



Medium-Term Plan

2009 - 2011



AVRDC

The World Vegetable Center

AVRDC – The World Vegetable Center

2009-2011 Medium-Term Plan

The Center

AVRDC – The World Vegetable Center is the leading international nonprofit research and development institute committed to ensuring food security, health, and stronger economies through vegetable research, development, and training.

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
I www.avrdc.org

AVRDC Publication: 09-714
ISBN 92-9058-170-0

Editor: Maureen Mecozzi
Layout and Graphic Design: Oliver Hanschke, Ming-che Chen
Publishing Team: Kathy Chen, Vanna Liu, Chen Ming-che, Lu Shiu-luan
Photos: AVRDC Image Archive

© 2009 AVRDC – The World Vegetable Center

Suggested citation
AVRDC. 2009. AVRDC Medium-Term Plan 2009-2011. Shanhua, Taiwan.
AVRDC – The World Vegetable Center. AVRDC Publication 09-714. 97 p.

Contents

Foreword

A unique research and development institution

AVRDC – The World Vegetable Center	1
Exotic and indigenous vegetables	1
The world’s largest public sector vegetable germplasm collection	3
Continuity from research to development, from idea to implementation	4
Committed to health	5
Emphasis on nutrition as well as productivity	8
Pro-women research and development	9
Communicating at all levels, for all needs	10
Global vision for local impact	11
A unique geographical location	12
A leader in climate change research	14
Close relationship with the private sector	15
Independent, flexible, and responsive	17

The Center’s Strategic Organization

Germplasm	21
Breeding	21
Production	21
Marketing	21
Nutrition	21

Our Global Focus

Regional Center for Africa	23
Central and West Asia and North Africa	23
Regional Center for South Asia	24
Asian Regional Center	25
Oceania	26
Latin America	25

A Network of Partners

Advanced Research Institutes	27
NARES, CSOs, and NGOs	27
Private sector	27
Donors	28

Selected Projects in Focus

Vegetable breeding and seed systems for poverty reduction in Africa	31
Application of molecular markers to broaden the genetic base of tomato for improved tropical adaptation and durable disease resistance	32
Integrated disease management for anthracnose, Phytophthora blight, and whitefly-transmitted geminiviruses in chili pepper in Indonesia	32
Integrated crop management package for sustainable smallholder gardens in the Solomon Islands	33
Improving vegetable production and consumption for sustainable rural livelihoods in Jharkhand and Punjab, India	34
Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of NAD Province, Indonesia	36
Integrating safe and off-season vegetable production with market through information, education, and training in Ha Tinh and Tra Vinh Provinces, Vietnam ..	37



Research and Development	39
Theme Germplasm: Germplasm conservation, evaluation, and gene discovery.....	41
Theme Breeding: Genetic enhancement and varietal development of vegetables....	51
Theme Production: Safe and sustainable vegetable production systems.....	59
Theme Marketing: Postharvest management and market opportunities.....	67
Theme Nutrition: Nutritional security, diet diversification, and human health.....	71
Global Support	
Administration and Services.....	77
Financial Management.....	79
Human Resources.....	80
Public Awareness and Information.....	81
Information Technology and Web.....	83
Editorial and Library.....	85
Global Technology Dissemination.....	87
Biometrics.....	88
Staff – 2009	91
Budget	95
Acronyms and Abbreviations	97

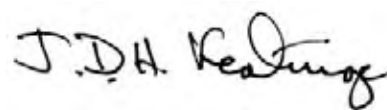
Foreword

Following the 7th External Program and Management Review Report in 2008, AVRDC – The World Vegetable Center seeks to continue to do what it does best: germplasm characterization and use, breeding of exotic vegetable species, improving vegetable cropping systems, enhancing opportunities for the poor in production and marketing, and ensuring all these activities contribute to overcoming the current world crisis of malnutrition by increasing the consumption of vegetables that are safe and healthy to eat. In addition, the Center intends to place greater emphasis on efforts to understand and promote improved nutrition for all people, especially through the greater use of indigenous vegetables, which frequently make up a substantial proportion of the diets of the poor.

The Center aims to undertake research, development, and capacity building in congruence with its capabilities at a global level. However, in view of the breadth of the Center's mandate—all vegetable crops—this ambition is unlikely to be fulfilled at present given current annual financial resources of approximately US\$20 million and a staff of only 75 higher-degree level scientists and managers. In the context of the global financial crisis of late 2008, ensuring continuity of budget resources is a prudent course of action. We seek to reduce the number of small projects, as these are less economically efficient to run and often are partially subsidized from core resources. For the Medium-Term Plan period of 2009-2011, the Center will focus on securing larger projects, and also on obtaining full cost recovery from all sources of special project funding. Further prioritization of our work within vegetable species will become more critical in the future.

The 2009-2011 Medium-Term Plan thus emphasizes ongoing work on the Solanaceous species, cucurbits, and a small number of indigenous vegetables. In geographic terms, our regional centers are strategically placed to address world malnutrition and poverty in sub-Saharan Africa, South Asia, and Southeast Asia. We seek to balance work in big countries with strong national programs with our efforts in smaller countries that may be deficient in human resources and scientific infrastructure to support effective vegetable production. Our focus on pro-poor research and good agricultural practices is strengthened and extended through public-private partnerships, which offer the most efficient and consistent means of supplying good quality vegetable seeds to smallholder farmers. As many smallholder farmers in our target areas are female with dependent children, we strive to ensure our combined efforts result in a genuine and demonstrable reduction in poverty and malnutrition.

We believe our 2009-2011 outputs will make a measurable, positive contribution to the Millennium Development Goals and help us to live up to our philosophy of “Prosperity for the Poor and Health for All”—the mission for which AVRDC – The World Vegetable Center was established by its founding nations and funding agencies in 1971.



J.D.H. Keatinge
Director General



A Unique Research And Development Institution

AVRDC – The World Vegetable Center is the world’s leading international nonprofit research and development institute committed to alleviating poverty and malnutrition in developing countries through vegetable research and development.

The Center was founded in 1971 as the Asian Vegetable Research and Development Center, with a mandate to support vegetable research for development in Asia and with a particular emphasis on Southeast Asia. In the early 1990s, operations were expanded from the Center’s headquarters in Shanhua, Taiwan to sub-Saharan Africa, with some limited project work in Latin America. Regional offices in Bangkok, Thailand (Asian Regional Center) and Arusha, Tanzania (Regional Center for Africa) were opened in 1992. The Regional Center for South Asia (Hyderabad, India) was opened in 2006. The Center currently has offices in Cameroon, Indonesia, Laos, Madagascar, Mali, the Solomon Islands, South Korea, Uzbekistan, and Vietnam. We continue to build partnerships and mobilize resources from the private and public sectors to promote the production and consumption of safe vegetables in the developing world.



Exotic and indigenous vegetables

Research conducted at AVRDC – The World Vegetable Center covers both exotic and indigenous vegetables.

Exotic vegetables refer to those species that are introduced to a country or location; in Africa and Asia examples of these would be tomato (*Solanum lycopersicum*), onion (*Allium cepa*), peppers (*Capsicum spp.*), and cabbage (*Brassica oleracea*). The Center works with public and private sector partners to ensure seeds of adapted exotic varieties are available at reasonable prices. In many developing countries, seeds of exotic varieties are often imported and may be poorly adapted to local climates, pests, and diseases; these varieties may not be the preferred ones for local consumption, but in many cases good quality seed of preferred types is unavailable.

Indigenous vegetables are underutilized species from specific locations. Although they may have been introduced from other regions in the distant past, over time they become naturalized, and often are not included in national inventories. Sometimes called “native vegetables,” indigenous species are eaten as part of traditional diets. In some local areas they are consumed widely, but in other places these vegetables have only small niche markets. High in nutrients and important sources of food in times of scarcity, indigenous vegetables are national treasures and part of a country’s heritage. With improved seed, these species can generate income for smallholder farmers. Yet indigenous vegetables are usually under-researched; there is little or no plant breeding or selection of traits, and seed is difficult for farmers to obtain as these species generally are not marketed through the formal seed sector. Indigenous vegetables

Purple amaranth is rich in iron, protein, and β -carotene (a vitamin A precursor). The new lines require only 10 minutes cooking time compared to four times as long for the local populations, which maximizes the nutritional value and helps save fuel—an added bonus for poor households.

The world's largest public sector vegetable germplasm collection

AVRDC – The World Vegetable Center's Genetic Resources and Seed Unit currently maintains more than 56,000 accessions of diverse vegetables in its genebank, making it the largest public collection of vegetable germplasm worldwide. The current collection has 44,563 accessions of the Center's principal crops, and 11,952 accessions of other crops. These comprise 404 species of 161 genera from 152 countries. The genebank contains many examples of wild and less well-known lines of "exotic" crops such as tomato (*S. lycopersicum* and other *Solanum spp.*), onion and garlic (*Allium spp.*), cabbage (*B. oleracea* types and other *Brassica spp.*), and pepper (*Capsicum spp.*), as well as collections of indigenous vegetables such as *Amaranthus spp.*, *Abelmoschus spp.*, *Lablab spp.*, and *Lagenaria spp.* The Center's vegetable breeders make extensive use of the germplasm collections, mining the genebank for candidate genes to include in the Center's crops. An example is Ty-2, a gene located on chromosome 11 of tomato, which confers resistance to geminiviruses.

Included within the collection are over 10,000 accessions of indigenous vegetables, many from Southeast Asia and Africa. These often highly nutritious species are typically more resistant to insect pests and diseases than exotic vegetables, and they generally grow well without fertilizer or other costly inputs. The Center has selected superior indigenous vegetable lines that have been released by national partners as varieties,

or which have been included in public and private sector breeding programs. The Center has developed specific crop management packages, provided training in participatory evaluation to select promising IV lines, and partnered with the public and the private sectors to ensure seed of elite varieties is available and affordable.

The Center's genebank actively exchanges seed, genetic resources, and expertise among national programs, regional organizations, and the private sector. Since its founding, the Center has distributed more than 571,000 seed samples to researchers in at least 180 countries. This has led to the release of hundreds of varieties throughout the world, with particular impact in developing countries.

The Center's genetic resources are documented in the AVRDC Vegetable Genetic Resources Information System (AVGRIS). AVRDC – The World Vegetable Center is also part of the System-wide Information Network for Genetic Resources (SINGER), the information exchange network of the Future Harvest Centers of the Consultative Group on International Agricultural Research (CGIAR). Vegetable germplasm collection data (passport information) has been integrated into the SINGER database.

include *Amaranthus cruentus* (purple amaranth) and *Corchorus olitorius* (jute mallow) in Africa, *Abelmoschus esculentus* (okra) and *Moringa oleifera* (drumstick tree) in South Asia, and *Basella alba* (vine spinach) and *Coccinia grandis* (ivy gourd) in Southeast Asia.

In the past, indigenous vegetables were often gathered or planted around houses and farms. Very little selection had taken place, resulting in robust plants with weedy, non-preferred characteristics. In breeding programs, the Center works with national partners to select preferred traits from naturally occurring populations, ensuring nutrients are retained, beneficial agronomic characteristics are conferred, and antinutritional components reduced, if necessary.

Elite amaranth lines selected by the Center in Tanzania provide a useful example. The traditional populations of *A. dubius* (spleen amaranth), *A. cruentus*, and *A. hypochondriacus* (Prince-of-Wales feather) are usually allowed to grow tall, and the leaves plucked as needed. But the *A. cruentus* lines selected and introduced to farmers by AVRDC – The World Vegetable Center in East Africa are softer, sweeter, and can be harvested as whole plants in just 21–28 days. Amaranth is very nutritious compared to exotic leafy vegetables such as cabbage.



Continuity from research to development, from idea to implementation

Research and development are part of a continuum. Basic research activities, driven by scientific curiosity, anchor one end of this continuum. Applied research, designed to solve practical problems, follows further along the continuum. Next, basic development activities are adapted from research. Applied development activities, at the other end of the continuum from basic research, transfer the technology to the end users.

AVRDC – The World Vegetable Center is the only international agricultural research center that always has had “development” in its name and mandate. Unlike many international agricultural research centers that have struggled to define their role along the continuum, AVRDC has long been comfortable with delivering products to end users. However, the Center has to balance its research and development portfolios. The Center does not focus on basic research as defined above, but begins its research and development activities further along the continuum, with more applied research; it takes the data and outputs of published basic research to conduct applied research addressing constraints and opportunities in vegetable production and consumption in developing countries. The Center’s research and development activities grow from applied research.

One of the many advantages to working along the continuum is that the needs and requirements of end users are easily made known to researchers, and thus are incorporated at the beginning of the research process. Multidisciplinary teams ensure all aspects of a constraint are addressed, and that all the potential opportunities are assessed. AVRDC – The World Vegetable Center has research and development teams comprised of scientists from around the world, selected through international competition,

working closely with national scientists eminent in their fields. These flexible, innovative teams perform leading-edge research and can adapt local innovations from one part of the world to others.

The Center’s genebank actively exchanges seed, genetic resources, and expertise among national programs, regional organizations, and the private sector. Since its founding, the Center has distributed more than 571,000 seed samples to researchers in at least 180 countries. This has led to the release of hundreds of varieties throughout the world, with particular impact in developing countries.

The development and dissemination of improved mungbean varieties in Asia is a good example of AVRDC teamwork. Mungbean is a major protein source, particularly where the population is predominantly vegetarian. Through the joint efforts of plant breeders, agronomists, plant pathologists, and nutritionists, the Center turned mungbean into a major commercial crop by developing breeding lines with large seeds, synchronous early maturity (55 days), and high yields (up to 2.5 t/ha). The lines are resistant to Mungbean yellow mosaic virus, *Cercospora* leaf spot, and powdery mildew. Using the Center’s breeding lines, national partners in South Asia, Southeast Asia, and other regions have developed and released more than 110 unique mungbean varieties. The economic value of improved mungbean varieties and technologies in Pakistan alone has been estimated to be US\$20 million. By 2005 the estimated area planted with mungbean incorporating genetic material from AVRDC – The World Vegetable Center was over 2.5 million hectares (600,000 hectares in China, 200,000 hectares in Pakistan, 200,000 hectares in Thailand, almost 1 million hectares in Myanmar, 70,000 hectares in Bangladesh, and about 500,000 hectares in India).





The Center developed mungbean recipes to increase the bioavailability of iron in diets. Research in India found that children eating these mungbean dishes suffered from fewer clinical deficiency symptoms and had higher blood hemoglobin levels compared to children who did not consume mungbean so prepared.

Participatory approaches involving farmers and other stakeholders from research or project inception to completion are standard practice at the Center. By evaluating needs together, and jointly designing and developing a project, we help ensure project outcomes are more likely to be adopted. Capacity building is a crucial component. Vegetable production is knowledge-intensive and the Center conducts regional training courses on

selected topics to enhance the capacity of scientists from national agricultural research and extension systems, as well as private sector partners, in vegetable research and development. The enhanced knowledge and skills enable partners to put the Center's technologies to use to improve the livelihoods of the poor in developing countries.

Committed to health

AVRDC – The World Vegetable Center is committed to working closely with the health sector to overcome the effects of micronutrient malnutrition in developing countries. A second facet of the Center's work is to highlight the overall health benefits of vegetables as part of a balanced diet, and to focus on the specific health-giving properties of particular vegetables.

While more than 0.83 billion of the world's people are underweight, the hidden hunger of micronutrient malnutrition affects up to 3.5 billion people. This hidden hunger is the cause of over 2.7 million deaths a year, with mothers and young children particularly vulnerable to the lack of vitamin A and iron. Vitamin A deficiency is the leading cause of preventable blindness in children and needlessly raises a child's risk of severe illness and death from infection. In pregnant women, vitamin A deficiency causes night blindness, increases the risk of maternal mortality, and is associated with elevated mother-to-child Human immunodeficiency virus (HIV) transmission that can lead to acquired immunodeficiency syndrome (AIDS).

Micronutrient malnutrition is best addressed through increased vegetable consumption. The recommended daily consumption of vegetables is 3-5 servings (80 g servings; a total of 240-400 g). However, average consumption in most countries, whether developed or developing, is well below this level.

It is possible to provide dietary supplements or to use biofortified crops, but a simpler, more sustainable solution is to eat a balanced diet with sufficient fruit and vegetables. “Golden tomatoes”—a conventionally-bred variety developed by the Center—contain three to six times more β -carotene than standard tomatoes. β -carotene is the precursor to vitamin A; one golden tomato can provide a person’s full daily vitamin A requirements.

Vegetables are good sources of essential micronutrients and health-promoting phytochemicals in diets. Increased consumption of vegetables and fruits is recommended for preventing nutrition deficiency disorders and reducing the risk of obesity and chronic diseases, including diabetes, cardiovascular diseases, and cancer. Vegetables differ in the types and amounts of essential nutrients and other phytochemicals they contain; the beneficial effects and health outcomes may differ. AVRDC works with the health sector to ensure its nutrition research and development activities are appropriate and effective.

To increase vegetable consumption and highlight the positive effects of a balanced diet, AVRDC – The World Vegetable Center develops vegetable recipes adapted to local tastes and

environments that ensure micronutrients are retained after food preparation. We promote vegetables as a source of food and potential income through home and school gardens and in other social contexts such as hospitals, prisons, and refugee camps. Home and school garden modules have been designed using a variety of vegetable crops to provide a year-round vegetable supply.

While micronutrient deficiencies and infectious diseases continue to devastate lives in the developing world, non-communicable diseases, including type-2 diabetes, are increasingly common in developed and developing countries. Like the poor, the urban rich also face nutritional imbalances due to the insufficient variety of foods in their diets; their ability to purchase and consume prepared, calorie-dense foods further complicates the problem. India has the highest diabetes prevalence in the world; the number of diabetics is projected to rise from 31.7 million in 2000 to 79.4 million in 2030. The economic, social, and health costs associated with diabetes are tremendous and add to overburdened national health care budgets. Diet is the primary therapy for diabetes, and is particularly critical when pharmaceuticals are not available. Bitter melon (*Momordica charantia*), a widely-grown but under-researched



tropical vegetable, contains nutrients and substances such as saponins and conjugated linolenic acid that can lower blood sugar; it has been used in traditional medicine to treat diabetes. But bitter melon germplasm is diverse: it varies in fruit type, shape, color, and bitterness. Genetic and environmental factors affect the profile and density of phytochemicals in vegetables; antidiabetic attributes may be similarly affected. To develop bitter melon as a supplement for diabetic and pre-diabetic patients, more research is needed on mode of action, specific active compounds, and clinical trials before a dietary recommendation can be made and a product brought to market.

Vegetables are cultivated on more than 500,000 ha in the Philippines, with tomato, eggplant and yard-long bean being grown on more than 70,000 ha. Vegetables are cultivated on small family-owned farms where the daily sale of vegetables provides a ready cash income for farmers. These vegetables are attacked by a plethora of insect pests; however, insects such as eggplant fruit and shoot borer (*Leucinodes orbonalis*), tomato fruitworm (*Helicoverpa armigera*) and legume pod borer (*Maruca vitrata*) on yard-long bean are the most destructive. As much as 50% of the fruit may be damaged by the eggplant fruit and shoot borer in a heavily infected field. During episodes of heavy infestation by tomato pests, a 50-90% reduction in yield has been reported. At present, farmers rely exclusively on chemical insecticides to combat these borers and other secondary insects in an attempt to produce blemish-free, marketable vegetables. Surveys in certain areas of the Philippines indicate vegetable farmers spray insecticides more than 50 times (up to 56 on eggplant) during a cropping season to protect their crops. Pesticide misuse harms the environment and human health, and increases the cost of production, making this humble vegetable expensive for poor consumers.

A four-step integrated pest management strategy proposed by AVRDC – The World Vegetable Center provides effective control: sex pheromones to continuously trap the pest adults; prompt destruction of pest-damaged shoots and fruits/pods; the use of biopesticides like neem, *Bacillus thuringiensis* (Bt) and nucleopolyhedrovirus (NPV); and the application of chemical pesticides only when absolutely necessary. This strategy allows local predators and parasitoids to proliferate, restoring the natural balance and enhancing biodiversity. Small-scale vegetable growers decrease their production costs by reducing pesticide use; safer, pesticide residue-free vegetables can be then sold at affordable prices to poor urban consumers. The risk of pesticide exposure to farmers and consumers is minimized. The overall improved environmental quality promotes ecological sustainability.



Emphasis on nutrition as well as productivity

The Center's mission emphasizes alleviating poverty and malnutrition in the developing world through the increased production and consumption of safe vegetables. The dual focus on poverty and malnutrition differs from the missions of most other international agricultural research centers. While these centers also focus on poverty alleviation, livelihoods, human health, food security, productivity, and the management and protection of natural resources, none of them specifically address the requirements for a diverse and balanced diet to alleviate malnutrition, in particular micronutrient malnutrition.

Vegetables are high-value crops that improve livelihoods; they alleviate malnutrition, generate income, and provide employment. Due to a rising demand for vegetables and an opportunity to employ available labor, vegetable production is becoming a popular choice for farmers in the tropics. However, high vegetable productivity must not come at the expense of health and the environment. AVRDC – The World Vegetable Center thus promotes the production of safe vegetables by developing technology to minimize risks to health and the environment, ensure appropriate input use, and maximize productivity per unit of water.

Water scarcity in many parts of Asia and Africa constrains high-value vegetable production. AVRDC – The World Vegetable Center addresses water management issues in vegetable farming through the use of low-cost, simply designed water control technologies. Microirrigation projects are community or privately organized, cheap, easy to operate, and environmentally friendly.

Locally available exotic and indigenous vegetables provide micronutrients in the diet, but the relative levels of different vitamins and other nutrients in vegetables grown under local conditions are not well known. Indigenous vegetables are often rich in micronutrients and bioactive compounds such as flavonoids and other antioxidants. Some African indigenous vegetables—cowpea (*Vigna unguiculata*) leaves, baobab (*Adansonia digitata*) leaves, amaranth (*Amaranthus* spp.), spider plant (*Cleome gynandra*), jute mallow (*Corchorus olitorius*), drumstick tree (*Moringa oleifera*) leaves, African nightshade (*Solanum scabrum*), cassava (*Manihot esculenta*) leaves, and sweet potato (*Ipomoea batatas*) leaves—contain relatively high levels of β -carotene and iron; many of these species are used in local foods and make a positive contribution to diets. Several traditional household food processing and preparation methods, including cooking, mechanical processing, soaking, and fermentation can be used and adapted to enhance the bioavailability of micronutrients and decrease the levels of antinutritional factors such as phytate. While eating certain foods together (such as citrus fruits or tomatoes and iron-containing foods to prevent chelation of iron) can improve availability of certain micronutrients, it is clear that increasing intake of both fruit and vegetables can significantly improve health and reduce the impact of micronutrient-associated chronic diseases.



