AVRDC
The World Vegetable Center

medium-term plan

2012 - 2014

AVRDC – The World Vegetable Center

2012-2014 Medium-Term Plan

Published by

AVRDC – The World Vegetable Center
P.O. Box 42 Shanhua, Tainan 74199
Taiwan

T +886 6 583 7801
F +886 6 583 0009
E info@worldveg.org

www.avrdc.org

AVRDC Publication: 12-760
ISBN 92-9058-193-X

Editor: Maureen Mecozzi
Publishing Team: Kathy Chen, Vanna Liu, Chen Ming-che, Lu Shiu-luan
Photos: AVRDC Image Archive

Suggested citation

AVRDC. 2012. *2012-2014 Medium-Term Plan*. AVRDC – The World Vegetable Center. Shanhua, Taiwan. Publication 12-760. 70 p.

Contents

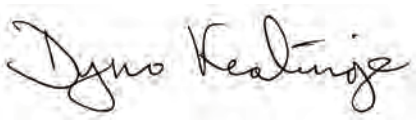

LEVERAGING
AGRICULTU
IMPROVING NUTR
& HEA
Lloyd Le Page
Siwa Msangi

Foreword

The attainment of the United Nations Millennium Development Goals is at severe risk owing to rising malnutrition, high child stunting and mortality rates, greater poverty, a large increase in the incidence of noncommunicable diseases, and lack of progress in women's empowerment. To help address these issues, in 2012 AVRDC - The World Vegetable Center expects to give heightened attention to the role of home, school, community and disaster recovery vegetable gardens as a pro-poor and pro-environment intervention in the developing world. These activities improve food and nutritional security, garner additional income, provide employment, contribute to better health, and help to empower disadvantaged groups in society.

The implications of global research in the tropics and sub-tropics over the last 20-30 years have been assessed over a wide geographic and linguistic range. The effectiveness and sustainability of such interventions will be considered in light of their contribution to the attainment of the Millennium Development Goals in a major review paper to be published this year. Suggestions for potential new directions for research are made and a call for better integration of effort in research and development between the agriculture, nutrition and health sectors is presented as a key issue if rapid development progress is to be made and sustained.

In this Medium-Term Plan the Center seeks to reflect the importance of these new directions and to emphasize the value of diverse, nutrient-dense vegetable production in overcoming malnutrition among the poor and disadvantaged throughout the world.



J.D.H. Keatinge
Director General

J.D.H. Keatinge, third from left, at the "Leveraging Agriculture for Improving Nutrition and Health Conference," February 2011, New Delhi, India.

Leafy greens, cucurbits, okra, and eggplant: Vegetables add diversity and nutrition to diets worldwide. Global benchmarks for nutrition will not be attained without increasing vegetable production and consumption.

The Nourished Millennium: How Vegetables Put Global Goals Within Reach

About three billion people in the world are malnourished due to a lack of food or imbalanced diets. Those without sufficient food are undernourished and have weakened immune systems, while people unable to consume a balanced diet may be overnourished and prone to develop chronic diseases such as anemia, blindness, cardiovascular disease, diabetes and cancer.

Many nations adopted the United Nations Millennium Declaration in 2000 and agreed to the Millennium Development Goals of halving global poverty by 2015, yet progress toward these goals has been uneven. Although some countries have made significant strides, the challenges to improve child and maternal health and eliminate chronic malnutrition remain, with many rural-urban disparities.

Vegetables are an important source of minerals and vitamins. Vegetables such as tomato (*Solanum lycopersicum*), cabbage (*Brassica oleracea*), onions (*Allium cepa*) and peppers (*Capsicum annuum*), and traditional vegetables such as moringa (*Moringa oleifera*), kangkong (*Ipomoea aquatic*), perilla (*Perilla frutescens*), anemone (*Nymphoides hydrophylla*), bitter gourd (*Momordica charantia*) and jute mallow (*Corchorus olitorius*) contain various levels and types of the micronutrients required for good health. Compared with cabbage, tomato contains somewhat more β-carotene, vitamin E and iron but has lower antioxidant activity. However, moringa can have 38 times the amount of β-carotene, 24 times the amount of vitamin C, 17 times the amounts of vitamin E, folates and iron, and eight times the amount of antioxidant activity exhibited by tomatoes.

Diets are influenced by traditional beliefs, religion and culture. To deliver appropriate dietary solutions, it is important to first assess consumption patterns and local dietary practices.

FOOD VS NUTRITIONAL SECURITY

The role of fruits and vegetables to ensure a balanced diet tend to be neglected in efforts to assuage the world's immediate hunger through starch-based diets and, where possible, some protein. Starchy crops often are grown in monocultures, readily scaled-up to fulfill demand. The concept of "food security" is defined as including physical and economic access to food that meets people's dietary needs as well as their food preferences, but economic drivers typically reduce the diversity of food available for the poor.

Price volatility makes smallholder farmers and poor consumers increasingly vulnerable to poverty and hunger. The Food and Agriculture Organisation of the United Nations clearly states that even short-term fluctuations in prices can have a long-term effect on development. However, the FAO's food price index measures monthly change in the prices of a basket only of cereals, oilseed, dairy products, meat and sugar; it does not take into account the vegetables and fruit that can help assure a balanced diet.

Sharp rises in the price of staple foods are the most obvious symptoms of fundamental problems in our food supply systems, which national, regional or global changes in energy costs and climate will only exacerbate. Greater investment is needed in food systems that address the nutritional quality of diets in addition to supplying sufficient calories.

In times of high prices, cutting back on nutritious food in the first 1,000 days of a child's life can affect mental and physical development and, ultimately, future earning capacity. Even those who are not hungry are likely to spend a much larger proportion of their income on staple foods as prices rise, further reducing their consumption of vegetables and fruit.

WOMEN, CHILDREN AND THE VULNERABLE

Women in developing countries face challenges driven by culture as well as gender-related differences. There is usually an unequal balance in power and influence between men and women; women often are affected by cultural and social factors that tend to reduce opportunities for education and employment; and women tend to focus on domestic and child-bearing roles. Poverty often has more serious consequences on the health of women: reduced access to healthcare, practices within the household where nutritious foods are often preferentially served to men leading to malnutrition in women and children, and risks that accompany pregnancy and childbirth.

Pregnant and lactating women and young children less than three years old are most vulnerable to malnutrition. Evidence shows that beyond the age of 2 or 3 years, the effects of chronic malnutrition are irreversible. To break the intergenerational transmission of poverty and malnutrition, children at risk must be reached during their first two years of life. Children who are malnourished and do not reach their optimum height or who have experienced bouts of weight loss during childhood are affected in many ways. As adults they may not reach their optimum size and thus may have reduced physical capacity for work. Malnutrition affects the development of the brain, which often results in a lower IQ. Malnourished children are at greater risk of infection due to impaired immune systems.

In developed countries, the population often is able to make a choice of whether to eat a nutritious diet. In many developing countries there may be no choice, and thus malnourishment is a common part of daily life. Poverty is an important factor, and often places a higher burden on women, children and the vulnerable. Empowering communities through information, education and appropriate tools can bring about the changes needed to make a more nutritious diet available to overcome impediments to healthy and productive lives.

RISK MITIGATION

Risks in terms of food security are often well and graphically documented, less so the risks due to malnutrition. Food and nutritional security can be compromised by climatic events and changes, civil disturbances, global economic fluctuations and, perhaps more poignantly, a lack of information and support for change.

Despite these complex challenges, developing countries can move toward the attainment of nutritional security by helping poor people provide their own nutrition. When people grow and consume their own vegetables and fruit they have access to a diversity of nutrient-rich food, regardless of rising food prices.

Weather has always posed a risk to farmers, but current climatic fluctuations challenge the nutritional resilience of farmers and households when confronted with warmer or cooler temperatures, drought or flooding, salinity, or a combination of these factors. There must be fruit and vegetable varieties available that can

thrive under these difficult conditions. With climate change, crop pests and pathogens will also evolve, adapt and change their distribution, affecting the quantity and quality of the yield. Plants suffering from abiotic stresses may be more vulnerable to pests and diseases, their pollinators may be less common, and consequently yields may be affected.

Plant breeders can develop vegetable varieties that perform well under these constraints, providing farmers and households with an important tool to reduce their vulnerability to climate. Many wild relatives of cultivated varieties may possess genes that make them more adaptable and tolerant to harsher environments. For example, *Solanum chilense*, a wild relative of the cultivated tomato, is indigenous to the desert areas of northern Chile and found to be adapted to extreme aridity, soil salinity, and low temperatures. Two wild nightshade species from the same region (*S. sitiens* and *S. lycopersicoides*) also share such traits. Gene transfer from these wild species could facilitate the development of drought- and salt-tolerant traits in standard tomato varieties. With adapted varieties and targeted crop management techniques, diverse and nutritious vegetables and fruit should remain available and affordable.

Threats to overall security can include overpopulation, population movement, deforestation, crime and disease, civil unrest, and international conflicts. Mechanisms to ensure food and nutritional security for both urban and rural populations are vital for national governments, which require the support of healthy, well-nourished people able to contribute to the development of society.

INTERVENTIONS TO IMPROVE NUTRITIONAL SECURITY

Nutritional security requires the availability and affordability of the essential vitamin and mineral micronutrients for human health as part of a balanced diet. Dietary supplements, fortification of food products, biofortification and assuring a diversity of vegetables and fruit in the diet are possible ways forward to ensure nutritional security.

Dietary supplements in the form of tablets and powders have been used to combat malnutrition in developing countries. High-dose supplements of vitamin A, for example, have been a means to control deficiency in this nutrient. Food fortification has not yet ensured coverage levels similar to supplementation in most affected areas. Achieving substantial reductions

in child mortality means that all children 6–59 months old living in affected areas need to receive high-dose supplements every 4–6 months. Dietary inadequacies can be prevented by using complementary food supplements such as moringa leaf powder, water dispersible or crushable micronutrient tablets, micronutrient sprinkles added to food just before feeding, or fortified spreads added to food just before feeding or eaten as snacks. Food fortification is a very effective strategy to increase intake of vitamin A and is widely used to prevent deficiencies of multiple nutrients. However, effective food fortification generally requires technical capacity and centrally processed and widely distributed foods that are amenable to fortification.

These approaches can be effective answers to deficiency but are not particularly sustainable. Another option includes the biofortification of staple crops, but this is costly and may be a high-risk and long-term strategy. Several crops have been the subject of intensive research to develop varieties that are high in specific nutrients, using both conventional breeding and genetic modification methods. Golden rice is biofortified with β-carotene and zinc and is due to be released in the Philippines in 2013; it was produced through genetic modification. There are also plans to develop sorghum with increased levels of lysine, vitamin A, iron and zinc through transgenic processes.

All plant breeders should focus on producing nutritious as well as productive crops. In the private sector, the emphasis tends to be on long shelf-life and appearance rather than health-promoting characteristics. Conventional breeding and selection has improved the nutritional quality of some crops: orange fleshed sweet potato is an excellent source of vitamin A and is in the process of widespread adoption in countries such as Mozambique and Uganda. However, as obesity is a growing global problem, providing a carbohydrate-based source of vitamin A is perhaps not a perfect solution. Biofortification of maize with provitamin A carotenoids has been successful, but the impact on vitamin A deficiency has yet to be quantified.

Common sense indicates a sensible solution would be to increase dietary diversity to include more pulses, additional green leafy and other vegetables of different colors (which can be an indicator of nutritional content—dark red/purple vegetables are usually high in anthocyanins, orange ones are often rich in β-carotene) and other nutrient-dense foods. Eating fruit and vegetables as part of an overall strategy to overcome micronutrient malnutrition is particularly important as fruit and vegetables are sources of a range of vitamins, minerals and other beneficial dietary components such as folate that make important contributions to human health.

A food-based approach to combat malnutrition requires a diet balanced with sufficient amounts of carbohydrate, proteins and fats/oils—and the produce from a home garden to supply vital micronutrients. Home gardens provide a sustainable solution to tackle micronutrient deficiencies and raise awareness of diet and nutrition. A home garden is an area, usually around or adjacent to the home, where a diversity of vegetables and fruit

can be grown throughout the year to meet family nutritional requirements; sometimes excess produce can be sold to generate extra income. Home gardening with vegetables and fruit usually can be undertaken by most of the rural and urban poor irrespective of their land resources, educational status, cash investment capacity, or gender. Produce from home gardens contributes substantially to the nutritional health of families, especially those that are malnourished or poor. Home gardens offer an additional advantage: they empower women, who are usually the ones tending the gardens, and give women greater authority and control over the quality of their family's diet. Home garden designs are available that take local conditions and dietary preferences into account; however, it is natural that individuals will adapt home gardens to suit their own needs. With information and education, these adapted home gardens will be able to contribute substantially to a family's nutritional needs.

CONCLUSION

Achieving the Millennium Development Goals on target appears to be an impossible task, yet every step taken toward these elusive goals improves the lives and livelihoods of millions of people. Substantial progress has been made in improving maternal and child health, and improving nutrition, thus equipping children to reap the benefits of education. But much remains to be done. Recent global financial and food crises were an alarm for which the ultimate cause is not widely acknowledged: the reliance on very few crops to feed an ever-increasing number of people. With fewer crop types, there is less diversity, less resilience, and more risk. The risk is not only to production and thus to national and regional economies, but also to human nutrition and health.

Even when families can afford to purchase ample food, they often select processed, high-starch, high-fat foods, resulting in another extreme: imbalanced diets that lead to obesity and associated health problems.

A diversity of fruits and vegetables must be included as part of the daily diet—and their production, use and consumption must be promoted. Vegetables can be grown in rural villages or in urban areas, in a home garden, or commercially. Different production and postharvest practices can be used to reduce risks (including injudicious use of inputs, climatic events and variation, and crop price fluctuations), increase profits and improve livelihoods. More investment is needed, more commitment by national and international agencies and governments is required, and more information and education about the risks of not eating a balanced and diverse diet must be shared. Unless we have balanced and health-promoting diets, we cannot nourish the hopes and dreams of millions of people in the world. ♦

Sources

Africa Harvest. 2010. ABS Project: Technology Development. http://biosorghum.org/articles.php?id=56 (accessed 11 Dec 2011).

Aguilar AVJ. 2005. Rice in the Filipino diet and culture. Discussion Paper Series No. 2005–15, Manila: Philippines Institute of Development Studies.

AVRDC. 2010. Prosperity for the poor and health for all: Strategic Plan 2011–2025. 41pp. Shanhua: AVRDC.

Berti PR, Krasevec J, FitzGerald S. 2004. A Review of the effectiveness of agriculture interventions in improving nutrition outcomes. Public Health Nutrition 7: 599-609.

