

contribute
learn
grow

20 years of service with AVRDC- The World Vegetable Center (March 1991 - April 2011)

a memoir by

M.L. Chadha



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FOREWORD

There are no formal academic or skill-based training courses to become a regional director—it is learned on the job. Much of my learning came from interactions with top leaders in the organization who had experienced the challenges of organizing and implementing research and development activities in a regional office, where logistical challenges and isolation can test even the best of managers. Their deep awareness of the obstacles involved and the strong, continuous support they offered provided the sense of security and solidarity I needed to move forward.

I received valuable guidance from AVRDC Directors General Dr. Emil Q. Javier (1991 - 1993), Dr. Samson Tsou (1993 - 2002), Dr. Thomas Lumpkin (2003 - 2008) and finally Dr. Dyno Keatinge (2008 - present). My first task after joining AVRDC in 1991—to establish research and development programs in Bangladesh—would not have been successful without the able support and guidance from Dr. Tsou, and also from colleagues Dr. Sundar Shanmugasundaram (1972 - 2005), Dr. Hideo Imai (1995 - 1998) and Dr. Juergen Friedrichsen (1999 - 2004).

I am fortunate that my hard and successful work in Bangladesh was recognized by AVRDC and led to the challenge to improve vegetable research and development in Africa. Deputy Director General for Research Dr. Jackie Hughes (2005 - present) was a great support and source of encouragement in my efforts to upgrade the Africa Regional Program to the Regional Center for Africa.

AVRDC further challenged me to establish a new Regional Center for South Asia. With support from Drs. Keatinge and Hughes, I established the Regional Center for South Asia in Hyderabad, Andhra Pradesh, India to reflect AVRDC's commitment to improve vegetable research and development in the region. Deputy Director General - Adminstration & Services Dr. Yin-fu Chang (2005 - present) offered valuable technical advice and personal support to me during my career.

Above all, I would like to acknowledge the hard work and support from my AVRDC colleagues and our national partners, who so successfully implemented projects and programs across Asia and Africa.

M.L. Chadha former Regional Director AVRDC Regional Center for Africa AVRDC Regional Center for South Asia

I. BANGLADESH



M.L. Chadha, March 1991







was in 1974 that Dr. Robert Chandler, AVRDC's first Director General, visited Bangladesh and explored the possibilities of establishing a partnership. AVRDC had a history of cooperation with Bangladesh; however, the collaboration was more at the scientist-to-scientist level. Establishing formal ties took almost 15 years and was made possible through the Bangladesh Agricultural Research Project II (ARP II) of the United States Agency for International Development (USAID).

In June 1988 AVRDC signed a memorandum of understanding with the Bangladesh Agricultural Research Council (BARC)/Bangladesh Agricultural Research Institute (BARI) to participate in collaborative research on vegetables, provide BARC/BARI with technical assistance and professional cooperation, and to jointly plan trainings with national partners.

To help the national agricultural research system, identify the problems and constraints involved in vegetable production and to have a sustainable strong vegetable sector in the country, Dr. Emil Q. Javier, AVRDC Director General, hired me as the resident Senior Horticulturist/Agronomist and Team Leader on March 21, 1991. After an initial briefing and consultation at headquarters and in the regional office in Bangkok, I moved to Bangladesh in mid-April.

AVRDC, in conjunction with BARI, BARC and USAID, organized a national vegetable planning and review workshop from 26-29 January 1992 involving more than 100 of the country's agricultural specialists. This meeting played a key role in gathering the baseline information and identifying the major constraints for the country, which included lack of good quality seeds of improved varieties of vegetables; poor seed production facilities; lack of facilities for vegetable storage and preservation; lack of horticultural and extension specialists; indiscriminate use of chemical pesticides; low quality

produce; lack of information on the nutritional importance of vegetables; a need for hybrid seed production; and off-season vegetable production.

I formed a small committee to review the recommendations, and the group selected the following areas for action:

- Prioritize vegetables for further improvement and development based on nutritional value, yield, socioeconomic benefits and social acceptance.
- Develop suitable technologies including crop management systems, for production of vegetables at the homestead level, for commercial production and export.
- Develop vegetable varieties suitable to stress-prone areas and that could be grown year-round to address vegetable scarcity.
- Conduct socioeconomic and marketing studies on vegetables.
- Emphasize postharvest processing techniques to prevent loss.
- Strengthen vegetable seed production research and vegetable germplasm collection.
- Develop integrated pest management (IPM) technologies.
- Analyze pesticide residues on vegetables to reduce hazards to humans and environment.
- Develop varieties resistant to major pests and diseases.
- Strengthen the home garden program to address nutritional and food security.
- Develop vegetable varieties with higher nutrition value and longer storage and shelf life.
- Conduct special skills training on breeding, biotechnology, diseases, seed production, IPM, processing, extension.
- Develop training and extension materials.
- Improve coordination and linkage among the institutions and agencies working on vegetable production and marketing.

During the project implementation period, AVRDC strengthened the national program on vegetable research and development through the introduction of germplasm; identified promising lines of different vegetables; carried out intensive research on off-season tomato and cauliflower production; imparted training scientists; and arranged demonstrations, field days and technology transfer training for extension workers, nongovernmental organizations and farmers.

SAVERNET

The South Asian national agricultural research systems (NARS), through a consultation sponsored by the Asian Development Bank (ADB) in 1990, initiated a framework for the South Asian Vegetable Research Network (SAVERNET); ADB then funded a joint research proposal in 1991. SAVERNET was a sub-regional framework for cooperation composed of Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka. A regional blueprint to implement the research activities under this network was developed at a joint planning meeting at the Bangladesh Agricultural Research Council in Dhaka from 24-27 February 1992.

AVRDC served as the SAVERNET secretariat, and was responsible

for overall coordination, execution and monitoring. AVRDC appointed Dr. S. Shanmugasundaram as network coordinator to oversee SAVERNET's implementation and management. I had the pleasure to work closely with Dr. Shanmugasundaram in implementing SAVERNET phases I & II from 1992 to 2001.

SAVERNET network facilitated a substantial exchange of germplasm: 157 varieties of 22 different vegetable species were shared and 45 promising lines of 15 different vegetables were selected. The region gained a cooperating framework and improved research infrastructure

to support vegetable production. Technical capacity of national scientists in each country improved, and farmers had better access to new high-yielding and disease resistant vegetable varieties to improve their income. An independent study by ADB in December 2002 to assessment the impact of ADB support to agriculture research noted that the network had generated very positive outcomes, high internal rates of return (more than 90%) and high levels of economic surplus (more than US\$500 million), which had accrued more to producers than to consumers.

AVRDC-USAID Bangladesh Project

With the aim of providing necessary support to vegetable research and development in Bangladesh, AVRDC implemented a project entitled "Introduction and Development of Adaptive Technologies for Sustainable Yearround Vegetable Production and Consumption in Bangladesh" with a USAID grant in March 1991. The project assisted in strengthening the vegetable research



and development capacity of the national program through the introduction of germplasm; improved production technologies; identification of promising lines/varieties; in-country and overseas training for scientists/extension/NGO workers, private sector representatives and farmers; and demonstrations and field days for transfer of new technologies. Linkages between government, NGO, and farmers were strengthened.

More than 1000 lines of 35 different vegetables were collected from AVRDC and other sources and made available to BARI Horticulture Research Center. Among the introduced varieties, 51 promising lines of 18 different vegetables were selected (Table 1).

The project made a significant impact in Bangladesh through its cyclone rehabilitation activities in April-May 1991. The project identified kangkong as a potential crop for affected areas and a large quantity of kangkong seed from AVRDC was distributed to about 900 farmers in eight districts of Cox's Bazaar and Chittagong. The kangkong crop was so successful



that it is now considered a perfect vegetable for cyclone rehabilitation activities. The crop was also multiplied vegetatively to reach about 100,000 farmers, and ultimately consumed by more than 500,000 people.

Strategies were adopted to develop high-yielding, short-duration mungbean varieties with stable yield, uniform maturity, and resistance to *Mungbean yellow mosaic virus* (MYMV) and Cercospora leaf spot diseases that would be suitable for inclusion in rice-wheat cropping systems. In 1997, mungbean line NM 92, introduced from AVRDC, was registered and released under the name 'BARI Mung-5' by BARI's Pulse Research Center. Four more mungbean lines introduced by AVRDC were released as varieties: 'Barimung-6' (BARI), 'BUmug-1' (BSMRAU) and 'BUmug-2 '(BSMRAU) in 2002, and 'Bumug-3' (BSMRAU) in 2003.