AVRDC – The World Vegetable Center evaluates nutritional, antinutritional, and functional properties of important exotic and indigenous vegetables, investigates the interactions of vegetables with people, the environment, food systems, and social and economic factors, and develops cost-effective dietary strategies and horticultural intervention programs for immediate malnutrition relief and sustainable access to quality food.

Pro-women research and development

Gender issues are an integral part of AVRDC – The World Vegetable Center’s activities in the research-to-development continuum, and in the five research and development themes: Germplasm, Breeding, Production, Marketing, and Nutrition. The Center itself has a good gender balance with women taking many senior positions; one of three Senior Management and three out of five Global Theme Leaders are women. In total, the Center has 27 percent women among its senior staff.

Productive vegetable farms are labor intensive, offer employment for women, and are more flexible in terms of general household needs than farms producing predominantly starchy staples or cash crops. There are opportunities for hiring additional labor on- and off-farm, and opportunities for labor to add value after harvest. Women have a significant role in value-addition after harvest; their participation in vegetable value chains has implications for family income and nutritional status. Employment for women in postharvest activities can be significant, thus empowering women within households, at the community level, and at higher levels thereafter. AVRDC – The World Vegetable Center monitors gender relations in its activities to ensure gender equity is not hampered by the Center’s technologies and processes.

An example of a woman empowered by AVRDC – The World Vegetable Center is a vegetable farmer-collector in Laos. She was trained through the Center’s “Mobile Training on Postharvest Technology of Tomato and Chili.” She applies the improved techniques she learned to her agribusiness, increasing her family’s income, improving their quality of life, and ensuring her children’s education. The training enables her to empower other farmers and villagers. As a farmer-collector she comes into contact with many farmers, putting her in a good position to disseminate the improved postharvest techniques she learned. She helps go into contract farming, providing capital to other farmers for farm inputs and, in return, the farmers sell their produce to her at the prevailing price in the area. Her obvious success lifts her standing in the community, making her and her family a model for the villagers to emulate.

Gender equity and gender relations are usually based on power; the power balance in many developing countries and agricultural contexts is heavily weighted in favor of men. Gender equity in the vegetable value chain will imply the power of women to invest in vegetable production or in other related or derived activities. It will also mean that women have attained the organizational level, power, or position to be heard at policy levels, and to influence policy decision-making, not just in vegetable value chains but in the broader community, and consequently in their families’ livelihoods and well-being.

Communicating at all levels, for all needs

AVRDC – The World Vegetable Center communicates its research and development activities globally, providing context, meaning, and value for the Center’s work at local, national, and international levels.

Global communication, locally adapted, promotes the Center’s visibility and accessibility.

The Center aims to provide transparency and clarity in decision-making and to ensure information is readily and easily available to staff and partners.

The internal exchange of information is facilitated through a weekly newsletter and the Center’s intranet. The Center also ensures services based at headquarters are made available to all its global locations. For example, the AVRDC Library is a global information hub for regional centers and staff posted outside of headquarters.

The communication strategy projects a coherent, recognizable presence through consistent corporate design and key messages. Strong media contacts promote the Center’s work to a worldwide audience. Exchanges and connections with other national and international agricultural research centers raise awareness of the Center’s

activities among donors; networking builds public and private partnerships for mutual benefit. Marketing materials prepared for specific audiences, including donors and decision makers, research and development partners, and the broader scientific community, reinforce the Center’s strategic focus.

Archiving the Center’s research using international standards eases access for all those who seek to use it. Datasets of primary and secondary data compiled by AVRDC – The World Vegetable Center researchers are made available to others for use in research and policy analysis.

Clear communication objectives for research and development projects ensure the benefits of the Center’s work reach the appropriate audiences. Informational and instructional materials including leaflets, training manuals, videos, and puppet shows are designed for the needs of extension staff, women, and farmers. The editorial staff sets standards to ensure clarity and accuracy of reports, articles, and other media. The website integrates the Center’s information services with those of the Consultative Group on International Agricultural Research (CGIAR) and other international research organizations to make them more globally accessible; online communities, social networking sites, video sharing sites, and other means



of sharing information and collaborating with colleagues, partners, and the public across long distances are also deployed. The combination of online and offline approaches allows the Center to deliver and share information that will bring positive change to people's lives.

Global vision for local impact

The Center's international staff members hail from 27 different countries. With its headquarters in Taiwan and regional or project offices in Cameroon, India, Indonesia, Korea, Laos, Madagascar, Mali, Niger, the Solomon Islands, Tanzania, Thailand, and Uzbekistan, the World Vegetable Center has a truly global presence. Offices are planned for the United Arab Emirates and Honduras. From these hubs, the Center extends into many other countries, ensuring a worldwide reach for its research and development.

AVRDC – The World Vegetable Center's activities are usually focused on issues of global relevance. Opportunities and constraints are identified with local partners, and are then assessed for regional or global importance.

Insect pests and plant pathogens are not constrained by national boundaries, and many vegetable production and consumption problems are common across countries and regions. By producing international public goods as outputs of its research and development activities, successes from one region can be adapted and transferred to other regions. For example, the Center's integrated pest management program for the most important insect pest of crucifers, the diamondback moth (*Plutella xylostella*), began in Southeast Asia but was progressively introduced into almost every country in Asia. It has been estimated that the adoption of integrated pest management to control diamondback moth would result in savings of at least Rs. 3,000-4,000/ha in India. The technology is also being



introduced to Eastern Africa. In Kenya, it was estimated that a 7.9% reduction in the cost of production was realized due to the adoption of integrated pest management in cabbage production. The estimated benefit was expected to be shared between consumers and producers, with consumers receiving 58 percent and producers receiving 42 percent of the benefit. Dissemination of this integrated pest management technology into West Africa is in progress.

Another example is AVRDC's integrated pest management program for managing the eggplant fruit and shoot borer (*Leucinodes orbonalis*). Eggplant fruit and shoot borer is the worst pest of eggplant and farmers rely exclusively on pesticides to control it, spraying up to 84 times during the 6-7 month cropping season. Starting in 2000, sustainable integrated pest management practices were developed and promoted in South Asia. The strategy reduced pesticide use by 65 – 75 percent in Bangladesh and India, cut production costs by 30 percent, and increased farmers' income by 60 percent. Farmers adopting integrated pest management technologies increased their production area by approximately 20 percent.

Better access to water is critical for growing vegetables and other off-season crops to increase farm incomes and alleviate poverty. The Center promotes small, divisible forms of microirrigation technology that are affordable to many

smallholder farmers in Asia and Africa. Common microirrigation schemes in tropical Asia and sub-Saharan Africa include treadle pumps, low-cost water storage, drip kits, small pumps, hand pumps, kick-start pumps, bucket irrigation, and cycle pumps. Different vegetables require different water management schemes; microirrigation types and vegetable production technologies must be adapted to the local agro-environment, available technology, and other economic, social, and institutional factors. AVRDC – The World Vegetable Center works closely with International Development Enterprises (IDE) to adapt low-cost drip irrigation technologies for vegetable production in dry areas and in areas where water of acceptable quality is scarce.

AVRDC – The World Vegetable Center aims to enhance the lives of poor individuals and communities in developing countries by reducing household poverty and improving health, particularly of the vulnerable. As individuals and communities are strengthened, the regional and national economies can be developed, which will again improve the livelihoods of the poor.



A unique geographical location

AVRDC – The World Vegetable Center is the only international agricultural research center with headquarters in a Chinese-speaking country. Founded in 1971 as the Asian Vegetable Research and Development Center in Taiwan (Republic of China) with a mandate to enhance vegetable production in the Asian tropics, AVRDC – The World Vegetable Center now has a global role in promoting and supporting vegetable research and development.

There are many advantages to being hosted by a country with a well-developed agricultural and horticultural research system, established universities, and high quality infrastructure. The support Taiwan's institutions provide to the Center is invaluable. The Center appreciates its special relationship with its host country; Taiwan supports the Center very generously both financially and through its missions in other countries.

AVRDC – The World Vegetable Center is ideally placed for research in different environments. Taiwan is located between the world's largest continent (Asia) and largest ocean (Pacific). The island has four climate types: 1) monsoon and trade-wind coastal characterized by high temperature and humidity, massive rainfall, and tropical cyclones during the summer in the south where the Center is headquartered; 2) mild, humid climate in the north; 3) wet-dry tropical climate in the west; and 4) temperate rainy climate with dry winter in inland mountain areas. This climate variation allows researchers to explore many different biotic and abiotic issues, including pests, diseases, drought, and flooding. The Center also draws on local expertise in protected cultivation, which has been adapted to address different constraints posed by climate and pathogens.

The proximity of the Center to the People's Republic of China (PRC)—the world's largest producer and exporter of vegetables—has allowed AVRDC researchers to develop productive and pragmatic relationships with PRC scientists who have attended our training courses, actively shared germplasm, conducted collaborative research on vegetable breeding and disease management, and contributed to our conferences. The collaborative work between AVRDC – The World Vegetable Center and the People's Republic of China has grown rapidly in recent years. As a result of shared project work and many long-term interactions between our scientists and senior managers, the Center and the world's largest vegetable producing country are developing an ever-richer, more productive relationship.



A leader in climate change research

Vegetables are generally sensitive to environmental extremes, and climatic changes will influence the severity of environmental stress imposed on vegetable crops. Increasing temperature, limited soil moisture, reduced irrigation water availability, flooding, and increased salinity will be major limiting factors in sustaining and increasing vegetable productivity. Extreme climatic conditions will also negatively impact soil fertility and increase soil erosion and degradation.

Farmers in developing countries of the tropics need tools to mitigate the adverse effects of climate change on vegetable quality and yield. However, these farmers are usually smallholders, have fewer options and must rely heavily on resources available on their farms or within their communities. AVRDC – The World Vegetable Center has been working on the production challenges posed by climate change and continues to expand its research into this important area, focusing on output technologies that are simple, affordable, and accessible to poor farmers in less developed countries. The Center has developed and promoted strategies to enhance vegetable production in suboptimal conditions through water-saving irrigation management, cultural practices that conserve water and protect crops, methods to improve input efficiency and resource use, and improved crop stress tolerance.

Low-cost drip irrigation technology delivers water directly to plants through small plastic tubes to minimize water loss due to runoff and deep percolation. The use of low-cost drip irrigation is cost effective, saves labor, and allows more plants to be grown per unit of water, saving water and increasing farmers' incomes at the same time. Mulching and the use of shelters and raised beds help conserve soil moisture, prevent soil degradation, and protect vegetables

from heavy rains, high temperatures, and flooding. To improve input efficiency, the Center has developed Starter Solution Technology, which applies nutrients directly to the soil rhizosphere at an early stage of plant growth; the solution reduces fertilizer applications, increases yields, and minimizes residual fertilizer contamination.

The Center has developed and disseminated grafting technology with rootstocks resistant to bacterial wilt to prevent or minimize production losses from the disease. Grafting can also provide tolerance to soil-related environmental stresses such as drought, salinity, low soil temperature, and flooding if tolerant rootstocks are used.

Improved selection techniques are employed to identify climate-resilient genotypes and associated traits—especially from wild, related species growing in environments that do not support the growth of their domesticated relatives. Center researchers combine biotechnology and molecular breeding strategies with a strong conventional breeding program to develop improved, climate-resilient vegetables, including heat-tolerant tomato and Chinese cabbage lines; adapted tropical varieties have subsequently been released worldwide. Research is in progress to identify the genetic factors underlying drought tolerance in *S. chilense* and *S. pennellii*, and to transfer these factors into cultivated tomatoes.



Close relationship with the private sector

AVRDC – The World Vegetable Center builds strong partnerships with the private sector to ensure our research and development technologies have the greatest impact possible. These partners can be large multinational entities or small, local entrepreneurs. Although public and private sector goals may differ, the Center strives to reach a mutual understanding of the needs of each; these positive relationships have resulted in close working interactions and direct support for the Center’s unrestricted core funding.

A strong, dynamic private sector can be a powerful partner for development-oriented agricultural research. In recent years the private seed industry in Asia has grown rapidly. AVRDC – The World Vegetable Center actively supports the private seed sector by providing improved inbred lines to accelerate cultivar development, sharing disease-screening protocols, offering training courses in genetic improvement and seed production, and transferring knowledge. AVRDC has successfully established effective partnerships on a broad range of activities: molecular marker development, intellectual property rights, baseline studies, and technology production and dissemination.

The Center’s work on indigenous vegetables provides a good example of successful private sector partnerships.



Amaranth leaves have been a traditional food across Africa for centuries. Three improved lines introduced by AVRDC – The World Vegetable Center to East Africa can now be harvested as whole plants in less than a month. Sweeter and softer than the leaves of old varieties, they require much less fuel wood to cook and are extremely nutritious, providing a cheap substitute for meat. Based on *Amaranthus cruentus*, *A. hybridis*, and *A. dubius*, these three lines were released through two local seed companies in East Africa. Heavy demand for the new varieties known locally as ‘White Elma’ and ‘Green Gina’ is helping these companies thrive, and is contributing to the growth of a viable vegetable seed sector in the region.

AVRDC – The World Vegetable Center also interacts with the private sector in postharvest processing. In Vietnam there is a surplus of tomato and chili, especially at the peak of production when markets are glutted or prices are low. Technologies to handle and process tomato and chili were provided to agricultural entrepreneurs with advice on factory construction and processing equipment. In the first year of operation, the venture plans to process 1,000 t of tomato puree and 40 t of chili sauce for the domestic market; 200–300 t of pickled chili and 500 t of baby cucumber in jars for export; and 30–40 t of large fresh tomatoes and 100 t of cherry tomatoes for export and domestic markets. The farmers in the vegetable processing venture emphasized that the business could produce higher profits compare to rice production, create more jobs and markets for farmers, and improve income/living standards of farmers and others in the community.

Another opportunity for public sector involvement is in the production of components for integrated pest management strategies, such as pheromone lures. In India, an IPM strategy for controlling eggplant fruit and shoot borer used sex pheromone

traps to catch male moths; however, the pheromone was not commercially available. After the pheromone-baited lures were proven to be effective in pilot projects, local small and East Africa. Heavy demand for the new varieties known locally as ‘White Elma’ and ‘Green Gina’ is helping these companies thrive, and is contributing to the growth of a viable vegetable seed sector in the region.

AVRDC – The World Vegetable Center also interacts with the private sector in postharvest processing. In Vietnam there is a surplus of tomato and chili, especially at the peak of production when markets are glutted or prices are low. Technologies to handle and process tomato and chili were provided to agricultural entrepreneurs with advice on factory construction and processing equipment. In the first year of operation, the venture plans to process 1,000 t of tomato puree and 40 t of chili sauce for the domestic market; 200–300 t of pickled chili and 500 t of baby cucumber in jars for export; and 30–40 t of large fresh tomatoes and 100 t of cherry tomatoes for export and domestic markets. The farmers in the vegetable processing venture emphasized that the business could produce higher profits compare to rice production, create more jobs and markets for farmers, and improve income/living standards of farmers and others in the community.

Another opportunity for public sector involvement is in the production of components for integrated pest management strategies, such as pheromone lures. In India, an IPM strategy for controlling eggplant fruit and shoot borer used sex pheromone traps to catch male moths; however, the pheromone was not commercially available. After the pheromone-baited lures were proven to be effective in pilot projects, local small and medium enterprises saw a business opportunity and began manufacturing the pheromones and traps. At the end

of 2005, a total of nine small firms were selling pheromone lures. The two pioneering firms tripled their sales in two years as demand from farmers increased. Farmers benefited from the competition: with more companies making the product, the price of the lures dropped to an affordable level, lowering farmers’ production costs and increasing their net incomes compared to farmers who relied solely on pesticides.

Because of these close partnerships, AVRDC – The World Vegetable Center has a better understanding of the use and management of intellectual assets, of intellectual property rights, and how to protect those rights to ensure the Center’s target clients are able to access the technologies they need now and in the future.



Independent, flexible, and responsive

The international agricultural research centers fall into two groups: those that belong to the Consultative Group on International Agricultural Research (CGIAR), and those that do not. The CGIAR's 15 international centers, located around the world, aim to achieve sustainable food security and reduce poverty in developing countries through scientific research and research-related activities in the fields of agriculture, forestry, fisheries, policy, and environment. Several other international agricultural research centers are affiliated with the CGIAR, of which AVRDC – The World Vegetable Center is one.

Although the CGIAR centers have taken a leading role in international agricultural research, their efforts have been constrained by administrative and bureaucratic issues that affect large organizations. Individual centers are to some extent autonomous, but because much of their funding is derived from contributions made to the CGIAR as a whole, the centers must align workplans and are fiscally accountable to the central entity. This results in an extensive administrative bureaucracy that consumes a substantial amount of time and funding to support a central administration and monitoring function, individual center management and administration, and individual

supervisory Boards of Trustees. The cumbersome central oversight of the 15 organizations prompted a reorganization and realignment; this process is still in progress.

In contrast, AVRDC – The World Vegetable Center is a wholly independent entity. The Center's management reports only to the Board of Directors, which retains oversight of the Center's activities but leaves considerable scope for the Center to realign as and when appropriate. The Center can therefore react very quickly to external and internal needs without referring to an additional layer of administration. This ability to be flexible and responsive is one of the Center's greatest assets, allowing it to address emerging issues quickly and efficiently.





Regional Centers and Offices



- 01_ AVRDC - The World Vegetable Center, Headquarters - Taiwan
- 02_ Asian Regional Center (ARC) - Bangkok, Thailand
- 03_ Project Office - Vientiane, Lao PDR
- 04_ Project Office - Central Java, Indonesia
- 05_ Project Office - Honiara, Solomon Islands
- 06_ Korean Sub-Center - Suwon, Republic of Korea
- 07_ Regional Center for South Asia (RCSA) - Hyderabad, India
- 08_ Sub-Regional Center for Central Asia and the Caucasus - Tashkent, Uzbekistan
- 09_ Regional Center for Africa (RCA) - Arusha, Tanzania
- 10_ Sub-Regional Office for West and Central Africa - Bamako, Mali
- 11_ Project Office - Niamey, Niger
- 12_ Project Office - Yaoundé, Cameroon
- 13_ Project Office - Antananarivo, Madagascar



AVRDC – The World Vegetable Center was founded in 1971 with headquarters in Shanhua, Taiwan. As the Asian Vegetable Research and Development Center, its mandate was to support vegetable research for development in Asia, with a particular emphasis on Southeast Asia.

In the early 1990s, activities were expanded to sub-Saharan Africa, with some limited project work in Latin America. Regional offices in Bangkok, Thailand (Asian Regional Center) and Arusha, Tanzania (Regional Center for Africa) were opened in 1992. In 2006, a third regional center was opened in Hyderabad, India (Regional Center for South Asia). The Center was renamed “AVRDC – The World Vegetable Center” in 2007 to reflect its growing global focus. The Center intends to open a regional office for Central and West Asia and North Africa, which will include the activities currently underway in Central Asia and the Caucasus, and is considering the opportunities for a regional center in Latin America.

The Center's research and development expertise is housed under five broad themes which work as a matrix with the regional centers and headquarters, as illustrated in Figure 1. The themes cover the whole vegetable system: collecting germplasm and ensuring seed availability; producing improved lines; improving production; promoting better postharvest handling and marketing; and finally, consumption and nutrition.

Germplasm

Germplasm conservation, evaluation, and gene discovery

Goal: Biodiversity of vegetable genetic resources is preserved and its use for food and nutritional security is enhanced. *Purpose:* Vegetable germplasm collected, conserved and distributed; the collection evaluated to identify those species with desirable traits; their genes identified, characterized, and introgressed using classical and molecular technologies.

Breeding

Genetic enhancement and varietal development of vegetables

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

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

Production

Safe and sustainable vegetable production systems

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

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

Marketing

Postharvest management and market opportunities

Goal: Profitable and efficient involvement of small-scale actors in vegetable supply chains.

Purpose: Smallholders participate in high-value supply chains through enhanced collaboration, improved technologies, and capacity building.

Nutrition

Nutritional security, diet diversification, and human health

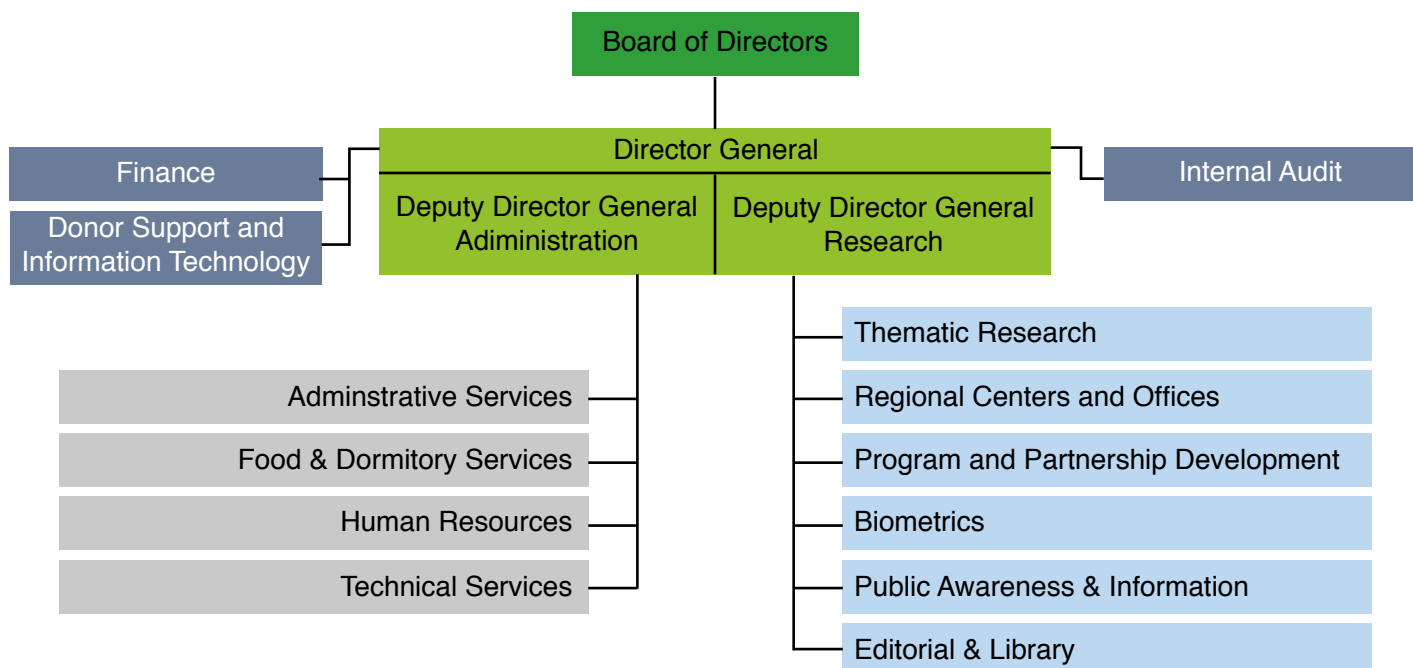
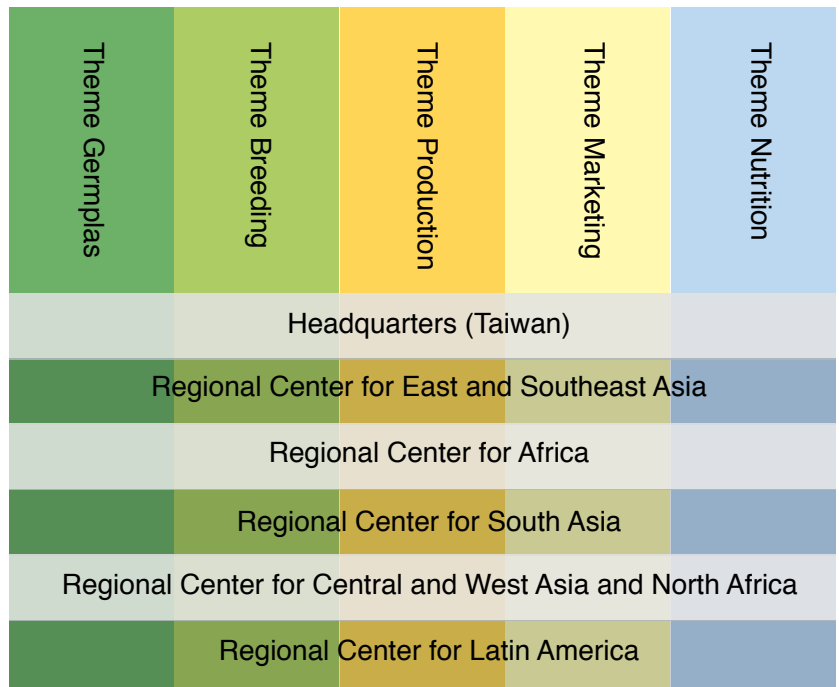
Goal: Nutrition and health of rural and urban poor consumers improved by increased consumption of vegetables.

