	(849,461)	-6%
TOTAL	**7,897,774**	65%	**4,313,052**	35%	**12,210,826**	100%	**15,348,091**	100%
Changes in net assets	1,033,695				1,033,695		50,000	
Net change in self-sustaining operating fund					64,735			
Net assets at the beginning of the year					2,918,148			
Net assets at the end of the year*					4,016,578			
* Allocated to:								
Working Capital Fund	1,500,000							
Accumulated Fund	1,272,177							
Capital Replacement Fund	525,415							
Fixed Asset Fund	166,031							
Self-sustaining Operating Fund	552,956							
Total	*4,016,578*							

TABLE 2. 2013 FINAL BUDGET ESTIMATE (USD '000)

		2013 ESTIMATE		2012 ACTUAL	
Revenues		**14,878**		**13,245**	
Budget Allocations by Objects					
	Personnel				
	- International	3,970	27%	3,951	32%
	- Local	5,172	35%	4,534	37%
	Operations				
	- Operational expenses, services	3,093	21%	2,523	21%
	- Travel costs	711	5%	627	5%
	- Trainings and Workshops	455	3%	414	3%
	- Equipment (Depreciation costs)	648	4%	162	1%
	- Overhead Charge	916	6%	587	5%
	Contingency	800	5%		
Sub-total		**15,766**	106%	**12,798**	105%
	Indirect cost recovery (overhead)	(916)	-6%	(587)	-5%
Total		**14,849**	100%	**12,211**	100%
Changes in net assets		**29**		**1,034**	
Net assets at the beginning		4,017		2,918	
Change in net assets		29		1,034	
Net change in self-sustaining operating fund				65	
Carried over/forward		4,046		4,017	
Budget allocations by Themes					
	I. Strategy Themes				
I-1	*Germplasm: Germplasm conservation, evaluation and gene discovery*	*789*	*5%*	*1,324*	*11%*
I-2	*Breeding: Genetic enhancement and varietal development of vegetables*	*2,588*	*17%*	*2,555*	*21%*
I-3	*Production: Safe and sustainable vegetable production systems*	*3,386*	*23%*	*3,266*	*27%*
I-4	*Consumption: Balanced diets through increased access to and utilization of nutritious vegetables*	*4,259*	*29%*	*2,140*	*17%*
	II. Administration and Services	*3,943*	*26%*	*2,927*	*24%*
Total *		***14,966***	*100%*	***12,211***	*100%*

TABLE 3. BREAKDOWN OF Y2013 ESTIMATED REVENUES (USD '000)

Donor	2013 Estimate		2012 Actual	
Unrestricted Funding				
Republic of China (ROC)	5,211		5,301	
UK Department for International Development (UK/DFID)	2,248		1,721	
United States Agency for International Development (USAID)	1,000		1,157	
Thailand	152		151	
Asia and Pacific Seed Association (APSA)	150		150	
Germany	123		122	
Korea	50		50	
Philippines	50		50	
Japan	30		30	
Sub-total	9,014		8,733	
Other revenues	200		199	
Total	**9,214**	***62%***	**8,931**	***67%***
Restricted Funding *				
Republic of Germany / BMZ / GIZ	1,165		1,053	
Swiss Agency for Development and Cooporation (SDC)	742		164	
Australian Centre for International Agricultural Research (ACIAR)	470		305	
National Health Research Institute (NHRI)	448		0	
Consortium of International Agricultural Research Centers (CGIAR)	390		0	
Republic of China (COA / NSC / MOFA)	170		558	
Korea / Rural Development Administration (RDA)	162		122	
European Union	122		0	
Sir Ratan Tata Trust (TATA)			156	
USAID	1,804		1,599	
Others	191		356	
Sub-total	**5,664**	***38%***	**4,313**	***33%***
Total Revenues	**14,878**	***100%***	**13,245**	***100%***

* Contribution less than US$ 100,000 grouped under "Others"

Contribution in-kind			
Korea [1/]	【 50】		【 50】
Thailand [2/]	【 45】		【 45】
GTZ/CIM [3/]	【 60】		【 60】
International Center for Agricultural Research in the Dry Areas (ICARDA) [4/]	【 50】		【 50】

Note:

[1/] Outposted scientist (in kind)
[2/] Land, utilities, facilities supported by Thai Government for the East and Southeast Asia Regional Center located within Kasetsart University
[3/] 1 Nutritionist, Mali office in Africa, is partially funded by GIZ/CIM Program
[4/] ICARDA/AVRDC collaborative research

TABLE 4. BUDGET PROJECTION FOR 2013 - 2015 (USD '000)