Cambodia Development Resource Institute. 2008. Survey Report: Impact of high food prices in Cambodia. 97pp. http://documents.wfp.org/stellent/groups/public/documents/ena/wfp189739.pdf (accessed 2 December 2011)

Chetelat RT, Pertuzé RA, Faúndez L, Graham EB, Jones CM. 2009. Distribution, ecology and reproductive biology of wild tomatoes and related nightshades from the Atacama Desert region of northern Chile. Euphytica 167:77-93

de la Peña R, Hughes Jd'A. 2007. Improving ve++etable productivity in a variable and changing climate. Journal of Semi-Arid Tropical Agricultural Research 4: 22

FAO. 2011. The November FAO Food Price Index nearly unchanged from October Release date: 08/12/2011 http://www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/ (accessed 12 December 2011)

FAOSTAT. 2011. FAOSTAT online. http://faostat.fao.org/site/339/default.aspx (accessed December 2011)

Howe JA, Tanumihardjo SA. 2006. Carotenoid-biofortified maize maintains adequate vitamin a status in Mongolian gerbils. Journal of Nutrition 136: 2562-7.

Keatinge, JDH, Ledesma D, Hughes Jd'A, de la Peña R. 2009. A strategic look to the future for vegetable research: The World Vegetable Center and its partners. Global Climate Change: Imperatives for Agricultural Research in Asia-Pacific (pp. 113–119). Tsukuba: JIRCAS.

Keatinge JDH, Yang R-Y, Hughes Jd'A, Easdown WJ, Holmer R. 2011. The importance of vegetables in ensuring both food and nutritional security in attainment of the Millennium Development Goals. Food Security 3:491–501

Levitt T. 2011. Can GM-free biofortified crops succeed after Golden Rice controversy? The Ecologist http://www.theecologist.org/News/news_analysis/1159571/can_gmfree_biofortified_crops_succeed_after_golden_rice_controversy.html (accessed 11 Dec 2011)

McKay J. 2009. Food and Health Considerations in Asia-Pacific Regional Security. Asia Pacific Journal of Clinical Nutrition 18: 654-663

Morton J. 1987. Fruits of warm climates. Morton JF, Miami, FL.

Naico ATA, Lusk JL. 2010. The Value of a nutritionally enhanced staple crop: Results from a choice experiment conducted with orange-fleshed sweet potatoes in Mozambique. Journal of African Economies 19:536-558

Nestel P, Briend A, de Benoist B, Decker E, Ferguson E, Fontaine O, Micardi A, Nalubola R. 2003. Complementary Food Supplements to Achieve Micronutrient Adequacy for Infants and Young Children. Journal of Pediatric Gastroenterology and Nutrition 36: 316–328

Overseas Development Institute. 2008. Rising food prices: a global crisis. Briefing Paper #37. 4pp London, UK. http://www.odi.org.uk/resources/docs/1630.pdf (accessed 2 December 2011)

PROTA. 2004. Plant Resources of Tropical Africa 2: Vegetables Moringa oleifera Lam. Pp392-395; In: Grubben GJH, Denton OA, Messiaen CM, Schippers RR, Lemmens RHMJ, Oyen LPA. Eds.; PROTA Foundation: Wageningen, Netherlands. 668pp

Ruel MT, Levin CE. 2001. Assessing the potential for food-based strategies to reduce vitamin A and iron deficiencies: A review of recent evidence. Food Consumption and Nutrition Division Discussion Paper no 92. International Food Policy Research Institute, Washington DC, 2000. See also Food Nutr Bull 22: 94-95.

Talukder A, Haselow N, Osei A, Village E, Reario D, Kroeun H, SokHoing L, Uddin A, Dhungel S, Quinn V. 2010. Homestead food production model contributes to improved household food security and nutrition status of young children and women in poor populations: Lessons learned from scaling up programs in Asia (Bangladesh, Cambodia, Nepal, Philippines). Field Action Science Reports, factsreports.org

The Mother and Child Health and Education Trust. 2011. Impact of Malnutrition. http://motherchildnutrition.org/malnutrition/about-malnutrition/impact-of-malnutrition.html (accessed 12 December 2011)

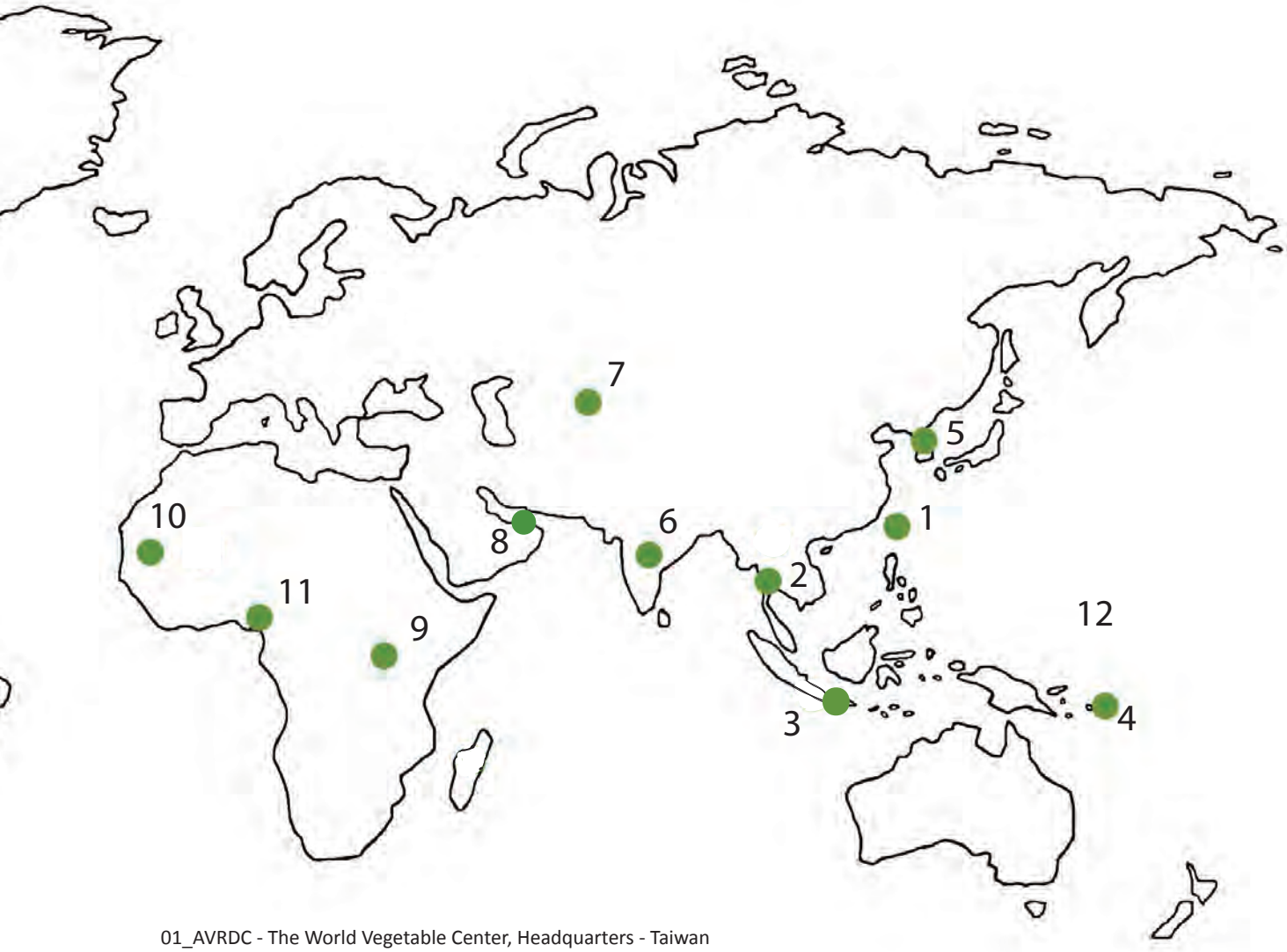
WHO. 2009. Women's health Fact sheet N°334 http://www.who.int/mediacentre/factsheets/fs334/en/index.html (accessed 4 December 2011)

Yang R-y, Keding GB. 2009. Nutritional contributions of important African Indigenous Vegetables. In: Shackleton CM, Pasquini M, Drescher AW (Eds.). African Indigenous Vegetables in urban agriculture. Earthscan. Virginia, USA. Pp. 105-143.

Offices


AVRDC - The World Vegetable Center


AVRDC
The World Vegetable Center
Regional Center for South Asia(RCSA)



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 - Honiara, Solomon Islands
05_Korean Sub-Center - Suwon, Republic of Korea
06_South Asia (SA) - Hyderabad, India
07_Office for Central Asia and the Caucasus - Tashkent, Uzbekistan
08_Central and West Asia and North Africa (CWANA) - Dubai, UAE
09_Regional Center for Africa (RCA) - Arusha, Tanzania
10_Sub-regional Office for West and Central Africa - Bamako, Mali
11_Project Office - Yaoundé, Cameroon
12_Oceania (through Headquarters, Taiwan)

Strategic Organization

Founded in 1971, AVRDC – The World Vegetable Center started as the Asian Vegetable Research and Development with a mandate to support vegetable research and development in Asia, focusing more on Southeast Asia. As AVRDC gained expertise and capacity, it began an expansion of its work beyond Asia and in 2008 formally adopted the name AVRDC – The World Vegetable Center to reflect its geographical scope.

The Center's headquarters is located in Shanhua, Taiwan. Currently, the Center is physically present in Asia, Africa and Oceania, with four regional offices in Bangkok, Thailand (for East and Southeast Asia), Arusha, Tanzania and Bamako, Mali (Regional Center for Africa), Hyderabad, India (South Asia) and Dubai, United Arab Emirates (Central and West Asia and North Africa). Additional offices and staff members are located in Bangladesh, Cameroon, Fiji, Indonesia, and Uzbekistan. The Center's work in Oceania is coordinated by headquarters through the Center's office in Fiji.

The Center's research and development activity is structured under four broad themes that work integrally as a matrix with the regional centers and headquarters. The themes represent aspects of the whole vegetable value chain: germplasm collection to conserve biodiversity and ensure seed availability; breeding for improved quality of crops; improved production techniques for higher and better quality yields; promotion of better postharvest management, value addition and marketing; and finally, consumption for better nutrition.

Theme 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.

Theme 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.

Theme 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.

Theme Consumption

Balanced diet through increased access to and utilization of nutritious vegetables

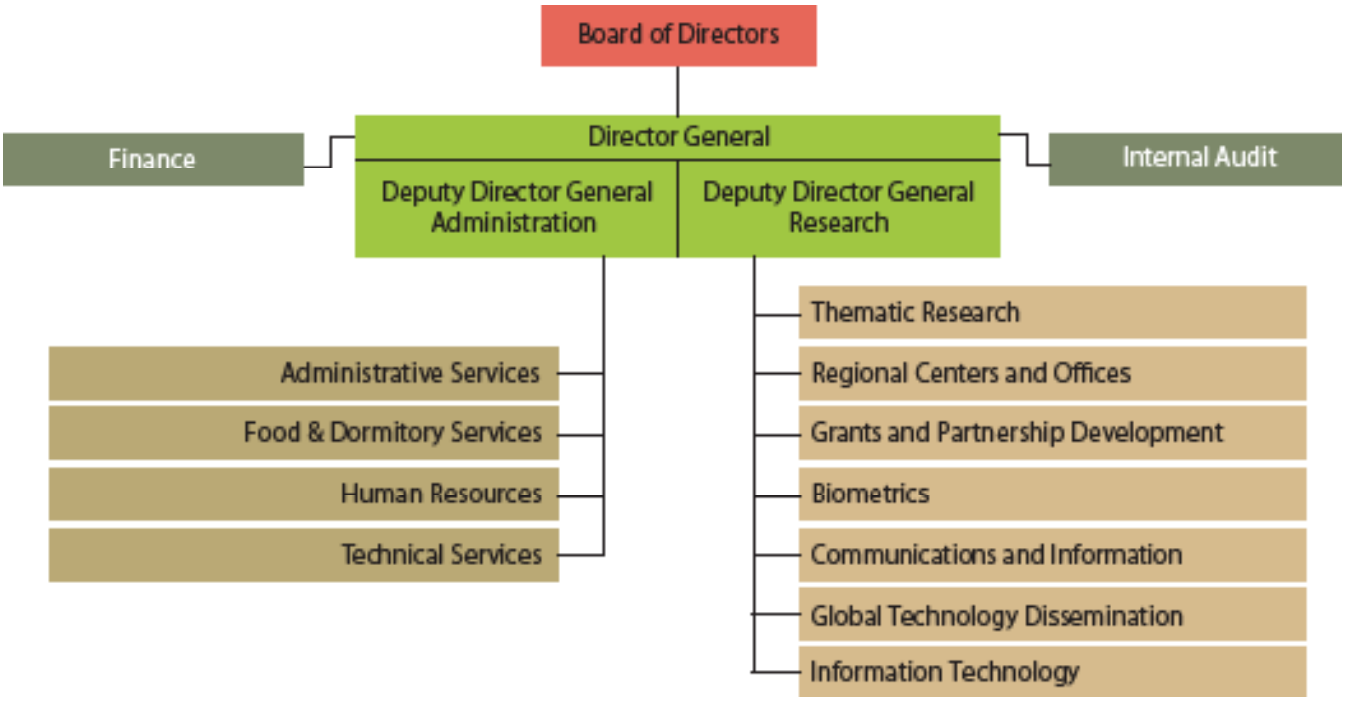
Goal: Consumer health improved by increased consumption of nutritious vegetables for a balanced diet.
Purpose: Increased public awareness, accessibility and utilization of nutritious and diverse vegetables.

Each theme conducts basic and applied research activities. The results are used to formulate development components to generate positive outcomes and impacts as the objective.

Partnering with many public and private sector institutions, the Center's work involves laboratories and greenhouse studies, field trials at multiple locations around the globe, participatory research and development work with national agricultural research and extension systems, the private sector, nongovernmental organizations, women's groups, and farmers' organizations, with a strong focus on capacity building, promotional and advocacy activities. The Center's Global Technology Dissemination group mobilizes AVRDC's research and development to ensure widespread awareness and adoption of improved vegetable technologies. ♦

Structure

The organizational structure of AVRDC – The World Vegetable Center serves the needs of a decentralized institution. Senior management comprises a Director General, a Deputy Director General for Research and a Deputy Director General for Administration and Services. A further level of management consists of a Director of Finance, a Human Resources Director, Global Theme Leaders, and Regional Directors. These senior staff members participate in two institutional committees to address the Center's practical, pertinent elements of conduct: the Institutional Management Committee (chaired by the Director General) and the Institutional Research and Development Committee (chaired by the Deputy Director General – Research).



(*facing page, right*) The quality of a family's diet is likely to improve when women are empowered to produce and market vegetables.

Our Global Focus

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

Established in 1992, the Regional Center for Africa (RCA) based in Arusha, Tanzania currently has staff based in Tanzania, Mali, and Cameroon. The Center operates in these countries through Memoranda of Understanding (MOUs) that provide various levels of immunities and/or tax exemptions in each host country. The Regional Center contributes to AVRDC's global agenda in developing improved varieties and better seed delivery systems, promoting the efficient use of labor, land, and water in low-input production systems, reducing pesticide use and other production hazards, reducing postharvest losses, and increasing consumption of nutritious vegetables.