Purpose: Increased public awareness, accessibility, and use of nutritious, diverse and safe vegetables.

Each theme conducts basic and applied research with many public and private sector partners. Additionally, each theme has a development component, with impact as the objective. Thematic research and development involves laboratory studies, field trials at locations around the world, participatory research

and development work with national agricultural research and extension systems (NARES), the private sector, nongovernmental organizations, women’s groups, farmers’ organizations, and other partners. The Center’s strong capacity-building and promotion activities with the public and private sectors ensure widespread awareness and adoption of improved vegetable technologies.

The organizational structure of AVRDC – The World Vegetable Center has been streamlined to serve the needs of a growing, increasingly decentralized institution. The Center is guided at the senior management level by a Director General and two Deputy Directors General (Research; Administration & Services). A Director of Finance, a Human Resources Director, Global Theme Leaders, and Regional Directors comprise a further level of management and participate in two committees: the Institutional Management Committee (chaired by the Director General) and the Institutional Research and Development Committee (chaired by the Deputy Director General – Research). The Center’s organizational chart is shown in Figure 2



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 works in Tanzania, Mali, Niger, Cameroon, and Madagascar on 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 vegetable consumption. Decentralizing operations and improving efficiency in finance and procurement are major goals; upgrading laboratories and other infrastructure is a priority. In 2008, RCA's 22 international and 59 national staff members completed a baseline survey of vegetable seed and production systems, established four regional vegetable breeding units and innovation platforms of private and public operators, and officially released two improved tomato lines, one in Malawi (ARP 366-4-23 under the name 'Phindu') and one in Tanzania (LBR 44-2).

RCA's 2009 activities will focus on improved vegetable variety releases and seed certification. Community seed supply systems will be strengthened as basic/foundation seed stocks will be made accessible to established or new seed companies. Looking ahead to 2010, research issues for vegetables as companion crops to staple food crops, crop compatibility, plant protection, and crop management will be identified and addressed. In 2011, staff will adapt and promote the concept of one-stop shops for vegetable plant nutrition and health care.



Central and West Asia and North Africa

The Center has had extensive activities in Central Asia and the Caucasus, coordinated by an office in Tashkent, Uzbekistan. The eight countries in the region have tested new varieties and lines, experimented with protected agriculture to reduce the effects of pests and diseases, and seek plant breeding support, particularly with respect to cucurbits.

In West Asia and North Africa, increasing interest in the potential of vegetable production to alleviate poverty and reduce malnutrition has prompted AVRDC to partner with the International Center for Agricultural Research in Dry Areas (ICARDA) to extend its research and development activities. A jointly appointed horticulturalist will lead the Center's activities in West Asia, North Africa, and Central Asia and the Caucasus. Research and development activities will focus on irrigated vegetable production, often under protected conditions, as well as the economics of vegetable production and water conservation in dry areas, and will continue the current activities in Central Asia and the Caucasus

Regional Center for South Asia

In 2006, AVRDC – The World Vegetable Center partnered with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) to open the Regional Center for South Asia (RCSA) in Hyderabad, India to address the region's vegetable research and development needs. At RCSA, three international and eight national staff focus on the conservation and exchange of germplasm; evaluation of germplasm for biotic and abiotic stress, nutritional and medicinal properties; multilocation trials; infrastructure for seed production; crop-specific IPM strategies and good agricultural practices; intensive cropping systems for peri-urban and urban agriculture; and home gardens to combat malnutrition.

In 2008, RCSA staff completed an exploratory survey on vegetable production and marketing constraints in Uttarakhand, India, funded by the Sir Ratan Tata Trust; the trust also funded a project to improve vegetable production and consumption in Jharkhand and



Punjab. A regional learning program on vegetable and legume germplasm management was well-received by the private sector, which provided some funding to help sustain the program. Training in nethouse production at AVRDC – The World Vegetable Center headquarters for three scientists from Punjab Agricultural University led to modified nethouse designs based on suggestions from stakeholders in the Punjab. 'Swarna Vasundhara,' an improved vegetable soybean variety developed from AVRDC line GC89009-1-1-2, was released; it is now being evaluated for commercialization. A project on crop legumes and vegetables for Eastern Afghanistan was completed, with 25 collaborating farmers and a considerable number of neighboring farmers replacing poppy cultivation with vegetables.

RCSA's focus for 2009 will emphasize regional training in vegetable breeding, home gardens, and nutrition for selected NARS and NGOs; evaluation of varieties under nethouse and open field conditions; seedling production technology; promotion of superior vegetable soybean and mungbean lines; collection and conservation of indigenous vegetables; and evaluation of home garden models along with recipes developed for home garden produce. In 2010, the Center's activities will include developing composting and balanced fertilization protocols; promoting starter solution and IPM technology for targeted crops; providing training in variety evaluation and crop management; organizing the Second International Conference on Indigenous Vegetables and Legumes; identifying and promoting heat- and drought-tolerant tomato lines; and establishing village-based training centers. Activities for 2011 will continue to promote home gardens, introduce vegetables in the region's watershed areas, develop and distribute materials on safe vegetable production, and develop a strategic document based on lessons learned.



Asian Regional Center

To address the specific research and development needs of Southeast Asia, the Asian Regional Center (ARC) opened in 1992 at Kasetsart University, Bangkok, Thailand. Four international and 12 national staff work on mungbean breeding, fruit fly management, tropical organic farming, indigenous vegetables, and safe vegetable production and marketing. Activities completed in 2008 include the enhancement of safe, off-season vegetable production in Vietnam; the successful hosting of the 26th and 27th Regional Training Courses on Managing Vegetable Production and Marketing, with 32 participants; and the publication of five articles in peer-reviewed journals and books.



In 2009, ARC will focus on safe, off-season vegetable production in the Mekong countries; study mungbean hybridization; conduct research on fruit fly ecology and management in bitter melon and chili; collaborate with the private sector on bitter melon research, and host the 28th Regional Training Course. 2010 activities will see the transfer of fruit fly management technology from Asia to Africa, the establishment of an international mungbean nursery, further bitter melon studies, and the 29th Regional Training Course. ARC plans to host international symposiums on mungbean research and development and fruit fly ecology and management in 2011.



Oceania

The Center commenced significant activities in Oceania in 2007 with a project funded by the Australian Centre for International Agricultural Research (ACIAR). This project focuses on smallholder vegetable production systems in the Solomon Islands.

There are many opportunities for interventions in the Pacific, addressing vegetable production in environments with high salinity and low soil fertility. Needs have been identified for some of the island nations of the Secretariat of the Pacific Community (SPC). There are opportunities for AVRDC – The World Vegetable Center to contribute to improved livelihoods in the region through adapted germplasm, seed systems and seed health, as well as protected agriculture.

In the Pacific nations there are high rates of anemia and deficiencies of vitamin A and other micronutrients. Over-nutrition (obesity) is becoming a major concern, as most urban populations rely on imported foods, many of which are of poor quality and nutritional value. Diets reflect both food availability and consumer preferences.

The Center's increased attention to the needs of Oceania will initially focus on the Solomon Islands; any expansion will depend on funding opportunities. Further activities in other Pacific nations are likely to focus on the use of adapted germplasm, seed and production systems. The seed systems activities will assure a reliable supply of quality seed, and the technologies developed in the Solomon Islands can be adapted to other locations in the Pacific.



Latin America

Negotiations to reestablish an AVRDC – The World Vegetable Center presence in Latin America began in 2005. In 2008, a likely location was identified at Zamorano University, Honduras. A base in Central America would help the Center develop strategies and technologies pertinent to Latin America, and to focus on the needs of Central American countries. Although a potential base and support have been identified, the opportunity to expand into Latin America depends on the availability of funding. The Center will not move into this new region until sufficient funds are guaranteed to ensure smooth operation of a Regional Center for Latin America for at least five years.



Since the foundation of AVRDC – The World Vegetable Center more than 30 years ago, the Center has attracted competent and dedicated partners to further its mission of alleviating poverty and malnutrition in the developing world through vegetable research and development.

Currently, AVRDC collaborates successfully with 178 partners in 46 countries. As awareness of the importance of vegetables in rural development increases, so does the number of our strategic partnerships.

Advanced Research Institutes

The Center's success is due in part to collaborations with highly reputable research laboratories in Europe, the United States, Japan, South Korea, and Australia. Both sides benefit by participating in joint projects and exchanging data, results, and staff: the Center gains access to the state-of-the-art research technologies, while the research labs can access the Center's genebank and tap into our global network of vegetable breeding expertise in different climatic regions. These successful partnerships are reflected in the Center's products, which can cope with extreme climatic stresses in the tropics, are tolerant to pests and diseases, and increase yields and income of farmers.

NARES, CSOs, and NGOs

Agriculture ministries, National Agricultural Research and Extension Systems (NARES), civil society organizations (CSOs), and nongovernmental organizations (NGOs) are essential partners for the Center.

NARES are key actors in releasing AVRDC lines and continuing research and breeding based on AVRDC material. NARES provide the Center with specific regional constraints of vegetable production, the latest information about prevalent pests and diseases, and the preferences of local consumers and

farmers. Through regular exchanges with NARES, the Center gains a better understanding of what our customers—small-scale farmers in the developing world—need; working together, NARES and the Center develop coherent strategies to address challenges to smallholder agriculture.

CSOs and local NGOs play a crucial role in disseminating new varieties and information on best practices for vegetable production. These organizations are well-connected locally and often know farmers on a personal basis. The Center has developed specific educational programs to help these organizations train trainers in good agricultural practices for vegetable production to ensure technologies and improved varieties reach the target groups.

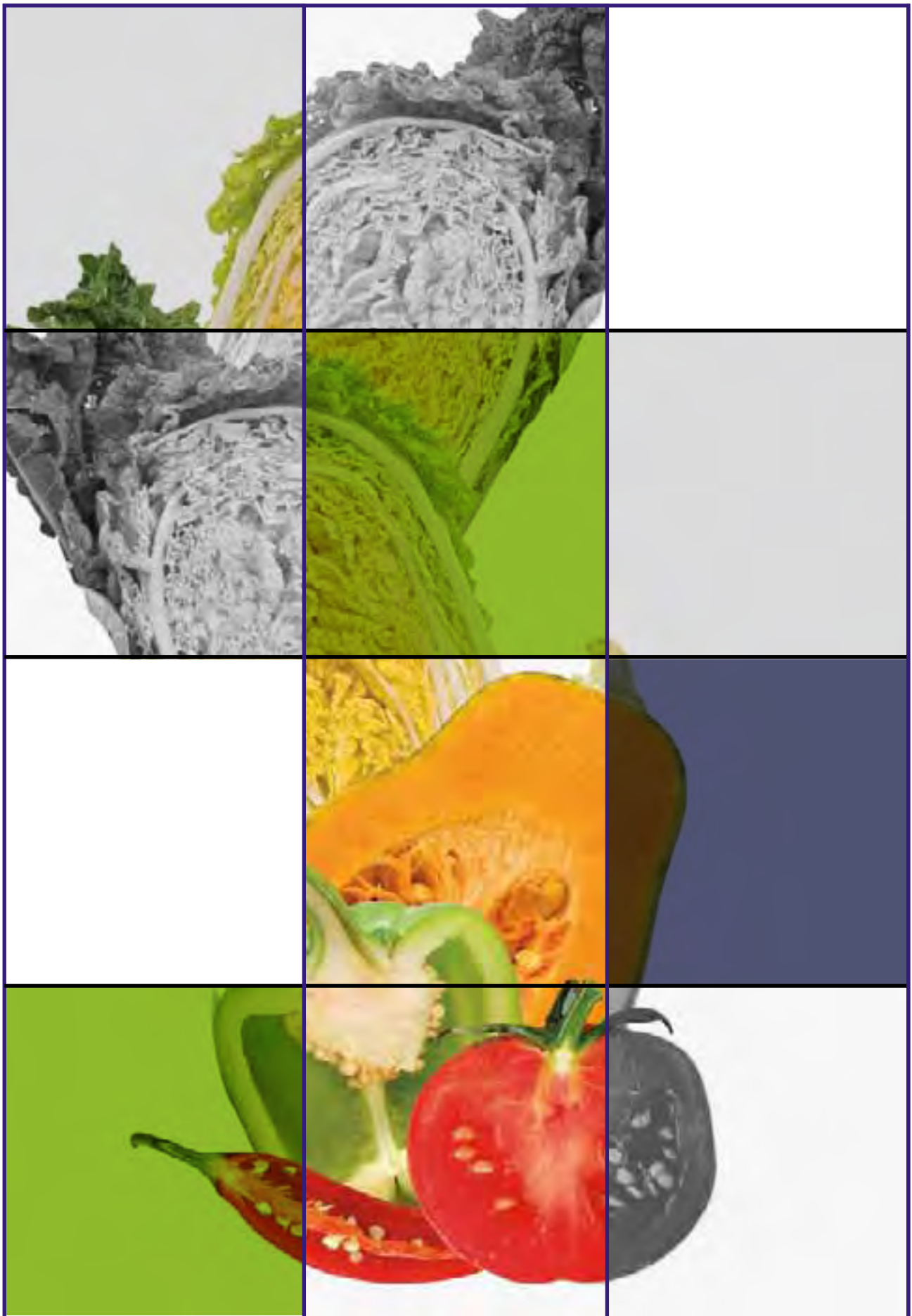
Private sector

While AVRDC – The World Vegetable Center appreciates its strong linkage with multinational seed companies in research and the development of new vegetable varieties, we put special emphasis on fostering small and medium seed enterprises in the developing world, especially in sub-Saharan Africa. By strengthening their research capacities and marketing strategies, local seed companies can provide a sustainable supply of quality seeds bred for the local market to meet the requirements of small-scale farmers. Locally adapted vegetable seed is crucial for successful agricultural production. Global seed companies limit their activities in most developing countries to seed imports; most of the varieties are not adapted to local conditions. The Center will continue supporting small and medium seed and breeding enterprises to help them become key partners in the agricultural sector.

Donors

AVRDC enjoys a fruitful relationship with many donors dedicated to rural development. The Center has a proven track record as a reliable partner capable of delivering results and impact. Our excellent partnership with the donor community is reflected by the increase in our annual budget. As well as contributing to our mission by providing the necessary financial resources, donors also are actively involved in priority setting and implementation of projects at AVRDC, and are represented on our Board of Directors. The donor community maintains a close network and aligns activities, strategies, and investments (basket funding) to make better use of financial resources while increasing impact. AVRDC is fortunate to be part of the Global Donor Platform for Rural Development, an important and influential network that enables us to interact with our partners and discuss future projects.







In total, AVRDC – The World Vegetable Center implements 77 projects worldwide in collaboration with partners to fight poverty and malnutrition in the developing world.

The projects represent the whole spectrum of the vegetable research and development continuum covered by the Center, from advanced breeding and transgenic research to outreach-oriented efforts using tools such as farmer field schools and “training-of-trainers.”

The projects highlighted below are the Center's largest projects at present; they display the broad expertise of vegetable R&D available at AVRDC.

Vegetable breeding and seed systems for poverty reduction in Africa

Funded by

Bill & Melinda Gates Foundation

Project duration

December 2006 - November 2009

Partner institutes

Public, private, and nongovernmental partners in the “hub” countries of Tanzania, Mali, Cameroon, and Madagascar and their surrounding “spoke” countries; international agricultural research centers active in the region.

Summary

This project aims to increase vegetable production, marketing, and consumption and foster rural development to reduce poverty and improve livelihoods of vulnerable groups, particularly poor women and children, in sub-Saharan Africa. To capitalize on the economic potential of vegetables in the region, hubs in each of the four major agroecological zones of sub-Saharan Africa have been established to breed introduced and indigenous vegetable varieties for pest and disease resistance; tolerance to the abiotic stresses of drought and heat; low requirement for inputs such as pesticides and fertilizers; high

economic yield; consumer preferences; and high micronutrient content. The project will then test and multiply the most promising lines, disseminate the outstanding varieties, and undertake demand creation activities to ensure widespread adoption. The four hub operations will work to develop vegetable seed system capacity in neighboring “spoke” countries; network with national vegetable breeding programs, private African seed companies, and vegetable seed supply systems; and promote increased and sustainable vegetable production, marketing, and consumption throughout sub-Saharan Africa.



Application of molecular markers to broaden the genetic base of tomato for improved tropical adaptation and durable disease resistance

Funded by

The Federal Ministry for Economic Cooperation and Development, Germany

Project duration

March 2004 - September 2009

Partner institutes

Indian Institute of Horticultural Science, India; Indian Council Agricultural Research, India; Tropical Vegetable Research Center, Kasetsart University, Thailand; National Center for Genetic Engineering Biotechnology, Thailand; University of Hannover, Germany, Central Queensland University in Australia



Summary

The project goal is to increase incomes of rural and urban poor in South Asia and Southeast Asia through better-adapted tomato cultivars that improve productivity in the hot humid lowland tropics. The project purpose is to improve heat tolerance, yield, and multiple disease resistance of tropical tomato cultivars through the application of molecular marker techniques that permit effective exploitation of wild species, and to make materials available for the use of NARES and the private sector for adoption by vegetable farmers. Molecular marker technology facilitates development of

tomato cultivars with durable disease resistance through the pyramiding of multiple resistance genes and permits tomato breeders to effectively identify beneficial genes in wild tomato (*Lycopersicon*) species and rapidly backcross them into elite cultivars. The project will enhance the capacity of AVRDC and the National Agricultural Research Systems (NARS) to efficiently use crop genetic resources and molecular markers for genetic improvement, provide molecular markers linked to beneficial genes, and finally develop high yielding, multiple disease resistant tomato lines for tropical vegetable farmers. Tomato researchers worldwide will benefit from access to the novel genes and linked molecular markers discovered in the project. Elite tomato lines incorporated with novel genes will be developed and freely distributed to public and private sectors as an international public good. Ultimately, vegetable farmers and consumers will benefit from superior tomato cultivars with durable resistance to diseases and insects, and tolerance to high temperatures, resulting in reduced risk and price seasonality.

Integrated disease management for anthracnose, Phytophthora blight, and whitefly-transmitted geminiviruses in chili pepper in Indonesia

Funded by

Australian Centre for International Agricultural Research (ACIAR)

Project duration

April 2006 - April 2010

Partner institutes

Commonwealth Scientific and Industrial Research Organisation Entomology, Australia; New South Wales Department of Primary Industry, Australia; Indonesian Vegetable Research Institute, Indonesia; Assessment Institute for Agricultural Technology, Indonesia; Bogor Agricultural University, Indonesia



Summary

In Indonesia, chili pepper (*Capsicum* spp.) is an important cash crop, providing income and nutritional benefits to smallholder producers. However, disease losses seriously affect crop productivity and supply/price reliability. *Phytophthora* blight caused by *Phytophthora capsici*, and anthracnose, caused by *Colletotrichum* species, are the two most serious fungal problems, while whitefly-transmitted geminiviruses are frequently implicated in crop failures. The development of satisfactory control measures against these diseases is a high priority for AVRDC – The World Vegetable Center and our Indonesian collaborators. The overall purpose of this project is to identify and demonstrate effective integrated strategies to limit losses to *Phytophthora* blight, anthracnose, and whitefly-transmitted geminiviruses in chili peppers in Indonesia. The project will capitalize on and complement progress made under previous AVRDC collaboration on chili disease management in Indonesia. The likelihood of success will be

enhanced through due attention to the socioeconomic context impacting technology/variety development and adoption in farmer-centered approaches, as well as through the use of advanced approaches to pathogen characterization and efficient screening methodologies. Key outputs from the project will be recommendations for culturally appropriate, improved low- and medium-input crop management approaches to control disease in chili pepper, and the identification and use of disease resistance in various breeding activities to enable sustainable development of the smallholder vegetable industry.

Integrated crop management package for sustainable smallholder gardens in the Solomon Islands

Funded by

Australian Centre for International Agricultural Research (ACIAR)

Project duration

May 2007 - April 2011

Partner institutes

New South Wales Department of Primary Industry, Australia; Ministry of Agriculture and Livestock, Solomon Islands; Kastom Garden Association, Solomon Islands; Don Bosco Technical Institute and Rural Training Center, Solomon Islands; Vois Blong Mere Solomons, Solomon Islands; Farmset Limited, Papua New Guinea

Summary

The Solomon Islands is one of the poorest island nations in the Pacific with a per capita Gross National Income of A\$925. Subsistence agriculture and fishing comprise over 80% of the livelihoods of Solomon Islanders. Smallholder vegetable gardens provide food and income for rural and urban populations, yet the area cultivated to vegetables is small compared to major staple starchy crops. However, the number of smallholder vegetable farms is rising around the capital,

Honiara, on Guadalcanal and on the neighboring islands of Malaita and Makira. Despite this encouraging trend, local production and supply cannot meet year-round domestic demand. There is great potential for improving and increasing vegetable production in the Solomon Islands. The aim of the project is to increase the economic status and income-generating opportunities for Solomon Islanders by developing and promoting integrated and improved crop management packages for smallholder vegetable gardens. The project will be based on the results of participatory and multidisciplinary rural appraisals. After the identification of promising and adapted varieties with preferred acceptance by consumers, AVRDC will facilitate production and supply of seed to meet local demands. Integrated pest management practices on selected, improved vegetable varieties will be adapted. Low-input, improved crop management practices will be evaluated in year-round vegetable gardening for sustainable production. Selected improved varieties and improved crop management practices will be promoted and disseminated for nationwide adoption and maximum impact. The improved gardening package will be disseminated through mass media, field days and demonstrations, farmer networks, the agriculture ministry, and NGOs.