	2012 Actual	2013 Estimate	2014 Projection	2015 Projection
Budget Allocation by Category				
Personnel				
- International	3,951	3,970	4,169	4,377
- Local	4,534	5,172	5,431	5,702
Operations				
- Operational expenses, services	2,523	3,093	3,248	3,410
- Travel costs	627	711	747	784
- Trainings and Workshops	414	455	477	501
- Equipment (Depreciation costs)	162	648	680	714
- Overhead Charge	587	916	962	1,010
Contingency		800	840	882
Sub-total	12,798	15,766	16,554	17,382
Indirect cost recovery (overhead)	(587)	(916)	(962)	(1,010)
	12,211	**14,849**	**15,592**	**16,371**

Budget Allocation by Themes								
I. Strategy Themes								
I-1 Germplasm: Germplasm conservation, evaluation and gene discovery	*1,324*	*11%*	*789*	*5%*	*828*	*5%*	*870*	*5%*
I-2 Breeding: Genetic enhancement and varietal development of vegetables	*2,555*	*21%*	*2,588*	*17%*	*2,717*	*17%*	*2,853*	*17%*
I-3 Production: Safe and sustainable vegetable production systems	*3,266*	*27%*	*3,386*	*23%*	*3,555*	*23%*	*3,733*	*23%*
I-4 Consumption: Balanced diets through increased access to and utilization of nutritious vegetables	*2,140*	*17%*	*4,259*	*29%*	*4,472*	*29%*	*4,696*	*29%*
II. Administration and Services	*2,927*	*24%*	*3,943*	*26%*	*4,140*	*26%*	*4,347*	*26%*
Total *	***12,211***		***14,966***		***15,714***		***16,500***	

* Excluding contingency and prior to cost recovery for projection.

ACRONYMS & ABBREVIATIONS

AARNET	ASEAN-AVRDC Regional Network
ACIAR	Australian Centre for International Agricultural Research
ADFCA	Abu Dhabi Food Control Authority
AIRCA	Association of International Research and Development Centers for Agriculture
ASEAN	Assocation of Southeast Asian Nations
AVGRIS	AVRDC Vegetable Genetic Resources Information System
BYVMV	*Bhendhi yellow vein mosaic virus*
CaCV	*Capsicum chlorosis virus*
CAPSA	Centre for Alleviation of Poverty through Sustainable Agriculture
CATIE	Tropical Agriculture Research and Higher Education Center
CFF	Crops for the Future
CGIAR	Consultative Group on International Agricultural Research
CIP	International Potato Center
CMS	Cytoplasmic male sterility
COA	Taiwan Council of Agriculture
CRS	Catholic Relief Services
CWANA	Central & West Asia and North Africa
DAAD	German Academic Exchange Service
ERP	Enterprise resource planning system
FAO	Food and Agriculture Organisation of the United Nations
FSC	Food Security Center, University of Hohenheim, Germany
GAA	Germplasm Acquisition Agreement
GIZ	Gesellschaft für Internationale Zusammenarbeit
GRSU	Genetic Resources and Seed Unit
GTD	Global Technology Dissemination
HortCRSP	USAID Horticulture Collaborative Research Support Program
ICARDA	International Center for Agricultural Research in the Dry Areas
ICBA	International Center for Biosaline Agriculture
ICIMOD	International Center for Integrated Mountain Development
icipe	Africa Insect Science for Food and Health
ICIS	International Crop Information System
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IITA	International Institute for Tropical Agriculture
INBAR	International Network for Bamboo and Rattan
ITS	Internal transcribed spacer
IPCC	Intergovernmental Panel on Climate Change
IVTC	International Vegetable Training Course
JIRCAS	Japan International Research Center for Agricultural Sciences
KGKV	Krishi Gram Vikas Kendra
KU	Kasetsart University, Thailand
LC-MS	Liquid chromatography – mass spectrometry
MAS	Marker-assisted selection
MGD	Millennium Development Goals

MOFA	Taiwan Ministry of Foreign Affairs
MTA	Material Transfer Agreement
MYMV	*Mungbean yelllow mosaic virus*
NARES	National agricultural research and extension systems
PADFA	Projet D'appui Au Developement Des Filieres Agricoles
PCR	Polymerase chain reaction
PVMV	*Pepper veinal mottle virus*
QTL	Quantitative trait loci
RCA	Regional Center for Africa
RIL	Recombinant inbred line
RNAi	RNA interference
SDC	Swiss Development Corporation
SMTA	Standard Material Transfer Agreement
SqLCPHV	*Squash leaf curl Philippine virus - Taiwan isolate*
SRTT	Sir Ratan Tata Trust
SSR	Simple sequence repeats
TSWV	*Tomato spotted wilt virus*
TYLCV	*Tomato yellow leaf curl virus*
ToLCTWV	*Tomato yellow leaf curl Taiwan virus*
TYLCTHV	*Tomato yellow leaf curl Thailand virus*
UAE	United Arab Emirates
UN-ESCAP	Economic and Social Commission for Asia and the Pacific of the United Nations
USAID	United States Agency for International Development
vBSS	Vegetable Breeding and Seed Systems for Poverty Alleviation in sub-Saharan Africa
VEGINET	Vegetable Science International Network
WARDA	Africa Rice Center