In 2012, the Regional Center will commemorate 20 years of presence in sub-Saharan Africa. The single most important measure of our success would be the extent to which stronger capacity for vegetable research and development will have been achieved as a result of the Center's work.

Therefore, we will seek to invigorate network support mechanisms as the most desirable and most cost-efficient approach to vegetable research and development in the region, in pursuing core activities on improved varieties and seed systems, good agricultural practices for increased nutrition and income, supportive policies, and capacity building through short- to medium-duration group training modules. In line with the international material transfer agreements, we will seek to obtain 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. Likewise, safety duplication of the accessions and improved lines will be completed.

In 2013, we will aim to conclude realignment with major geopolitical research and development domains and increase operational efficiency by splitting the Regional Center for Africa into two regional offices: one for Eastern and Southern Africa (based in Tanzania) and another for West and Central Africa (based in Mali).

In light of the increased devolvement of national research and development prioritization and coordination to sub-regional organizations such as the West and Central African Council for Agricultural Research and Development (CORAF/WECARD) and the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), the Center will pursue a gradual shift towards sub-regionally focused partnerships. The Regional Center will consolidate relationships with entities with regional or international scope/mandates, such as the Alliance for a Green Revolution in Africa (AGRA) (joint training activities, support of AVRDC in African Centre for Crop Improvement/West Africa Centre For Crop Improvement (ACCI/WACCI) graduate training, with possible placement of students at AVRDC). This shift would facilitate the management of partnerships and provide an active dimension to the partnerships.

In 2014, the new regional offices will invest in sustainable intensification of food crops systems alongside commodity centers. Key priorities will be on enhancing cereal-based systems through crop integration using vegetables. Testing various models of mixed or sequential cropping of vegetable varieties and associated technologies with rice, sorghum and maize will be undertaken in collaboration with AfricaRice, the 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 also be pursued. ♦

AVRDC builds networks across Africa. Seed Marketing Specialist Takemore Chagomoka and Ashu Tambe from the Centre for Assistance to Sustainable Development viewed demonstration plots at Cameroon's National Agricultural Fair.

Central & West Asia and North Africa

AVRDC will conduct research and development activities in the region in 2012 and beyond, and strive to will strengthen international collaboration and ensure extensive training and capacity building along the vegetable value chain.

Research and development activities in the region will include vegetable variety and line adaptive trials, in collaboration with local counterparts in Yemen, Egypt, Qatar, and Oman to identify suitable lines for different regions. Similar adaptive trials will be conducted in Central Asia and the Caucasus (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan).

A two-year workplan for research and development activities will be developed with the Abu Dhabi Food Control Authority (ADFCA) and its Farmers Service Center (FSC) based on our signed agreement. The workplan will address issues including vegetable lines tolerant to salt and drought, vegetable grafting techniques, postharvest techniques, and hydroponics and intensive production systems. In 2014, a workplan for research and development activities with the Farmers' Association of Uzbekistan will be developed to cover vegetable grafting techniques and hydroponics and intensive production systems.

We hope to begin research and development activities related to the project "Innovative protected agriculture to produce high-quality nutritious vegetables in Qatar"; this project has been submitted as an Exceptional Proposal to the Qatar National Research Fund (QNRF) and is awaiting final approval. This is a joint project between AVRDC, ICARDA, Qatar University, and the Al Sulaiteen Agriculture and Industrial Complex (SAIC). Research and development activities related to three biotechnology projects in Qatar have been submitted to QNRF and are pending final approval from the donor. The activities will be joint activities between the Qatar Biotechnology Centre and AVRDC.

New partners in the Arabian Peninsula.

To enhance and expand the region's international collaboration, the Memorandum of Understanding between AVRDC and Oman will be finalized and signed. A proposed Memorandum of Agreement to establish an AVRDC Regional Office in Qatar to be hosted by the Ministry of Environment will be pursued.

Training and capacity building will be an important part of the region's activities. Two training courses on vegetable grafting will be conducted in Abu Dhabi and Doha, Qatar in collaboration with ADFCA and the Ministry of the Environment, respectively. A training course on postharvest handling for high value crops is planned in collaboration with the International Center for Agricultural Research in the Dry Areas (ICARDA) at SAIC. Training courses on breeding and modern agrotechnologies in vegetable production have been planned in Tashkent in collaboration with partners, and a workshop on "Integration of Education, Science and Production in Agricultural Colleges" will be held in Bostanlyk, Uzbekistan in collaboration with the CGIAR's Project Facilitation Unit for Central Asia and the Caucasus and the National University of Uzbekistan. A training course on "Access of Women to Scientific Achievements and Innovations" is also planned.

The Fifth Steering Committee Meeting of the Central Asia and the Caucasus Vegetable R&D Network will be held in Tashkent in 2012. Training for farmers on the creation of an innovative Farmers School with the Farmers' Association of Uzbekistan will be held in 2012, as well as Farmers' Field Days in eight Central Asia and the Caucasus countries. ♦

East and Southeast Asia

The year 2012 will see the launch of a three-year EuropeAid funded project "Network for Knowledge Transfer on Sustainable Agricultural Technologies and Improved Market Linkages in South and Southeast Asia (SATNET Asia)," led by the United Nations Centre for Alleviation of Poverty through Sustainable Agriculture (UN-CAPSA). The project aims to support agricultural innovation by strengthening South-South dialogue and intraregional learning on sustainable agriculture technologies and facilitating trade. AVRDC's main role will be to organize in-country technical workshops on specific research-for-development topics and to host selected participants from the partner countries during the International Vegetable Training Course, which will remain a regional priority from 2012 through 2014.

The Gesellschaft für Internationale Zusammenarbeit (GIZ) has approved the 18-month project "Understanding Urban and Peri-urban Vegetable Production and Marketing Systems through GIS-based Community Food Mapping in Greater Bangkok, Thailand" under its Small Grants Scheme. The project, led by the University of Freiburg, Germany, will start in April 2012 and is expected to set the foundation for a possible larger regional project in 2013/2014. Under the GIZ Funding for International Agricultural Research Centres scheme, the project "Beating Begomoviruses: Better livelihoods for farmers in tropical Asia with begomovirus-resistant tomato, hot pepper and mungbean and integrated disease management" will commence in 2012 with a component being implemented through the East and Southeast Asia office.

Home, school, community and disaster-recovery gardens provide a variety of fruits and vegetables throughout the year, thus contributing significantly to nutritious diets for family members and offering opportunities for income generation through the sale of extra produce. Due to the importance of these gardens for the region, an Expert Workshop is planned to be held in 2012/2013 in Bangkok to discuss strategies on how a corresponding project can be conceptualized and sustainably implemented throughout the ASEAN region.

Among other foreseen activities for 2012-2014, East and Southeast Asia intends to strengthen its collaboration with the WorldFish Center, particularly in the area of the Consultative Group on International Agricultural Research (CGIAR) Research Program 1.3 "Harnessing the Development Potential of Aquatic Agricultural Systems for the Poor and Vulnerable." The regional office also will begin preparations for the SEAVEG Regional Symposium, which is scheduled to be held in 2014.♦

South Asia

The main activities will focus completing work on current projects, gaining extra project funding, building networks with partners and regional donors, formalizing our relationships with the Indian and Sri Lankan governments and expanding our regional presence.

A major activity will the final scaling up, evaluation and report for the Sir Ratan Tata Trust-funded project. and building synergies with this project. Efforts will be made to seeking funding to expand the gains made by the United States Agency for International Development (USAID)-funded project in Bangladesh. Work on the Gesellschaft für Internationale Zusammenarbeit (GIZ) bittergourd project will also be maintained.

A project proposal for work on mungbean has been submitted to the Bill & Melinda Gates Foundation and others will be developed for Australian and Canadian funding for work across Asia and Africa that will likely involve developing new mungbean lines.

Collaboration will expand to more countries in the region and with other CGIAR centers. In the first quarter of 2012 two Swedish interns will work on a joint project between the International Water Management Institute (IWMI) and AVRDC on urban home gardening in Hyderabad. Discussions have been held in Sri Lanka to expand this collaboration to joint appointments and more common project work. Meetings with three government ministries there revealed considerable interest in joint work; this will hinge on finalization of the Memorandum of Understading with the Sri Lankan government. Expanding collaborative work with the WorldFish Center is also likely, and there are also ongoing discussions about a joint CGIAR-AVRDC project in Pakistan.

Visitors view the East and Southeast Asia Demonstration Garden.

Formalization of our legal status in India looks much more likely in 2012 and this will have far-reaching effects on our ability to develop partnerships with national organizations and to reduce our operating costs. ♦

Oceania

The rate of type 2 diabetes in Oceania is very high by global standards—Nauru has the highest proportion of diabetic people of any country in the world (33%) and Tonga is in the top ten of severely affected nations. The role of vegetables in improving diets and the health of the populations in the region is critical. Anemia, riboflavin deficiency, and calcium deficiency are common nutritional problems in rural and urban areas of many islands, while heart disease, hypertension and other chronic diseases are on the rise. This is due primarily to diets based on carbohydrate-rich staple crops, imported and highly refined foods that are low in fiber and high in fat and sugars, and cheap canned meat.

Although traditional diets frequently include local vegetables (e.g. greens of taro, yam, and slippery cabbage) and tomatoes, cucumbers and green beans, vegetable production has been insignificant and of low priority in the Pacific nations. The dietary transition to more processed, refined food makes vegetables even scarcer. This has been exacerbated by population growth, urbanization, exporting produce, and selling produce to hotels.

In Fiji, Kiribati, Solomon Islands, Mariana Islands and Papua New Guinea there are some efforts to diversify food production through vegetable cultivation. However, most vegetable production is carried out on a subsistence basis, with a few vegetable species of poor quality. Production is wholly dependent on imported seeds of varieties that often are not adapted to local harsh environmental conditions.

With the termination of the Center's project "Integrated Crop Management Package for Sustainable Smallholder Gardens in Solomon Islands" funded by the Australian Centre for International Agricultural Research (ACIAR) at the end of 2011, the Center has sought resources to continue and expand its impact in the region.

Promoting the nutritional value of vegetables at international conferences.

Two projects have been funded for 2012: "Strengthening integrated crop management research in the Pacific Islands in support of sustainable intensification of high-value crop production" funded by ACIAR, and "Developing an integrated participatory guarantee scheme in the Pacific Islands in support of sustainable production of high-value vegetable crops" supported through the Pacific Agribusinesses Research for Development Initiative (PARDI).

The Center's base for regional operations will move from Honiara, Solomon Islands to an office in Fiji under the auspices of the Secretariat of the Pacific Community (SPC) with the support of the Ministry of Primary Industries, Department of Agriculture. This will allow the Center to extend its network to reach more island nations in the region. Fiji, the Solomon Islands, Samoa, Kiribati, and Tonga will be targeted for specific projects.

The Center will continue to raise funds with the support of partners. This will increase AVRDC's capacity in the region and also strengthen linkages with partners to improve vegetable research and development capacity in the region. This in turn will help improve the nutrition and health of people in the island nations of the Pacific. ♦

Improving vegetable production throughout Oceania can bring greater prosperity and health to island communities.

The Center's Projects

Although relatively small in number, scientists and supporting staff members of AVRDC – The World Vegetable Center have strong multidisciplinary competence and capability to implement research and development projects globally, creating significant impacts to benefit our target beneficiaries in the developing world.

AVRDC – The World Vegetable Center 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 whole 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.

Project Title	Donor Name	Duration
Scaling up farmer-led seed enterprises for sustained productivity and livelihoods in Eastern and Central Africa	Association for Strengthening Agricultural Research in East and Central Africa	2009 - 2012
Bioinformatics for breeding: Data management and cross prediction	Australian Centre for International Agricultural Research, Australia	2012
Strengthening integrated crop management research in the Pacific Islands in support of sustainable intensification of high value-crop production	Australian Centre for International Agricultural Research, Australia	2011 - 2015
Strengthening the Cambodia and Australian vegetable industries through adoption of improved production and postharvest practices	Australian Centre for International Agricultural Research, Australia	2010 - 2012
Vegetable seed kits for immediate rehabilitation of vegetable production and consumption of vulnerable households in Tanzania	Department for International Development, UK	2011 - 2012
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, Germany	2012 - 2014
Enhancing horticultural productivity, incomes and livelihoods through integrated management of aphid pests on vegetables in sub-Saharan Africa	Deutsche Gesellschaft für Internationale Zusammenarbeit, Germany	2011 - 2014
Better bitter gourd: Exploiting bitter gourd (*Momordica charantia* L.) to increase incomes, manage type 2 diabetes, and promote health in developing countries	Deutsche Gesellschaft für Internationale Zusammenarbeit, Germany	2011 - 2014
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, Germany	2010 - 2013
Network for knowledge transfer on sustainable agriculture technologies and improved market linkages in South and Southeast Asia (SATNET Asia)	EuropeAid	2011 - 2014
Regeneration and safeguard of valuable collections of vegetable germplasm held at the AVRDC – The World Vegetable Center	Global Crop Diversity Trust	2008 – 2012

Project Title	Donor Name	Duration
Develop a begomovirus-resistant and early blight tomato varieties that will help farmers increase production and income in South Asia and other parts of the tropics	Indus Seeds, India	2011 - 2013
Screening for development of begomovirus-resistant processing tomato hybrid	Kagome Co. Ltd., Taiwan	2010 – 2013
Screening for breeding of tomato late blight resistance	Known-You Seed Co. Ltd., Taiwan	2009 – 2012
Characterize and map late blight resistance in wild tomato accessions	National Science Council, Taiwan	2010 – 2013
Identification of genetic determinants associated with virulence of *Ralstonia solanacearum* on a resistant tomato variety, Hawaii 7996	National Science Council, Taiwan	2009 – 2012
Variation and diversity of phytochemicals in vegetables affected by different production seasons and cooking methods – a plant metabolomic approach	National Science Council, Taiwan	2010 – 2012
Developing an integrated participatory guarantee scheme in the Pacific Islands in support of sustainable production of high-value vegetable crops	Pacific Agribusiness Research and Development Initiatives, Australia	2011 - 2014
Development of environmental friendly substances to control bacterial wilt and *Phytophthora* late blight of solanaceous crops	Rural Development Administration, South Korea	2010 –2012
Improving vegetable production and consumption for sustainable rural livelihoods in Jharkhand and Punjab, India	Sir Ratan Tata Trust, India	2008 –2013
Value addition of indigenous food crops by low cost sustainable processing: towards poverty reduction, food and nutrition security in sub-Saharan Africa	The Africa-Australia Food Security Initiative	2011 - 2014
Urbanization and its impacts on the use of natural resources in Africa	University of Freiburg, Germany	2009 –2012
Growing vegetables for improved nutrition, empowerment of women and a healthy vegetable value chain in southern Bangladesh	US Agency for International Development, Bangladesh Mission	2011 - 2012
Development of sustainable African indigenous vegetable production and market-chain for smallholder farmers in Kenya and Tanzania	US Agency for International Development, Horticultural Collaborative Research and Support Program	2011 - 2012
Semillas de Esperanza (Seeds of Hope)	US Agency for International Development, Horticultural Collaborative Research and Support Program	2010 - 2013
Mobilizing vegetable genetic resources and technologies to enhance household nutrition, income and livelihoods in Indonesia	US Agency for International Development, Indonesia Mission	2011 –2014
Improving vegetable production and consumption in Mali	US Agency for International Development, Mali Mission	2011 – 2013
Empowering youth through market-oriented vegetable production	US Agency for International Development, Tanzania Mission	2010 -2012

Research and Development Output Targets 2012-2014

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 2012-2014 and serves as a benchmark for monitoring and evaluation. ♦

High in beta-carotene, vitamin C and calcium, the fragrant leaves and stems of Vietnamese coriander (*Polygonum odoratum*) add nutrients and flavor to diets in Southeast Asia.