Improving vegetable production and consumption for sustainable rural livelihoods in Jharkhand and Punjab, India

Funded by

Sir Ratan Tata Trust

Project duration

April 2008 - March 2013

Partner institutes

Birsa Agricultural University (BAU), Ranchi, India; Indian Council for Agricultural Research (ICAR), Ranchi, India; Tata Steel Rural Development Society (TSRDS), Jamshedpur, India; Krishi Gram Vikas Kendra (KGVK), Ranchi, India; Nav Bharat Jagriti Kendra (NBJK), Khunti, Ranchi, India; Professional Assistance for Development Action (PRADAN), Khunti, Ranchi, India; Punjab Agricultural University (PAU), Ludhiana, India; Department of Horticulture and Department of Agriculture, Government of Punjab, India

Summary

The project has two major components. The first component—safer vegetable production—will improve safe commercial vegetable production to raise the competitiveness and incomes of farmers, and expand production of vegetables as cash crops and/or alternative crops in the targeted areas of Jharkhand and Punjab. Appropriate and relevant technologies will be introduced to increase the competitiveness of rural farmers in tribal areas of Jharkhand and ensure the sustainability of the newly introduced safe vegetable cultivation methods. Providing access to markets is an important component in an overall strategy that aims to diversify farmers into vegetable production. Strengthening farmers' bargaining power could be done by supporting the organization of farmer groups, by encouraging the establishment of shorter, more direct supply chains, and by identifying market opportunities and product quality requirements for

high-value crops. Initially, one pilot group in each project site will be identified to support market access. Based on lessons learned, this activity will be scaled up in collaboration with local partners to include more groups at a later stage of the project.

The second component - home gardens for diet diversification and better health - will promote variety in diets and improve household nutrition of the rural population in India while expanding improved home garden practices in the targeted areas of Jharkhand and Punjab. Dietary diversification and modification is a sustainable, economically feasible, and culturally acceptable means to alleviate several micronutrient deficiencies simultaneously. A growing body of evidence from epidemiological studies underlines the benefits of a varied diet in improving nutritional quality and child growth in developing countries. New evidence also points to the benefits of a diverse diet in increasing longevity and reducing the rates of chronic degenerative diseases. Balanced diets and health depend on dietary diversity, not only in terms of nutrients but also in other functional components like fiber, antioxidants, immuno-modulators, lipids, and glycemic agents. A review of papers published in recent years on the impact of agricultural interventions on the nutritional status of populations showed home gardening projects had a higher success rate than other types of agricultural interventions. Home gardens can provide households with direct access to vegetables and fruits that are not readily available or within the families' financial reach. Home gardens can therefore improve the overall nutritional quality of the diet, address multiple nutrient deficiencies simultaneously, and are also a means to improve household food security.



Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of NAD Province, Indonesia

Funded by

Australian Centre for International Agricultural Research (ACIAR)

Project duration

January 2007 - January 2010

Partner institutes

New South Wales Department of Primary Industries (NSW DPI), Australia; Assessment Institute for Agricultural Technology of Nanggroe Aceh Darussalam (AIAT-NAD), Indonesia; Indonesian Vegetable Research Institute (IVEGRI), Indonesia

Summary

Indonesia suffered the most damage and loss of life of all the countries hit by the 26 December 2004 tsunami. Up to 92,000 farms and small enterprises were partially or completely destroyed. These enterprises provided employment for roughly 160,000 people before this catastrophic event. The tsunami affected nearly 40,000 hectares of agricultural land. It is estimated that over 600,000 men and women have lost their livelihoods due to this disaster. While the area planted to vegetables was a relatively small component of the devastated area, an effort to rehabilitate vegetable production could have a large positive impact. In response to the disaster, AVRDC – The World Vegetable Center is conducting a vegetable research and development project in the tsunami-affected areas of Indonesia. The aim of this project is to restore and enhance food security, nutrition, and livelihoods through rehabilitation of vegetable production, and to strengthen the integrated crop management approach with emphasis on soil and crop nutrition problems. AVRDC and its collaborators will extend vegetable production technologies to thousands of Indonesian farmers to enable sustainable, long-term

development in tsunami-affected areas. In addition, the AVRDC-led team will train trainers who can continue to use their skills to benefit the region after the project has finished. Capacity building for researchers and extension agents is also a major feature of this project, as more than 40% of staff in the target area died in the disaster; rebuilding human resources for Nanggroe Aceh Darussalam Province as a whole is extremely important. In addition, farmer-participatory research trials will be conducted to rehabilitate vegetable production and evaluate remediation options that address identified nutritional problems. Integrated nutrient management strategies for vegetables, based on field research results, will be developed and combined with other strategies, such as integrated pest management.



Integrating safe and off-season vegetable production with market through information, education, and training in Ha Tinh and Tra Vinh Provinces, Vietnam

Funded by

International Fund for Agricultural Development (IFAD)

Project duration

April 2007 - April 2009

Partner institutes

Nong Lam University, Vietnam; Hanoi Agriculture University, Vietnam

Summary

The project contributes to a sustainable improvement of incomes of poor people from rural areas in the provinces of Ha Tinh and Tra Vinh in Vietnam by developing and testing innovative approaches in safe and off-season vegetable production, and providing market information, education, and training with organizational support for replication and upscaling by governments. Objectives include facilitating access of the rural poor to participation in commodities markets by developing models and information packages for safe and off-season vegetable production and marketing. In addition, farmers will be trained in technologies for safe vegetable production, which will lead to higher agricultural incomes for families. Groups of farmers will be organized for practical on-site training and will learn to use improved varieties and how they interact in an agroecosystem. Awareness and practice of advanced agricultural practices, such as grafting to overcome seasonal disease and root stock sales, will be increased to enable farmers to participate in market activities. Livelihood improvement plans will be developed with stakeholder groups in the villages. As a result of the livelihood improvement plan, farmers are encouraged to adopt uniform planting and harvesting schedules,

which will produce sufficient quantities to encourage intermediaries to collect the harvest. Farmers will be introduced to uniform sorting, grading, and packaging methods so that they may negotiate prices as a group with market intermediaries and strengthen their bargaining power.





AVRDC – The World Vegetable Center was traditionally discipline-based, focusing on a few principal crops. However, the Center’s mandate does not specify a set of core commodities, and its crop targets and disciplinary focus have changed in response to global needs.

As the only international center with “development” specifically in its name, the Center has always tried to find an effective and appropriate balance between research to produce technologies, and development to ensure impact. The Center’s portfolio of projects means there is an ever-changing shift in the relative proportions of research and development, but the Center tries to ensure that a balance between technology development and technology dissemination and uptake is maintained.

AVRDC – The World Vegetable Center now focuses its research and development on five global themes: Germplasm, Breeding, Production, Marketing, and Nutrition. Multidisciplinary teams of scientists and support staff ensure the whole vegetable value chain is addressed and the needs of partners and stakeholders are taken into account.

The Center’s original crop focus was on tomato, mungbean, soybean, sweet potato, and Chinese cabbage. By the early 1990s, the focus had shifted and widened, comprising tomato, peppers, onion, shallot, garlic, mungbean, vegetable soybean, cabbage, Chinese cabbage, and some indigenous vegetables. At present, the Center’s research and development focuses on the Solanaceae (tomato, sweet and chili pepper), onion (and to a lesser extent, garlic and shallot), some crucifers (cabbage, Chinese cabbage, broccoli), cucurbits (particularly cucumber and pumpkin) and indigenous vegetables (especially African eggplant, bitter melon, okra, African nightshade, amaranth, Moringa, sweet potato leaves, and roselle).

The main research and development groups at the Center are in the following disciplines and groups: plant breeding (bulb alliums, crucifers, cucurbits, legumes, solanaceous species including pepper and tomato, and selection and breeding of indigenous vegetables), plant pathology (bacteriology, mycology, virology), entomology, biotechnology/molecular breeding, crop and ecosystem management, nutrition, socioeconomics, postharvest, genetic resources and genebank management, and technology dissemination. These are supported by biometrics, editorial, library, public awareness and information, and program and partnership development. The diversity of skills and disciplines within the Center’s global geographic locations results in scientific teams that are flexible, innovative, able to address changing biotic and abiotic constraints, and can respond rapidly to the consequences of economic and social change.

Theme logframes

The following logframes provide a concise map to each theme’s activities, outputs, and expected outcomes for the 2009-2011 term, and serve as benchmarks for monitoring and evaluation. Progress reports toward output targets are compiled in the annual *Year in Review*.





Theme
GERMPLASM

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 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 indigenous vegetable and legume germplasm from Asia and Africa

Output Targets 2009

- 500 accessions collected/acquired from Asia
- 200 accessions collected/acquired in Mali, Tanzania, Cameroon, Madagascar
- 30 AVRDC – The World Vegetable Center-developed elite breeding lines conserved and seeds multiplied

Output Targets 2010

- 400 accessions collected/acquired from Asia
- 90 accessions collected/acquired in Mali, Tanzania, Cameroon, and Madagascar
- 30 AVRDC – The World Vegetable Center-developed elite breeding lines conserved and seeds multiplied

Output Targets 2011

- 300 accessions collected/acquired from Asia
- 90 accessions collected/acquired in Mali, Tanzania, Cameroon, and Madagascar
- 30 AVRDC – The World Vegetable Center-developed elite breeding lines conserved and seeds multiplied

Activity 1.2

Maintain effective regeneration of priority vegetable germplasm

Output Targets 2009

- 1600 accessions of *Vigna*, *Solanum*, *Brassica*, *Phaseolus*, and *Cucurbita* species regenerated at AVRDC – The World Vegetable Center’s headquarters
- 250 accessions of *Abelmoschus*, *Amaranthus*, *Cleome*, *Cucurbita*, *Hibiscus*, *Lablab*, *Moringa*, *Solanum* and *Allium* species regenerated at the Regional Center for Africa in Tanzania and Mali

Output Targets 2010

- 1800 germplasm accessions regenerated at headquarters
- 200 germplasm accessions regenerated at the Regional Center for Africa and Mali

Output Targets 2011

- 1200 germplasm accessions regenerated at headquarters
- 200 germplasm accessions regenerated at the Regional Center for Africa

<p>Activity 1.3</p> <p>Distribute vegetable germplasm accessions and improved lines worldwide</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • 4000 genebank seed samples distributed worldwide <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • 4000 genebank seed samples distributed worldwide <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • 4000 genebank seed samples distributed worldwide
<p>Activity 1.4</p> <p>Safety duplicate AVRDC – The World Vegetable Center vegetable germplasm in other genebanks</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • 5000 accessions duplicated at the National Agrobiodiversity Center of Korea’s Rural Development Administration <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • 2000 accessions duplicated at the National Agrobiodiversity Center of Korea’s Rural Development Administration <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • 2000 accessions duplicated at the National Agrobiodiversity Center of Korea’s Rural Development Administration
<p>Activity 1.5</p> <p>Systematically store information on conservation and distribution of vegetable germplasm in AVRDC – The World Vegetable Center’s electronic databases</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • All acquisition, regeneration and distribution data generated in 2008 entered into the Center’s Vegetable Genetic Resources Information System (AVGRIS) • Characterization data of 2007 accessible in the Center’s Vegetable Genetic Resources Information System (AVGRIS) <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • All acquisition, regeneration and distribution data generated in 2009 entered into the Center’s Vegetable Genetic Resources Information System (AVGRIS) • Characterization data of 2008 accessible in the Center’s Vegetable Genetic Resources Information System (AVGRIS); headquarters and regional databases linked <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • All acquisition, regeneration and distribution data generated in 2010 put into the Center’s Vegetable Genetic Resources Information System (AVGRIS) • Characterization data of 2009 available in the Center’s Vegetable Genetic Resources Information System (AVGRIS) • Available DNA fingerprint data integrated into the Center’s Vegetable Genetic Resources Information System (AVGRIS)
<p>Activity 1.6</p> <p>Develop procedures for in-situ conservation of indigenous vegetables</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Production technologies, marketing, and policies supporting on-farm diversity of selected African and Asian indigenous vegetables developed • Farmer-managed vegetable-agroforestry trials with farmer-selected indigenous vegetables conducted by 10-15 households in the Philippines, Indonesia and Vietnam

Activity 1.7

Develop effective seed health and quarantine program at AVRDC – The World Vegetable Center’s headquarters and regional centers

Output Targets 2009

- Quarantine techniques and seed health programs strengthened at AVRDC – The World Vegetable Center’s headquarters, in close collaboration with Taiwan’s Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ)
- Quarantine and seed testing facilities at the Regional Center for Africa, Tanzania and in Mali, Madagascar and Cameroon established
- All seed shipments from AVRDC – The World Vegetable Center comply with host country regulations
- List of quarantine pests in sub-Saharan Africa assembled

Output Targets 2010

- All seed shipments from AVRDC – The World Vegetable Center comply with host country regulations
- List of quarantine pests in sub-Saharan Africa updated

Output Targets 2011

- All seed shipments from AVRDC – The World Vegetable Center comply with host country regulations
- List of quarantine pests in sub-Saharan Africa updated

Output 2: Germplasm characterized to enhance understanding and use of biodiversity in the vegetable germplasm collection

Outcome: Genetic diversity of the AVRDC – The World Vegetable Center vegetable germplasm collection 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 2009

- 1,650 accessions characterized at the Center’s headquarters and 200 accessions at the Regional Center for Africa based on standard morphological descriptors

Output Targets 2010

- 1,800 accessions characterized at the Center’s headquarters and 235 accessions at the Regional Center for Africa, based on standard morphological descriptors
- Germplasm collected from Tanzania, Mali and Cameroon in 2009 characterized and multiplied

Output Targets 2011

- 1,200 accessions characterized at the Center’s headquarters and 200 accessions at the Regional Center for Africa, based on standard morphological descriptors
- Germplasm collected from Tanzania, Mali and Cameroon in 2010 characterized and multiplied

Activity 2.2

Conduct molecular characterization, genetic relationship and diversity analysis of germplasm collections

Output Targets 2009

- Cross-compatibility of *B. oleraceae* species determined

Output Targets 2010

- A set of 92 accessions of *S. lycopersicum* var. *cerasiforme* fingerprinted and analyzed

Output Targets 2011

- A set of 330 accessions of *S. pimpinellifolium* fingerprinted and analyzed

Activity 2.3

Develop, characterize, and validate AVRDC – The World Vegetable Center’s germplasm core collections

Output Targets 2009

- Pepper (*Capsicum annuum*) core collection set revised

Output Targets 2010

- Tomato (*S. lycopersicum*) core collection developed

Output Targets 2011

- Asian eggplant (*S. melongena*) core collection developed

Activity 2.4

Conduct association analysis to identify markers and genes linked to important agronomic traits

Output Targets 2010

- Association genetic analysis of *S. lycopersicum* var. *cerasiforme* accessions conducted

Output Targets 2011

- Association genetic analysis of *S. pimpinellifolium* accessions conducted

Output 3: Trait-based characterization and screening of vegetable germplasm conducted to increase the levels and effectiveness of important horticultural traits and to diversify the genetic base of vegetable varieties

Outcome: Superior sources of genes for important horticultural traits identified

Activity 3.1

Identify and characterize sources of resistance to viral diseases

Output Targets 2009

- Seed transmission of *Cucumber green mottle mosaic virus* determined
- Cucurbit germplasm screened for resistance to *Zucchini yellow mosaic virus*, *Cucumber green mottle mosaic virus*, and begomoviruses
- Methodology for *Papaya ringspot virus - watermelon isolate* resistance screening in cucurbits developed
- Pepper germplasm screened and confirmed for resistance to begomoviruses
- Multilocation resistance of tomato to *Tomato yellow leaf curl virus* determined

Output Targets 2010

- Cucurbit germplasm screened for resistance to *Zucchini yellow mosaic virus*, *Cucumber green mottle mosaic virus*, *Papaya ringspot virus - watermelon isolate* and begomoviruses
- Methodology for polerovirus resistance screening in cucurbits developed
- Multilocation resistance of pepper and tomato to begomoviruses determined

Output Targets 2011

- Cucurbit germplasm screened for resistance to *Zucchini yellow mosaic virus*, *Cucumber green mottle mosaic virus*, *Papaya ringspot virus - watermelon isolate*, begomoviruses, and poleroviruses
- Tomato germplasm

<p>Activity 3.2</p> <p>Identify and characterize sources of resistance to fungal diseases</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Cucurbit germplasm screened for downy and powdery mildew resistance • Pepper germplasm screened for anthracnose and Phytophthora blight resistance • Tomato accessions screened for late blight resistance <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • Cucurbit germplasm screened for downy and powdery mildew resistance • Pepper germplasm screened for anthracnose and Phytophthora blight resistance • Tomato germplasm screened for late blight resistance • Tomato and pepper germplasm screened for resistance to Fusarium wilt at the Regional Center for Africa • Asian eggplant (<i>S. melongena</i>) screened for resistance to Fusarium wilt at the Regional Center for Africa <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Cucurbit germplasm screened for downy and powdery mildew resistance
<p>Activity 3.3</p> <p>Identify and characterize sources of resistance to bacterial diseases</p>	<p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • Wild tomato germplasm screened for resistance to bacterial wilt
<p>Activity 3.4</p> <p>Identify and characterize sources of resistance to insect pests</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Pepper germplasm screened for resistance to aphids and broad mites • Tomato germplasm screened for resistance to whiteflies and red spider mites <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • Pepper germplasm screened for resistance to aphids and broad mites • Tomato germplasm screened for resistance to whiteflies and red spider mites <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Tomato and pepper germplasm screened for thrips tolerance
<p>Activity 3.5</p> <p>Identify and characterize sources of tolerance to drought, heat, flooding, and salinity stress</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Screening protocols for tolerance to drought and heat stresses in tomato validated <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • Drought-tolerant accessions of solanaceous crop species and indigenous vegetables identified • Screening method for flooding tolerance developed <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Screening method for salt tolerance developed

Activity 3.6

Identify and characterize sources of tolerance to nutrient deficient soils

Output Targets 2010

- Screening method for tolerance to low nitrogen developed

Output Targets 2011

- Nitrogen-use efficient tomato accessions identified

Output 4: Specialized genetic materials, molecular tools, and methods developed to enable the more rapid development of new varieties

Outcome: Genes conferring improved horticultural traits introgressed, genetically mapped, and DNA markers developed for marker-assisted selection

Activity 4.1

Develop mapping populations and identify QTLs for resistance to biotic stresses

Output Targets 2009

- Tomato mapping populations developed/identified and screened for resistance to *Tomato yellow leaf curl virus*, bacterial wilt, late blight and whiteflies
- Pepper mapping populations developed/identified and screened for resistance to anthracnose

Output Targets 2010

- Tomato genes associated with resistance to *Tomato yellow leaf curl virus*, bacterial wilt, late blight and whiteflies identified, introgressed, and mapped
- Pepper genes associated with resistance to anthracnose identified, introgressed, and mapped

Output Targets 2011

- Pepper mapping populations developed and quantitative trait loci (QTLs) for resistance to *Phytophthora blight* identified

Activity 4.2

Develop mapping populations and identify quantitative trait loci (QTLs) for tolerance to abiotic stresses

Output Targets 2009

- Tomato mapping populations developed/identified and screened for tolerance to drought and heat stress
- Pepper mapping populations developed/identified and screened for tolerance to heat stress

Output Targets 2010

- Tomato genes associated with drought and heat tolerance identified, introgressed, and mapped
- Pepper of genes associated with heat tolerance identified, introgressed, and mapped

Output Targets 2011

- Tomato mapping populations developed/identified and screened for tolerance to salt stress

<p>Activity 4.3</p> <p>Develop mapping populations and identify quantitative trait loci (QTLs) for enhanced nutritional value</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Mapping population for high pigment accumulation in tomato fruits developed <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • High pigment gene in tomato mapped and markers developed <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Relationship of lycopene and carotene levels in high pigment phenotypes determined
<p>Activity 4.4</p> <p>Conduct fine mapping of quantitative trait loci (QTLs) and develop markers for marker-assisted selection (MAS)</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Quantitative trait loci (QTLs) for bacterial wilt resistance in tomato mapped and DNA markers developed • Ty-3 gene for resistance to <i>Tomato yellow leaf curl virus</i> fine-mapped • Bruchid resistance locus in mungbean fine-mapped <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • Anthracnose resistance locus in pepper fine-mapped <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Genes associated with drought and heat tolerance in tomato fine-mapped
<p>Activity 4.5</p> <p>Assemble and develop molecular marker sets for priority vegetable crops</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • 700 simple sequence repeats (SSR) marker set for tomato developed <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • New tomato simple sequence repeats (SSR) mapped and genetic linkage maps developed • DNA fingerprints of at least 90 AVRDC – The World Vegetable Center and Asia & Pacific Seed Association (APSA) consortium tomato lines developed <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • 300 simple sequence repeats (SSR) marker primer set for pepper assembled

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 transgenic vegetables with enhanced characteristics generated where appropriate

Activity 5.1

Allele mining to identify variation conferring superior traits

Output Targets 2009

- Allelic variation in the high pigment gene in tomato determined
- Allelic variation in priority candidate genes for drought and heat tolerance in tomato determined

Output Targets 2010

- Single nucleotide polymorphisms (SNPs) in priority candidate genes for drought and heat tolerance in tomato identified

Activity 5.2

Characterize and validate candidate genes conferring tolerance to abiotic stresses

Output Targets 2009

- Expression assays of candidate genes for heat and drought tolerance conducted

Output Targets 2010

- Critical candidate genes for heat and drought tolerance validated and prioritized

Output Targets 2011

- Critical candidate genes for salt tolerance validated and prioritized

Activity 5.3

Characterize and validate genes conferring resistance to biotic stresses

Output Targets 2009

- Known defense-related candidate genes screened for bacterial wilt resistance using the virus-induced gene silencing (VIGS) system
- Candidate genes from the cDNA subtractive library for resistance to bacterial wilt screened for efficacy

Output Targets 2010

- Functions of selected candidate genes for bacterial wilt resistance or general defense determined

Activity 5.4

Evaluate gene function and efficacy through genetic engineering

Output Targets 2009

- Transgenic tomato events carrying hairpin (RNA) constructs derived from elements of the *Tomato yellow leaf curl virus* genome generated
- RNAi events evaluated for *Tomato yellow leaf curl virus* resistance

Output Targets 2010

- RNAi constructs containing *Tomato yellow leaf curl virus* intergenic region and fragments from multiple strains developed
- RNAi tomato events generated