Mungbean has been transformed from a marginal to a relatively important crop and has contributed to improving rural household income, expanding employment opportunities, diversifying diets, increasing nutritional security, and enhancing soil fertility. Mungbean also promises health benefits for consumers, especially poor women and children, who are most vulnerable to the effects of poor nutrition and a lack of micronutrients in their diets. Mungbean is rich in protein and iron, and improved AVRDC mungbean

Сгор	Scientific name	Number of varieties introduced
Tomato	Solanum lycopersicon (syn. Lycopersicon esculentum)	26
Chilli	Capsicum annum	99
Vegetable soybean	Glycine max	60
Brinjal	Solanum melongena	39
Peas	Pisum sativum	27
Chinese cabbage	Brassica pekinensis	21
Onion	Allium cepa	15
Cucumber	Cucumis sativus	13
Okra	Abelmoschus esculentus	11
Muskmelon	Cucumis melo	11
Рарауа	Carica papaya	9
Bitter gourd	Momordica charantia	9
Malabar spinach	Basella alba	8
Cauliflower	Brassica oleracea var. botrytis	8
Radish	Raphanus sativus	8
Pumpkin	Cucurbita moschata	6
Pai tsai	Brassica parachinensis	5
Cowpea	Vigna unguiculata	4
Spinach	Spinacea oleracea	42
Sponge gourd	Luffa cylindrica	3
Turnip	Brassica campestris var. rapa	3
Bottle gourd	Lagenaria siceraria	3
Lettuce	Lactuca sativa	3
Seem or Country bean	Dolichos lablab	2
Kangkong	Ipomoea reptans	2
Garlic	Allium sativum	2
Round melon	Citrullus vulgaris var. fistulosum	2
Long melon	Cucumis melo var. utilizzi	2
Watermelon	Citrus lanatus	2
Asparagus	Asparagus officinalis	2
Leaf beet	Beta vulgaris	2
Yard-long bean	Vigna sinensis var. sesquipedalis	2
Cabbage	Brassica oleracea var. capitata	1
Methi or fenugreek	Trigonella foenum-graecum	1
Asparagus bean or winged pea	Tetragonolobus purpureus	1
Celery	Apium graveolens	1
Mungbean	Vigna radiata	351

Table 1. Vegetable germplasm made available to BARI Horticultural Research Center

varieties contain 6 mg iron per 100 g of raw seed, whereas traditional mungbean varieties contain only 3.0 to 3.5 mg.



Off-season and year-round tomato production

In Bangladesh, the normal or main season tomato crop is grown from October to March. Tomatoes were seldom available during the hot, rainy summer months in Bangladesh. To manage abiotic stress in the off-season, technologies such as grafting and the use of polytunnels to improve tomato yield under high rainfall and temperature conditions were identified for farmer adoption. Two tomato lines, TM 0111 and TM 0367, were identified as tolerant to high temperature and high moisture with yields of 23.8 and 27.5 t/ha, respectively; they could be grown in all agroclimatic zones in Bangladesh when sown with tomatotone (a hormone solution) under polytunnels. Using AVRDC's tomato parental lines, summer hybrids were produced at BARI and released for general cultivation.

AVRDC's production technology using raised beds was successfully introduced. Grafting was introduced using Solanum torvum as the rootstock to overcome problems with nematodes, bacterial wilt and high temperatures, as well as to reduce the production cost and the use of pesticides.

At AVRDC and BARI, scientists developed a summer tomato production system based on three technologies: planting in raised beds to avoid waterlogging; using heat-tolerant and disease-resistant varieties developed by AVRDC; and spraying with tomatotone to promote fruit setting under high nighttime temperatures. Using this system, experimental plots yielded nearly 20 t/ha during the rainiest time of the year.

Farmers who followed the summer tomato production system were able to produce 2-3 crops from June to September, with an average yield of about 40 t/ha/season. Heat tolerant cherry tomato hybrids introduced from AVRDC

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in 1996 were found to be quite promising, both with and without application of tomatotone. Summer tomato was really a new crop for Bangladesh farmers. Returns were so good for farmers that the Minister of Agriculture in Bangladesh at that time referred to me as the "Father of Summer Tomato."

Summer cauliflower production using a heat-tolerant line from Taiwan was also standardized in Bangladesh. Using this technology, four crops of summer cauliflower could be produced from May to October.

Strengthening the seed sector

Apart from varieties, AVRDC participated in the development of the National Seed Policy of Bangladesh in 1993. The purpose of the policy was to make the best quality seeds of improved varieties of crops conveniently available to farmers to increase crop production, productivity, per capita farm income and export earnings. The Center provided technical support to produce base seed, made parental lines available, and offered training for tomato hybrid seed production.

Homestead cultivation model

From 1991-1997 the Center collaborated with NARS and NGOs in Bangladesh to promote home gardens for year-round vegetable production. The garden model, designed for a 6 x 6 m plot, combined various vegetable varieties to approximately double productivity. Evaluation of the home gardening program recorded an increase in vegetable and energy consumption, a slight reduction of night blindness, and an increase in income compared to control families during the study period.

Capacity building

In Bangladesh I coordinated many training courses to strengthen vegetable research, improve vegetable production, explore the vegetable seed production potential, improve the nutritional level of people, and increase health and

income of rural women and children. Overall, more than 5,000 NARS personnel, including scientists, NGO representatives, and farmers were trained and more than 9,500 field demonstrations were organized to promote technologies with project partners including Bangladesh Rural Advancement Committee (BRAC), Mennonite Central Committee (MCC), Gonokallayan Trust (GKT), Grameen Krishi Foundation (GKF) and Helen Keller International (HKI) (Table 2).





Summer tomato and kangkong: two crops suited to the hot, rainy season in Bangladesh.

Training	Period	Participants
Vegetable breeding	29 September - 4 October 1991	40 researchers from 8 institutions
Germplasm collection, evaluation, documentation and conservation	4-6 May 1992	50 scientists from 11 institutions
Intensive vegetable production for NGOs	3-5 June 1992	38 participants from 30 NGOs
Homestead and sustainability of gardens through seed production at farm level	8 one-day programs in September-October 1992	700 participants from 8 agencies
Disease and insect pest management in vegetable crops	8-10 November 1992	40 participants from 10 organizations
Experimental design and data analysis in vegetable crops	9-11 February 1993	40 staff from 11 institutions
Innovative practices for specialized summer vegetable production	26-29 April 1993	40 staff from 11 institutions
Intensive vegetable growing and its utilization	22-25 November 1993	47 staff from 11 institutions and NGOs
Vegetable breeding and genetic analysis	28 May – 2 June 1994	45 staff from 8 institutions
Off-season and protected vegetable cultivation	20 - 23 June 1994	41 staff from 10 institutions including NGOs
Use of laboratory equipment for vegetable crops research	22-26 February 1995	40 staff from 7 institutions including NGOs
Vegetable crops agribusiness	2-4 May 1995	~120 staff from AVRDC, BARC and BARI at BARC, Dhaka,
Discussion and training on summer tomato	15 May 1996	51 participants from 10 institutions
Hybrid production of solanaceous vegetables and cucurbits	22-27 June 1996	49 staff from 11 institutions
Trainer's training course on mungbean sprouts production and uses	30 March to 1 April 1997	~45 trainers

Table 2. AVRDC training courses held in Bangladesh, 1991-1997

Publications

Seven different compilations aimed to improve the knowledge base of agricultural research and extension workers in Bangladesh: *Vegetable Production and Marketing*; *Breeding of Solanaceous and Cole Crops*; *Germplasm Collection, Evaluation, Documentation and Conservation*; *A Primer of Vegetable Gardening in English and Bangla*; *Vegetable Research and Development in Bangladesh*; *Intensive Vegetable Growing and its Utilization*; and *Vegetable Crops Agribusiness*. In addition, booklets and handouts for farmers, producers and extension workers were published in Bangla on tomato varieties, simple seed storage, home composting, summer tomato, mungbean sprout production, and mungbean varieties.