Theme 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 2012* • 200 accessions collected/acquired at the Center's headquarters • 90 accessions/breeding lines collected/acquired from hubs in sub-Saharan Africa for safety duplication at the Regional Center for Africa *Output Targets 2013* • 200 accessions collected/acquired the Center's headquarters • 90 accessions/breeding lines collected/acquired from hubs in sub-Saharan Africa for safety duplication at the Regional Center for Africa *Output Targets 2014* • 200 accessions collected/acquired the Center's headquarters • 90 accessions/breeding lines collected/acquired from hubs in sub-Saharan Africa for safety duplication at the Regional Center for Africa
Activity 1.2 Maintain effective regeneration of priority vegetable germplasm	*Output Targets 2012* • 1500 accessions regenerated • Production and increase of good quality seed: 10 crops for nutritional seed kit; advanced lines for multilocation and on-farm trials; maintenance of breeder materials *Output Targets 2013* • 900 accessions regenerated • Production and increase of good quality seed: 10 crops for nutritional seed kit; advanced lines for multilocation and on-farm trials; maintenance of breeder materials *Output Targets 2014* • 1500 accessions regenerated

Activity 1.3 Distribute vegetable germplasm accessions and improved lines worldwide	*Output Targets 2012* • 80% of vegetable germplasm requests served • 6000 accessions/breeding lines distributed worldwide to public and private partners *Output Targets 2013* • 80% of vegetable germplasm requests served • 6000 accessions/breeding lines distributed worldwide to public and private partners *Output Targets 2014* • 80% of vegetable germplasm requests served • 6000 accessions/breeding lines distributed worldwide to public and private partners
Activity 1.4 Safety duplicate AVRDC – The World Vegetable Center's germplasm in other genebanks	*Output Targets 2012* • 1500 accessions from the Center's headquarters duplicated at the National Agrobiodiversity Center, Korea and the Svalbard Global Seed Vault, Norway • 200 accessions from Regional Center for Africa duplicated at Center headquarters and the Svalbard Global Seed Vault, Norway *Output Targets 2013* • 750 accessions from Center headquarters duplicated at the National Agrobiodiversity Center, Korea and the Svalbard Global Seed Vault, Norway • 200 accessions from the Regional Center for Africa duplicated at Center headquarters and the Svalbard Global Seed Vault, Norway *Output Targets 2014* • 1500 accessions from Center headquarters duplicated at the National Agrobiodiversity Center, Korea and the Svalbard Global Seed Vault, Norway • 200 accessions from the Regional Center for Africa duplicated at Center headquarters and the 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 2012* • 100% of acquisition and distribution data generated in 2011 entered into the Center's Vegetable Genetic Resources Information System (AVGRIS) and the Regional Center for Africa's database • Characterization and evaluation data of the 2009/2010 regeneration cycle available in AVGRIS and the Regional Center for Africa's database *Output Targets 2013* • 100% of acquisition and distribution data generated in 2012 entered into the Center's AVGRIS and the Regional Center for Africa's database • Characterization and evaluation data of the 2010/2011 regeneration cycle available in AVGRIS and the Regional Center for Africa's database *Output Targets 2014* • 100% of acquisition and distribution data generated in 2013 entered into the Center's AVGRIS and the Regional Center for Africa's database • Characterization and evaluation data of the 2011/2012 regeneration cycle available in AVGRIS and the 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 2012* • All seed shipments from AVRDC - The World Vegetable Center comply with host country regulations *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 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 – The World Vegetable Center and its Regional Centers	*Output Targets 2012* • 1500 accessions characterized based on standard morphological descriptors • Seed of 50 *Cucurbita moschata* and *Momordica charantia* accessions each multiplied and preliminary evaluation completed *Output Targets 2013* • 850 accessions characterized based on standard morphological descriptors • Seed of 50 *C. moschata* and *M. charantia* accessions each multiplied and preliminary evaluation completed *Output Targets 2014* • 1500 accessions characterized based on standard morphological descriptors • Seed of 50 *C. moschata* and *M. charantia* accessions each multiplied and preliminary evaluation completed
Activity 2.2 Conduct molecular characterization, genetic relationship and diversity analysis of germplasm collection	*Output Targets 2012* • Diversity analysis of *Abelmoschus* collection (~400 accessions) accomplished • 100 simple sequence repeat (SSR) markers for *Momordica* assembled
Activity 2.3 Develop, characterize, and validate AVRDC – The World Vegetable Center germplasm core collections	*Output Targets 2012* • *Abelmoschus* core collection initiated at Center headquarters *Output Targets 2013* • *Amaranthus* core collection initiated at the Regional Center for Africa

Activity 2.4 Conduct studies to identify markers and genes linked to important agronomic traits	*Output Targets 2012* • Combined gene expression and quantitative trait loci (QTL) analysis in biparental populations of *Solanum lycopersicum* conducted to identify genes involved in heat tolerance • Association genetics study conducted to identify salt tolerance QTLs in tomato *Output Targets 2013* • QTLs 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 2012* • Tomato and pepper germplasm screened for resistance to *Pepper veinal mottle virus – Taiwan isolate* (potyvirus*)* • Methodology for screening tomato and pepper germplasm for resistance to *Taiwan* isolates of *Tomato spotted wilt virus* and *Capsicum chlorosis virus* (tospoviruses) optimized • Cucurbit germplasm and breeding lines confirmed for resistance to *Squash leaf curl Philippine virus – Taiwan isolate* (begomovirus) *Output Targets 2013* • Tomato and pepper germplasm screened for resistance to Taiwan isolates of *Tomato spotted wilt virus* and *Capsicum chlorosis virus* (tospoviruses) • Inheritance of resistance to *Cucumber mosaic virus* from *Solanum habrochaites* (LA1033) determined • Method for screening leguminous germplasm for resistance to *Bean common mosaic virus* developed and host range of the virus assessed *Output Targets 2014* • Tomato and pepper germplasm screened for resistance to Taiwan isolates of *Tomato spotted wilt virus* and *Capsicum chlorosis virus* (tospoviruses) • Inheritance of resistance to *Squash leaf curl Philippine virus* (begomovirus) in *Cucurbita moschata* determined • Method for screening *Capsicum* germplasm for resistance to *Pepper mottle virus* (potyvirus) developed and host range of the virus assessed

Activity 3.2 Identify and characterize sources of resistance to fungal and bacterial diseases	*Output Targets 2012* • Pepper accessions screened for resistance to anthracnose and *Phytophthora* blight • Tomato accessions screened for late blight resistance • Cucurbit accessions screened for powdery mildew resistance *Output Targets 2013* • Pepper accessions screened for resistance to anthracnose • Tomato accessions screened for late blight resistance Cucurbit accessions screened for powdery mildew and downy mildew resistance *Output Targets 2014* • Pepper accessions screened for resistance to anthracnose • Tomato accessions screened for late blight resistance • Cucurbit accessions screened for powdery mildew and downy mildew resistance
Activity 3.3 Identify and characterize sources of resistance to insect pests	*Output Targets 2012* • Bases of resistance to striped flea beetle in selected radish accessions characterized • Okra accessions screened for their resistance to aphids • Bitter gourd accessions screened for resistance to melon fly *Output Targets 2013* • Mechanisms and bases of resistance to aphids in selected okra accessions, and to sucking insects and broad mites in selected pepper accessions characterized • Onion accessions screened for resistance to thrips *Output Targets 2014* • Mechanisms and bases of resistance to thrips in selected onion accessions characterized • Pumpkin accessions screened for resistance to aphids • Tomato accessions screened for resistance to thrips
Activity 3.4 Identify and characterize sources of tolerance to drought, heat, flooding and salinity stress	*Output Targets 2013* • Molecular markers for heat tolerance developed and validated

Activity 3.5 Evaluate vegetable germplasm for selected nutrition-related compounds	*Output Targets 2012* • Liquid chromatography - mass spectrometry (LC-MS) profiles of non-targeted phytochemicals of commonly consumed vegetables determined • Profile and content variation of anti-diabetic compounds of promising bitter gourd germplasm determined • Analytical protocol finalized and alkaloid content in *Solanum* vegetables quantified *Output Targets 2013* • Metabolome databases of commonly consumed vegetables developed • Profile and content variation of anti-diabetic compounds of promising bitter gourd germplasm determined *Output Targets 2014* Nutritional and functional values measured for vegetable species/ accessions which have not been evaluated and included in the nutrient database
Output 4: Specialized genetic materials, molecular tools, and methods made available to enable the development of new varieties more rapidly **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 QTLs for resistance to biotic stresses	*Output Targets 2012* • Tomato genes associated with resistance to late blight mapped *Output Targets 2013* • Begomovirus resistance identified in *Capsicum* • Double-haploid technology for rapid production of mapping populations in solanaceous crops developed *Output Targets 2014* Begomovirus resistance identified in mungbean
Activity 4.2 Develop mapping populations and identify QTLs for tolerance to abiotic stresses	*Output Targets 2012* • Population development initiated for mapping of tomato genes associated with heat tolerance *Output Targets 2013* • Population development completed for mapping of tomato genes associated with heat tolerance

Activity 4.3 Conduct fine mapping of QTLs and develop markers for marker-assisted selection (MAS)	*Output Targets 2012* • Determine presence of *Bwr*-12 on various resistance sources • Develop gene-based marker of *Bwr*-12 *Output Targets 2013* • Fine-map *Bwr*-6 region by developing near-isogenic lines *Output Targets 2014* • Evaluate durability of QTLs
Activity 4.4 Assemble and develop molecular marker sets for priority vegetable crops	*Output Targets 2012* • 100 new polymorphic SSRs for *Momordica* and mungbean developed/ assembled • 1000 markers for pepper developed/assembled *Output Targets 2013* • A set of suitable markers developed for Bulked Segregant Analysis in *C. moschata*
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 2014* • Allelic variation between heat susceptible and tolerant tomato determined • Allelic variation between salt susceptible and tolerant tomato determined
Activity 5.2 Characterize and validate candidate genes for heat and salt tolerance	*Output Targets 2014* • Introduction of QTLs into different backgrounds and validation in different environments
Activity 5.3 Evaluate gene function and efficacy through genetic engineering	*Output Targets 2012* • Transformation of RNAi constructs covering multiple viral strains for non-strain specific resistance to *Tomato yellow leaf curl virus* *Output Targets 2013* • Evaluation of *Tomato yellow leaf curl virus* reaction in the R_2-R_3 generation *Output Targets 2014* • 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 2012* • 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 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 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 2012* • Training on germplasm conservation and management conducted • Training on use of molecular tools for biodiversity analysis and germplasm evaluation conducted *Output Targets 2013* • Training on germplasm conservation and management conducted • Training on use of molecular tools for biodiversity analysis and germplasm evaluation conducted *Output Targets 2014* • Training on germplasm conservation and management conducted • Training on use of molecular tools for biodiversity analysis and germplasm evaluation conducted

A field trial of African eggplant captures the attention of vegetable producers during a Farmers' Day in the Dogon villages of Anakanda and Bandiagara, Mali. Field days offer opportunities for information exchange and education.

Theme 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 2012* •5-10 fresh market tomato lines with *Ty*-3 and multiple late blight resistance (*Ph*-2+*Ph*-3) evaluated in replicated yield trial, and seed multiplied for international distribution •Utility of markers associated with *Bwr*-12 confirmed *Output Targets 2013* •F7 fresh market/dual purpose lines with begomovirus resistance genes *Ty*-5 or *Ty*-3a and bacterial wilt, early blight and good horticultural traits •*Ty*-3 + high carotenoid lines advanced to F_6 •High flavonoid QTL fine-mapped and high flavonoid tomato lines developed *Output Targets 2014* •Marker-assisted selection conducted to combine acylsugar insect resistance and *Ty*-3 begomovirus resistance •Marker-assisted selection to develop lines combining *Ph*-2+*Ph*-3+*Ph*-4 late blight resistance genes
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 2012* •Seeds of 10-15 promising lines increased for multilocation evaluation/ testing and for use in developmental •1-4 advanced lines carrying resistance to two or more diseases developed •Crosses for insect resistance/tolerance (aphids, mites, and/or thrips) to study inheritance developed *Output Targets 2013* •Germplasm systematically screened for begomovirus resistance •1-4 new advanced lines carrying resistance to two or more diseases developed •Seed of 7-12 new lines distributed to project collaborators and 5-10 promising pepper lines increased and maintained for international distribution *Output Targets 2014* •Initial crosses to study inheritance of leaf curl resistance developed using identified resistant and susceptible lines •Seeds of 5-10 promising pepper lines increased for use in development projects and international distribution •Inheritance study on aphid resistance published, 2-3 progenies showing resistance/tolerance released along with their proposed use in integrated pest management

Activity 1.3 Develop heat tolerant tropical sweet pepper	*Output Targets 2012* • Heat tolerance data consolidated and potential for use in marker development and selection methodologies assessed • Candidate hybrid combinations and promising lines evaluated and multiplied *Output Targets 2013* • 5-10 promising heat tolerant pepper lines increased for use in breeding programs, or for direct release after further evaluation • Candidate heat tolerant and sensitive lines used to develop initial crosses to study inheritance and develop mapping populations *Output Targets 2014* • Heat tolerance and disease resistance (e.g. bacterial wilt) combined and progenies selected
Activity 1.4 Develop short-day red onions and yellow onions for improved yield, extended shelf-life, and/or Stemphylium resistance	*Output Targets 2012* • Final seed production of onion lines at the Center's headquarters completed; operations phased out • Selected open pollinated (OP) onion lines evaluated for adaptation in West Africa • Seed increase of 10-20 open pollinated lines for multilocation trials in West/East Africa and bulk seed production of uniform varieties *Output Targets 2013* • Seeds of local selected varieties produced for regional and international trials • Mother bulbs of AVRDC elite lines reselected for multilocation trials in West/East Africa • Regional allium network established and multilocation trials conducted *Output Targets 2014* • Multilocation trial conducted in West and East Africa or other regions of 5-10 best local populations and 3-5 AVRDC open pollinated lines • Mother bulbs of local selected varieties and AVRDC elite lines produced for regional and international trials