Output Targets 2011

- RNAi events evaluated for non-strain specific resistance to *Tomato yellow leaf curl virus*
- Transgenic tomato plants expressing candidate genes for bacterial wilt resistance generated

Output 6: Intellectual Property Rights (IPR) strategy on germplasm, transgenic and genes implemented

Outcome: AVRDC – The World Vegetable Center, national agricultural research and extension systems (NARES) and the private sector benefit from using AVRDC – The World Vegetable Center vegetable germplasm collection and improved breeding lines

Activity 6.1

Utilize, develop or improve Material Transfer Agreements (MTAs) for in-trust germplasm, breeding lines and transgenic materials that support AVRDC – The World Vegetable Center’s mission

Output Targets 2009

- Material Transfer Agreement (MTA) for germplasm accessions revised and acquisition agreement compatible with international treaties and agreements developed
- Material Transfer Agreement (MTA) for AVRDC – The World Vegetable Center-developed materials revised
- Material Transfer Agreement (MTA) for genes and constructs reviewed and upgraded
- Options for the adoption of standard Material Transfer Agreement (SMTA) evaluated

▪

Activity 6.2

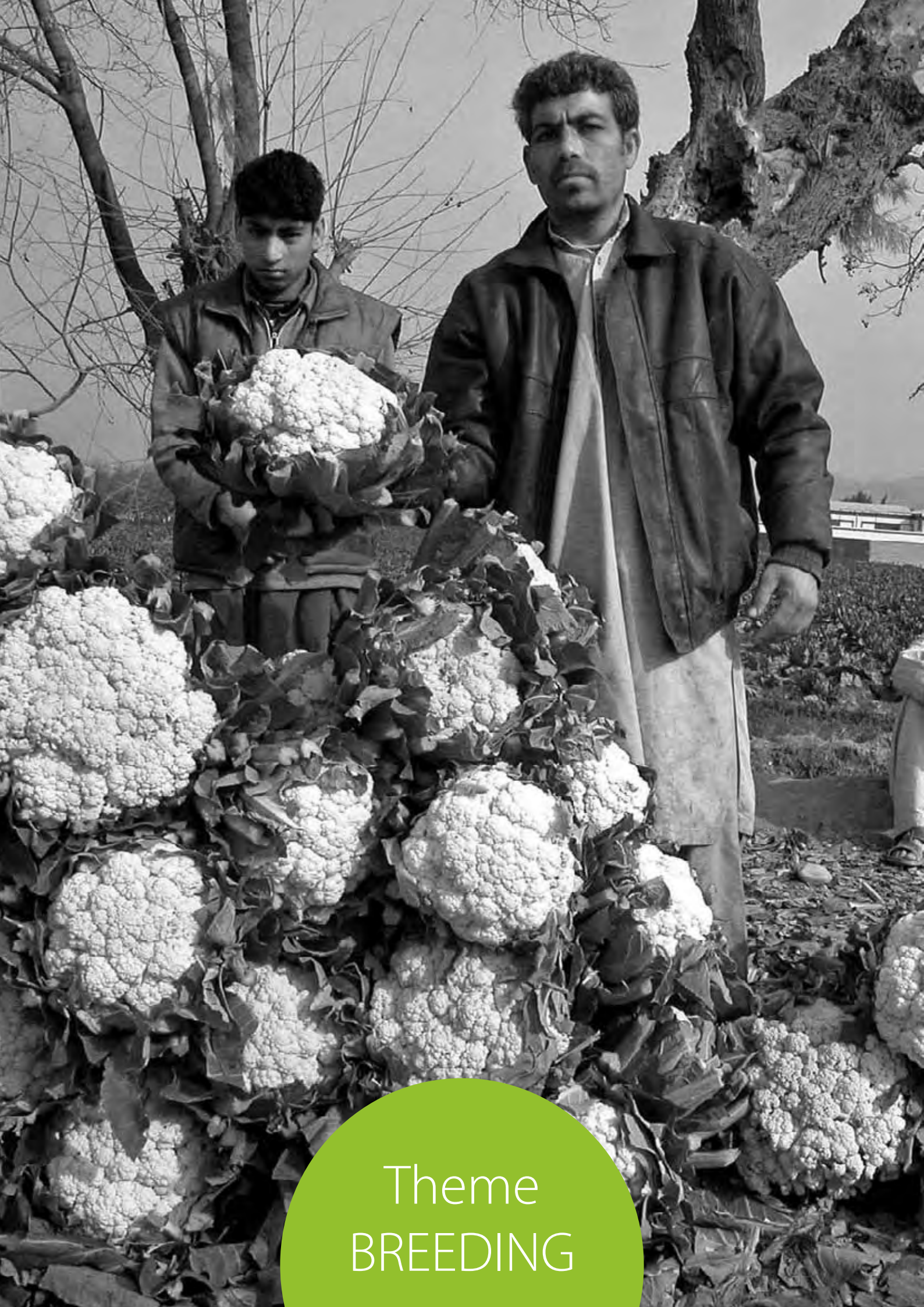
Support the development of an Intellectual Property Rights (IPR) strategy for AVRDC – The World Vegetable Center

Output Targets 2009

- Protocol for processing incoming seed to AVRDC – The World Vegetable Center developed and implemented
- Process for review of incoming Material Transfer Agreements (MTAs) developed and implemented

Output 7: Capacity developed in germplasm conservation, evaluation, characterization, and gene discovery

Outcome: Skills of national agricultural research and extension (NARES) scientists in germplasm conservation, utilization and gene discovery enhanced



Theme
BREEDING

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 and stress tolerance 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 2009

- 5-10 F6 begomovirus (incorporating Ty-3 + Ty-2 genes) resistant lines increased, and evaluated in Mali and India for resistance and horticultural traits
- Local/AVRDC – The World Vegetable Center-introduced varieties and lines evaluated in Tanzania, Mali, Cameroon, and Madagascar for adaptation, fruit qualities, and disease resistance
- Tomato entries evaluated for drought tolerance under field conditions in India

Output Targets 2010

- Lines representing different combinations of Ty genes (Ty-1, Ty-2, Ty-3) tested for resistance to diverse begomoviruses in Mali, India, Thailand, Vietnam, Tanzania
- 3-5 crosses made to incorporate acyl sugar insect resistance into begomovirus-resistant tropical tomato lines
- At least 3 segregating/back cross populations evaluated for multiple disease (late blight, early blight, Fusarium wilt) resistance in selected highland locations
- Determinate tomato lines carrying begomovirus, bacterial wilt, *Tomato mosaic virus*, and Fusarium wilt resistance evaluated in Tanzania, Mali, Cameroon, Madagascar, India, and Central Asia

Output Targets 2011

- 5-10 super-early maturity lines distributed to Tanzania, Mali, Cameroon, Madagascar, India and Central Asia for yield and horticultural evaluation
- 5-10 F5 lines with multiple disease resistance (late blight, early blight, Fusarium wilt) evaluated for horticultural and quality traits in target countries in sub-Saharan Africa
- Drought tolerant tomato lines identified and confirmed in India and other locations

Activity 1.2

Develop and distribute disease-resistant chili and sweet pepper varieties (targeting anthracnose, Phytophthora, bacterial wilt, Cucumber mosaic virus, Chilli vein mottle virus, and/or begomoviruses)

Output Targets 2009

- 1-4 advanced lines carrying resistance to two or more diseases developed
- Seed of 10-15 new lines distributed through the International Chili Pepper Nursery (ICPN)
- Seeds of 5-10 promising pepper lines increased for use in breeding programs or for direct release after further evaluation in Taiwan, Southeast Asia, and other regions

Output Targets 2010

- 1-4 advanced lines carrying resistance to two or more diseases developed
- Seed of 10-15 new lines distributed through the International Chili Pepper Nursery (ICPN) and/or International Sweet Pepper Nursery (ISPN)

Output Targets 2011

- 1-4 advanced lines carrying resistance to two or more diseases developed
- Seed of 10-15 new lines distributed through the International Chili Pepper Nursery (ICPN) and/or International Sweet Pepper Nursery (ISPN)
- Seeds of 5-10 promising pepper lines increased for use in breeding program, or for direct release after further evaluation in Taiwan and/or Southeast Asia, or other regions

Activity 1.3

Develop heat tolerant tropical sweet pepper

Output Targets 2009

- Parents and progenies evaluated in hot-humid locations (e.g. Cameroon)
- Test hybrid combinations evaluated
- 5-10 fixed lines tested and promising lines multiplied for further evaluation

Output Targets 2010

- Test hybrid combinations and promising lines evaluated and multiplied
- Mechanisms and/or markers for heat tolerance clarified

Output Targets 2011

- Test hybrid combinations and promising lines evaluated and multiplied
- Germplasm introduced to sub-Saharan Africa to evaluate and identify sources of tolerance
- Clarified mechanisms and markers for heat tolerance utilized in selection methodologies

<p>Activity 1.4</p> <p>Develop short-day red onions and yellow onions for improved yield, extended shelf-life, and/or Stemphylium resistance</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> Selected open pollinated (OP) onion lines provided to Tanzania, Mali, Cameroon, Madagascar and evaluated for their adaptation to West African conditions Hybrids and recombined progenies evaluated for bulbing, Stemphylium resistance, and seed productivity Seed multiplied at Tanzania and/or Mali for international trials <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> Selected open pollinated (OP) onion lines provided to Tanzania, Mali, Cameroon, Madagascar and evaluated for adaptation in West Africa Hybrids and recombined progenies evaluated for bulbing, Stemphylium resistance, and seed productivity Seed multiplied at Tanzania and/or Mali for international trials <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> Possibility of shuttle breeding via shipment of onion bulbs from Taiwan to Tanzania explored Seed increase of best populations of ‘Violet de Galmi’ and ‘Bombay Red’ for promotional trials Crosses to develop elite open pollinated (OP) red or yellow onion lines resistant to pink root
<p>Activity 1.5</p> <p>Develop horticulturally superior leafy crucifer and heat-tolerant broccoli</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> Leafy crucifers (pakchoy, choysum, kailaan) selected for uniformity and seed of selected entries increased Regional trials of three elite broccoli hybrids conducted in Taiwan for potential release <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> Seed of horticulturally superior leafy crucifer lines distributed to Asia & Pacific Seed Association partners and interested partners in Tanzania, Mali, Cameroon, and Madagascar <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> Seed of leafy crucifers provided for promotion in sub-Saharan Africa
<p>Activity 1.6</p> <p>Develop improved vegetable soybean and mungbean with improved nutritional and flavor qualities</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> Seed of basmati-flavored vegetable soybean lines distributed and evaluated in India, Tanzania, Mali, Cameroon, and Madagascar <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> High yielding vegetable soybean lines tested in India <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> 1-2 vegetable soybean lines promoted in India and selected countries in sub-Saharan Africa

Activity 1.7

Develop cucumber lines for improved horticultural traits, disease resistance, good fruit quality, and high gynoecy

Output Targets 2009

- Selection and generation advance of F3 families for yield and fruit qualities
- Downy mildew-resistant F4 families of the Central Asian fruit type and bitter-free F4 families of the South and Southeast Asian fruit types evaluated for yield and horticultural traits and superior entries increased or advanced

Output Targets 2010

- Downy mildew-resistant F5 families of the Central Asian fruit type evaluated for yield and fruit qualities and 5-10 selected inbred lines made available for distribution
- 30-50 F3BC1 and F5 families of bitter-free South and Southeast Asian fruit types evaluated and increased

Output Targets 2011

- 100-120 selected F6 families evaluated for yield and fruit qualities
- 20-30 downy mildew-resistant F6 families of the Central Asian fruit type evaluated and increased and 5-10 selected inbred lines increased for distribution
- 20-30 F3BC1S1 and F6 families of bitter-free South and Southeast Asian fruit types evaluated for yield and horticultural traits

Activity 1.8

Develop disease resistant and high quality summer and winter squash

Output Targets 2009

- Selection and generation advance of *Cucurbita moschata* and *C. maxima* F3 families for yield and fruit qualities
- *Zucchini yellow mosaic virus*-resistant *C. moschata* BC2 populations developed, screened, and resistant plants selfed
- 30-40 advanced inbred lines and 50-80 F3 and BC1S1 families of *C. pepo* evaluated for yield and fruit qualities and selected entries advanced

Output Targets 2010

- Evaluation and generation advance of *C. moschata* F4 families
- Screening and generation advance of ZYMV-resistant *C. moschata* BC3 populations
- Evaluation and selection of *C. maxima* F4 families and advanced inbred lines, F4 and BC1S2 F4 families of *C. pepo* for yield and fruit qualities and generation advance

Output Targets 2011

- Screening and selection of *C. moschata* BC4 populations for *Zucchini yellow mosaic virus* resistance and F5 families for yield and horticultural traits
- *C. maxima* F5 families evaluated yield and horticultural traits and generation advance of selected plants
- Advanced inbred lines, F5 lines and BC1S3 families of *C. pepo* evaluated for yield and horticultural traits and generation advance of selected entries

Output 2: African indigenous vegetables improved for disease resistance and quality

Outcome: Lines adopted directly by farmers and used by private and public sector breeding programs

Activity 2.1

Develop African indigenous vegetables with superior horticultural traits and/or disease resistance

Output Targets 2009

- 3-5 horticulturally superior lines of each target species selected in Tanzania, Mali, Cameroon and Madagascar, and seed increased for on-farm and multilocational trials
- At least 4 lines/varieties of target species increased, distributed and released by Tanzania, Mali, Cameroon, and Madagascar

Output Targets 2010

- Inheritance of resistance to fungal diseases (*Fusarium wilt*, *Verticillium wilt*) and virus (*Turnip mosaic virus*) determined and at least one line of African eggplant with resistance to two spotted mites selected
- At least 8 lines/varieties of target species increased, distributed and released

Output Targets 2011

- At least 12 lines/varieties of target species increased, distributed and released
- 1-4 lines of nightshade and African eggplant carrying resistance to *Fusarium wilt* identified and improved

Activity 2.2

Develop Pepper veinal mottle virus-resistant *Capsicum chinense*

Output Targets 2009

- *C. chinense*, *C. frutescens*, *C. baccatum*, and *C. annuum* accessions evaluated for Pepper veinal mottle virus-resistance

Output Targets 2010

- Pepper veinal mottle virus-resistant *Capsicum* spp. x *C. chinense* crosses made

Output Targets 2011

- BC1 *C. chinense* screened for resistance to *Pepper veinal mottle virus*

Activity 2.3

Okra breeding for West Africa

Output Targets 2009

- Germplasm and local okra accessions (150) collected, characterized, maintained, re-selected, and shared; additional germplasm introduced
- Artificial screening of putative *Okra leaf curl virus*-resistant lines conducted
- Superior segregants derived from cold tolerant parentage selected and advanced

Output Targets 2010

- Additional collected accessions regenerated and preliminary characterization conducted for cold tolerance, *Okra leaf curl virus*, and/or whitefly-transmitted geminivirus resistance
- Seed of purified populations and advanced lines (F6) multiplied and shared with national agricultural research systems and the Center's scientists in Mali
- Field screening of okra for whitefly-transmitted geminiviruses conducted

Output Targets 2011

- Newly introduced germplasm characterized and evaluated
- Crosses derived from local inbred lines advanced and selected, and genetics of some contrasting traits (like fruit color, resistance to *Okra leaf curl virus*) studied

Output 3: Vegetable variety testing networks and improved seed systems developed

Outcome: Improved testing of varieties leading to better understanding of genotype-environment interactions and traits critical for particular agroecosystems and markets, distribution of AVRDC – The World Vegetable Center-bred material increased to stakeholders, and efficiency of national agricultural research and extension system variety evaluation and release systems improved

Activity 3.1

Development of vegetable nurseries for global and regional testing

Output Targets 2009

- Germplasm nurseries, testing protocols, and standardized feedback forms designed/modified for tomato, cucurbits, crucifers, mungbean, vegetable soybean, onion, and African indigenous vegetables
- 10-20 selected lines of pepper and tomato evaluated in multilocal trials across West Africa
- Multilocal variety evaluation of amaranth, African eggplant, okra, nightshade, jute mallow, spider plant, cowpea, and pumpkin carried out in Tanzania, Malawi, Uganda, and Rwanda and outstanding entries identified and implications of results for future breeding objectives assessed

Output Targets 2010

- Vegetable variety evaluation technical committee for Africa becomes functional

Output Targets 2011

- Africa-specific tomato, pepper, African eggplant, and amaranth germplasm nurseries distributed and evaluated with farmer participation in at least 21 key production areas in Tanzania, Mali, and Cameroon
- Global distribution and testing of international chili pepper, sweet pepper, tomato, fresh market, crucifer and cucurbit nurseries continued, multilocal trials over years analyzed, outstanding entries identified, and implications of results for future breeding objectives assessed

Activity 3.2

Multi-environment testing of AVRDC – The World Vegetable Center's improved germplasm

Output Targets 2009

- Field trial protocols for multi-environment testing of pepper and tomato developed
- Pepper and tomato field trials established in Tanzania, Mali, Madagascar, and Cameroon

Output Targets 2010

- Replication of pepper and tomato multilocal variety trials from 2009 replicated

Output Targets 2011

- Genotype x environment interaction analyzed and implications of results for allocation of testing resources and breeding/selection strategies assessed

<p>Activity 3.3</p> <p>Identification and use of a common database management system for the Center's vegetable breeding programs</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Important criteria for a database management system for vegetable breeding, testing, distribution, and release determined • Database management system selected <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • Database management system for different breeding programs installed • AVRDC – The World Vegetable Center's plant breeding and germplasm related databases assembled <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Plant breeding and germplasm-related databases from national agricultural research and extension systems and the private sector assembled • Assembled databases standardized
<p>Activity 3.4</p> <p>Development of on-line database to facilitate seed requests of AVRDC – The World Vegetable Center's improved vegetables</p>	<p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • Prototypes of tomato and pepper databases updated and added to AVRDC – The World Vegetable Center's website • Protocol for on-line seed requests established and implemented <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • On-line databases for tomato and pepper updated • On-line databases for additional crops developed • At least 95% of seed requests for AVRDC – The World Vegetable Center's improved vegetables received are serviced
<p>Activity 3.5</p> <p>Improvement of seed systems</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Participatory selection of amaranth, African eggplant, okra, nightshade, jute mallow, spider plant, cowpea, and pumpkin carried out in Tanzania, Malawi, Uganda, and Rwanda to identify elite entries for promotion • New variety release and registration procedures developed for Tanzania <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • A network of seed growers developed by at least two private seed companies in Tanzania and neighboring countries • Commercial seeds of newly developed AVRDC – The World Vegetable Center-derived varieties produced and distributed by at least two seed companies in Tanzania and neighboring countries <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Variety release and registration procedures harmonized for Tanzania and neighboring countries
<p>Activity 3.6</p> <p>Male sterility to improve the efficiency of hybrid vegetable seed production</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Cytoplasmic male sterility (CMS) versions of additional elite chili and sweet pepper lines developed • Heterosis and combining ability in selected chili pepper backgrounds characterized at AVRDC – The World Vegetable Center • Inheritance of male sterility in mungbean determined <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • Cytoplasmic male sterility (CMS)-based hybrid sweet pepper combination recommended for production in Africa • Cytoplasmic male sterility (CMS) versions of additional elite chili and sweet lines developed <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Cytoplasmic male sterility (CMS) versions of additional elite chili and sweet lines developed



Theme
PRODUCTION

Theme Production: Safe and sustainable vegetable production systems

Goal: Substantial contributions to safe and sustainable vegetable production generated

Purpose: Increased supply of safe 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 adopted by national agricultural research and extension systems, nongovernmental organizations, and small-scale farmers

Activity 1.1

Diagnose and characterize major insect pests

Output Targets 2009

- Thrips populations in South Asia and Southeast Asia characterized using DNA markers
- Whitefly vectors transmitting begomoviruses on peppers in Indonesia characterized
- Population dynamics of fruit flies on different host plants in Thailand monitored

Output Targets 2010

- Thrips populations on major vegetable crops in sub-Saharan Africa characterized using DNA markers

Output Targets 2011

- Population structure of the legume pod borer in Southeast Asia and sub-Saharan Africa evaluated

Activity 1.2

Develop integrated pest management technologies for major insect pests

Output Targets 2009

- Efficiency of biological control practices against red spider mite on tomato and sweet pepper, thrips on tomato and chili pepper, and spotted beetle (*Epilachna* sp.) on eggplant measured in Taiwan, India, and Tanzania
- Efficacy of biological control practices (trap crops, host-plant volatile organic compounds, etc.) to manage striped flea beetle and diamondback moth on vegetable brassicas determined in Taiwan

Output Targets 2010

- Efficacy of biological control practices to manage major insect pests on tomato (*Helicoverpa armigera*), sweet pepper (broad mite, mites), and vegetable brassicas (striped flea beetle) determined in Taiwan and an integrated pest management strategy for dual-Bt gene transgenic vegetable brassicas developed in India
- Tests completed with biopesticides and locally occurring parasitoids and predators for controlling insect pests of tomato (spider mite, fruit borer), pepper (spider mite), cabbage (diamondback moth, aphid, web worm), and okra (spider mite, fruit borer, aphid) in Cameroon, Mali, and Tanzania
- Major natural enemies and entomopathogenic fungi of legume pod borer identified in Southeast Asia and control efficacy of *Maruca vitrata* multiple nucleopolyhedrovirus (MaviMNPV) validated in Southeast Asia and sub-Saharan Africa

	<p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Parasitism of major parasitoids on legume pod borer determined and effective sex pheromone blends identified • Integrated pest management packages for selected insect pests on target crops for low-input and nethouse production systems in India assembled and indigenous parasitoids and predators of major lepidopteran insects on target vegetables in the Himalayan foothills identified and monitored • Exotic parasitoids and commercially available sex pheromones against the target insect pests of tomato, pepper, cabbage, and okra identified and evaluated in Cameroon, Mali, and Tanzania; and integrated pest management technology for red spider mite, aphid and fruit fly on tomato, sweet and hot pepper developed in Madagascar
<p>Activity 1.3</p> <p>Diagnose and characterize major bacterial diseases</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Phylogenetic origin of the bacterial wilt pathogen (<i>Ralstonia solanacearum</i>) of tomato in India characterized • Genes associated with virulence of the highly virulent tomato strain Pss190 of bacterial wilt on Hawaii 7996 identified using genomic subtractive hybridization <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • Genes associated with virulence of the highly virulent tomato strain Pss190 of bacterial wilt on Hawaii 7996 identified using transposon mutagenesis • Phylogenetic origin of the bacterial wilt pathogen (<i>R. solanacearum</i>) isolated mostly from tomato in sub-Saharan Africa characterized • Variation in aggressiveness on tomato of <i>R. solanacearum</i> in sub-Saharan Africa evaluated <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Molecular markers associated with aggressiveness of phylotype I strains of <i>R. solanacearum</i> on tomato developed
<p>Activity 1.4</p> <p>Develop integrated management technologies against major bacterial diseases</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> • Soil effect on the control efficacy of Indian mustard on tomato bacterial wilt determined • Control efficacy of phosphorous acid on tomato bacterial wilt determined <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> • Effect of organic amendments in controlling tomato bacterial wilt determined • Methods to sustain populations of microbial biocontrol agents in the soil determined <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> • Contribution of a sustained population of microbial biocontrol agents in enhancing control efficacy on soil-borne diseases determined