Impact

The project successfully linked Bangladesh with SAVERNET for the exchange of vegetable germplasm with other South Asian countries, and developed close linkages with NGOs for transfer of new technologies. The presence of AVRDC contributed much toward improving the quality of vegetable research, extension and development programs. A large number of vegetable varieties were developed by the national institutes and the project. Good feedback was received on the performance of summer tomato, mungbean, okra, main season tomato, kangkong, radish and other vegetables in farmers' fields. About 72% of the adopted vegetables were improved open-pollinated varieties. About 43% of farmers adopted the improved technologies, which were found to be sustainable and quite profitable in the year 1996, when farmers were able to earn Tk 6000 to 13,000 (US\$ 150-325) from just 300 plants of summer tomato and Tk 1500-3000 (US 37.5-75) from 5 decimals of land (about 200 m²) with okra. Farmers were able to grow an additional crop of virus-free mungbean, giving an income of about Tk 1,000-1,400 (US\$ 25-35) from 10 decimals of land (about 400 m2). The total value added in wages was approximately US\$ 390 per ha—7.5 times higher than value added through employment in rice. With the introduction of new varieties, average production per unit area increased by 30-80%. With higher production, on an average a small farmer was able to earn about Tk 1,000 (US\$ 25) per month from 30 decimals of land (about 1200 m2). The home garden models increased productivity from an existing 141kg to about 365 kg from a 6 x 6m area. The new models reached more than 68,000 households in Bangladesh, and had a significant spillover effect.

The two external reviews of the project conducted in 1993 and 1995 were quite impressed with AVRDC's interventions and work, and thus a third five-year extension was granted to the project in 1995.

II. AFRICA



From the ground up: The Regional Center for Africa in Arusha, Tanzania.







March 1990 AVRDC, the Tanzanian Government, and the Southern African Centre for Co-operation in Agriculture and Natural Resources Research and Training (SACCAR) for the Southern African Development Community (SADC) signed a memorandum of understanding, which led to the creation of AVRDC's African Regional Program (ARP) in 1992.

In July 1997, I took over as the ARP Regional Director under the leadership of Director General Dr. C. S. Samson Tsou. In 2002, the program was renamed the Regional Center for Africa (RCA).

I planned and developed the major infrastructure of the RCA campus almost from scratch. In 1999 hostel facilities were expanded to include a multipurpose hall and one administrative building. The eight-hectare farm became a good site for research, where trainees could gain hands-on experience.

By the year 2000, the campus had a field laboratory, seminar room, concrete roads and an irrigation network for the research farm. By 2005, the periphery was extended with a change in the entry gate near the main road, internal roads were constructed, and a seed laboratory with storage refrigerators was added.

National priority setting workshops for vegetable research and development

A workshop was conducted in June 1998 to review the advances in vegetable research and development in Tanzania. With the objective of determining common goals, priorities and potential areas of collaboration between advanced research programs and NARS, national meetings were held in Zambia (1996), Ethiopia (1998), Botswana (1998), Swaziland, Mozambique, Malawi (1999), and Mauritius (2001).

In 2002, a strategic planning workshop was held at the Regional Center for Africa from 28 January to 2 February to define the future focus of AVRDC's work in Africa. Stakeholders from NARES in Tanzania, Kenya, Uganda, Ethiopia, Malawi, Swaziland, Senegal, Benin and Niger, as well as from the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, German Development Service (Tanzania), Association for Strengthening Agricultural Research in Eastern and Central Africa (Uganda), International Plant Genetic Resource Center (Kenya), icipe (Kenya), Helen Keller International (USA) attended.

Three priority areas were identified by the partners 1) African indigenous and priority standard vegetables; 2) capacity building; and 3) seed production systems. The priority indigenous vegetables identified at that time were: Amaranth, African eggplant, African nightshade, Ethiopian kale, jute mallow, spider plant, okra, pumpkin, vegetable cowpea, Moringa, lablab, and Crotolaria. Priority standard crops were tomato, sweet pepper, eggplant, onion, garlic, vegetable soybean, and mungbean.



The quest to develop a vibrant vegetable seed production system in Africa began in 2002.

Training courses, workshops and field days

Training courses: AVRDC initiated five-month regional vegetable production training courses in 1994. Courses engaged an average of 21 to 24 participants. A new training module was developed in 1997. From 1997 to 2004, 12 Africa Regional Vegetable Crops Production and Research Training courses were conducted and more than 300 people were trained (Table 3). Table 4 shows a summary of participants in AVRDC Regional Vegetable Production Training courses in Africa, 1994 – 2005. Table 5 provides a summary of in-country training led by AVRDC.

In 2000, a regional training course on germplasm management sponsored by SADC Plant Genetic Resource Center, was conducted in March in Zambia for the benefit of eleven participants including three women from Angola, Malawi, Zambia, Lesotho, Swaziland, South Africa, Mozambique, Tanzania, Mauritius, and Zimbabwe. I also served as a member of their Regional Vegetable Crop Working Group from 1997 to 2004.

In collaboration with the United Nations Children's Fund Operation Lifeline Sudan (UNICEF-OLS) in 2000, the Regional Center for Africa organized two training courses in Yambio and Rumbek, southern Sudan, on vegetable crops production, in July and September, respectively. Seventy participants from self-help groups, NGOs, and UNICEF attended. In 2001, the Regional Center for Africa in collaboration with UNICEF-OLS organized three intensive in-country vegetable production courses in Yambio, Rumbek and Aweil East counties in southern Sudan in January, June and November respectively. One hundred and thirty participants from self-help groups and NGOs attended these courses. Under the same collaboration, two intensive incountry vegetable production courses were implemented in Yambio Country (Western equitorial) and Nyal District (Liech state, western Upper Nile) from June 26-July 3, 2002 and September 26-October 3, 2002, respectively. A total of 94 farmer representatives from self-help groups and NGOs attended, 50% of which were women.

About 435 kg of seeds of short maturing and priority vegetable crops were distributed to the training participants, UNICEF-OLS and local authorities for adaptation, adoption and dissemination to local farmers in each region. The seeds were packed into 1 kg nutrition kits comprising 12 vegetable species to supply fresh vegetables year-round and provide additional income for each household. Based on the absence of a formal seed industry in South Sudan, the seed production initiative was proposed to be formed at community level and seed exchange among farmers was promoted.

A participatory planning workshop on "Production, Processing and Utilization of Vegetable Crops" was held at the Regional Center for Africa from 28–30 April 2002. Seven participants from Mozambique and 14 participants from NARES, NGOs, and international development organizations in Tanzania attended the workshop.

An in-country training course hosted by UNICEF Zambia, with emphasis on home gardening, was conducted in Monze, Zambia from 18–23 November, 2002. A total of 30 personnel from the Ministry of Agriculture and local NGOs attended the course.

The training component of the CONVERDS received support from the United States Agency for International Development (USAID) in 2002 and since its inception, 306 NARES personnel were trained.

In 2002, in collaboration with Commonwealth Regional Health Community Secretariat for East, Central and Southern Africa (CRHCS-ECSA), the Regional Center for Africa organized a training course in May on production, processing and utilization of vegetable crops to prevent micronutrient malnutrition. Twenty-three participants (17 from Tanzania and 6 from Mozambique) attended the course.