Activity 1.5 Develop and distribute heat-tolerant broccoli and Chinese cabbage varieties	*Output Targets 2012* • Evaluate 60 new broccoli hybrids, multiply seed of promising hybrids, and, identify promising parental lines • Test 20 new Chinese cabbage hybrids, multiply seed of promising hybrids and identify promising parental lines *Output Targets 2013* • Test new broccoli hybrid combinations and promising lines evaluated and multiplied • Test new Chinese cabbage hybrid combinations 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 2012* • Seed multiplication and distribution of 10-15 basmati and super-nodulating vegetable soybean lines • BC3 populations evaluated for methionine content, additional backcrosses carried out, and molecular markers associated with the high methionine trait developed • Database developed for legume breeding lines using Agrobase and ICIS *Output Targets 2013* • 10-15 vegetable soybean lines promoted in South Asia and sub-Saharan Africa • Iimproved mungbean lines for methionine content tested by HPLC • Markers for *Mungbean yellow mosaic virus* resistance in mungbean developed • 10 elite mungbean lines promoted in sub-Saharan Africa *Output Targets 2014* • Vegetable soybean lines promoted in South Asia and sub-Saharan Africa • ungbean lines with resistance to *Mungbean yellow mosaic virus* developed • Bruchid resistant mungbean lines developed using resistant mungbean accessions V2709 and V2802

Activity 1.7 Develop cucumber lines for improved horticultural traits, disease resistance, good fruit quality, and high gynoecy	*Output Targets 2012* • 60-80 F_7 lines of bitter-free and high gynoecy South and Southeast Asian types evaluated • 20-40 F_6 lines of bitter free and high gynoecy South and Southeast Asian type evaluated and advanced *Output Target 2013* • 10-15 F_7 entries evaluated in a replicated trial and characterized for key horticultural traits and disease resistance • 20-30 hybrid combinations of South and Southeast Asian types evaluated in targeted countries along with 5-8 improved inbreds *Output Target 2014* • Seed increase and international distribution of 3-5 F_7 cucumber lines identified from the 2013 replicated trial
Activity 1.8 Develop disease resistant and high quality pumpkins (*Cucurbita moschata*)	*Output Targets 2012* • 20-35 F_6 lines for yield, fruit quality and field resistance to diseases evaluated and advanced • *Zucchini yellow mosaic virus* (ZYMV) resistant *C. moschata* BC_6S_1 populations evaluated and advanced • 20-30 F_3 and 30-40 F_4 families derived from elite hybrids evaluated and advanced *Output Targets 2013* • 15-20 F_7 entries evaluated in replicated trials and characterized for key horticultural traits and nutritional components and field resistance to diseases • BC_6S_1 local papaya used as ZYMV resistant *C. moschata* donor parent and crossed to varieties representing three market types (China, Southeast Asia, India) to develop 15-20 F_1s, for evaluation in target countries. *Output Targets 2014* • Multilocation trial of 8-10 F_8 lines conducted • ZYMV-resistant *C. moschata* BC_6S_1 populations evaluated
Activity 1.9 Develop bitter gourds possessing improved yield, earliness, good fruit quality and resistance to diseases/insects	*Output Targets 2012* • 60 F_4 and 40-50 F_5 families derived from elite hybrids evaluated and advanced • Multilocation trials of elite bitter gourd germplasm and commercial lines conducted to evaluate the effects of environment, ripening stage, local postharvest management on level of nutrients and anti-diabetic compounds *Output Targets 2013* • 20-30 F_6 lines derived from elite hybrids evaluated and advanced; a set of 15-20 F_7 lines evaluated in replicated trial • Multilocation trial of elite bitter gourd germplasm and commercial lines investigated to evaluate the effects of environment, ripening stage, local postharvest management on level of nutrients and anti-diabetic compounds *Output Targets 2014* • Multilocation trials of selective F_7 lines conducted

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 2012* • Promising lines of African eggplant, African nightshade and amaranth evaluated for horticultural traits and organoleptic/nutritional qualities *Output Targets 2013* • Promising lines of African eggplant and amaranth evaluated for horticultural traits and organoleptic/nutritional qualities *Output Targets 2014* • Promising lines of African eggplant and amaranth evaluated for horticultural traits and organoleptic/nutritional qualities
Activity 2.2 Evaluation, seed multiplication, and distribution of elite indigenous vegetables	*Output Targets 2012* • 5-10 elite lines of amaranth, roselle, jute mallow, kangkong, basella, Malabar spinach, and spider plant evaluated for horticultural, nutritional and anti-nutritional traits, and seed of selected lines/accessions increased for international distribution *Output Targets 2013* • Elite indigenous vegetables evaluated for horticultural, nutritional and anti-nutritional traits and seed of selected lines/accessions increased for international distribution *Output Targets 2014* • Selected elite indigenous vegetables lines/accessions increased for international distribution
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) availability of traits critical 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 2012* • Global distribution and testing of AVRDC chili pepper, sweet pepper, tomato, leafy crucifer and other AVRDC-developed lines continued *Output Targets 2013* • Global distribution and testing of AVRDC chili pepper, sweet pepper, tomato, vegetable soybean, mungbean and other AVRDC-developed lines conducted

Activity 3.2 Analyze and review of multi-environment testing of AVRDC-improved germplasm	*Output Targets 2012* • Results of multi-location testing of tomato, sweet pepper, chili lines in Central America analyzed and implications for breeding assessed • Vegetable variety trials and implications for breeding and variety release analyzed and summarized *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
Activity 3.3 Develop on-line seed catalog to facilitate seed requests for AVRDC-improved vegetables	*Output Targets 2012* • On-line seed catalogs for tomato, pepper, and soybean updated • On-line seed catalogs for root stocks, Chinese cabbage, leafy *Brassica*, selected indigenous vegetables developed *Output Targets 2013* • On-line seed catalogs for tomato, pepper, soybean, root stocks, Chinese cabbage, leafy *Brassica*, indigenous vegetables and onion updated • On-line seed catalog for cucumber developed *Output Targets 2014* • On-line seed catalogs for tomato, pepper, soybean, root stocks, Chinese cabbage, leafy *Brassica*, indigenous vegetables, onion and cucumber updated • On-line seed catalogs for pumpkin developed
Activity 3.4 Monitor and assess variety release, commercialization and adoption of AVRDC-bred lines	*Output Targets 2012* • Commercialization of newly developed AVRDC varieties by seed companies in Tanzania, Cameroon, Mali and neighboring countries monitored • Release and seed production of AVRDC lines monitored in Central Asia and Caucasus *Output Targets 2013* • Commercialization of newly developed AVRDC varieties by seed companies in Tanzania, Cameroon, Mali and neighboring countries monitored *Output Targets 2014* Commercialization of newly developed AVRDC varieties by seed companies in Tanzania, Cameroon, Mali and neighboring countries monitored

Activity 3.5 Use male sterility to improve the efficiency of hybrid vegetable seed production	*Output Targets 2012* • Establish Cytoplasmic Male Sterility (CMS) and maintainer versions of 'Jupiter' sweet pepper • CMS versions of additional elite chili and sweet lines developed *Output Targets 2013* • Molecular markers for CMS cytoplasm and nuclear factors utilized in backcrossing activities • CMS versions of additional elite chili and sweet lines developed • Advanced CMS-'hot-restorers' evaluated for efficacy in sweet pepper hybrid combination strategies *Output Targets 2014* • Design and implement impact assessment of AVRDC CMS pepper lines in improving access to improved varieties.

AVRDC's disease resistant chili pepper lines can improve yields for farmers in Indonesia.

Recognizing pests is the first step in finding safe and effective methods to control them. The Center's integrated pest management strategies help farmers in the Solomon Islands and elsewhere protect their crops.

Theme PRODUCTION: Safer 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 2012* • Species identity and phylogenetic relationship of the genus *Maruca* occurring on vegetable legumes in South Asia, Southeast Asia and sub-Saharan Africa established • Association of molecular variations in the *Maruca* populations with host plants and geographical origins in South Asia, Southeast Asia and sub-Saharan Africa determined • Phylogenetic relationship of eggplant fruit and shoot borer in Southeast Asia and South Asia established *Output Targets 2013* • Most common species of aphids associated with okra (*Abelmoschus* spp.) catalogued • Whitefly species/cryptic species/biotypes associated with major vegetables and food legumes in South Asia, Southeast Asia and West Asia characterized *Output Targets 2014* • Most common species of thrips vectors associated with tospovirus hotspots in South Asia and Southeast Asia catalogued

Activity 1.2 Develop integrated pest management technologies for major insect pests	*Output Targets 2012* • Parasitism of major parasitoids (*Therophilus marucae* and *Phanerotoma philippinensis*) on legume pod borer determined • Most effective sex pheromone blends against legume pod borer in South Asia, Southeast Asia and sub-Saharan Africa identified • Trap crop strategy for fruit worm (*Helicoverpa armigera*) on tomato validated *Output Targets 2013* • Integrated pest management strategy based on sex pheromone, biopesticides and parasitoids for legume pod borer validated in South Asia, Southeast Asia and sub-Saharan Africa • Efficacy of an integrated pest management strategy to manage aphids on okra determined in West Africa • Epidemiology of thrips vectors transmitting tospoviruses in vegetable cropping systems established *Output Targets 2014* • Integrated pest management strategy based on healthy seedling production, biopesticides and sticky traps for whitefly vectors and tomato leaf miner validated in South Asia, Southeast Asia and West Asia • Efficacy of integrated pest management practices to manage aphids, diamondback moth and striped flea beetle on vegetable brassicas determined in Southeast Asia and sub-Saharan Africa • Integrated pest management strategy for thrips vectors transmitting tospoviruses and spider mite developed
Activity 1.3 Diagnose and characterize major bacterial and fungal pathogens	*Output Targets 2012* • Usefulness of molecular markers associated with virulence of phylotype I strains of *Ralstonia solanacearum* on tomato in strain profiling determined • Virulence of Phylotype II/biovar 2/race 3 strains of *R. solanacearum* on tomato, eggplant and pepper determined • *Colletotrichum* species associated with chili pepper anthracnose in Indonesia identified *Output Targets 2013* • Survival capacity of Phylotype II/biovar 2/race 3 strains of *R. solanacearum* in lowland tropics determined • *Colletotrichum* species associated with chili pepper anthracnose in Oceania identified • Pathotypes of cucurbit downy mildew in Taiwan identified *Output Targets 2014* • Protocol for determining pathotypes of cucurbit powdery mildew developed

Activity 1.4 Develop and validate integrated disease management technologies for major bacterial and fungal diseases	*Output Targets 2012* • Control efficacy of phosphoric acid salt on tomato foliar diseases evaluated • Control efficacy of plant activator and tolerant variety on tomato late blight evaluated • Effect of biochar as an amendment in potting mixture on plant growth and induced resistance in tomato evaluated *Output Targets 2013* • Control efficacy of plant activators on pepper foliar diseases evaluated • Effect of biochar as an amendment in potting mixture on plant growth and induced resistance in pepper evaluated *Output Targets 2014* • Control efficacy of plant activators on tomato and pepper diseases validated in Fiji and other countries • Effect of biochar as an amendment in potting mixture on plant growth and induced resistance in tomato and pepper validated
Activity 1.5 Detect, characterize and explore integrated management strategies for major viral diseases	*Output Targets 2012* • The important viruses, especially begomoviruses, infecting or emerging in vegetable crops in Asia and Africa identified and monitored • Genetic diversity of cucurbit-infecting begomoviruses in Taiwan studied • An infectious clone of a cucurbit-infecting begomovirus from Taiwan developed *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 the Philippines 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 studied • An infectious clone of a cucurbit-infecting begomovirus from the Philippines 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 2012

- Simple, quick testing kits for determining pH, nitrate-N, P and K in soils validated
- General guidelines of simple soil health assessment suitable for smallholder vegetable production developed
- Effects of biochar application on soil nutrient retention determined

Output Targets 2013

- Guidelines of simple soil health assessment suitable for smallholder vegetable production in Oceania developed
- Components of biochar briquette and its effects in soil studied
- Long-term trials to determine the benefits of balanced fertilization designed and started in Oceania

Output Targets 2014

- Guidelines for simple soil health assessment suitable for smallholder vegetable production in Oceania developed
- Effects of biochar briquette on selected vegetables evaluated
- Long-term trials to determine the benefits of balanced fertilization 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 2012

- A checklist on how to effectively implement technology dissemination projects published
- Participatory appraisals of vegetable farming conducted in targeted countries, and dissemination strategies determined for integrated crop management technologies
- Major insect and mite pests on selected vegetables in West Asia identified

Output Targets 2013

- Participatory appraisals of vegetable farming conducted in targeted countries, and dissemination strategies determined for integrated crop management technologies
- Major insect and mite pests on mungbean and vegetable soybean in humid-tropics and semi-arid areas of South Asia identified

Output Targets 2014

- Participatory appraisals of vegetable farming conducted in targeted countries, and dissemination strategies determined for integrated crop management technologies
- Major insect and mite pests on indigenous vegetables (African eggplant, African nightshade, amaranth, Ethiopian mustard, spider plant and okra) in sub-Saharan Africa identified

Activity 3.2 Adapt integrated production technologies for targeted systems or regions	*Output Targets 2012* • Integrated pest management packages and improved vegetable production technologies (e.g. composting, balanced fertilization and crop rotations) for target crops under open-field and net house production systems in India adopted • Integrated crop management technologies for tomato and pepper (e.g. balanced fertilization, starter solution technology and soil management) adapted in Indonesia • Integrated crop management technologies (e.g. insect exclusion net, drip irrigation etc.) evaluated and adapted in year-round vegetable production systems in Oceania *Output Targets 2013* • Integrated pest management packages for target crops in Bangladesh validated • Integrated crop management technologies (e.g. insect exclusion net, drip irrigation etc.) evaluated and adapted in year-round vegetable production systems in Oceania • Integrated crop management technologies for tomato and pepper (e.g. balanced fertilization, starter solution technology and soil management) adapted in Indonesia *Output Targets 2014* • Integrated pest management packages for mungbean and vegetable soybean in humid-tropics and semi arid areas of South Asia validated • Integrated crop management technologies (e.g. insect exclusion net, drip irrigation etc.) evaluated and adapted in year-round vegetable production systems in Oceania • Integrated crop management technologies allowing vegetable producers to meet market demands validated in Oceania through the arrangement of a participatory guarantee system
Activity 3.3 Strengthen capacity of local partners and farmers to promote technology adoption	*Output Targets 2012* • Extension and training materials published on various vegetable production technologies • Key vegetable production skills of farmers that need to be strengthened in Oceania identified • Four issues of *Feedback from the Field* published and mature technologies database updated *Output Targets 2013* • Extension and training materials published on various vegetable production technologies • Capacity of vegetable farmers in Indonesia strengthened through Farmer Field Schools • 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 vegetable farmers in Indonesia strengthened through Farmer Field Schools • Adoption of best practice technologies, based on key constraint analysis outcomes, enhanced by training activities in Oceania