<p>Activity 1.5</p> <p>Diagnose and characterize major fungal diseases</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> Races of tomato late blight pathogen in Tanzania determined Changes in populations of late blight pathogen monitored and races of Asian soybean rust determined in Taiwan Pathotype of <i>Colletotrichum acutatum</i>, causal agent of pepper anthracnose, in Taiwan characterized <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> Pathogens of tomato late blight, buckeye rot, Phytophthora root rot, and cucumber powdery mildew characterized and monitored in Taiwan Races of tomato Fusarium wilt in Tanzania determined Pathotype of chili Phytophthora blight pathogen in Indonesia and Tanzania and Colletotrichum species associated with pepper anthracnose in Indonesia determined <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> Pathogenicity of <i>Verticillium</i> sp. isolates on tomato, African eggplant and nightshade determined <i>Colletotrichum</i> spp. associated with chili anthracnose in Tanzania determined Race of cucumber downy mildew pathogen in Taiwan determined
<p>Activity 1.6</p> <p>Develop integrated management technologies against major fungal diseases</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> Integrated management technologies for pepper Phytophthora blight and anthracnose developed Integrated management technologies for pepper Phytophthora blight and anthracnose evaluated in Tanzania and validated in Indonesia Importance of wild soybeans as alternative hosts of Asian soybean rust determined and integrated pest management package for soybean rust developed <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> Efficacy of biopesticides and cultural practices in controlling tomato late blight and <i>Phytophthora capsici</i> evaluated for tomato in Taiwan Basic components of integrated management technologies for cucumber powdery mildew developed <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> Basic components of integrated management technologies for tomato late blight and <i>P. capsici</i> developed for tomato Basic components of integrated management technologies for cucumber downy mildew developed for cucurbits
<p>Activity 1.7</p> <p>Detect and characterize major viral diseases</p>	<p><i>Output Targets 2009</i></p> <ul style="list-style-type: none"> Genomic sequence of poleroviruses infecting cucurbits in Mali and Taiwan determined Pepper vein mottle virus isolate collected in Taiwan characterized and survey of begomoviruses infecting pepper in Indonesia conducted Infectious clone of <i>Tomato yellow leaf curl Thailand virus</i> constructed <p><i>Output Targets 2010</i></p> <ul style="list-style-type: none"> Cucurbit, pepper, and tomato begomoviruses and other important viruses from Asia and Africa characterized and monitored Infectious clone of poleroviruses from Taiwan constructed <p><i>Output Targets 2011</i></p> <ul style="list-style-type: none"> Cucurbit viruses in Asia and Africa, and pepper viruses in Asia, Africa, and Central America identified and characterized Strain/species specific primers for polerovirus identification developed Begomoviruses infecting tomato in Taiwan assessed

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

Characterize water requirements of selected vegetables under different agroecosystems

Output Targets 2009

- Crop coefficients to determine water requirements for each growth stage developed for selected vegetables
- Irrigation water requirement characterized for selected vegetables in various agroecosystems in Asia (Taiwan, Cambodia, Indonesia, Philippines, Solomon Islands) and Africa (Niger)
- Simple tools for soil moisture measurements developed and validated for use in irrigation scheduling

Output Targets 2010

- Water use efficiency determined and compared between selected vegetable crop species in different agro-ecological regions in Asia (Taiwan, Cambodia, Indonesia, Philippines, Solomon Islands) and Africa (Niger)

Activity 2.2

Develop/validate technologies to improve water use efficiency under different agroecosystems

Output Targets 2009

- Simple and low-cost drip irrigation technology validated for various soil types during the dry season in Cambodia, Indonesia, Philippines, and Solomon Islands

Output Targets 2010

- Simple and low-cost drip irrigation technology developed for various soil types during the dry season developed in Cambodia, Indonesia, Philippines and Solomon Islands, and validated in Niger

Output Targets 2011

- Practices to apply fertilizers with drip irrigation for increased nutrient use efficiency developed

Activity 2.3

Develop technologies to improve soil nutrient use efficiency and soil sustainability

Output Targets 2009

- Simple, quick soil testing kits for determining soil pH, nitrate, phosphorus, and potassium developed

Output Targets 2010

- Efficacy of simple, quick soil testing kits for determining soil pH, nitrate, phosphorus, and potassium validated
- Enhancement of nutrient retention in rhizosphere-soil zone with biocharcoal determined in mini-plots

Output Targets 2011

- Simple, quick testing kits for determining nitrate and potassium in petiole sap of selected vegetables developed
- Principles in formulating rhizosphere-soil management packet for field application developed

Activity 2.4

Develop balanced fertilization technologies for selected vegetables

Output Targets 2009

- Nutrient requirement patterns of tomato analyzed and balanced fertilization technologies developed

Output Targets 2010

- Nutrient requirement patterns of chili pepper analyzed and balanced fertilization technologies for pepper developed
- Principles and application protocol of vegetable balanced fertilization technologies published as a technical bulletin

Output Targets 2011

- Nutrient requirement patterns of amaranth, kale, cabbage, and okra determined and balanced fertilization technologies developed

Activity 2.5

Develop integrated crop and soil fertility management packages of selected vegetables

Output Targets 2009

- Principles of integrating suitable crop/soil management practices evaluated for selected vegetables in Cambodia, Indonesia, Philippines, and Solomon Islands
- Training manual on integrated crop and soil management packages published
- Improved crop management practices and cropping systems for selected indigenous vegetables in Malawi, Mozambique, Tanzania, Rwanda, and Uganda developed

Output Targets 2010

- Improved crop/soil management package developed for selected vegetables in sub-Saharan Africa (Tanzania, Mali) and South Pacific (Solomon Islands)

Output Targets 2011

- Improved crop/soil management package developed for selected vegetables in Central Asia (Uzbekistan=

Output 3: Improved vegetable production technologies integrated, disseminated, and impact assessed

Outcome: Farmers adopt new technology packages 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 2009

- Major insect pests on target crops under open-field and nethouse production systems in rural and semi-arid areas of India identified
- Integrated pest management packages for eggplant fruit and shoot borer validated in Tamil Nadu and Jharkhand, India
- Insect pest and disease surveys conducted in Madagascar, Tanzania, Cameroon, and Mali and major biotic constraints in the dry season determined

Output Targets 2010

- Major insect pests on selected vegetable crops under open-field and nethouse production systems in rural and semi-arid areas of India monitored
- Seasonal occurrence of major insect pests on target vegetable crops in the Himalaya foothills in India identified
- Insect pest and disease surveys conducted in Madagascar, Tanzania, Cameroon, and Mali and major biotic constraints of targeted vegetables identified and documented

Output Targets 2011

- Participatory appraisal of vegetable farming conducted in poor, low-input areas of Indonesia and dissemination strategies determined for integrated pest and crop management technologies
- Seasonal occurrence of major insect pests on target vegetable crops in the Himalaya foothills in India monitored

Activity 3.2

Adapt integrated production technologies for targeted systems or regions

Output Targets 2009

- Improved vegetable production technologies with medium levels of inputs for tomato, chili/sweet pepper, and cucumber during wet and dry seasons adapted for Indonesia, Philippines, and Cambodia
- Soil remediation techniques and starter solution technology adapted in tsunami-affected areas of Indonesia via farmer participatory trials
- Integrated crop production technologies for tomato, chili/sweet pepper, and cucumber during wet and dry seasons adapted for the Solomon Islands

Output Targets 2010

- On-farm performance of affordable microirrigation based vegetable production documented in selected agro-systems of Cambodia and evaluated in Niger
- Improved vegetable production technologies (e.g. suitable nethouse design, healthy seedling production technology, and adaptation of mungbean and soybean rotations) adapted in rural India
- Starter solution technology adapted for chili pepper in the Solomon Islands

Output Targets 2011

- Soil health management technologies for selected vegetables in targeted areas of India adapted
- Improved low-input vegetable production technologies adapted for targeted area

Activity 3.3

Strengthen capacity of local partners and farmers to promote technology adoption

Output Targets 2009

- Improved vegetable production technologies disseminated in Indonesia through training of farmers
- Extension publications focused on soil improvement and fertility management produced
- Annual Regional Training Course on improved vegetable production conducted in Thailand and training of trainers on integrated pest management and drip irrigation conducted in the Solomon Islands

Output Targets 2010

- Chili integrated disease management technologies disseminated via field days in Indonesia
- Integrated vegetable management technologies disseminated to farmers in collaboration with NARES/NGOs in the Solomon Islands
- Training courses on variety evaluation, integrated pest management, vegetable production under nethouses, and advances in breeding of vegetables and vegetable legumes conducted in India

Output Targets 2011

- Training courses on variety evaluation, integrated pest management, and soil fertilization aspects of safer vegetable production conducted in India
- Extension materials on safer vegetable production technologies published

Activity 3.4

Understand farmers' behavior, cost-benefit, and constraints/opportunities of technology adoption

Output Targets 2009

- Cost-benefit analysis for alternative vegetable production technologies in high-input production systems (Java) and low-input production systems (tsunami-affected areas of Aceh) in Indonesia conducted and documented
- Factors affecting adoption of chili pepper in high-input and low-input production systems in Indonesia analyzed and documented
- Performance and impact of adapted farmer-field schools in tsunami-affected areas of Indonesia analyzed and documented

Output Targets 2010

- Economic analysis of various low-cost microirrigation technologies for vegetable production in low-input production systems of Cambodia and Niger evaluated and documented
- Costs and benefits of various crop management technologies for vegetables in Solomon Islands analyzed and recommendations developed for 'best practices'
- Farmers' knowledge of pesticide (mis)use and health-associated impacts in India analyzed and documented

Output Targets 2011

- Policy and institutional constraints for microirrigation technologies analyzed and recommendations developed for wide-scale adoption in tropical Asia (Cambodia) and in the Sahelian region (Niger) of sub-Saharan Africa
- Gaps at policy level for integrated pest management and effective use of pesticides identified and entry points for improvements suggested for India

Activity 3.5

Understand the impact of improved technologies on production systems and livelihoods

Output Targets 2009

- Production characteristics of chili in high-input production systems (Central Java) and other vegetables in low-input production systems (tsunami-affected area in Aceh) in Indonesia documented
- Characteristics of the vegetable cultivation practices of small-scale vegetable farmers in the Solomon Island analyzed and documented
- Characteristics of vegetable production in rural tribal areas in India analyzed and documented

Output Targets 2010

- Impact of improved chili production technologies on rural livelihoods in high-input production systems in Indonesia assessed and documented
- Performance and impact of Private Extension Agents for technology transfer assessed and documented in Cambodia
- Economic performance of affordable microirrigation technologies for vegetables in water-scarce regions of Cambodia and Niger analyzed and documented

Output Targets 2011

- Impacts of affordable microirrigation technologies for vegetable production in water-scarce regions of Cambodia and Niger assessed and documented
- Improved strategies for wider-scale adoption of affordable microirrigation technologies for water-scarce regions of Cambodia and Niger developed and recommended
- Impact on rural livelihoods of various integrated crop management practices for vegetables in selected low-input production systems in Indonesia assessed and documented



Theme
MARKETING

Theme Marketing: Postharvest management and market opportunities

Goal: Profitable and efficient involvement of small-scale actors in vegetable supply chains

Purpose: Smallholders participate in high-value supply chains by means of enhanced collaboration, improved technologies, and capacity building

Output 1: Approaches for enhanced market cooperation to strengthen vegetable supply chains developed and recommended

Outcome: Small-scale farmers and other actors in sub-Saharan Africa, Asia, and the Pacific benefit from improved market coordination along vegetable supply chains

Activity 1.1

Identify, and map and analyze components of supply chains for high-value crops in sub-Saharan Africa, South Asia, Southeast Asia, and the Pacific

Output Targets 2009

- Vegetable seed supply chains mapped in Tanzania
- Vegetable supply chains mapped in India, the Solomon Islands, and two countries in sub-Saharan Africa

Output Targets 2010

- Supply chains for microirrigation technologies mapped in Cambodia and Niger
- Farmers' modes of cooperation, and outcomes on transaction cost and bargaining power in vegetable supply chains analyzed in Tanzania and India
- Market potential of new vegetable species and varieties evaluated in domestic markets of the Solomon Islands

Output Targets 2011

- Consumers' willingness to pay for pesticide-free vegetables assessed in two states in India
- Participatory approaches to analyze supply chains for high-value crops' input and output markets promoted among national agricultural research and extension systems, project partners, and the scientific community

Activity 1.2

Facilitate the establishment of enhanced market coordination mechanisms for vegetables in supply chains geared towards domestic markets of sub-Saharan Africa, South Asia, and Southeast Asia

Output Targets 2009

- Processes of the vegetable supply chain, including mode of farmer-buyer linkages, defined in Mozambique
- Critical bottlenecks in African indigenous vegetable supply chains identified in Tanzania, Rwanda, Uganda, and Malawi

Output Targets 2010

- Success and failure factors of strategies for linking smallholders to vegetable supply chains identified in Tanzania
- Interventions for enhanced competitiveness of farmers for vegetable supply chains that enhance bargaining power in India identified

Output Targets 2011

- Recommendations developed for strengthening supply chain systems for microirrigation technologies in Southeast Asia and the Sahel in West Africa.
- Recommendations on appropriate pro-poor business models in high-value vegetable supply chains developed and tested in collaboration with partners at one site in India and two sites in sub-Saharan Africa
- Lessons learned during pilot phase scaled up by initiating policy dialogue on regulations to strengthen supply chains of safe vegetables in India

Output 2: Low-cost solutions to minimize postharvest loss in fruit and leafy vegetables developed and adapted to local conditions

Outcome: Postharvest research capacity of national horticulture scientists enhanced and regional scientific platforms and networks established

Activity 2.1

Build postharvest research capacity of national scientists and establish postharvest research networks in Southeast Asia and sub-Saharan Africa

Output Targets 2009

- Postharvest research capacity building (including training, workshops, graduate degree programs) and networking activities continued in Southeast Asia

Output Targets 2010

- State-of-the-art of vegetable postharvest technologies in sub-Saharan Africa published
- Manpower (core scientists) and physical capacity-building programs conducted for two countries in sub-Saharan Africa, including but not limited to training, workshops, scientific conference participation, advanced degree programs, and establishment of postharvest technology laboratories or upgrading of existing ones
- Sub-Saharan Africa Postharvest Technology network organized

Output Targets 2011

- Manpower and physical capacity-building programs in two countries in sub-Saharan Africa continued
- Sub-Saharan Africa postharvest technology networking activities (e.g. workshops, between country visits) conducted

Activity 2.2

Develop low-cost postharvest handling and processing technologies for fruit and leafy vegetables

Output Targets 2009

- Need for grades and standards for African indigenous vegetables and orange-fleshed sweet potato assessed in Kenya and Tanzania
- At least five low-cost postharvest technologies (packaging, storage, solar drying, fermentation, sauce processing) for priority fruit and leafy vegetables developed and made available for dissemination in Cambodia, Laos, and Vietnam

Output Targets 2010

- Research and development programs to develop low-cost postharvest technologies (fresh produce handling and processing) for priority vegetables in sub-Saharan Africa conducted and findings disseminated in scientific fora

Output Targets 2011

- Technical and economic analysis of most promising postharvest technologies for priority vegetables conducted in sub-Saharan Africa
- At least five low-cost postharvest technologies for fruit and leafy vegetables made available for dissemination in sub-Saharan Africa

Output 3: Training curricula and materials for proper postharvest management, food safety, and enhanced marketing skills developed and “training of trainers” programs developed

Outcome: Small-scale farmers and other supply chain agents in Southeast Asia, South Asia, and sub-Saharan Africa have increased their capacity for proper postharvest management and marketing

Activity 3.1

Develop training curricula and materials on proper postharvest management and marketing skills for trainers in South Asia, Southeast Asia, and sub-Saharan Africa and conduct training courses

Output Targets 2009

- Training curricula and materials for vegetable postharvest technology, food safety and marketing developed, translated into country languages, and disseminated in the various training programs in Cambodia, Laos, and Vietnam in collaboration with other development agencies
- Training of trainers (ToT) programs with at least 600 trainers conducted in Cambodia, Laos, and Vietnam
- Technology users’ training programs with at least 6,000 participants (farmers, processors, other supply chain actors) conducted in Cambodia, Laos, and Vietnam

Output Targets 2010

- Training materials for proper postharvest management developed and promoted in India and two countries of sub-Saharan Africa
- Farmer participatory technology testing for raising awareness on food safety and occupational health conducted in India

Output Targets 2011

- Training materials to improve marketing skills developed and distributed in target countries
- Training curricula and materials for vegetable postharvest technology, food safety and marketing developed, translated into country languages, and disseminated in the various training programs in sub-Saharan African countries in collaboration with other development agencies
- Training of trainers programs for at least 50 trainers per country conducted in two countries of sub-Saharan Africa



Theme
NUTRITION

Theme Nutrition: Nutritional security, diet diversification, and human health

Goal: Nutrition and health of rural and urban poor consumers improved by increased consumption of vegetables

Purpose: Increased public awareness, accessibility and utilization of nutritious, diverse, and safe vegetables

Output 1: Information on food choice, consumption, and health outcomes compiled/obtained and made available

Outcome: Research communities have greater understanding of consumers' attitudes toward food safety, health, and the nutritional benefits of home gardening, and adjust their research activities accordingly

Activity 1.1

Assess food choice and its determinants for food safety in India

Output Targets 2010

- Knowledge base on consumer preferences, their knowledge on pesticide residues and fears regarding existence of health risks and consumers' willingness to pay for pesticide-free vegetables determined in two states in India

Activity 1.2

Assess consumption and health outcomes of home gardeners in India

Output Targets 2009

- Vegetable consumption of households participating home garden training in target areas of Punjab and Jharkhand evaluated

Output Targets 2010

- Nutritional health indicators of household members adopting home gardens in target areas in Punjab and Jharkhand assessed

Output Targets 2011

- Mid-term nutritional and socioeconomic impact of home garden practice on village members in Punjab and Jharkhand monitored

Output 2: Nutritional and functional values measured and nutritionally improved food preparation methods established

Outcome: Researchers and general public have greater appreciation of the nutritional and functional values of African and South Asian indigenous vegetables and make more nutritionally effective uses of these vegetables

Activity 2.1

Conduct nutritional and functional analysis of indigenous vegetables from Africa and South Asia

Output Targets 2009

- Indian indigenous vegetables collected from home gardens and protein, vitamin A, and iron contents measured
- Anti-diabetic properties of bitter melon accessions assessed in vitro and 1-2 potential accessions evaluated in vivo (using animal models)
- Protocol for anti-tumor assay and pro- and anti-inflammation established and validated for indigenous vegetables

Output Targets 2010

- Iron accessibility and anti-nutrient factors of selected Indian indigenous vegetables evaluated
- High anti-diabetic bitter melon accessions identified and promoted
- Anti-tumor activity, pro- and anti-inflammation qualities of selected African and South Asian indigenous vegetables evaluated

Output Targets 2011

- Intervention approach using bitter melon for ameliorating effects on diabetes identified
- Information on anti-tumor, anti- and pro-inflammation properties of selected indigenous vegetables published and potential food intervention approaches identified to enhance immune function

Activity 2.2

Develop nutritionally improved recipes and food preparation methods based on Indian traditional food practices for promotion of vegetables and nutrition to household women in targeted areas in India

Output Targets 2009

- Carotenoid and iron retention of vegetable dishes commonly prepared in north India measured, food preparation methods modified to improve their retention
- 20-30 recipes with vegetables high in protein, vitamin A, iron, ascorbic acid, and fiber developed based on nutritionally improved preparation methods and vegetable items available in home gardens in targeted sites of Punjab and Jharkhand

Output Targets 2010

- Nutrition leaflets, posters, and booklets developed and printed for promotion in Punjab and Jharkhand

Output Targets 2011

- Nutritionally improved and modified food practices and recipes recommended and promoted in Punjab and Jharkhand

Output 3: Breeding of nutritionally enhanced vegetables

Outcome: Nutritionally enhanced varieties of tomato, pepper and cucurbits are available to home gardeners, nongovernmental organizations, and public and private sector breeding programs

Activity 3.1

Develop vegetable lines/ varieties with improved contents of nutrients or bioactive compounds

Output Targets 2009

- 3-5 tomato lines high in carotenoids increased for international distribution; *S. chilense* introgression lines evaluated for carotenoids, flavonoids and antioxidant activity
- Intercrosses to combine multiple disease resistance in paprika lines selected
- Trial of 10 commercial pumpkin varieties for carotenoid content and trial of 17 bitter gourd accessions for anti-diabetic properties evaluated

Output Targets 2010

- 3-5 tomato lines with high lycopene and virus resistance distributed internationally; selected *S. chilense* inbred lines high in nutrients crossed to elite tomato lines
- Superior paprika selections evaluated for pigments (carotenoids), pungency, disease resistance, and yield
- Carotenoid evaluation trial of commercial pumpkin varieties and bitter gourd evaluation trial for anti-diabetic activity reported

Output Targets 2011

- High-pigment paprika in target regions in West Africa, India, and Southeast Asia evaluated

Output 4: Food-based intervention packages developed

Outcome: AVRDC – The World Vegetable Center, national agricultural research and extension systems, and nongovernmental organizations promote and distribute home garden seed kits to poor households in India and sub-Saharan Africa

Activity 4.1

Develop home garden packages of which the technologies can be adapted by poor households in Eastern Africa and India, and the vegetable cropping system designed to enable year-round production for households to continuously have access to vegetables

Output Targets 2009

- African indigenous vegetable home garden technology package including indigenous vegetable seeds and training materials prepared, and at least 2 home gardens set up in Rwanda, Uganda, Tanzania, and Malawi for demonstration and promotion
- Participatory home gardens designed and demonstrated in Punjab and Jharkhand

Output Targets 2010

- African indigenous vegetable home garden technology packages including indigenous vegetable seeds continually demonstrated, promoted, and distributed in Rwanda, Uganda, Tanzania, and Malawi
- Nutritional yield and contribution of designed home gardens to household diets of Punjab and Jharkhand investigated

Activity 4.2

Develop nutritious vegetable seed kits for disaster response in tropical and sub-tropical Africa and Asia

Output Targets 2009

- 3-12 nutritious, hardy vegetable crops selected in Taiwan, Thailand, India, Tanzania, and Mali for seed kits
- Easy-to-understand instructions on cultivation, field management, and food preparation in various local languages prepared for publication

Output Targets 2010

- 10,000 kits per location produced in Taiwan, Thailand, India, Tanzania and Mali, and made available for distribution in response to future disasters in Africa and Asia

Output Targets 2011

- 10,000 kits per location produced in Taiwan, Thailand, India, Tanzania and Mali, and made available for distribution in response to future disasters in Africa and Asia

Output 5: Dissemination and promotion of production, utilization, and consumption of nutrient-rich vegetables

Outcome: Poor households in India and sub-Saharan Africa grow and consume nutrient-rich vegetables

Activity 5.1

Promotion campaigns/events to encourage production, utilization, and consumption of nutrient-rich vegetables in India and sub-Saharan Africa

Output Targets 2009

- African and Indian home garden designs promoted and demonstrated to trainees, visitors, and media in Tanzania and India
- Home garden seed kits produced and distributed to interested local farmers, national agricultural research and extension systems, researchers, and trainees in India and Tanzania

Output Targets 2010

- African and Indian home garden designs promoted and demonstrated to trainees, visitors, and media in Tanzania and India
- Home garden seed kits produced and distributed to interested local farmers, national agricultural research and extension systems, researchers, and trainees in India and Tanzania

Output Targets 2011

- African and Indian home garden designs promoted and demonstrated to trainees, visitors, and media in India and Tanzania
- Home garden seed kits produced and distributed to interested local farmers, national agricultural research and extension systems, researchers, and trainees in India and Tanzania

Activity 5.2

Conduct training courses on home garden production, food and nutrition in India and sub-Saharan Africa

Output Targets 2009

- Two 2 to 3-day training courses per month delivered on techniques of home garden production, processing and preservation of vegetables for mainly women's groups, small scale farmers, nongovernmental organization personnel, and agricultural/nutrition/health researchers and extensionists in Tanzania and Rwanda
- 1-2 training courses on home gardens, food and nutrition conducted for selected national agricultural research and extension services and nongovernmental organizations in Punjab and Jharkhand, India

Output Targets 2010

- Two 2 to 3-day training courses per month delivered on techniques of home garden production, processing, and preservation of vegetables for mainly women's groups, small scale farmers, nongovernmental organization personnel, and agricultural/nutrition/health researchers and extensionists in Tanzania and Rwanda
- Conduct 3-5 training courses on home gardens, food and nutrition in Punjab and Jharkhand, India
- Village-based training centers established in Punjab and Jharkhand, India

Output Targets 2011

- Nutrition education curriculum/tool kits with school gardens for elementary schools in selected regions designed
- Women's groups identified and trained to grow, use, and benefit from nutrition gardens

Activity 5.3

Conduct workshops and symposia

Output Targets 2009

- A joint roundtable of National Health Research Institutes (NHRI) - AVRDC - The World Vegetable Center on 'Food and Health Security (FAHS) in the Asia-Pacific Region' formed



PURE CEYLON TEA
PACKED AND EXPORTED
BY
A. F. JONAS EXPORTERS, CEYLON LTD.
Paddy Packaged For
Local For Foodstuffs Trading Co.
Damascus - Syria

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

Administration and Services

Efficient, supportive, prepared

The duties of the groups under the Office of Administration and Services range from providing for the most basic of human needs—food, shelter, and security—to guiding complex international relationships as liaison to host government Taiwan and overseeing budgets to ensure the Center's viability.