Table 3. AVRDC training courses held at AVRDC's African RegionalProgram/Regional Center for Africa, 1997-2004

Training	Period	Participants
Regional Training Course on vegetable production in Southern Africa	July-November 1997	21
Regional Training Course on vegetable production in Southern Africa	July-November 1998	24
Regional Training Course on vegetable production in Southern Africa	July-November, 1999	24 participants from South African Development Community countries and Kenya
Regional Training Course on Vegetable Production in Southern Africa	July-November 2000	graduated 11 men and 9 women from 11 countries
Regional Vegetable Production Training Course for sub-Saharan African countries	July-November 2001	19 NARES participants from 14 countries
Regional Vegetable Production Training Course for sub-Saharan African countries	7 July to 7 November 2002	20 NARES participants from 12 countries
Regional Vegetable Production and Research Training Course for African countries	7 July to 7 November 2003	24 NARES participants from 20 countries
Africa Regional Vegetable Crops Produc- tion and Research Training Course	July-November 2004	22 NARES participants from 15 countries
12 th Africa Regional Vegetable Crops Pro- duction and Research Training Course	July to November 2005	24 participants from 17 countries
Short training course on fungal disease of vegetable crops	1999	Twelve participants including scientists, NGOs and private sector from SADC countries
Variety Evaluation and Seed Production	1997	12
Management of Fungal Diseases	1999	11
Germplasm, Conservation and Manage- ment	2000	16
Vegetable Crop Production	Two courses in May and June, 2000	24 trainees(Ministry of Agriculture and Coop. and 40 from NGOs operating in Tanzania
Vegetable Seed Production CIDA/DFID	2001	
Special skills training courses on indigenous vegetable crops production, marketing, and utilization under the GTZ/ BMZ project	April 4 to 24 2004 and May 23 to 30, 2004	20 participants (12 male and 8 female) from 5 countries and 24 participants (10 female and 14 male) from Kenya (13) and Tanzania (11)
Two- to three-day training courses in vegetable crops processing, preservation, and utilization	12 trainings from January to December, 2004	A total of 250 participants, comprising 90% women

Table 4: Summary of participants in AVRDC Regional Vegetable Production Training courses in Africa, 1994 – 2005

Country	No. of Participants		Overall Total
	Male	Female	
Angola	4	7	11
Тодо	1	0	1
Cameroon	1	1	2
Bukina Faso	1	0	1
Ghana	1	1	2
Eritrea	1	0	1
Ethiopia	2	1	3
Botswana	11	9	20
Malawi	11	9	20
Namibia	9	6	15
Mozambique	7	3	10
Zimbabwe	7	4	11
Swaziland	10	4	14
Lesotho	3	8	11
Zambia	7	9	16
Mauritius	5	2	7
Seychelles	6	2	8
Tanzania	31	37	68
S. Africa	6	1	7
Kenya	6	10	16
Uganda	2	2	4
Rwanda	2	-	2
Sudan	1	3	4
Senegal	1	1	2
Benin	1	0	1
Total	137	120	257
% of Total	53	47	100

Country	Year	Participants
Botswana	1999	32
Zimbabwe	1999	25
Tanzania (Govt. Staff)	2000	24
Tanzania (NGOs)	2000	40
Sudan (southern sector)	2000-01	137
Sudan (southern sector)	2002	98
Zambia	2002	27

Table 5. In-country training courses	on production of vegetable crops in
Africa, 1999-2002	

Field days: From 1997 to 2005, nine annual farmers' days were organized at the Regional Center for Africa. More than 1800 farmers, scientists, and personnel from NARES and the private sector attended the field days featuring technology demonstrations for applied vegetable production. During these events, the participants received seed of improved varieties for adoption. Several programs organized 20 special field days 1997 to 2005 on various aspects of vegetable production and consumption.

Women's empowerment training programs: Special emphasis was placed on training women in nutrition and vegetable production. Numerous in-country training courses were designed and conducted for women's groups and farmers in rural Tanzania, focusing on production, processing and utilization of indigenous vegetables. More than 2000 women were trained (Table 6).



Table 6.	Vegetable crops production,	processing,	and preservation training
courses			

Training	Period	Participants
Special course on tomato processing for rural women farmers	1997-1998	100 participants from Arusha and Kilimanjaro regions
Three additional courses on tomato processing were organized in December, 1998.	December, 1998	78
Two short training courses on tomato processing	November, 1999	70 Tanzanian women farmers
Two tomato fruit processing courses	August & Septem- ber, 1999	37 women and 8 men from Arusha
Three training courses on tomato and indigenous vegetable processing	November, 2001	59 rural women farmers and women's groups
12 courses on processing tomato (2), preserving indigenous vegetables for long term utilization (2), establishing seedling nurseries (4), and using IPM in vegetable production (4)	2002	148 persons
12 two-day courses in nursery management, vegetable production, IPM techniques, and vegetable processing and utilization	2003	250 farmers were trained, 90% were women from Kilimanjaro, Arusha and Manyara regions
12 courses of three-day duration conducted on processing and recipe-making courses	2004	250 farmers were trained
20 two- to three-day training courses in vegetable crops production, processing, and preservation conducted from January to December	2005	430 participants from self-help women groups, small-scale farmers, and university students, including 90% women
Training on production, processing, utilization and marketing of vegetable crops under new women's market and education facility in Tengeru	2005	380 participants in Tengeru market education training program and 200 women in processing utilization trained

WAVNET

A workshop on vegetable research and development in West Africa was conducted at the Regional Center for Africa on 5-6 February 2001 to identify the current status and constraints of vegetable production systems, prioritize research areas, prepare a work plan, and present a national policy and future strategies for vegetable research and development. Representatives of 11 West African countries (Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Gambia, Ghana, Mali, Niger, Nigeria, Senegal, Togo) attended. During this workshop, the West African Vegetable Network (WAVNET) was conceived and all participants requested AVRDC to be the coordinating agency.

Partnerships developed in the region

RCA had strong relationships and worked in partnership with regional organizations including SACCAR, ASARECA, CORAF, FARA, SADC-FANR for vegetable research and development in sub-Saharan Africa (SSA). The International Agricultural Research Centers located in SSA including the International Plant Genetic Research Institute (IPGRI), West Africa Rice Development Agency (WARDA), International Center for Insect Pests and Ecology (icipe), IITA and RCSA worked together in joint projects.

The Regional Center for Africa hosted IPGRI's Tanzania Officer to develop a partnership and to act as a focal point for IPGRI in the SADC region. Other joint efforts were conducted with international organizations including UNICEF (Household food security through vegetable cultivation in southern sector of Sudan); CRHCS (Promotion of African indigenous vegetables for health and nutrition); FAO (Food security and nutrition through African indigenous vegetables); IDRC (Regional training on African indigenous vegetables) and DANIDA (Training in vegetable seed production).

New initiatives were established with international and national institutes like Purdue University (on Appropriate Horticultural Germplasm for Southern Africa) and Oregon State University's Rural Livelihoods Consortium. AVRDC developed a partnership with ASARECA to implement a project on "Accelerating Indigenous Vegetable Crops Productivity through Sustainable Seed Production and Supply Systems in East and Central Africa"; with SADC-FANR for "Promoting Production and Utilization of African Indigenous Vegetables and Tomatoes for improved Nutrition and Income of Resource Poor Households in Southern Africa"; with USAID for a project on "Seed Dissemination and Maintenance of Variety Purity at the Farm Level in Tanzania"; and with the European Union for a project on "Networking to promote the sustainable production and marketing of indigenous vegetables through urban and peri-urban agriculture in sub-Saharan Africa".

The Regional Center for Africa organized a workshop with the United Nations Food and Agriculture Organization (FAO) on "Increasing Consumption of Micronutrient-rich Foods through Production and Promotion of Indigenous Foods" in Arusha, Tanzania from 5-8 March 2002. Twenty-five participants attended the workshop, including representatives from NARES in South Africa, Swaziland, Tanzania and Uganda, and other representatives from CRHCS-ECSA, FAO and AVRDC. The workshop provided a forum for planning and consensus, at which policymakers, agricultural researchers, nutritionists, and extension workers exchanged ideas and formulated strategies for international collaboration on indigenous food crops.

A national review and planning workshop on vegetable research and development in Malawi was held at the Malawi Institute of Management (MIM) in Lilongwe, Malawi, on 23–24 September 2003. Forty-five participants from NARES, relevant ministries, universities, and farmer organizations attended the workshop and developed a workplan for vegetable research and development strategies in Malawi.

A planning workshop was organized on 19-20 September 2005 to foster collaboration with regional public and private institutes to map future vegetable research and development needs in the region. Public and private sector representatives from Tanzania (Tanseed International Limited, Kibo Seed Company, Alpha Seed Company, Tanzanian Vegetable Seed Program (TVSP), Krishna Seed), Uganda (Harvest Farm Seeds Ltd., Victoria Seeds Limited, FICA Seeds, Farm Inputs Care Center (FICA) Ltd.), and Kenya (Kenya Seed Company (Simlaws), FAIDA Seeds, HORTITEC (K) LTD, Lagrotech Seed Company, Eastern Africa Seed Committee (EASCOM)) attended. As a result of this workshop, a positive collaborative relationship was developed with private seed companies.



During training courses participants learned improved methods for vegetable production, processing and preservation.