Activity 3.4 Understand farmers' behavior, cost-benefit, and constraints/ opportunities of technology adoption	*Output Targets 2012* • Socioeconomic factors affecting bitter gourd production in selected regions of India analyzed • Socioeconomic factors affecting net house-based vegetable farming in India analyzed • Socioeconomic analysis of vegetable production practices in Indonesia analyzed and documented *Output Targets 2013* • Socioeconomic factors affecting disease management practices in legume and chili in India analyzed and documented • Economic costs and benefits of integrated crop management technologies in Indonesia and Oceania analyzed and documented • Economic value of the major non-marketed goods and services of integrated pest management at the farmer's level in parts of South Asia analyzed *Output Targets 2014* • Socioeconomic factors affecting current pesticide uses and disease management practices on chili and mungbean in India, Vietnam, and Thailand analyzed and documented • Socioeconomic characteristics of demonstration sites for promoting integrated crop management technologies in Oceania analyzed • Adoption and impacts of IPM practices on selected crops in Thailand and Vietnam analyzed
Activity 3.5 Understand the impact of improved technologies on production systems and livelihoods	*Output Targets 2012* • Baseline survey on extent of uses, production and consumption levels of amaranth in Tanzania conducted and documented • Baseline status of current vegetable variety use and source of planting material of target crops in Bangladesh analyzed and documented *Output Targets 2013* • Economic value, policy implications and social impacts of eggplant IPM practices in South Asia analyzed • Impacts of adoption of improved vegetable production technologies in India and Oceania analyzed and findings documented • Ex-ante field validation studies of bitter gourd production and consumption in managing type 2 diabetes in Tanzania and India conducted and results documented *Output Targets 2014* • Ex-ante impacts and benefits of production and consumption of bitter gourd in managing type 2 diabetes analyzed and results documented and disseminated • Adoption of pest management practices in Oceania evaluated • Ex-post impacts of Farmer Field Schools implemented in Aceh, Indonesia in 2009 analyzed and documented

Theme CONSUMPTION: Balanced diet 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 and development practitioners 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 2012

- Baseline surveys and data collection conducted to assess knowledge on vegetable consumption, consumer attitude and preferences, and the nutritional and socio-economic outcomes of vegetable consumption
- Participatory impact pathway appraisal framework for vegetables in improving incomes, nutrition and health in Bangladesh developed
- Comprehensive database on food and nutritional security of urban and peri-urban communities of selected project sites in Greater Bangkok identified

Output Targets 2013

- Ex-ante analysis of production and consumption of bitter gourd for managing type 2 diabetes conducted
- Validated on-farm coping practices and strategies for low-input and limited land and water resource use for enhanced vegetable production and consumption in Mali promoted and disseminated
- Interactive GIS-based platform established for data exchange and visualization of local perspectives and views of urban and periurban vegetable production, consumption and marketing in Greater Bangkok, Thailand

Output Targets 2014

- Midterm monitoring conducted for nutritional and socioeconomic impact of home gardening practices among community rural and urban members in Mali
- Baseline survey conducted on the perceptions, production, and consumption of organic vegetables for healthy and balanced diets, nutritional security, and income of households in rural and urban areas of Mali
- Outcomes of vegetable consumption promotion in south Bangladesh on targeted consumers' knowledge, attitude and behavior change evaluated

Activity 1.2 Study nutritional and functional values and benefits of vegetables from sub-Saharan Africa and Asia	*Output Targets 2012* • Nutritional values of vegetables commonly consumed in Mali evaluated • Information on anti-and pro-inflammation properties of selected indigenous vegetables published and potential food intervention approach identified to enhance immune function • Anti-diabetic activities and compounds in bitter gourd evaluated, accessions high in anti-diabetic activity selected for efficacy studies, and optimal preparation method and dosage investigated for using bitter gourd in diabetes management in an animal model *Output Targets 2013* • Anti-hyperglycemic effect of bitter gourd validated in insulin-resistant patients in India and Tanzania assessed • Phytochemical database and liquid chromatography–mass spectrometry (LC-MS) fingerprints of common vegetables established • Stability and retention of Glu-Met dipeptide in mungbean-blackgram hybrids as affected by food preparation methods evaluated • Nutritional values of local vegetables in Bangladesh evaluated *Output Targets 2014* • Nutritional values of indigenous vegetables from Oceania evaluated • Digestibility and amino acid score of high methionine mungbean and the combination of high methionine mungbean and rice in evaluated

Output 2. Dietary strategies and food based intervention packages developed

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 and advocate more nutritionally effective use of vegetables.

Activity 2.1 Develop home, school and community garden packages for poor households in Asia and sub-Saharan Africa for technology adaptation and increased access to vegetables	*Output Targets 2012* • Nutritional seed kits for home, school and community gardens distributed in selected locations of sub-Saharan Africa, Asia and Pacific • Participatory demonstration and pilot projects on vegetable gardens in selected schools and communities in sub-Saharan Africa, Asia and Pacific established • Regional experts' workshop to discuss strategies for establishing home, school and other public facility vegetable gardens in the ASEAN region conducted *Output Targets 2013* • School and community gardens in target locations in Asia and sub-Saharan Africa established and functional • Demand creation and promotion activities for vegetable consumption in Indonesia conducted • Targeted crop diversity enrichment of existing home gardens in Bangladesh implemented *Output Targets 2014* • Demand creation and promotion activities for vegetable consumption in Indonesia conducted • More than 100 school gardens/home gardens in Indonesia established

Activity 2.2 Develop nutritious vegetable seed kits for tropical and sub-Saharan Africa and Asia	*Output Targets 2012* • 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 for publication in sub-Saharan Africa and Asia and disseminated *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 local languages prepared for publication in sub-Saharan Africa, Asia and Pacific and disseminated *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 for publication in sub-Saharan Africa and Asia and disseminated

Activity 2.3 Develop dietary strategies, nutrition-improved recipes and food preparation methods based on traditional diet and food practices for promotion of vegetables and nutrition to household women in Asia and sub-Saharan Africa	*Output Targets 2012* • Nutrition leaflets, posters, booklets and recipes developed, printed and distributed in Punjab and Jharkhand, India and in Mali • Bitter gourd recipes developed based on local preparation methods for promotion in diabetic communities in India, Tanzania, Taiwan and Thailand • Locally adaptable dietary strategies with increased consumption of sweet potato and vegetables developed for poor households in south Bangladesh *Output Targets 2013* • Bitter gourd recipes based on local preparation methods revised and disseminated in target communities in India, Tanzania, Taiwan and Thailand • Dietary intervention approaches and strategies of vegetables developed in Bangladesh, Tanzania, Mali and Cameroon • Innovative multiple communication tools to promote good nutritional practices and increased vegetable consumption of families in rural and urban areas of Mali developed and tested *Output Targets 2014* • Production and postharvest technologies related to nutrient composition of indigenous vegetable varieties studied and evaluated in sub-Saharan Africa and Asia • Nutritional, social marketing strategies developed, demand creation and promotional events for increased vegetable consumption in Bangladesh conducted • Validated innovative multiple communication tools to promote good nutritional practices and increased vegetable consumption of families in rural and urban areas of Mali disseminated

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

Outcome: Small-scale farmers and other value chain actors in Africa, Asia and the Pacific benefitted 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 and marketing systems of vegetables in sub-Saharan Africa, Asia and Pacific

Output Targets 2012

- Marketing systems of bitter gourd in selected locations in India and Tanzania assessed.
- Baseline data on production, post-harvest handling practices and consumption of vegetables in Thailand established and vegetable value chain study conducted in Indonesia
- Feasibility of strengthening existing linkages between vegetable value chain actors through facilitating the setting up of stakeholder forums in Mali assessed

Output Targets 2013

- Baseline data on the production and consumption of fermented vegetables in Cambodia, Laos and Myanmar established and possible cross-country influences with Thailand analyzed
- Markets supply and consumers demands for integrated pest management produce in selected countries of Asia analyzed
- Strengthen existing linkages between vegetable value chain actors in Mali through stakeholder fora complemented by targeted demand-creation activities and educational symposia

Output Targets 2014

- Adoption and consumer demand studies of β-carotene rich tomato in Mali analyzed and documented
- Marketing systems of indigenous vegetables in selected countries in Asia analyzed and documented

Activity 3.2 Facilitate the establishment of enhanced market coordination mechanisms for vegetable supply in sub-Saharan Africa, Asia and Pacific	*Output Targets 2012* • Vegetable marketing systems and consumer demand of high value vegetables in target countries in Oceania analyzed and documented; effective linkages along globally important and indigenous vegetables value chains in Tanzania, Cameroon and Mali enhanced through various demand creation activities • Three enhanced market pilot schemes under the Participatory Guarantee System (PGS) model, tailored to demands of specific market segments, in target countries in Oceania designed for field testing and validation • Rapid assessment of public, private, and civil society contributions to value chain development of selected vegetables for improved nutrition in Bangladesh conducted *Output Targets 2013* • Effective linkages along value chains for globally important and indigenous vegetables from Africa in Tanzania, Mali and Cameroon enhanced through various demand creation activities • Organizational structure to review and adapt existing market standards with stakeholders aimed at promoting farm level self-certification of local vegetable brands in Oceania developed • Market-orientated farm-business management skills to facilitate adoption of business development driven technologies in target countries in Oceania developed and delivered to program beneficiaries *Output Targets 2014* • Effective linkages along value chains for globally important and indigenous vegetables from Africa in Tanzania, Mali and Cameroon enhanced through various demand creation activities • Existing extension training approaches reviewed and strategic options to improve training course curricula with Participatory Guarantee System (PGS), postharvest handling and produce quality management components in target countries in Oceania developed • Impact assessment of training in production, marketing and consumption of vegetables in Mali conducted and lessons shared with vegetable sector stakeholders

Activity 3.3 Develop and enhance training curricula and materials on proper postharvest management and marketing skills for trainers in Asia, sub-Saharan Africa and Pacific	*Output Targets 2012* • International Vegetable Training Course curricula and lecture/ training materials on vegetables, postharvest marketing, and nutrition at AVRDC East and Southeast Asia (ESEA) office reviewed and updated annually • Training materials in marketing and postharvest handling activities adapted for program intervention beneficiaries in Mali developed • Capacity strengthening of National Agricultural Research and Extension Systems (NARES) partners in use of collective action and participatory approaches for vegetable marketing and postharvest handling practices in Bangladesh conducted *Output Targets 2013* • International Vegetable Training Course curricula and lecture/ training materials on vegetables, postharvest marketing, and nutrition at ESEA office reviewed and updated annually • Training materials in marketing and postharvest handling activities adapted and disseminated to program beneficiaries in targeted locations in sub-Saharan Africa, Asia and Oceania • Participatory Guarantee System linked training workshops based on the outcome of key client constraints analysis (including market-orientated farm-business management skills) in Oceania conducted *Output Targets 2014* • International Vegetable Training Course curricula and lecture/ training materials on vegetables, postharvest marketing, and nutrition at ESEA office reviewed and updated annually • Training materials in marketing and postharvest handling activities revised and disseminated to program beneficiaries in targeted locations in sub-Saharan Africa, Asia and Oceania

Activity 3.4 Strengthen postharvest research capacity of national partners through trainings and awareness raising on postharvest loses and post harvest research in national and regional level in Asia, Africa, and Oceania	*Output Targets 2012* • At least 20 participants from Asia trained in vegetable production, postharvest and marketing • Capacities building of NARES program partners in research and training in vegetable postharvest handling and utilization practices for enhanced nutrition in Mali conducted • Postharvest quality and nutritional composition of selected vegetable varieties in Bangladesh analyzed *Output Targets 2013* • At least 25 participants from Asia trained in vegetable production, postharvest and marketing *Output Targets 2014* • At least one policy round table on options and mechanisms for institutionalizing the research component of postharvest handling and utilization practices for enhanced nutrition in NARES programs in Mali conducted and recommendations shared with policy makers

Output 4: Policy recommendations with an aim to increase vegetable consumption developed, capacity strengthened and technology and knowledge disseminated

Outcome: Consumers are aware of the health-promoting benefits of increased utilization of vegetables through better access to nutritional education information, enhanced capacities of national agricultural research and extension systems and non-governmental organizations and improved policy support

Activity 4.1

Conduct training courses and promotion campaigns to increase production, utilization and consumption of nutrient-rich vegetables in Asia, sub-Saharan Africa and Oceania

Output Targets 2012

- Training courses on vegetable home garden production, processing and preservation delivered to farmers, youth, women groups and employees of national agricultural research and extension systems in Asia, Pacific and sub-Saharan Africa
- Consumer awareness of vegetable consumption and nutrition effects on health promoted through various demand creation activities (i.e., field days, seed fairs, national agricultural shows on-farm demonstration plots and social marketing communicative tools) in sub-Saharan Africa, Asia and Oceania
- Approaches for effectively promoting indigenous vegetable production, consumption (and utilization) explored and implemented in Asia, Oceania and sub-Saharan Africa

Output Targets 2013

- Consumer awareness of vegetable consumption and nutrition effects on health promoted through farmer field days, seed fairs, national agricultural shows and on-farm demonstration plots in Asia, sub-Saharan Africa and Oceania
- Technical training units in production, and consumption of nutrient rich vegetables made available to corresponding target demand groups in Asia, sub-Saharan Africa and Oceania
- Community-based promotion campaigns for enhanced vegetable consumption conducted in four project hubs of south Bangladesh

Output Targets 2014

- Selected training programs in sub-Saharan Africa and Asia evaluated and analyzed, and report on lessons learned available for reviewing and conceptualizing future training programs
- Community-based promotion campaigns for enhanced vegetable consumption conducted in four project hubs of south Bangladesh
- Promotion strategies involving integration of vegetable gardening, livestock, food and nutrition components for enhanced vegetable consumption and good nutrition practices for rural and urban families in Mali developed

Activity 4.2 Develop policy briefs on outcome and impact assessment of program interventions in sub-Saharan Africa, Asia	*Output Targets 2012* • At least one policy brief on best Farmer-Led Seed Enterprise models in Tanzania prepared and disseminated for scaling-up • Impact assessment of tomato grafting technology on production, consumption and household income in Vietnam quantified through surveys *Output Targets 2013* • At least one policy brief on impact assessment of tomato grafting technology in Vietnam published • At least one policy brief on economic cost quantification of postharvest losses of selected globally important vegetables in sub-Saharan Africa and Asia prepared and disseminated *Output Targets 2014* • At least one policy brief to promote uptake of grafting technology in 3 other selected Asian countries prepared • At least one policy brief on use of bitter gourd to manage type 2 diabetes in India and Tanzania prepared and disseminated

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 Office of the Deputy Director General - Research has the leadership and oversight role for 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 who reports to the Deputy Director General - Research. Regional offices have geographical oversight, also reporting to the Deputy Director General - Research and forming a matrix with the four themes. The regional offices cover East and Southeast Asia, South Asia, Africa, and Central & West Asia and North Africa, with Oceania being coordinated from headquarters. This cross-cutting matrix is supported by Grants and Partnership Development, Intellectual Property, Biometrics, Communications and Information, Information Technology and Global Technology Dissemination. This complex matrix requires judicious balancing of resources against global opportunities and challenges, and also the careful balancing of research and development components within the Center's portfolio of activities.