The Center's new name "AVRDC – The World Vegetable Center" was unveiled in April 2008 in a ceremony attended by former ROC President Chen Shui-bian. In June 2008, Taiwan's Ministry of Foreign Affairs (MOFA) documented AVRDC's legal standing in the country, according the Center diplomatic privileges for its premises, property, assets, archives, and international staff.

As the scope of the Center's research and development activities expands, particularly in the regional offices, the need for more decision-making autonomy closer to the local and project level has grown. In July 2008, authority to sign for purchases, leave, and other requests was placed with Regional Directors and Global Theme Leaders. The decentralization effort has streamlined tracking procedures and reduced paperwork, and helps staff promptly obtain the equipment and services necessary for their work. Decentralization and devolution in other areas will continue as the Center redefines the roles of headquarters and the regions.

The new Financial Manager hired in 2008 has begun implementing full cost

recovery for services. This practice will be rolled out gradually. By shifting costs for services to projects, the Center can decrease overheads and build up reserves for the future. Financial Services is presently reviewing financial management software capable of integrating budgets and human resource functions to provide managers with accurate, timely financial reports and personnel information. A new Human Resources Director joined the Center in February 2009. Recruiting quality staff will be a top priority for HR, particularly for the Regional Center in Africa, where the need is acute. HR will review and update personnel procedures and identify opportunities for staff development.

Following recommendations made in the 7th External Program and Management Review, a Global Risk Management Committee was established at headquarters in June 2008. The committee will work with regional Risk Management Teams to address pertinent issues such as staff safety at work, during natural disasters, and in times of social unrest. A new key-card security system was installed at headquarters in January 2008 and a campus phone tree set up in October to communicate messages between residents during an emergency.

In September 2008, the new Food and Dormitory Services Manager began an extensive renovation of AVRDC's guest rooms to provide more comfortable quarters for visiting dignitaries, board members, and other guests. The rooms were repainted; new carpeting, doors, windows and light fixtures were installed; and each room was outfitted with new furniture and cabling for Internet, telephone, and TV. The AVRDC Cafeteria and Guest Lounge also received a long-overdue makeover. Renovation work was completed in October 2008. Pending the availability of funds in 2009-2011, the Center plans to renovate the genebank building to safely and securely house its germplasm collection. Seed storage facilities must

be expanded to accommodate the current collection and provide room for new germplasm; thermal barriers, cold storage units, and the building's electrical wiring need to be upgraded to reduce electricity costs and improve effectiveness. Apartments in the Training Hostel and apartments on campus will also receive renovation as funds permit.

In 2008, Taiwan contributed core funding of US\$5.75 million to the Center. The Council of Agriculture (COA) and National Science Council funded 22 projects in 12 units, for a total 2008 project budget of US\$721,000. Future funding support from MOFA for the Center's global activities is under consultation.

The Center applied for accreditation as a Qualified GM Crops Testing Institute in February 2008; after making improvements, the application was approved by COA in November. A 2-hectare land exchange to consolidate the Center's holdings was carried out with the Tainan County Government in December 2008. Further exchanges will be explored in the next two years.

Technical Services constructed four new research greenhouses at headquarters in 2008; facility maintenance and farm management projects for the next two years include improvements to irrigation channels and the installation of monitoring cameras. Administrative Services managed purchase requests for agricultural supplies and instruments from the Vegetable Breeding and Seed Systems for Poverty Reduction in Africa (vBSS) regional breeding units

in Tanzania, Madagascar, Mali, and Cameroon and will continue to provide purchasing support as needed to the Center's global offices.



Financial Management

Building a sound fiscal foundation

The research world is constantly changing as new areas of research evolve, which in turn influence the Center's operational priorities and funding sources. The Center has been responding to these challenges over the years by upgrading infrastructure at headquarters and in the regional centers, including laboratories, IT, buildings, and vehicles. Attracting quality staff for key positions and providing training to increase staff skills in management and other areas remains a priority. The Center is now poised to start a gradual build-up of its reserves beginning in financial year 2009, and will continue to focus on reserves until it reaches a comfortable benchmark.

AVRDC has secured several large projects in recent years, and has commitments from donors for further increases. These expected increases will move the Center's total budget from the bracket of small centers to near that of a medium-size center in the next two years. In view of this rapid growth of activities, funding, volume of transactions, and financial management/reporting needs, the management has obtained the Board of Directors' approval to replace the current financial system with a mid-range Enterprise Resource Planning (ERP) system. The implementation of the system is expected to cost about US\$300,000. The implementation should start and be completed within the year 2009. The cost of this application will be depreciated over 4 years, according to the center's policy of depreciating electronics/computer equipment. This system will further strengthen the capability of financial management and other operations to efficiently and effectively carry out their deliverables.

Center management is aware of the uncertainty that surrounds unrestricted funding, which could affect the

Medium-Term Projection; the volatile exchange rate of the US dollar, which is the Center's transaction currency; and also the effect of the current economic recession affecting almost all donor countries. The management will constantly and continuously review these uncertainties and the likely effects and respond accordingly.



Human Resources

Developing staff in a growing organization

As AVRDC – The World Vegetable Center transitions from a small regional organization to a global institution and becomes increasingly decentralized, the Center will focus more on strategic Human Resource development. HR strategies will aim to achieve the following strategic objectives of the Center:

- nurture a learning organization
- strengthen competencies to meet growth, the complexities of R&D, and transformational leadership
- enhance performance alignment between individuals, functions, themes, regions, and headquarters

With the recent recruitment of a professional HR Director, the Center expects that appropriate policies, systems, and best practices will be implemented to enhance the alignment of staff potential to the performance of the Center.

Currently, human resources management functions separately for internationally recruited staff (IRS) and nationally recruited staff (NRS), with the Office of the Director General handling many of the contracts. These functions will be combined so that all recruitment is handled exclusively by the Human Resources Office. Human resource management in the regions will also be addressed with the addition of HR staff and coordinated policy development. The selection process for new hires will continue to become more transparent with the development of clear policies that are globally adopted.

As of January 2009 AVRDC had 69 internationally recruited staff members from 27 different countries, with 36 located at headquarters in Taiwan, 26 in Africa and seven elsewhere in Asia.

Women comprise 26 percent of staff. In 2008, IRS appointment contracts began to be converted to renewable 3-year fixed terms. Renewals of existing contracts have been staggered to prevent contracts coming up for renewal at the same time.

The performance appraisal system and reporting lines were updated and simplified in 2008 for the evaluation of personnel. Staff development and training will receive increased attention over the next 2-3 years. The appraisal system will be further developed for each staff member to encompass self-assessment and personal development, and to confirm plans and objectives for the coming year. A discussion with the line manager to review and evaluate a person's contribution will continue to be an essential component of the process, which will be captured with the updating of personnel policies and procedures. Increasing consideration will be given to the motivation and stimulation of AVRDC's nationally recruited staff.

Development of a salary policy for AVRDC will assist the Center in establishing equity among staff and aid in staff planning and resource allocation for the future. Key components will include up-to-date job descriptions and a job classification or banding structure. The practice of monitoring market salaries and reviewing the Centers salary ranges will be carried out annually, and a compensation committee that determines salaries for each job band will be established.

To facilitate the flow of information, enhance efficiency of transactions and integrate the HR information system with project and financial management systems, the implementation of software to automate human resources administration processes over the next 1-3 years is essential. Creating a single point of entry for HR and payroll will help AVRDC to efficiently meet its personnel objectives and handle the demands of a globally expanding Center.



Public Awareness and Information

Informing strategy, building transparency

Public awareness or public relations encompasses all points of contact between an institution and other parties. The Public Awareness and Information group at AVRDC – The World Vegetable Center serves as a strategic communication instrument directed both inward and outward. The group comprises four members—secretary, photographer, graphics and layout, and visitor services—and a group head.

A stronger face means stronger recognition: Public Awareness at AVRDC – The World Vegetable Center plays a key role in developing and implementing communication strategies to ensure understanding, increase awareness, and assure support from donors and other stakeholders. As information and transparency are a prerequisite for ongoing financial support in a highly competitive funding environment, Public Awareness and Information provides adequate tools, identifies channels, and establishes platforms for information exchange. It helps shape the public perception of the Center through management of information flows and creation of materials to promote the Center's research and development activities and its status as a corporate institution.

Public Awareness and Information supports fundraising through tailored presentations for the Director General and other managers. The group conceptualizes and designs posters, displays, and promotional material for events, from national or regional workshops to major international conferences such as the Annual General Meeting of the Consultative Group of International Agricultural Research (CGIAR). It also prepares pre-event

products such as programs and handbooks, and post-event materials include summary notes and CD-ROMs.

In mid-2008, Public Awareness and Information developed and published a set of communication tools whose purpose is to highlight the Center's key messages for targeted audiences. The "Point of Impact" fact sheet series is one example. These fact sheets present selected research and development themes relevant to the Center's activities in a clear, easily understood manner.

Partner in dialogue: As the Center's link to the media, Public Awareness and Information establishes proactive relations with various outlets and is building a network of partners to stimulate and lift communication with external audiences to a new level. The major focus of these media-related activities will be on print media and the internet, with technologies such as radio, TV, and other audio-visual included in the mix. All will be investigated, assessed, and applied as needed.

Finding the right hook: We aim to directly engage journalists and media representatives at major communication hubs located near our regional centers. Media work accompanying major events will be continued and expanded. Media briefings on selected topics, held at selected offices and project sites, will complement other awareness activities. The complexity of shaping public opinion in partnership with stakeholders demands fair and transparent interaction to establish a relationship of mutual trust. Media workshops on selected issues at headquarters, in the regional centers, or at important project sites should be assessed and implemented.



Form follows function: The group has a leading role in communicating the Center's corporate identity through design and targeted text. To project a coherent, recognizable image, measures will be continued to implement a consistent corporate design for the Center and assure its application by staff and project partners. A corporate design handbook will be developed to provide guidance and standards. Corporate gifts for investors and other partners will focus on quality and recognition. Gifts also will be promoted on the Center's web site and through mailings, as there is a high demand for such items.

Digital networking: The internet is the major interface for the Center's communication with partners and stakeholders. Public Awareness and Information is responsible for all visual and design aspects of the Center's website and for content management. Web information services must be continuously evaluated, improved, and enhanced to meet the information expectations of a demanding audience. A separate media section will provide relevant corporate materials as well as research and development information. Public Awareness and Information will also evaluate other web services for user-friendliness and appropriateness. Together with the Editor it will assure a uniform appearance in look, content, and language.

Partner to staff: Public Awareness and Information also serves internal audiences. It assists management and staff with communication matters, and assures that text and design are congruent with the Center's strategy and policy. Information packages, presentations, press kits, and poster sets will be made available to the Center's offices worldwide. Support and training will be provided to brief staff for media interviews, and guide them in documenting their work through photography, video, and other technologies.

Information is the key: The Center's weekly Newsletter informs staff about current research themes and serves as a tool to promote the Center to external audiences. To ensure quality, the Newsletter may evolve into a bi-weekly or monthly publication to offer more in-depth information on the Center's activities in the context of current global developments. Information for staff at headquarters is shared through The Big Cabbage, a bulletin in English and Mandarin.

See and be seen: Public Awareness and Information maintains a digital photo archive of several thousand images for publications, presentations, etc. A selection of images from each region and each of the Center's five research and development themes will be made available to staff and other approved users in a digital image library. The group's photographer will continue documenting research and development activities and will provide other services (news photography, technical photography) as needed. The image collection is expected to grow by about 2000 images each year. A database to store and track these images is needed.

Visitor Services is one of the most important instruments the Public Awareness and Information group has for face-to-face communication. On average more than 100 groups and delegations (approximately 1000 people) visit headquarters each year. A corporate briefing on the Center's mission and activities is presented to all visitors. The presentation will be updated and developed into a multimedia presentation in the languages most relevant to the Center and its stakeholders: English, French, Chinese (Mandarin), Russian, and Arabic. Other languages will follow as required.

Information Technology and Web

Connecting a global center: IT services provide the essential communications nervous system for a distributed global organization to do its job. The Center's IT services should be raised to the standard of other international agricultural research centers to support the growing complexity of its global operations. Over the next three years major changes in global IT products and services may change the IT options available, but the following needs and trends will be the major focus of activities for the next 1-2 years.

Moving IT to an annual subscription service supporting corporate workstations: In the past, most software and hardware purchases have been done on an individual ad-hoc basis, but the cost of support and infrastructure to run a computer is about four times its purchase price; this has been a hidden on-going cost borne by the organization. Computers need to be seen as organizational workstations paid for by an annual service fee rather than as personal possessions. More IT costs need to be shifted to projects by standardizing them as a set of tools and services to enable an employee to do their job. This will require organizational contracts for software and hardware, standard service level agreements, and full cost recovery to fund IT services.

High bandwidth connecting all offices: Good connectivity is essential to the effective working of a distributed global organization. The center is currently generating over 13 GB of e-mail traffic per month, equivalent to almost 300,000 pages of text. If an office has poor connectivity it is cut off from the work of the center. Headquarters is not effectively using its current bandwidth, and there are growing regional connectivity problems. Investment is needed to ensure that connectivity keeps up with growing organizational demands.

Upgraded IT services to support Enterprise Resource Planning (ERP): In the past IT services have mostly maintained the e-mail and web infrastructure and some organizational databases. As more sophisticated financial, HR, and project management services (Enterprise Resource Planning) are needed to support the organization there will be a need for more highly skilled in-house or contracted IT services to maintain and develop them. Expanding our current IT service contracts with IRRRI into joint appointments may also be needed.

More use of mobile devices supported by "cloud computing" open access services: Improved connectivity and "cloud computing" services promoted by groups such as Google are shifting computing from static desktops running high cost proprietary software to more portable computing devices using low cost open access software. The center is leading the CGIAR in its shift to using Gmail services; increasing use of other open-office tools may become viable in the near future.



Expanded use of integrated voice, e-mail and videoconferencing services: Successful trials of videoconferencing using Googletalk and Polycom 2000 software were done between headquarters and the Regional Center for Africa in Arusha, Tanzania in late 2008. The integration of videoconferencing with chat and e-mail using Googletalk provides a richer variety of communication services, and could reduce travel requirements and costs. Training, good bandwidth, and effective VoIP (Voice over Internet Protocol) infrastructure will be needed.

Distributed website content development and maintenance: The replacement of our current internet and intranet with sites built using Content Management Systems (CMS) will significantly reduce their maintenance costs and decentralize updating, which will be able to be done without specialist IT skills. This is likely to increase the volume of information provided over our websites and require greater managerial oversight over changes to the content.

An interactive globally-used intranet supported by Web 2.0 tools: The current intranet does provide for interactivity, and is essentially a centrally updated reference source. Rebuilding it around a CMS and incorporating Web 2.0 tools such as blogs and wikis would shift more organizational communications to the intranet, reduce staff e-mail loads, and help build a more open, collaborative online organizational culture.



Editorial and Library

A multidimensional, multidisciplinary information resource

Data and knowledge are the lifeblood of a research center. From production to collection to dissemination, the Center's Editor and Library circulate the information vital to researchers, scholars, partner institutions, the private sector, and the public.

The AVRDC Library made strides in improving the quality of the library experience in 2008. The physical space was reorganized, to allow for easier, faster browsing; new tables and chairs were placed in the reading room to provide a comfortable, quiet workspace for researchers and students. More than 2000 reports, book chapters, journal articles, and proceedings by AVRDC researchers have been digitized and placed online. Staff members published a brochure outlining the Library's services, and regularly promote new books and websites of interest in the Center's weekly newsletter.

The Library's virtual space will receive more attention in 2009 and beyond, as technology and an explosion of information converge to alter the services an agricultural research library should provide. Library staff will begin redesigning the library website in 2009. The web interface will require an extensive visual overhaul and technical upgrade to serve as the primary contact point for organizing and archiving the Center's research, sharing it with others, and providing background and source materials for globally dispersed researchers, scholars, and others. The emphasis will be on ease of use, ease of maintenance, and full integration with other agricultural research libraries and organizations for more complete access.

The biosciences are multidisciplinary, and the Center's researchers collaborate in a multi-institutional environment. To deal with the growing quantity of information and the diversity of formats, library staff must keep their collection management skills up to date. Appropriate training courses will be sought in handling research datasets and databases for wider distribution; data mining; image archiving; and document metatagging to ensure the AVRDC collection meets international cataloging standards. Donors are increasingly aware of the value research data represents; the Center must ensure this data is appropriately preserved and shared.

Traditionally viewed as knowledge finders and brokers, the Center's librarians will add advanced searching skills and personal data management to their services. Library staff will also become adept at using social networking tools to help staff based around the world connect to ideas, information, colleagues, and collaborators.

Journal acquisition absorbs a significant portion of the library's subscription budget. In mid-2009, staff will survey researchers and other library users to determine journal use and explore more cost-effective methods of providing access to journal articles. In line with the Center's move to full cost recovery, as of December 2008 all requests for journal articles not offered by the Library will be charged to projects.

Hired in February 2008, the Center's new Editor placed the organization's publishing docket on a more regular schedule. To ensure the Center's publications are accurate and project a consistent tone, the Editor reviewed more than 200 articles, abstracts, books, proposals, reports, award applications, newsletters, and other documents for grammar, style, and coherence of content structure and design.



A standard operating procedure for the submission of journal articles was written in October 2008 and is pending approval. The Editor guides the internal peer-review process for researchers, and has been testing two platforms (Google Sites and an in-house wiki) to allow anonymous commenting; a platform will be selected and procedures set up in early 2009. “First Draft,” an online style guide featuring interactive word lists, grammar and style points, and linked resources for authors, will be made available mid-year.

In 2008 a new publication series, *Explorations*, was established to inform discourse on the convergence of science, technology, and practice in vegetable breeding, production, and marketing. The first title in the series, *The Vegetable Industry in Tropical Asia*, was published in December. *Research in Action*, a series to disseminate the practical applications of the Center’s work, will be launched in 2009. A future focus for the Editor will be to help researchers and projects present information in formats appropriate for their target audiences, and to track the impact of various communication tools.



Global Technology Dissemination

Sharing knowledge and skills

The Global Technology Dissemination (GTD) group, which was formed in July 2008, has three main goals: to integrate vegetable technologies from the Center and other sources and make them readily available to farmers, trainers, consumers, public/private institutions, and other end users; to respond to disaster situations in less-developed countries by providing appropriate short-term development activities in line with the Center's strengths and abilities; to enable training and capacity building activities at headquarters to be conducted in an effective, efficient manner.

The group actively disseminates technologies that involve all five R&D Themes at the Center. One major technology dissemination activity is the International Vegetable Variety Development Network (IVVDN). A large expansion of IVVDN is planned over the coming three years by increasing the number of projects that enable dissemination and testing of the Center's promising germplasm. Global Technology Dissemination plays an important role in the Center's development-oriented donor-funded projects; it leads a project in Indonesia and provides a support/service role in a wide range of projects in Asia, Africa, and the Pacific. The group coordinates its activities with the regional centers to enhance implementation of the Center's mission.

Global Technology Dissemination plans to compile information on the Center's mature technologies into a database during 2009, as a part of the Center's intellectual asset management. The database will be used to enable efficient dissemination of technologies to farmers, consumers, and other end users in developing countries. GTD will work with other groups at the Center

to develop extension publications that disseminate the Center's technologies in ways that enable adaptation by end users. We are also building a comprehensive searchable database on the Center's extension publications. Global Technology Dissemination manages the Demonstration Garden at headquarters, which will be further developed in 2009 to clearly display the Center's technologies to visitors and trainees.