Germplasm collection and distribution

Germplasm collection missions were carried out in Cameroon and Tanzania beginning in May 1998. Studies funded by the Department for International Development (DFID), U.K. in 1997 on germplasm collection, evaluation and management for African indigenous vegetables were completed in April 2001. Researchers collected 209 accessions of target species: amaranth, African eggplant, African nightshade, Ethiopian kale, fluted gourd, jute mallow, roselle, water leaf and spider plant from Cameroon and Tanzania, and 177 accessions from Ghana, Zambia, Mozambique and Zimbabwe.

Under a BMZ/GTZ project, 155 lines of indigenous vegetables were collected in 2004. By the 2005, a total of 1365 germplasm accessions of African indigenous vegetables had been collected. The Regional Center for Africa characterized and evaluated 478 germplasm accessions (Table 7).

Common name	Scientific name	Accessions
Amaranth	Amaranthus spp.	248
Ethiopian kale	Brassica carinata	120
African eggplant	Solanum aethiopicum/macrocarpon/anguivi	154
Jute mallow	Corchorus sp.	73
Roselle	Hibiscus sp.	44
Pumpkin	Curcubita sp.	120
Okra	Abelmoschus sp.	74
Bitter leaf	Vernonia sp.	8
Nightshade	Solanum scabrum/americanum/villosum/ retroflexus/eldoreti	168
Sunnhemp	Crotolaria spp.	5
Spider plant	Cleome gynandra	158
Bambara groundnuts	Vigna subterranea	20
Hyacinth bean	Lablab purpureus Dolicos lablab	55
Vegetable cowpea	Vignia unguiculata	111
Moringa	Moringa olifera	7
Total		1365

Table 7. List of African indigenous vegetables collected by AVRDC Regional Center for Africa, 1997-2005

Impact of research

Research at the Regional Center for Africa focused on tomato and African indigenous vegetables. Tomato breeding lines with a high level of field resistance to late blight were selected with good horticultural traits. Crop management studies on cultivar description, plant nutritional requirements and plant populations were conducted on African indigenous vegetables.

Two tomato lines—AVRDC-ARP 367-2 and Det-2—were found to be promising compared with local varieties, and were officially released in 1997 under the names of 'Tanya' and 'Tengeru 97' (with average yields of 61 and 64 t/ ha, respectively) in Tanzania. Fruit of these high yielding varieties had a thicker pericarp and firm flesh that could withstand long-distance transportation and maintain good keeping quality. Six years after their introduction more than two-thirds of sampled households in Tanzania grew 'Tanya' and/or 'Tengeru 97'.

The MAFS Tanzania did a country-wide survey to assess the impact of 'Tanya' and 'Tengeru 97'. These varieties were disseminated to the Northern, Central, Eastern and Southern highlands production zones of Tanzania. The hectares planted with the new tomato varieties in the 2003/4 season were more than 80% of the total area used to grow tomatoes. Farming households enjoyed better-than-average yields due to the new varieties' higher resistance to Tomato mosaic virus and nematodes. Overall net income rose and was 40% higher compared with formerly cultivated varieties. Revenues from market sales led to other positive after-effects, such as improvements in basic infrastructure. With the additional income generated from producing the improved tomatoes, about 85-95% of the farmers in Ilula were able to build modern houses. Some farmers bought improved dairy cows, goats and pigs; others purchased bicycles, motorbikes, and various types of vehicles. Some farmers built retail or wholesale shops. Farmers were able to pay for medical services for household members and school fees for their children. Employment opportunities increased in various sectors. Social services (banks, NGOs, extension and research services, formation of groups and financial agents/aid) expanded. The new tomato varieties also contributed to increased food and nutritional security, as the tomatoes had improved nutritional value and were available for longer periods.

Starting in 1997 AVRDC refined agronomic practices to maximize tomato seed production and worked closely with small local seed companies to develop a Tanzanian tomato seed industry. These varieties have now become popular across Eastern and southern Africa. 'Tengeru 97' was released as 'Mbambande' in Malawi in 2003, and both were officially released in 2006 in Kenya and in 2007 in Uganda. Lines ARP 367-1 and ARP 367-2 were released in Malawi for general cultivation. Two brochures describing the recommended cultural practices for the two tomato varieties were published for distribution. Five more sister lines and promising late blight resistant lines were selected and disseminated.

Indigenous vegetables research

The Regional Center for Africa conducted a research to select improved varieties and improve production methods for smallholder farmers for regionally important indigenous vegetables. Initiatives undertaken for indigenous vegetables included:

- 1. Improving Food Security in sub-Saharan Africa through increased Utilization of Indigenous Vegetables: Studies on seed production and agronomy of major African vegetables
- 2. Germplasm Management of Underutilized African Vegetables for Improving Agro-biodiversity, Food Security and Increasing Income of Rural and Urban Poor in Southern Africa
- 3. Enhancing Production and Utilization of African Indigenous Vegetables through sustainable seed Production and Distribution for Better Health, Nutrition and Small Agribusiness in ASARECA member countries
- **4.** Germplasm Collection, Evaluation and Improvement of African Leafy Vegetables
- **5.** Technical support to IPGRI on conservation, capacity building and regional characterization of African leafy vegetables
- 6. Promotion of Neglected Indigenous Leafy and Legume Vegetable Crops for Nutritional Health in Eastern and Southern Africa

These initiatives resulted in the collection of more than 668 accessions of 15 common indigenous vegetables in Africa. Priority African indigenous crops included: Amaranth, African eggplant, African nightshade, Ethiopian kale, jute mallow, spider plant, okra, pumpkin, vegetable cowpea, and *Moringa*. Approximately 4.5 tonnes of indigenous vegetable seed was produced and distributed to NARES, NGO's, and more than 10,000 farmers in several countries in Africa.

Research at the Regional Center for Africa resulted in the development and identification of several promising African eggplant lines, including 'Tengeru White.' Farmers procured seed from RCA and commented that they preferred growing 'Tengeru White' because of its high yield, slower maturity(did not turn red fast), bigger fruits in clusters of up to five fruits, and better taste. Demand for fruit of the improved variety was high.

In Kenya, African nightshade became a profitable crop when AVRDC promising broad-leafed lines SS 52, SS 49, and SS 0.4S were introduced in 2004. Studies showed that nightshade brought additional income of 200,000 Ksh/year (US\$ 2800) to farmers who grew the crop.

By 2005, 56 lines of 18 crops were found promising at RCA for promotion (Table 8). Thirty varieties were released by NARES in Africa using the selected promising lines (Table 9).

Vegetable	No. lines	Names
African nightshade	4	SS52, SS04.2, SS49, SA1
African eggplant	4	DB3, AB2, UVPP, Tengeru white
Ethiopian kale	1	Mbeya Green
Amaranth	4	AH-TL, AH-NL, AH-MX, AC-NL
Okra	1	ARP-1
Spider plant	2	PS, GS
Corchorus	3	ES1, SUD-1, HS1
Pumpkin	2	PO-1, PF-1
Moringa	1	MARP-1
Sunnhemp	1	CH-1
Vegetable cowpea	4	Dakawa, Fahari, Vuli, Tumaini
Mungbean	2	VC6148(50-12), VC1653(B-20P)
Onion	1	Red bone
Garlic	3	VFG 180, VFG 34, VFTA 325
Vegetable soybean	4	AGS 292, AGS 329, AGS 338, AGS 339
Sweet pepper	1	977126
Hot pepper	3	97-7644, 9852-173, 9852-170
Tomato	15	Tengeru 97, Tanya, 44-2, 19-2, 19-3, 50-2, 2366B, ARP 366-1, ARP 366-3, ARP 367-1, CLN 15581, CLN 157, CLN 155B, CLN 555- 106-4, CLN 1558-100-10

Table 8: Promising lines identified at the Regional Center for Africa for promotion

Crop	Varieties released	Country
Tomato	17 (Kiboko, Meru, Tanya, Tengeru 97, Little Cherry, Creeper, Big Red, Xin, Mbambande, Khama, Xin, Samtom 13, Samtom 14, Samtom 15, MST20/13, Xina, Tropiva 3)	Tanzania, Kenya, Uganda, Mauritius, Cape Verde, Nigeria, Senegal, Seychelles, Democratic Republic of Congo, Malawi
Vegetable soybean	4 (Edamame1, VSS1, VSS2, AGS292)	Sudan, Zimbabwe, Mauritius
African eggplant	2 (Tengeru White, DB3)	Tanzania
Okra	1 (ARP1, BARI Dhirosh)	Tanzania, Uganda (BEN, BKF, CIV, GAM, MLI, SNL)
African nightshade	1 (Giant Nightshade)	Kenya
Cowpea	1 (Tumaini)	Kenya
Pepper	4 (F1 Forever, Remington, CRI-Shito Adope, CRI-MakoNtoos)	Senegal, Ghana, South Africa

Table 9.	Varieties	released	using	the sel	lected	promising	lines
						r · · 0	



Processing tomato for sauce. AVRDC's 'Tengeru 97' proved to be a profitable crop for farmers in 10 countries across Africa.