The Deputy Director General - Research leads the team in interacting 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 to assure funding. The quality of project proposals will be monitored to ensure proposals are in line with the Center's mission and donor requirements. In 2012 and beyond it will be increasingly important to maximize restricted project funding to reduce the burden on the Center's core funds, and to ensure the donor base is diverse, reducing dependency on any specific donors. The restricted project focus will be on larger projects, rather than a large number of smaller projects. The transaction costs of smaller projects often are as great as those of larger projects, taking up valuable scientist and management time.

Input will be provided to developing realistic indicators and in the measurement of performance and attainment of those indicators as required by some donors to the Center's core funds. The Center's agreements, contracts and Memoranda of Understanding or Agreement will be monitored and will pass through rigorous checking before approval 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 issues 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 - Research and includes processes for internal peer review and quality control. The Center is encouraging its scientists to publish more, and to target high quality peer-reviewed publications to disseminate their research. The Center has instigated a 'Writing Week' to give scientists an undisturbed period of time to produce manuscripts for internal review and subsequent publication, preferably in journals listed in the Thomson Science Citation Index (SCI). The Center's production of publications such as conference papers and posters, public relations and press materials, extension materials, and documentation such as the *Year in Review, Medium-Term Plan* and *Annual Report* will continue.

The Deputy Director General - Research will continue to chair the Institutional Biosafety and Ethics Committee and the Institutional Research and Development Committee. The Institutional Biosafety and Ethics Committee has a mandate to ensure the Center's activities involving genetically modified organisms and any research involving animal or human trials follow all necessary protocols and procedures to minimize 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 and provides advice, insight and guidance. ♦

Office of the Deputy Director General - Administration and Services

The Office of Administration and Services provides administrative support to headquarters and regional offices including human resources, purchasing, travel arrangements, technical services, food and accommodation, security, risk management and host country liaison. Recruiting competent staff, promoting staff morale, raising operational efficiency, and fostering awareness and preparedness for risk management will be the main activities of the office in 2012-2014.

During the past five years, major buildings and facilities at headquarters and in the regions were renovated and modernized. Research facilities and communications infrastructure were also upgraded. The Center's administration and services are now better positioned to support research and development needs in next decade.

In the next three-year period, energy saving and reduction of carbon emissions will be emphasized and closely monitored to save costs and protect the environment. To facilitate energy saving, actions being considered for technical services include modifying farm machinery and rebuilding facilities on an economical scale, such as the steam sterilizer and water pumping systems in the farm and greenhouses; replacing old vehicles; constructing new irrigation and drainage ditches; and retiring old laboratory and household facilities and machines.

Food and Dormitory Services will replace old kitchen and lodging equipment to contribute to energy-saving and to provide better services to the staff and guests. Training for the catering staff will continue to enhance skills in preparing international cuisine for the Center's diverse guests.

For purchasing and travel ticketing, concerned staff are encouraged to obtain as much price information on-line as possible to obtain the best prices available in the market for quotation and procurement.

Administration and Services will continue to provide support for travel risk management. For environmental protection and health of personnel, the storage of pesticides at headquarters and regional offices will be closely monitored and adjustments will be made as necessary. Other action plans include seeking structural safety expertise from the Southern Taiwan Science Park to check the safety of headquarters campus facilities, conducting fire drills and --training in the regions, and exploring the possibility for our Regional Office for South Asia to be included in ICRISAT's evacuation plan. ♦

Improvements to the AVRDC Genebank include a roof shade to help maintain more constant internal temperatures.

Financial Services

Increasing the Center's level and diversification of funding is necessary to maintain stability and growth. Financial Services will continue to work closely with the Grants and Partnership Development team to ensure the Center pursues only projects and funding sources that are viable and in line with the Center's strategic plan, and that will diversify AVRDC's portfolio of investors. 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. The level of the financial discipline that was attained in the past year will be maintained or raised where necessary; cost control and efficient operation of service units will be key areas.

Progress in updating the Center's Standard Operating Procedures will move forward to provide clarity and eliminate ambiguity to staff and stakeholders regarding operations. Improvements and changes brought about by the new Enterprise Resource Planning system, Maconomy, have necessitated this update.

New service packs have been released by Maconomy/Deltek, which will have to be installed for the Center. An upgraded version of the system will soon be released; Financial Services will work with the Maconomy consultant to consider upgrading the system for better efficiency. ♦

Internal Audit

Internal Audit will continue to assist staff in the use of the Maconomy through audit findings and/or requests.

The global economic slow down has put pressure on the Center's fundraising abilities. The Center continues to raise funds for normal operations and organizational objectives, and also has reduced the use of certain utilities to save on costs. These measures include turning off air conditioning systems in the administration building when ambient temperatures and humidity permit, and shutting off electrical appliances rather than leaving them on or in stand-by mode when offices and laboratories are not in use. Internal Audit will continue to review and examine expenditures and identify avoidable expenses to help the the Center achieve its cost-saving objectives.

In 2012-2014, Internal Audit will continue working on the planned audits of functions such as Information Technology, property management, Grants and Partnership Development, farm management, and the regional offices. Besides the functional audits, Internal Audit will also pay more attention to the enhancement of current systems and processes to assist in the proper functioning and delivery of targeted outputs. ♦

Human Resources

With a comprehensive policy framework now in place for human resources management, the Center will focus on strengthening policies in the regions to conform with local statutes, market practices, and aspirations of staff. The consolidation of the Center's organizational structure into themes and regions, followed by the recent reorganization through consolidation of themes, delineating geographical boundaries of regions, and shifting of breeding programs, is now complete.

One of the fundamental aspects for alignment of individual jobs to the organization's purpose, structure and strategy is clarity of roles. The Center will undertake a review of roles, redefine wherever necessary, and make the jobs meaningful to the incumbent and relevant to the Center's current strategy. Enabling staff members to understand and establish the link from their roles to performance plans will increase engagement and job satisfaction, and foster the achievement of the Center's strategic objectives.

Based on the Center's research and development plan, the Center has now a reasonable number of breeders at headquarters and in most regions to undertake long-term breeding of key crops. However, after the conclusion of the Vegetable Breeding and Seed Systems for Poverty Reduction in Africa (*vBSS)* project, the African region has to build fresh capacity in breeding and plant protection competencies. Leadership capacity

is now optimal across management, themes, regions and breeding programs, the focus will shift to building specialized competencies in impact, socioeconomics, horticulture, soil and water, crop physiology, etc. It is hoped that some of the new projects in the pipeline will support building this capacity in the coming years.

The plans noted below will address the issues and directions articulated above.

Plan for 2012

- Development of Diversity and Inclusion Policy
- Review of staff policies at regional locations
- 'Go Green' initiative: a participatory approach involving staff members to optimize energy and utility cost and support environment protection
- Revising role descriptions
- Enriching 'Performance Management System' and link it with strategy and 'Result Based Management'
- Facilitating staffing requirements for upcoming projects
- Communication workshops for staff to enhance understanding of Center's strategy and link to their jobs
- Conduct a survey to measure knowledge acquisition through training, seminars, etc.
- Review of staffing across programs and offices and plan for optimization
- Extending goal-based performance management to senior positions of nationally recruited staff
- Conduct of in-house training and nominations to selective external programs

Plan for 2013 & 2014

- Bridging competency gaps through recruitment
- Review of compensation practices for all cadres through market survey and benchmarking
- Staff engagement and satisfaction surveys
- Staff development activities through training, job rotations and team development
- Preparation of External Program and Management Review (EPMR) documentation ♦

Human Resources aims to develop staff skills through study tours and seminars. Sophie Chou from Genetic Resources and Seed reported on her experiences during a study trip to Eastern Taiwan.

Communications and Information

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

- In 2012, the AVRDC website will be rebuilt on a new content management platform to facilitate rapid page updates and offer visitors current, newsworthy and lively pages with a more intuitive, accessible browsing structure. A shopping cart for easier ordering of seeds, books, and promotional items will enhance the user experience. An online photo archive accessible to all regional offices will be a priority for the year. Efforts to expand the Center's media reach and press performance will continue through targeted placement of news releases and closer collaboration with reporters, commentators, bloggers, and partners.
- 2013 will find the Center in a celebratory mood as it marks its 40th anniversary of service to tropical agriculture. Plans include the design of an attractive commemorative logo and postage stamp; World Vegetable Day (May 22) festivities at headquarters and regional offices; online reunions with former staff; testimonials from partners; art and culinary competitions; exhibits; a historical calendar; and more.
- In 2014, Communications and Information will seek to standardize electronic archiving practices; update and redesign the lobby displays in the Laboratory Building and Genebank to enhance their educational value for visitors; and encourage greater user of video and mobile technologies for extension information dissemination, surveys, and documentation. ♦

Information Technology

The Information Technology group has provided a reliable back-up system for user data on a weekly basis, and implements Network Access Storage (NAS) for public and group drives. This is particularly useful for storage and transfer of large files. As part of the Center's Risk Management policy, management of disaster recovery of data is critical and a second back-up system is being considered.

To facilitate electronic communication within the Center and with other partners and contacts, a wireless system has been installed. However, there will be many insecure mobile devices such as cellphones and notebooks used by our staff and guests and thus security systems must be enhanced to secure AVRDC's network. The Center's firewall policy will need to be reviewed and adjusted to secure AVRDC's local area network.

While the backbone of the Center's network and hubs/switches has been upgraded to 1000Mb in order to speed up data transfer, many of the personal computers in use still only support 100Mb transfers. To improve performance, the Center is considering upgrading the network cards of users to maximize the usage of the improved data transfer rates.

The Information Technology group will also focus on delivering "green IT" to the Center's staff members by developing protocols and procedures to reduce energy consumption, encourage sharing of devices such as printers and scanners and promote hardware recycling. ♦

Global Technology Dissemination

The Global Technology Dissemination group conducts a range of activities in capacity building, technology dissemination and agricultural development. Global Technology Dissemination 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 themes. Global Technology Dissemination plays a vital role in the Center's donor-funded projects; it leads a four-year project in Indonesia and provides a supporting role in a number of projects in Asia, Africa, and Oceania. The group coordinates its activities with the regional centers to enhance implementation of AVRDC's mission.

Global Technology Dissemination 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. Nutritional and other information about each crop can be found on signs distributed throughout the Garden. Global Technology Dissemination staff provide tours of the Garden to visitors.

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 is disseminated via email and Facebook.

In collaboration with the breeding units, Global Technology Dissemination maintains and updates a web-based seed catalog, which greatly facilitates germplasm transfer. Global Technology Dissemination promotes the Center's improved lines of tomato, pepper and other vegetables to stakeholders, in addition to its collection of indigenous vegetables. The group frequently updates the AVRDC website to promote grafting, integrated pest management, drip irrigation, and other technologies. Global Technology Dissemination 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. Global Technology Dissemination works with other groups at the Center to develop training manuals and extension publications that transfer the Center's technologies in ways that enable adaptation by end users.

Global Technology Dissemination'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. Global Technology Dissemination provides participatory training activities on grafting and other technologies. Global Technology Dissemination also organizes field days, training workshops, exhibitions and study tours.

The group also coordinates the Center's Disaster Response Program, which features seed 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 high quality of research output generated by AVRDC is ensured through the scientists' utilization of AVRDC's Biometrics resource. When used properly and efficiently, biometrics can help solve potential problem areas in experimental trials and data analysis, which otherwise would render statistical results invalid.

Sound biometrical methods are essential in achieving reliable and high quality research output and so is access to statistical information and techniques used in research. 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 provides the following consulting services to headquarters and outreach research scientists and staff: statistical review of reports/proposals/abstracts/scientific papers and posters for publication; evaluation of experimental/sampling plans; statistical analysis of data; 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 national agricultural research

Global Technology Dissemination reaches out to farmers with improved technologies such as rain shelters that can be adapted to local conditions.

system collaborators in conducting research; and advice on how to use statistical software available at AVRDC.

The quality of research outputs starts at the planning stage of experiments. Evaluation of experimental plans ensures that proper and efficient experimental designs are used and potential statistical issues are addressed before the start of the trials, and valid statistical procedures are followed in the data analysis.

In-country and in-house Biometrics training aims at improving the skills and understanding of researchers and collaborators who may be infrequent users of statistics. The statistical review of reports, proposals and scientific manuscripts aims at ensuring that the experiment was designed and conducted properly, results were appropriately presented, and possible errors and omissions are revealed before submission to donors or international peer-reviewed journals. ♦

Efforts will continue to contribute to a better understanding within the Center of full cost recovery from projects, as well as ensuring it as much as is possible, given circumstances, on each proposal.

The group will continue to ensure that the Deputy Director General - Research receives relevant information in a systematic manner, and add the Center's concept notes/proposals, project data and agreements to the Maconomy system.

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

Grants and Partnership Development

The institutionalization of the processes and procedures for resource mobilization and project administration will be strengthened. Focus in 2012 will be to (i) analyze 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 mobilization and project administration issues to global theme leaders and regional directors.

For risk management purposes, Grants and Partnership Development will create a generic archiving system that can be easily navigated.

The group will also focus on enhancing staff skills in proposal development through short papers/guidelines and a process for "Starting proposal development as a team."

Grants and Partnership Development Manager Annelie Öberg (right) leads a proposal development workshop.

Key Staff

Name	Position	Location	Nationality
Afari-Sefa, Victor	Scientist – Socioeconomics and Global Theme Leader, Consumption	Arusha, Tanzania	Ghana
Ahmad, Shahabuddin	Vegetable Sector Leader	Dhaka, Bangladesh	India
Belarmino, Marilyn	Scientist – Genetic Resources	Arusha, Tanzania	Philippines
Bhattarai, Madhusudan	Agricultural Economist	Shanhua, Taiwan	Nepal
Chagomoka, Takemore	Liaison Officer for Cameroon and Seed Business Specialist	Yaoundé, Cameroon	Zimbabwe
Chang, Yin-Fu	Deputy Director General – Administration & Services	Shanhua, Taiwan	Taiwan
Chang, Jan	Postdoctoral Fellow, Molecular Entomology	Shanhua, Taiwan	Taiwan
Chen, Huei-mei	Associate Specialist, Biotechnology/Molecular Breeding	Shanhua, Taiwan	Taiwan
Chen, Wuu-yang	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
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
Ghai, Tilak Raj	Technical Officer	Ludhiana, India	India
Gniffke, Paul	Plant Breeder, Pepper and Bulb Allium	Shanhua, Taiwan	USA
Habicht, Sandra	Postdoctoral Fellow, Biochemical Nutrition	Shanhua, Taiwan	Germany
Hanson, Peter	Plant Breeder (Tomato and Indigenous Vegetable Research) and Global Theme Leader, 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	Deputy Director General - Research	Shanhua, Taiwan	United Kingdom
Inukonda, Nagaraj	Director of Human Resources	Shanhua, Taiwan	India
Keatinge, Dyno	Director General	Shanhua, Taiwan	Ireland
Kenyon, Lawrence	Plant Virologist	Shanhua, Taiwan	United Kingdom
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, Gregory	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
Mariyono, Joko	Project Site Coordinator	Jawa Timur, Indonesia	Indonesia
Mavlyanova, Ravza	Regional Coordinator for Central Asia and the Caucasus	Tashkent, Uzbekistan	Uzbekistan
Mecozzi, Maureen	Head, Communications and Information	Shanhua, Taiwan	USA
Moustafa, Ahmed	Regional Director, Central & West Asia and North Africa	Dubai, UAE	Egypt
Nair, Ramakrishnan	Vegetable Breeder, Legumes	Hyderabad, India	India
Ndung'u, Philip	Regional Administration and Finance Officer	Arusha, Tanzania	Kenya
Neave, Suzanne	Project Coordinator, Solomon Islands	Honiara, Solomon Islands	United Kingdom
Öberg, Annelie	Manager, Grants and Partnership Development	Shanhua, Taiwan	Sweden

Key Staff

Name	Position	Location	Nationality
Ojiewo, Christopher	Vegetable Breeder	Arusha, Tanzania	Kenya
Olatifede, Kolade	Director of Finance	Shanhua, Taiwan	Nigeria
Ramasamy, Srinivasan	Entomologist	Shanhua, Taiwan	India
Ravishankar, Manickam	Site Coordinator	Ranchi, India	India
Reddy, Vamsidhar	Project Coordinator	Hyderabad, India	India
Rouamba, Albert	Vegetable Breeder, Onion	Bamako, Mali	Burkina Faso
Schafleitner, Roland	Head, Molecular Genetics	Shanhua, Taiwan	Austria
Tenkouano, Abdou	Regional Director, Africa	Arusha, Tanzania	Burkina Faso
Tsai, Wen-shi	Associate Specialist, Virology	Shanhua, Taiwan	Taiwan
Wang, Jaw-fen	Plant Pathologist and Global Theme Leader, Production	Shanhua, Taiwan	Taiwan
Wang, Peter	Technical Services Superintendent	Shanhua, Taiwan	Taiwan
Yang, Ray-yu	Nutritionist	Shanhua, Taiwan	Taiwan

The Center's dedication and knowledge in developing improved vegetable lines and production methods for small-scale farmers was recognized when AVRDC received the Team Award of Distinction from the International Association for the Plant Protection Sciences.