Global Technology Dissemination will integrate vegetable technologies from the Center and other sources into coherent and holistic packages that can be adapted by resource-poor farmers to their situations. The group'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 a feedback function to the Center's research groups regarding local vegetable production and consumption constraints to enable research to be increasingly pertinent to end users. One key component of this is the quarterly publication of a concise bulletin that communicates urgent issues from the field to its readers.

The group will also endeavor to fully implement the Center's disaster response strategy over the coming three years in collaboration with the regional centers. Pending obtaining sufficient funding, the Center is slated to produce seeds of hardy and nutritious vegetable crops appropriate to the site-specific situations and needs of 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

Data management for better research

Knowledge of sound biometrical methods and access to statistical information and techniques is essential for reliable, high-quality research. The high standard of data generated from AVRDC research is ensured through the efficient use of biometrics, which 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. The 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 biometrics consulting services to 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, and interpretation/presentation of results to improve and enhance the skills of staff and the national agricultural research system collaborators in conducting research
- advice on how to use statistical software available at AVRDC

By providing consulting services or general help in designing experiments, dealing with data, or other statistical issues, Biometrics aims to improve the skills and understanding of researchers, NARS collaborators, and scientists who may be infrequent users of statistics. A benchmark can be set to assure the quality of research outputs right from the start—at the planning stage, through detailed evaluation of experimental plans. This would also assure proper recording and archiving of procedures used in each experiment, and proper statistical review of reports, proposals, and scientific manuscripts submitted for publication in international peer-reviewed journals.

Databases

Over the years we have seen a proliferation of databases at AVRDC, independently set up by groups at headquarters and in the regional centers based on their specific needs and requirements. Many of these databases have the potential to be useful to other groups. The evolving needs of scientists and research staff to access and retrieve information whenever and wherever needed will be addressed through integrated information systems. We propose hiring a database administrator to provide the necessary oversight.

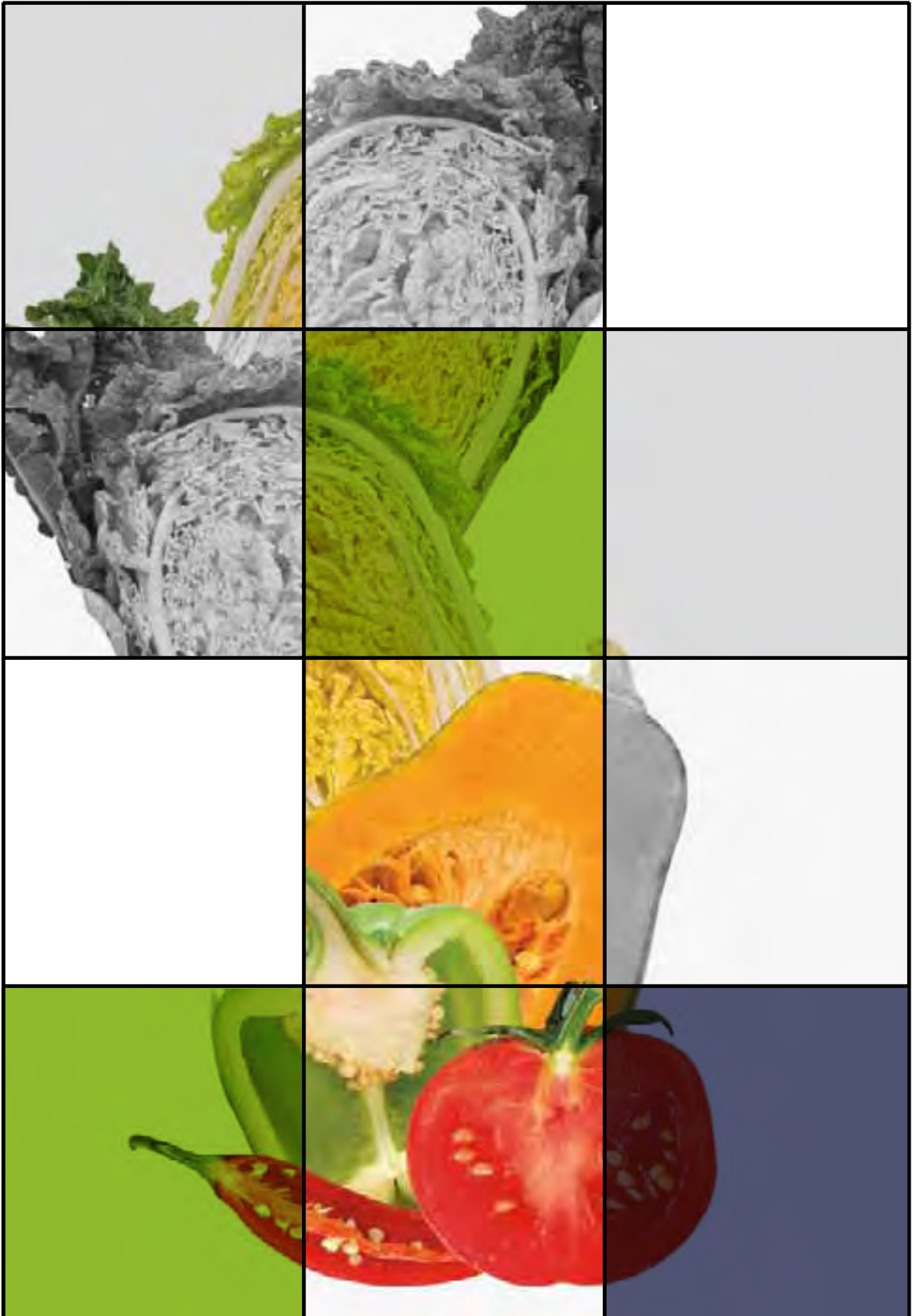




Name	Position	Location	Nationality
Abang, Mathew	Vegetable Breeder	Arusha, Tanzania	Cameroon
Abdourhamane, Issoufou	Plant Pathologist	Bamako, Mali	Niger
Abdulai, Mashark	Vegetable Breeder	Yaounde, Cameroon	Ghana
Acedo, Antonio	Regional Project Coordinator	Vientiane, Lao PDR	Philippines
Adeniji, Olawale	Vegetable Breeder	Arusha, Tanzania	Nigeria
Akyeampong, Ekow	Liaison Officer	Bamako, Mali	Ghana
Baxter, Nathalie	Horticulturist	Honiara, Solomon Islands	Australia
Belarmino, Marilyn	Genetic Resources Support Specialist	Arusha, Tanzania	Philippines
Bhattarai, Madhusudan	Agricultural Economist	Shanhua, Taiwan	Nepal
Chadha, Madan Mohan Lal	Regional Director	Hyderabad, India	India
Chagomoka, Takemore	Seed Marketing Specialist	Arusha, Tanzania	Zimbabwe
Chang, Yin-fu	Deputy Director General – Administration & Services	Shanhua, Taiwan	Taiwan
Chung, Kyeong-ho	Biotechnologist	Shanhua, Taiwan	Korea
Dagnoko, Sokona	Vegetable Breeder	Bamako, Mali	Mali
Dhaliwal, Major Singh	Vegetable Breeder	Yaounde, Cameroon	India
de la Peña, Robert	Molecular Plant Breeder	Shanhua, Taiwan	Philippines
Dibiyantoro, Anna	Project Site Coordinator	Tegal, Indonesia	Indonesia
Dinssa, Fekadu Fufa	Tomato Breeder	Arusha, Tanzania	Ethiopia
Diouf, Meïssa	Vegetable Breeder	Bamako, Mali	Senegal
Easdown, Warwick	Donor Support and Information Technology Manager	Shanhua, Taiwan	Australia
Ebert, Andreas	Genebank Manager	Shanhua, Taiwan	Germany
Galvez, Hayde	Molecular Marker Specialist	Arusha, Tanzania	Philippines
Gniffke, Paul	Plant Breeder	Shanhua, Taiwan	United States of America
Hamilton, Kathryn	Special Project Coordinator	Shanhua, Taiwan	United Kingdom
Hanschke, Oliver	Public Awareness and Information Manager	Shanhua, Taiwan	Germany
Hanson, Peter	Plant Breeder	Shanhua, Taiwan	United States of America

Name	Position	Location	Nationality
Helsen, Jan	Project Manager	Arusha, Tanzania	Belgium
Hughes, Jacqueline d'Arros	Deputy Director General - Research	Shahua, Taiwan	United Kingdom
Javier, Edwin	International Variety Development Coordinator	Shanhua, Taiwan	Philippines
Joshi, Ravindra	Project Site Coordinator	Honiara, Solomon Islands	India
Kaiser, Markus	Coordinator of Program and Partnership Development	Shanhua, Taiwan	Germany
Katoch, Viveka	Vegetable Breeder	Aloatra, Madagascar	India
Keatinge, John Donough	Director General	Shanhua, Taiwan	Ireland
Kenyon, Lawrence	Virologist	Shanhua, Taiwan	United Kingdom
Kouame, Christophe	Liaison Officer	Yaounde, Cameroon	Côte d'Ivoire
Kumar, Sanjeet	Vegetable Breeder	Niamey, Niger	India
Knierim, Dennis	Post-doc Fellow in Virology	Shanhua, Taiwan	Germany
Kriesemer, Simone Kathrin	Post-doc Fellow in Socioeconomics	Hyderabad, India	Germany
Kwazi, Nadine Mujinge	Executive Assistant to the Regional Director	Arusha, Tanzania	Zambia
Ledesma, Dolores R.	Specialist for Statistics and Database Development	Shanhua, Taiwan	Philippines
Lu, Vincent	Internal Auditor	Shanhua, Taiwan	Taiwan
Luther, Gregory	Technology Dissemination Specialist	Shanhua, Taiwan	United States of America
Luther, Kartini	Assistant to the Deputy Director General - Research	Shanhua, Taiwan	Indonesia
Maryono, Joko	Research Associate- Socioeconomics	Tegal, Indonesia	Indonesia
Mavlyanova, Ravza	Regional Coordinator	Tashkent, Uzbekistan	Uzbekistan

Name	Position	Location	Nationality
Mecozzi, Maureen	Editor	Shanhua, Taiwan	United States of America
Nagaraj, Inukonda	Director of Human Resources	Shanhua, Taiwan	India
Ndung'u, Philip Kamau	Regional Administration and Finance Officer	Arusha, Tanzania	Kenya
Nono-Womdim, Rémi	Liaison Officer	Arusha, Tanzania	Cameroon
Ojiewo, Christopher Ochieng	Vegetable Breeder	Arusha, Tanzania	Kenya
Olatifede, Kolade	Director of Finance	Arusha, Taiwan	Nigeria
Oluoch, Mel	Training Specialist	Arusha, Tanzania	Kenya
Ooi, Peter	Regional Director	Bangkok, Thailand	Malaysia
Palada, Manuel	Ecosystem Specialist	Shanhua, Taiwan	United States of America
Palchamy, Kadirvel	Post-doc Fellow in Molecular Breeding	Shanhua, Taiwan	India
Rakotoarisoa, Benjamin	Liaison Officer	Aloatra, Madagascar	Madagascar
Ramasamy, Srinivasan	Entomologist	Shanhua, Taiwan	India
Rouamba, Albert	Onion Breeder	Bamako, Mali	Burkina Faso
Silue, Drissa	Plant Pathologist	Arusha, Tanzania	Côte d'Ivoire
Subramaniam, Gheetanjali	Post-doc in Molecular Breeding	Shanhua, Taiwan	India
Sun, Zhanyong	Cucurbit Breeder	Shanhua, Taiwan	People's Republic of China
Symonds, Rachael	Post-doc Fellow in Molecular Breeding & Biotechnology	Shanhua, Taiwan	United Kingdom
Tanyongana, Ronia	Seed Health Specialist	Arusha, Tanzania	Zimbabwe
Tenkouano, Abdou	Regional Director	Arusha, Tanzania	Burkina Faso
Venuprasad, Ramaiah	Post-doc Fellow in Abiotic Stress Tolerance	Shanhua, Tanzania	India
Wang, Jaw-fen	Plant Pathologist	Shanhua, Taiwan	Taiwan
Wang, Tien-chen	Mycologist	Shanhua, Taiwan	Taiwan
Weinberger, Katinka	Socioeconomist	Shanhua, Taiwan	Germany
Yang, Ray-yu	Nutritionist	Shanhua, Taiwan	Taiwan
Yeboah, Martin Agyei	Vegetable Breeder	Aloatra, Madagascar	Ghana



The following tables show sources of funding, allocation of finances to the thematic research and development activities, and trends covering the period 2008–2011.

By 2011 the amount allocated to research themes would have increased to 78% of the total budget, while the amount allocated to administration is expected to decline to about 22%. The allocations between the themes are fairly constant over the period.

Table 1: Details of the 2008 budget along with allocations to themes and administration

Table 2: Comparison of estimated 2009 budget with 2008 actual and budget

Table 3: Main sources of revenue for 2008 and 2009

Table 4: Budget projections for the next three years

Table 1 - Financial activities for the twelve months ending 31 December 2008

	2008 Actual				2008 Budget	
	Unrestricted	Restricted	Total	%	Total	%
Revenues						
Unrestricted grants	7,417,806		7,417,806	48%	7,979,000	44%
Restricted grants		7,530,453	7,530,453	48%	9,878,000	54%
Challenge program		200,000	200,000	1%	200,000	1%
Other revenues	460,635		460,635	3%	150,000	1%
Total	7,878,441	7,730,453	15,608,894	100%	18,207,000	100%
Expenditures						
Personnel						
- International	2,500,034	1,485,300	3,985,334	25%	4,458,000	24%
- Local	3,415,383	580,739	3,996,121	25%	4,571,000	24%
Operating expenses						
- Field labor	463,321	166,695	630,017	4%	829,000	4%
- Supplies & services	687,135	1,312,914	2,000,049	13%	3,033,000	16%
- Travel	208,316	694,088	902,403	6%	1,063,000	6%
- Training and workshop	125,383	428,569	553,952	4%	294,000	2%
- General expenses	740,392	512,728	1,253,119	8%	1,703,000	9%
Contract outreach research	366,885	2,004,519	2,371,404	15%	1,537,000	8%
Renovations	100,243	544,901	645,144	4%	1,184,000	6%
Contingency					1,023,000	5%
Sub-Total	8,607,090	7,730,453	16,337,543	103%	19,695,000	105%
Indirect cost recovery (overhead)	(532,362)		(532,362)	-3%	(900,000)	-5%
Total	8,074,729	7,730,453	15,805,182	100%	18,795,000	100%
Changes in net assets	(196,287)	0	(196,287)		(588,000)	
Appropriation to working capital	(300,000)		(300,000)			
Net assets at the beginning of the year	588,101		588,101		588,000	
Net assets at the end of the year*	91,814	0	91,814		0	

* Excludes working capital fund of \$1,500,000 at the end of 2008

Table 2 - 2009 final budget estimate

	2009		2008		2008	
	Estimate		Actual		Budget	
Revenues	15,905		15,609		18,207	
Budget Allocations by Objects						
Personnel						
- International	5,076	32%	3,985	25%	4,458	24%
- Local	4,356	27%	3,996	25%	4,571	24%
Operations						
- Field labor	630	4%	630	4%	829	4%
- Supplies & services	2,258	14%	2,000	13%	3,033	16%
- Travel	480	3%	903	6%	1,063	6%
- Training and workshop	554	3%	554	4%	294	2%
- General expenses	938	6%	1,253	8%	1,703	9%
- Contracted outreach research	1,537	10%	2,371	15%	1,537	8%
Equipment, facilities & renovation	466	3%	645	4%	1,184	6%
Contingency	500	3%			1,023	5%
Sub-Total	16,795	106%	16,337	103%	19,695	105%
Indirect cost recovery (overhead)	(913)	-6%	(532)	-3%	(900)	-5%
Total	15,882	100%	15,805	100%	18,795	100%
Changes in net assets	23		(196)		(588)	
Net assets at the beginning	92		588		588	
Changing in net assets	23		-196		(588)	
Appropriation from working capital fund	0					
Appropriated for capital reserve			-300			
Carried over/forward	115		92		0	

Budget allocations by Themes**I. Strategy Themes**

I-1. Germplasm: Germplasm Conservation, Evaluation, and Gene Discovery	2,376	15%	3,120	20%	3,960	21%
I-2. Breeding: Genetic Enhancement, Varietal Development, and Selection of Indigenous Lines	2,615	16%	2,760	17%	3,390	18%
I-3. Nutrition: Nutrition Security, Diet Diversification, and Human Health	2,376	15%	2,880	18%	2,260	12%
I-4. Production: Seed and Safe Vegetable Production Systems	2,020	13%	1,800	11%	2,070	11%
I-5. Marketing: Postharvest Management, Market Opportunities, and Income Generation	2,495	16%	1,440	9%	2,350	13%
II. Administration and Services	4,000	25%	3,805	24%	4,765	25%
Total	15,882	100%	15,805	100%	18,795	100%

Table 3 - Breakdown of Y2009 Estimated Revenues

Donor	\$'000		
	2009 Estimate	2008 Actual	2008 Budget
Unrestricted Core			
ROC	5,480	5,521	5,822
USAID	291	291	291
UK/DFID	728	1,168	1,374
Japan	73	66	66
Korea	30	30	30
Thailand	137	138	143
Philippines			
France	49	44	103
Iran	40	0	0
APSA	150	150	150
Sakata Seed Cooperation	0	10	
MOFA	750		
Sub-total	7,728	7,418	7,979
Other revenues	600	461	150
Total	8,328 52%	7,879 50%	8,129 45%
Restricted Core			
Australia/ACIAR	341	563	527
Asian Development Bank	289	336	631
Asia Pacific Seed Association	77	10	63
Austrian AID	8		
CropLife Asia		21	20
Canadian International Development Agency		105	93
CIRAD	13		
European Union		41	36
FARA	80		
French Ministry of Foreign Affairs			
Gates Foundation	3,307	3,823	3,880
Global Crop Diversity Trust	86	43	
Germany/Vater und Sohn Eiselen-Stiftung		6	21
Germany/BMZ/GTZ	1,895	1,276	2,058
International Bioversity		4	2
International Fund for Agricultural Development	87	71	64
Japan	7	77	65
Kilimo Trust	48	71	93
Korea/RDA		94	73
Philippines		1	23
Relief International/RALF		40	39
ROC/COA	420	340	566
ROC/NSC	112	94	
ROC/MOFA			1,000
Rockefeller Foundation		57	70
Swiss/SDC			
Sir Ratan Tata Trust Foundation	662	143	254
The Organic Center		4	0
UK/DFID	118	67	56
USAID	13	221	203
USDA	9	5	13
Training funds and others	5	17	28
Sub-total	7,577 48%	7,530 48%	9,878 54%
Challenge program		200 1%	200 1%
Sub-total	7,577 48%	7,730 50%	10,078 55%
Total Revenues	15,905 100%	15,609 100%	18,207 100%
Contribution in-kind			
Korea	^{1/} [50]	[50]	[50]
France	^{1/} [0]	[50]	[50]
Thailand	^{2/} [45]	[45]	[45]
GTZ/CIM	^{3/} [0]	[0]	[50]
GTZ/Postdoc program	^{4/} [0]	[0]	[60]
ICARDA	^{5/} [50]	[0]	[50]

Note -^{1/} Out posted scientist (in kind)^{2/} Land, utilities, facilities supported by Thai Government for the Asian Regional Center located within Kasetsart University^{3/} 2 economists, Regional Center for Africa, are partially funded by GTZ/CIM Program^{4/} 1 socioeconomist postdoc, Regional Center for South Asia, funded by GTZ/Postdoc Program^{5/} ICARDA/AVRDC collaborative research

Table 4. Budget Projection for 2009 - 2011

	<i>USD'000</i>			
	2008	2009	2010	2011
	Actual	Estimate	Projection	Projection
Budget Allocation by Objects				
Personnel				
- IRS	3,985	5,076	5,200	5,200
- Local	3,996	4,356	4,800	5,000
Operations				
- Field labor	630	630	870	950
- Supplies & services*	1,468	1,345	3,980	4,000
- Travel	903	480	800	1,000
- Training and workshop	554	554	350	400
- General expenses	1,253	938	1,000	1,250
Contract outreach research	2,371	1,537	1,600	1,700
Equipment, renovation, and facilities	645	466	800	1,000
Contingency		500	500	500
	15,805	15,882	19,900	21,000

*This figure is net of overhead recovery

Budget Allocation by Themes

I. Strategy Themes

I-1	<i>Germplasm: Germplasm Conservation, Evaluation, and Gene Discovery</i>	3,120	26%	2,376	20%	3,080	20%	3,097	19%
I-2	<i>Breeding: Genetic Enhancement and Varietal Development of Vegetables</i>	2,760	23%	2,614	22%	3,234	21%	3,423	21%
I-3	<i>Nutrition: Nutrition Security, Diet Diversification, and Human Health</i>	2,881	24%	2,376	20%	3,080	20%	3,260	20%
I-4	<i>Production: Safe and Sustainable Vegetable Production Systems</i>	1,800	15%	2,020	17%	2,772	18%	2,934	18%
I-5	<i>Marketing: Postharvest Management, Market Opportunities, and Income Generation</i>	1,440	12%	2,495	21%	3,234	21%	3,586	22%

II. Administration and Services

Total		15,805		15,882		19,900		21,000	
--------------	--	---------------	--	---------------	--	---------------	--	---------------	--



ACIAR	Australian Centre for International Agricultural Research
ARC	Asian Regional Center
AVGRIS	AVRDC Vegetable Genetic Resources Information System
AVRDC	Asian Vegetable Research and Development Center
Bt	<i>Bacillus thuringiensis</i>
CGIAR	Consultative Group on International Agricultural Research
CMS	Cytoplasmic male sterility
COA	Council of Agriculture
CSO	Civil society organization
ERP	Enterprise Resource Planning
GAP	Good agricultural practices
GTD	Global Technology Dissemination
ICARDA	International Center for Agricultural Research in the Dry Areas
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
IPM	Integrated pest management
IPR	Intellectual property rights
IRS	internationally recruited staff
ISPN	International Sweet Pepper Nursery
IV	Indigenous vegetable
IVVDN	International Vegetable Variety Development Network
MAS	Marker assisted selection
MTA	Material Transfer Agreement
NAD	Nanggrioe Ache Darussalam
NARES	National agricultural research and extension system
NGO	Non-governmental organization
NPV	Nucleopolyhedrovirus
NRS	Nationally recruited staff
OP	Open pollinated
PRC	People's Republic of China
QTLs	Quantitative trait loci
RCA	Regional Center for Africa
RCSA	Regional Center for South Asia
SINGER	System-wide Information Network for Genetic Resources
SNP	Single nucleotide polymorphisms
SPC	Secretariat of the Pacific Community
SSA	sub-Saharan Africa
SSR	Simple sequences repeat
ToT	Training of trainers programs
vBSS	Vegetable Breeding and Seed Systems for Poverty Reduction in sub-Saharan Africa
VIGS	Virus-induced gene silencing
VoIP	Voice over Internet Protocol



Contact and further information

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
I www.avrdc.org