TENGERU 97

Seed kits for home gardens and disaster relief

The Regional Center for Africa designed and developed a Vegetable Nutrition Kit with seed of 14 nutritious and quick growing indigenous vegetables to provide common nutrients often lacking in diets in sub-Saharan Africa, such as protein, vitamin A, iron and iodine, and to improve the diets of people with HIV. These activities were fully supported by UNICEF.

A Healthy Diet Gardening Kit containing seeds of 16 nutritious vegetables was developed for emergency relief. During 2002-2003, 4.5 tonnes of vegetable seed were produced and distributed to NARES, NGO's, and to more than 10,000 farmers in Africa. During 2004, 1.5 tonnes of seed were produced and distributed to more than 1200 families, and efforts to institutionalize seed supply and distribution were undertaken.

Teaching and research

From 2000 to 2005, four Ph.D., 3 M.Sc., and 27 B.Sc. students were hosted. Two postgraduate students were trained in Germany, Israel and the Regional Center for Africa.

Projects implemented

Phase II of the training component of the Collaborative Network for Vegetable Research and Development in Southern Africa (CONVERDS) funded by BMZ/ GTZ ended in January 2001. The Regional Center for Africa trained 286 NARES personnel under this project component.

Phase III of the project on Tomato Germplasm Improvement Program for Africa was successfully completed on 31 December 2001. Significant progress was achieved in breeding tomato varieties with good horticultural traits and resistance to late blight. Eleven projects grants from BMZ/GTZ, USAID, IPGRI, FAO and Rockefeller Foundation etc. were received and implemented:

- **1.** UNICEF Africa (2001-2003) Project Manager: Household food security through vegetable cultivation in southern Sudan.
- 2. Promotion of Neglected Indigenous Leafy and Legume Vegetable Crops for Nutritional Health in Eastern and Southern Africa (Funded by BMZ/GTZ, March 2003-Feb. 2006).
- 3. BMZ/GTZ project, phase II Africa (2006-2008).
- 4. Germplasm Collection, Evaluation and Improvement of African Leafy Vegetables (Joint grant from USAID to Ben Gurion University and RCA from 2002-2006).
- 5. AVRDC-RCA Technical Support to IPGRI on Conservation, Capacity

Building and Regional Characterization of African Leafy Vegetables (Funded by IPGRI from 2002-2004).

- 6. Empowering Small Scale and Women Farmers through Sustainable Production, Seed Supply and Marketing of African Indigenous Vegetables in Eastern Africa (March 2004 to Feb 2006, Phase 1). Planning meeting conducted from 22–23 March 2004; fifteen participants from Tanzania and Kenya attended (funded by Maendeleo Agriculture Technology Fund (MATF), Gatsby and Rockefeller Foundation).
- 7. Promotion of neglected indigenous leafy and legume vegetable crops for nutritional health in Eastern and Southern Africa (Funded by BMZ/GTZ, phase I, March 2003-Feb. 2006).
- 8. Germplasm collection, evaluation and improvement of African leafy vegetables (Joint grant from USAID to Ben Gurion University and AVRDC for 2002 -2006).
- 9. Empowering small scale and women farmers through sustainable production, seed supply and marketing of African indigenous vegetables in Eastern Africa (Farm Africa, February 2004 to January 2006); planning meeting conducted from September 19–20 2005 to prepare a workplan for implementing the project. Twenty-five participants mainly from Tanzania, Uganda, and Kenya attended the meeting.
- Technology transfer of promising vegetable lines through sustainable seed production in East Africa (Funded by Rockefeller Foundation, 2005 – 2008).
- Joint AVRDC and the Commonwealth Regional Health Community Secretariat for East, Central and Southern Africa (CRHCS-ECSA) project on "Promoting multidisciplinary approaches to prevent vitamin A and micronutrient/malnutrition in Southern Africa" (2000-01).

Major meetings

The Regional Center for Africa hosted the board meeting of International Society for Horticulture Science (ISHS) and facilitated the Committee for Research Cooperation meetings in Arusha from 9-13 February 2005.

AVRDC and the University of California - Davis organized the USAID-funded Global Horticulture Initiative Africa Regional Workshop in Arusha, Tanzania from February 14-16, 2005. The workshop brought together 85 leading experts and key stakeholders to prioritize the issues constraining

horticulture development in various regions in Africa and to identify potential projects to address these issues.

Farewell to Africa

I had the good fortune to be awarded the AVRDC merit award for the years 1999, 2000, and 2002 in recognition of my contributions to the Center's activities in Africa. In January 2006, I was asked to guide the Center's activities in South Asia. I handed over charge of the Regional Center for Africa and the ongoing funded projects to the incoming director, and looked ahead to my new posting.



III. SOUTH ASIA



Groundbreaking for the Regional Center for South Asia, 2009







THE SAVERNET project in South Asia and the USAID-Bangladesh project had begun to identify the problems of vegetable growers, scientists and extension workers, to build their capacity, and to support NARS institutes by providing useful germplasm and assistance in identifying promising lines, varieties, and technologies suitable for the region. At South Asia I assisted AVRDC scientists in implementing and successfully completing the following projects in South Asia:

- 1. Phase II (2003-2006) of the project on "Implementation and promotion of an IPM strategy for control of EFSB in South Asia" was taken up in Bangladesh and India. The project was successful in finding strategies for eggplant fruit and shoot borer (EFSB) with the minimal use of pesticides.
- 2. DFID-funded project on "Dissemination of validated IPM technology in developing countries affected by whitefly pests and whiteflytransmitted viruses that hinder food production and socioeconomic development in the tropics" was implemented by headquarters in collaboration with University of Agricultural Sciences, and Indian Institute of Horticultural Research (IIHR), Bangalore, India, and completed in March 2008.
- 3. A GTZ project entitled "Application of molecular markers to broaden the genetic base of tomato for improved tropical adaptation and durable disease resistance" (2004-2009) was implemented by headquarters in collaboration with scientists of IIHR, Bangalore. The project aimed to map novel alleles from wild tomato for selection of bacterial wilt resistance, durable resistance and tropical adaptation.
- 4. A GTZ project on "Development of locally adapted, multiple diseaseresistant, high yielding chili (Capsicum annuum L.) cultivars for

China, India, Indonesia and Thailand" was a two-phase project. Phase II (2005-2008) was carried out with the Indian Institute of Horticultural Research, Bangalore. The project was designed to incorporate multi-disease resistance into predominant chili varieties for economic and environmental betterment.

Birth of Regional Center for South Asia

AVRDC aimed to further strengthen its operations in South Asia by establishing the Regional Center for South Asia (RCSA) at the ICRISAT campus, Hyderabad, India through a memorandum of understanding signed between the two institutes in March 2006. RCSA was created to place strong regional emphasis on building partnerships with other public and private sector organizations active in vegetable research and development network in Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

AVRDC Director General Dr. Thomas Lumpkin selected me to serve as the first regional director of the new office. The groundbreaking ceremony occurred on October 3, 2008. Offices were built, staff members were hired, and research fields were developed. The new office was inaugurated in March 2009 during the 42nd AVRDC Board of Directors Meeting by Board Chair Dr. Paul M.H. Sun. Since then, the regional center has added a conference hall, separate office chambers, laboratory, work stations, and official vehicles for its staff and field operations.

A good beginning

To highlight the collection and utilization of indigenous vegetables and legumes for their important role in achieving food and nutritional security, the Regional Center for South Asia in collaboration with Bioversity International, ICRISAT, the International Society for Horticultural Science and the Global Horticulture Initiative organized the "First International Conference on indigenous vegetables and legumes" at RCSA, from 12-15 December, 2006. Two hundred seventy-one participants representing 42 countries attended the event. More than 100 papers were compiled and published in the proceedings on "First International Conference on Indigenous Vegetables and Legumes" (Acta Horticulturae vol. 752) in collaboration with ISHS. I received the ISHS Medal and Certificate in recognition of meritorious service to the society as convener of the conference and also won the best poster award for the paper entitled "Healthy diet gardening kit: For better health and income."