The award was presented to all AVRDC plant protection specialists and breeders—past and present—and to the partners that have contributed to the Center's integrated pest management strategies for tomato, pepper, and eggplant.

The winners, from left to right: Pepper Breeder Paul Gniffke, Entomologist Srinivasan Ramasamy, Virologist Lawrence Kenyon, Tomato Breeder Peter Hanson, and Plant Pathologist Jaw-fen Wang.

Budget

The following tables show the trend of the Center's budget over the period 2011 to 2014 along with sources of funding and allocation of finances to thematic research and development activities.

Table 1: *Details of the 2011 actual outcome along with the budget.*

Table 2: *How the estimated 2012 budget compares to 2011 actual and budget along with thematic allocation.*

Table 3: *Main sources of revenue, comparing the 2011 and 2012 budgets.*

Table 4: *Expected budgets for the next three years and how the allocations to themes are expected to change. By 2014 the amount allocated to research themes is projected to have slightly increased to 83% of the total budget, while the amount allocated to administration is expected to be 17%. The allocations between the themes are fairly constant between 2013 and 2014, except Theme Production, which is likely to reduce to 27% in 2014 from 32% in 2013, and Theme Consumption, which will increase to 26% in 2014 from 23% in 2013. The total funding is expected to gradually increase to slightly over US$ 20 million by 2014.*

Table 1: Financial activities for the twelve months ending 31 December 2011

	2011 Actual						2011 Budget	
	Unrestricted		**Restricted**		**Total**	%	**Total**	%
Revenues								
Unrestricted grants	8,362,190				8,362,190	60%	8,094,848	56%
Restricted grants			5,314,637		5,314,637	38%	5,988,678	41%
Other revenues	155,791				155,791	1%	350,000	2%
Total	**8,517,981**	62%	**5,314,637**	38%	**13,832,618**	100%	**14,433,526**	100%
Expenditures								
Personnel								
- International	3,329,159		842,434		4,171,593	31%	4,525,746	31%
- Local	4,120,951		477,982		4,598,933	34%	4,376,078	30%
Operating expenses								
- Field labor	-		218,147		218,147	2%	200,000	1%
- Supplies and services	797,462		1,334,461		2,131,924	16%	1,788,154	12%
- Travel	12,279		474,835		487,114	4%	563,488	4%
- Training and workshops	-		343,352		343,352	3%	300,000	2%
- General expenses	355,258		472,237		827,496	6%	1,000,000	7%
Contract outreach research	-		411,394		411,394	3%	1,000,000	7%
Contingency							250,000	2%
Depreciation/special project assets	58,207		739,794		798,001	6%	895,241	6%
Sub-total	**8,673,317**	62%	**5,314,637**	38%	**13,987,954**	103%	**14,898,707**	104%
Indirect cost recovery (overhead)	(436,607)				(436,607)	-3%	(511,194)	-4%
Total	**8,236,710**	61%	**5,314,637**	39%	**13,551,347**	100%	**14,387,513**	100%
Changes in net assets	281,271		0		281,271		46,013	
Allocated to Working Capital Fund	(279,450)				(279,450)			
Net assets at the beginning of the year	548,656				548,656		548,656	
Net assets at the end of the year*	550,477		0		550,477		594,669	

** Excludes Working Capital Fund of $1,500,000; Capital Replacement Fund of $198,415; and Fixed Asset Fund of $181,035 at the end of 2011*

Table 2: 2012 final budget estimate (USD '000)

		2012 Estimate		2011 Actual		2011 Budget	
Revenues		**15,398**		**13,833**		**14,434**	
Budget Allocations by Objects							
	Personnel						
	- International	4,742	31%	4,172	31%	4,526	31%
	- Local	4,996	33%	4,599	34%	4,376	30%
	Operations						
	- Field labor	200	1%	218	2%	200	1%
	- Supplies and services	2,583	17%	2,132	16%	1,789	12%
	- Travel	609	4%	487	4%	563	4%
	- Training and workshops	300	2%	343	3%	300	2%
	- General expenses	1,000	7%	828	6%	1,000	7%
	- Contracted outreach research	600	4%	411	3%	1,000	7%
	Equipment, facilities & renovation	262	2%	798	6%	895	6%
	Contingency	905	6%			250	2%
Sub-total		**16,197**	106%	**13,988**	103%	**14,899**	104%
	Indirect cost recovery (overhead)	(849)	-6%	(436)	-3%	(511)	-4%
Total		**15,348**	100%	**13,552**	100%	**14,388**	100%
Changes in net assets		**50**		**281**		**46**	
Net assets at the beginning		551		549		549	
Changing in net assets		50		281		46	
Appropriated to Working Capital Fund				(279)			
Carried over/forward *		601		551		595	

** Excludes Working Capital Fund of $1,500,000; Capital Replacement Fund of $198,415; and Fixed Asset Fund of $181,035 at the end of 2011*

Budget allocations by Themes								
	I.	***Strategy Themes***						
	I-1	*Germplasm: Germplasm conservation, evaluation and gene discovery*	*1,320*	*9%*	*1,716*	*13%*	*2,302*	*16%*
	I-2	*Breeding: Genetic enhancement and varietal development of vegetables*	*3,660*	*24%*	*3,629*	*27%*	*3,021*	*21%*
	I-3	*Production: Safe and sustainable vegetable production systems*	*4,790*	*31%*	*3,436*	*25%*	*3,597*	*25%*
	I-4	*Consumption: Balanced diets through increased access to and utilization of nutritious vegetables*	*2,015*	*13%*	*1,552*	*11%*	*2,158*	*15%*
	II.	***Administration and Services***	*3,563*	*23%*	*3,219*	*24%*	*3,309*	*23%*
Total			***15,348***	100%	***13,552***	100%	***14,387***	100%

Table 3: Breakdown of Y2012 estimated revenues (USD '000)

Donor	2012 Estimate		2011 Actual		2011 Budget	
Unrestricted Core						
Republic of China (ROC)	5,805		6,214		6,156	
United States Agency for International Development (USAID)	1,000		700		700	
UK Department for International Development (DFID)	2,529		1,029		809	
Japan	37		37		47	
Korea	50		30		30	
Thailand	153		152		153	
Philippines	50		50		50	
Asia and Pacific Seed Association	150		150		150	
Sub-total	9,774		8,362		8,095	
Other revenues	150		156		350	
Total	9,924	*64%*	8,518	*62%*	8,445	*59%*
Restricted Core						
Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)	35		33		47	
Australia/Australian Centre for International Agricultural Research (ACIAR)	420		248		237	
Austrian AID	66		0		0	
EuropeAID	130		0		0	
Food and Agricultural Organisation	81		0		0	
Bill & Melinda Gates Foundation	0		1,065		1,083	
Global Crop Diversity Trust	16		51		59	
Republic of Germany/BMZ/GIZ	1,941		1,088		1,125	
INDUS Seeds	10		0		0	
Japan	1		9		6	
Kagome Co., Ltd.	15		33		27	
Known-You Seed Co., Ltd.	12		19		16	
Korea/Rural Development Administration (RDA)	149		108		136	
Rijk Zwaan	161		0		0	
ROC/Council of Agriculture	178		162		340	
ROC/National Science Council	204		204		140	
ROC/Ministry of Foreign Affairs	0		1,676		1,792	
Sir Ratan Tata Trust	184		184		126	
USAID	1,833		361		754	
Volkswagen/University of Freiburg	23		33		37	
Training funds and others	15		40		63	
Sub-total	**5,474**	*36%*	**5,314**	*38%*	**5,988**	*41%*
Total Revenues	**15,398**	*100%*	**13,832**	*100%*	**14,433**	*100%*
Contribution in-kind						
Korea [1/]	【 50】		【 50】		【 50】	
Thailand [2/]	【 45】		【 45】		【 45】	
GIZ/CIM [3/]	【 60】		【 60】		【 60】	
International Center for Agricultural Research in the Dry Areas (ICARDA) [4/]	【 50】		【 50】		【 50】	

Note -

[1/] Outposted scientist (in kind)

[2/] Land, utilities, facilities supported by Thai Government for the East and Southeast Asia Regional Office 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 2012 - 2014 (USD '000)

	2011 Actual	2012 Estimate	2013 Projection	2014 Projection
Budget Allocation by Objects				
Personnel				
- IRS	4,172	4,742	4,863	5,200
- Local	4,599	4,996	5,000	5,000
Operations				
- Field labor	218	200	230	200
- Supplies and services*	1,696	1,734	1,845	3,000
- Travel	487	609	500	1,000
- Training and workshops	343	300	554	400
- General expenses	828	1,000	1,000	2,250
Contract outreach research	411	600	1,000	1,700
Equipment, renovation and facilities	798	262	800	1,000
Contingency		905	500	500
	13,552	**15,348**	**16,292**	**20,250**

**This figure is net of overhead recovery*

	Budget Allocation by Themes							
I.	***Strategy Themes***							
I-1	*Germplasm: Germplasm conservation, evaluation and gene discovery*	*1,716*	*17%*	*1,320*	*11%*	*3,057*	*23%*	*3,853*	*23%*
I-2	*Breeding: Genetic enhancement and varietal development of vegetables*	*3,629*	*35%*	*3,660*	*31%*	*2,924*	*22%*	*4,020*	*24%*
I-3	*Production: Safe and sustainable vegetable production systems*	*3,436*	*33%*	*4,790*	*41%*	*4,253*	*32%*	*4,523*	*27%*
I-4	*Consumption: Balanced diets through increased access to and utilization of nutritious vegetables*	*1,552*	*15%*	*2,015*	*17%*	*3,057*	*23%*	*4,355*	*26%*
II.	***Administration and Services***	*3,219*		*3,563*		*3,000*		*3,500*	
	Total	***13,552***		***15,348***		***16,292***		***20,250***	

Acronyms and Abbreviations

AARNET	ASEAN-AVRDC Regional Network on Vegetable Research and Development
ACCI	African Centre for Crop Improvement
ACIAR	Australian Centre for International Agricultural Research
ADFCA	Abu Dhabi Food Control Authority
AGRA	Alliance for a Green Revolution in Africa
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASEAN	Association of Southeast Asian Nations
AVGRIS	AVRDC Vegetable Genetic Resources Information System
AVRDC	Asian Vegetable Research and Development Center
Bt	*Bacillus thuringiensis*
CGIAR	Consultative Group on International Agricultural Research
CMS	Cytoplasmic male sterility
COA	Council of Agriculture
CORAF/WECARD	Conseil Ouest et Centre africain pour la recherche et le développement agricoles / West and Central African Council for Agricultural Research and Development
CPR	Cardiopulmonary resuscitation
CSO	Civil society organization
CWANA	Central & West Asia and North Africa
EPMR	External Program and Management Review
ERP	Enterprise resource planning
ESEA	East and Southeast Asia
FAO	Food and Agriculture Organization of the United Nations
FSC	Farmers Service Center
GAP	Good agricultural practices
GIZ	Gesellschaft für Internationale Zusammenarbeit
GTD	Global Technology Dissemination
HortCRSP	Horticulture Collaborative Research Support Program
ICARDA	International Center for Agricultural Research in the Dry Areas
ICBA	International Center for Biosaline Agriculture
icipe	African Insect Science for Food and Health
ICPN	International Chili Pepper Nursery
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDE	International Development Enterprises
IFAD	International Fund for Agricultural Development
IITA	International Institute for Tropical Agriculture
IPM	Integrated pest management
IPR	Intellectual property rights
IRS	Internationally recruited staff
ISPN	International Sweet Pepper Nursery
IVTC	International Vegetable Training Course
IWMI	International Water Management Institute
LC-MS	Liquid chromatography - mass spectrometry
MAS	Marker assisted selection
MDG	Millennium Development Goal
MoU	Memorandum of Understanding
MTA	Material Transfer Agreement
NAS	Network access storage
NARES	National agricultural research and extension system

Acronyms and Abbreviations

NGO	Nongovernmental organization
NPV	Nucleopolyhedrovirus
NRS	Nationally recruited staff
NSC	National Science Council
OP	Open pollinated
PARDI	Pacific Agribusinesses Research for Development Initiative
PGS	Participation Guarantee System
PRC	People's Republic of China
QNRF	Qatar National Research Fund
QTLs	Quantitative trait loci
RCA	Regional Center for Africa
SAIC	Al-Sulaiteen Agricultural and Industrial Complex
SINGER	System-wide Information Network for Genetic Resources
SNP	Single nucleotide polymorphisms
SPC	Secretariat of the Pacific Community
SRO	Sub-regional organization
SSA	sub-Saharan Africa
SSR	Simple sequence repeat
ToT	Training of trainers
UN-CAPSA	United Nations Centre for Alleviation of Poverty through Sustainable Agriculture
USAID	United States Agency for International Development
vBSS	Vegetable Breeding and Seed Systems for Poverty Reduction in sub-Saharan Africa
VIGS	Virus-induced gene silencing
WACCI	West African Centre for Crop Improvement
WHO	World Health Organization

AVRDC – The World Vegetable Center
P.O. Box 42, Shanhua, Tainan
Taiwan 74199

T +886 6 5837801
F +886 6 5830009

E info@worldveg.org

www.avrdc.org