South Asia Planning Meeting

To discuss issues and problems related to the improvement, production, and utilization of vegetable crops in their countries and to identify priority crops and areas of research, a participatory South Asia Regional Planning Meeting was organized at the Regional Center for South Asia from 16-17 December 2006. Twenty-four NARES representatives from South Asia and seven from AVRDC participated. Partner NARS of South Asia prepared a blueprint for collaborative activities, and unanimously recommended and agreed for the establishment of a network for vegetable research and development in South Asia under AVRDC's leadership. The network now serves as a framework for the NARS to develop research partnerships and cooperation with each other. Proceedings of the planning meeting were published in January 2008.



The mungbean transformation

Phase II (2002-2005) of the project "Improving income and nutrition by including mungbean in cereal fallows in the Indo-Gangetic Plains of South Asia" was focused on farm trials and extension of new varieties during the fallow period after wheat or potato and before rice crops in Bangladesh, India and Nepal. The project successfully identified and introduced short-duration and *Mungbean yellow mosaic virus* (MYMV) resistant varieties that were released by NARS: 'BARImung 5' (2002), 'BUmug-1' (2000), 'BUmug-2'(2001), and 'BINAmung 6' (2002) in Bangladesh; 'Pant Mung-5' (2002), 'Pusa Vishal,' and 'SML-668' (2004) in India; and 'KPS-1' (2002), 'Kalian' (2006), and 'Prateeksha' (2006) in Nepal. In 2009, NM 92 and KPS-2, BARImung-2 were also released in Pakistan and Bhutan, respectively as well as in Afghanistan: NM 92 as 'Maash-2008' and NM 94 as 'Mai-2008'.

AVRDC re-initiated activities to promote the extra short-duration mungbean varieties and disseminate improved technologies in different cropping systems. RCSA hosted demonstrations of the new vareties; helped to popularize the Seed Village Programme; and conducted marketing and socioeconomic assessments. The RCSA mungbean project (2005-07) was implemented with Punjab Agricultural University (PAU); Rajasthan Agricultural University; Rajendra Agriculture University, Bihar; Birsa Agricultural University, Jharkhand; and CSK Himachal Pradesh Agricultural University. In 2008-09 Haryana Agricultural University and Tamilnadu Agricultural University were included.

The project made a good impact with the release and popularization of short-duration, virus-free, high yielding mungbean variety SML 668, developed at PAU, Ludhiana from AVRDC line NM 94. A complete package of practices was developed for SML 668 in Punjab.

Demonstrations to promote cultivation technologies and mungbean varieties including SML 668 were conducted in seven selected states of India. The Seed Village Programme (SVP) helped farmers produce sufficient quantities of their own quality mungbean seed and to provide additional seed to other farmers. During 2006, 2620 t of SML 668 seed was produced under the SVP by partners in four states and 2.1 t nucleus/basic seed of SML 668 was produced at PAU, Ludhiana.

The encouraging results from field experiments and demonstrations clearly indicated that SML 668 fit very well in rice-wheat cropping systems, and had wide adaptability. It was recommended for cultivation in the states of Punjab, Rajasthan, Himachal Pradesh, Bihar, and Jharkhand. The cultivation of SML 668 using improved technologies helped farmers to earn on an average 20 years of service with AVRDC - The World Vegetable Center



AVRDC promoted virus-resistant, short-duration mungbean varieties for use in rice or wheat rotations in South Asia. The nutritious legume soon found a following among consumers and farmers. Mungbean had the additional benefit of adding nitrogen to the soil after harvest to nourish the succeeding crop.



US\$ 900/ha when planted after potato or wheat over the variable cost within 60-65 days in Punjab.

Besides higher output, a summer mungbean crop added about 40 kg N/ ha into the soil after the harvest to nourish the succeeding crop. By following no-tillage practices, farmers produced almost the same grain yield as obtained in tillage treatment and saved Rs. 2000/ha (US\$50). Raised-bed sowing of three rows 20 cm apart gave yields equivalent to flat sowing, yet the practice saved about 30% of irrigation water.

Due to the great success and wider adaptability of SML 668 the project was extended on a no-cost basis to August 2010. A new variety of summer mungbean, SML 832, was released for cultivation and demonstrated in 300 trials in 11 districts of Punjab. Thirty-eight new AVRDC mungbean lines were introduced and 55 tonnes of SML 668 seed were produced. Recipes were developed and training courses were conducted for improved nutrient bioavailability through the consumption of mungbean and mungbean sprouts.

RALF-0104 Afghanistan project

AVRDC implemented a Research in Alternative Livelihood Fund (RALF) project entitled "Introduction, evaluation and promotion of appropriate crop legumes and vegetables for Eastern Afghanistan (CLVEA)" from 2004 to 2006 with project partners Nangarhar University, International Development Enterprises (IDE) and Relief International (RI). To analyze the project impact and further promotion in Afghanistan, an extension phase of CLVEA was funded and successfully completed on June 30, 2008.

Under this project, greenhouse technology for off-season vegetable production and drip irrigation technology was adopted, and farmers showed interest in switching over to vegetables in place of poppy cultivation. Staff members from Nangarhar University as well as 21 trainers and 426 farmers were trained on various aspects of vegetable production. The introduced varieties yielded 12.7 to 37.5% more income than poppies, which indicated that income generated by poppy cultivation was only 1/5th that of vegetable cultivation. Twenty-five collaborating farmers shifted to vegetable cultivation and 50 neighboring farming households reduced the area under poppy cultivation. On April 15, 2009, two high yielding, early maturing mungbean varieties were released in Afghanistan: NM 92 as 'Maash-2008' and NM 94 as 'Mai-2008'.



Sir Ratan Tata Trust projects

In May 2007, a Sir Ratan Tata Trust Small Grant Programme entitled "Developing partnership between AVRDC-The World Vegetable Center and Sir Ratan Tata Trust to improve vegetable production, consumption and income in selected regions of India" was initiated.

Under this grant, exploratory surveys were conducted in selected areas of India to identify problems and constraints in vegetable production, consumption and marketing in the states of Jharkhand, Maharashtra, Punjab and Uttarakhand. A team of AVRDC and Tata Trust staff completed the exploratory mission for Punjab, Maharashtra and Jharkhand in May 2007 and for Uttarakhand in September 2007. Based on the key problems identified, a project proposal for Punjab and Jharkhand was developed and funded for five years starting April 1, 2008.

The project, "Improving vegetable production and consumption for sustainable rural livelihoods in Jharkhand and Punjab, India" under the Central India Initiative (CInI) and Reviving Green Revolution (RGR) has two sub-projects: Safer Vegetable Production, and Home Gardens for Diet Diversification and Better Health. The project activities were designed and are being implemented to directly address the prevailing problems of farmers in Jharkhand and Punjab, such as poor availability of suitable varieties and good quality seed, lack of proper crop management, pesticide abuse, inappropriate net-house design, lack of information on marketing of high-value horticultural crops, and deficiency of important micronutrients intake such as vitamin A, riboflavin and iron.

To ensure efficient implementation, AVRDC and its project partners organized an annual review and planning workshop. Constraints and shortcomings of the previous year were examined and workplans for the next year were prepared.

Farmers were involved at all levels of the project, organizing field days, training, visits, and demonstrations; they also attended the partners' meetings. During these interactions a large number of farmers made their constraints known, and began to adopt new varieties and technologies to overcome their prevailing problems.

In Jharkhand, out of a total of 77 hybrids/varieties introduced from AVRDC, NARS and eight leading private seed companies that were evaluated at 567 on-station and farmer's field trials, 22 promising and disease-tolerant varieties of okra (2), tomato (5), eggplant (3), cowpea (4), garden pea (4), bottle gourd (3), and vegetable soybean were selected and demonstrated in 9000 farmer's fields in Jharkhand. The promotion of these varieties reduced use of insecticides/pesticides, leading to safer vegetables.

In Punjab, the project has created greater awareness about vegetable cultivation in net-houses. During the exploratory survey it was observed that the existing net-houses in Punjab were poorly designed. To improve the designs and cultivation technologies including IPM, three scientists from project partners were sent to AVRDC headquarters for special training. They designed new net-houses that were much stronger and stable than the old nethouses. The new net-houses were constructed and demonstrated at Punjab Agricultural University PAU and on-farm in four districts of Punjab. The technology was well-accepted by farmers and led to a boom in safe vegetable cultivation. AVRDC, PAU, and eight private seed companies brought together 126 varieties of tomato, eggplant, capsicum, okra, garden pea, cucumber, French bean, early cauliflower, coriander and spinach to provide farmers with the best varieties for cultivation in 10 different cropping sequences under nethouse conditions at PAU and in farmers' fields. Among these varieties, 22 selected varieties of 9 vegetables were demonstrated in farmers' net-houses. AVRDC's role as neutral party in testing public-private sector varieties was established, and its role in making these varieties available to farmers is unique, yet well-accepted by partners.

A healthy seedling production method developed by AVRDC was validated for eggplant and tomato. Farmers were able to get good seed germination, over 50% more yield, and seedlings were ready 7-13 days earlier for transplanting in Punjab and Jharkhand. More than 220 farmers and extension staff were trained in healthy seedling production methods. Liquid fertilizer for tomato and capsicum was validated in Punjab, which saved 53 kg (39%) of N against the recommended 137 kg/ha.

For Jharkhand, vegetable soybean has emerged as a "miracle crop." Variety 'Swarna Vasundhara,' developed from AVRDC line GC 89009-1-1-2 and released by ICAR's Horticulture & Agroforestry Research Programme (HARP), brought significant benefits to the 4210 farmers who adopted it; these farmers earned about Rs. 80,000-100,000/ha from the crop. Four other AVRDC vegetable soybean lines (AGS-339, 357, 380, 406) found promising were selected for further demonstration.

A large number of demonstrations were held for short duration mungbean lines SML 668 and SML 832. In addition, 55 t of SML 668 and 0.8 t seed of SML 832 was produced.

Capacity building is a major strength of the Regional Center for South Asia. Through the Tata project, 1541 farmers and 230 technical staff in Punjab and 12,733 farmers and 215 technical staff in Jharkhand were trained on IPM and vegetable cultivation. To address malnutrition and to make vegetables available year round, home garden models suited for Jharkhand and Punjab







were developed. Farmers showed great interest in adopting these models capable of producing 250-275 kg of vegetables in a year, which is 5-6 times more production than the average vegetable crops' yield per ha under commercial cultivation. Many were willing to try new vegetables that had never before been grown or consumed in in Punjab and Jharkhand.

Sixty-five nutritionally rich recipes for Jharkhand and Punjab have been developed, demonstrated and published in books. Extension material for home gardening and nutrition awareness were prepared and distributed to trainers and farmers. More than 110 trainers and 6708 NGOs community service providers, farmers, and households in Punjab and Jharkhand have been trained in training/demonstration programs on home gardening, nutrition awareness and recipe development.

In 2008, an exploratory survey to understand current practices, opportunities and constraints in the production and marketing of vegetables in Uttarakhand, India was conducted in four districts of Uttarakhand (Nainital, Almora, Tehri, and Uttarkashi) with different ecological and geographical characteristics. Constraints to vegetable production and marketing within farming systems of poor, remote households in Kumaon and Garhwal regions were evaluated. Lack of irrigation facilities, availability of quality seeds, and marketing were the major problems faced by farmers. A comprehensive project report was published in 2008.

GTZ/BMZ project

AVRDC and ICRISAT implemented a 3-year GTZ/BMZ project entitled "Genetic, physiological, and molecular approaches to improve drought and heat tolerance of tropical tomato." Six best performing lines were identified for drought stress: CLN2585D, CLN2498E x CA4, CLN2498E, CLN2026D x CA4, CLN1621L x CA4, and DT-CLN2498E/LA1579-BC1F4-2. In the dry down/ reproductive stage experiment, four promising lines were identified based on minimum % fruit yield reduction over control: CA1, CA4, CL 5915-93D4-1-0-3 and CLN 1621L/ CA4.

In 2008, Postdoctoral Fellow Dr. Simone Kathrin Kriesemer undertook a study in Jharkhand, India in collaboration with RCSA staff for a project entitled "Adoption pathways for vegetable integrated pest management technologies to reduce pesticide misuse and pesticide related health hazards in India." The work was published in an AVRDC report, Demand for and awareness of safely produced vegetables in India.

Under the cooperative plan for preparation and distribution of seed kits for disaster relief, seeds of six nutritious, hardy and fast growing vegetables (amaranth, basella, brassica (vegetable mustard), chenopodium, kangkong and fenugreek (Kasuri methi)/ spinach) were produced. For each crop, a total of 10,000 healthy diet gardening seed kits were prepared. Each kit contained seed of six crops to cover an area of about 100 square meters, and contained easy-to-understand instructions on cultivation, field management, and food preparation guidelines in English.



Regional workshops and training course

To strengthen the capacity of South Asian NARS, the Regional Center for South Asia organized training course each year, inviting scientists from various institutes, universities, private seed companies and NGOs. The main purpose behind these self-sustaining learning programs was to expose scientists to recent advances in vegetable research and enhance knowledge for vegetable research and development. Courses held from 2007 to 2010 included "Safe vegetable production", "Germplasm management and utilization of vegetables and legumes", "Advances in vegetable and vegetable legume breeding technologies", and "Application of molecular markers in vegetable and legume breeding." More than 101 participants from Sri Lanka, Bhutan, Maldives, Afghanistan, Bangladesh, Nepal and India received training.

Two special Home Garden training courses were organized from 31 August-4 September 2009 at RCSA and from 25 September to 5 October 2010 in response to a special request received from Bhutan. Eighteen extension staff from the Department of Agriculture, Bhutan participated in the training course. The trainers returned to Bhutan and imparted their knowledge to households in Metakha block in Chukha District. To date, about 70% of the households have home gardens and grow a diversity of vegetable varieties. The sizes of the home gardens are based on the size of the family; a 4 x 4 meter garden is large enough to supply vegetables for a family of four or five people.

Teaching and research

Ms. Jennifer Lauren Bond, a MSc. Intern in Agricultural Development from the University of Copenhagen worked at RCSA for four months (4 October to 20 December 2008) and continued from 11-29 January 2009 on "Adoption pathways for vegetable integrated pest management technologies reducing pesticide use and pesticide related health hazards in India" under the joint supervision of Dr. M.L. Chadha and Dr. S. K. Kriesemer, Research Associate (Socioeconomics).

Mr. Laurence James Tait, a Ph.D. research scholar from Central Queensland University, Australia, joined RCSA under the GTZ-funded tomato drought and heat tolerance project on 22 July 2009 for five months. He conducted research on the "Physiological investigations of drought tolerance in tomato" under the supervision of Dr. Chadha, and Dr. Vincent Vadez, Plant Physiologist, ICRISAT.

Ms. Claire Barnes Runquist, World Food Prize Summer Intern, worked at RCSA from 12 June to 10 August 2010 on aspects of "Home gardening and nutrition" under the guidance of RCSA's home gardening team.



Home garden models, seed kits, and vegetable preparation demonstrations helped to spread improved varieties and production methods across South Asia.

Memoranda of Understanding signed

- On 30 October 2008, a Collaborative Research Agreement (CRA) was signed between AVRDC The World Vegetable Center and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The CRA strengthened the joint programs between the two international research institutes.
- On 9 December 2008, a Letter of Agreement (LOA) was signed between AVRDC and Birsa Agricultural University (BAU), Ranchi, Jharkhand
- On 20 April 2010, a Memorandum of Understanding between AVRDC The World Vegetable Center and Department of Horticulture, Government of Andhra Pradesh was signed to facilitate research activities in the state.
- On March 4 2011 a Memorandum of Understanding was signed between AVRDC The World Vegetable Center and the University of Horticultural Sciences, Bagalkot, Karnataka.

Meetings and milestones

The 42nd AVRDC Board Meeting was held from 9–13 March 2009 at RCSA. Committee meetings preceded the full board meeting. It was the first time that the AVRDC program committee (ProCOM) doubled-up with the ICRISAT ProCOM for a joint session. The two program committees had a positive and fruitful meeting that assured extensive collaboration in the future. ICRISAT's outstanding hospitality and the excellent administrative organization provided by the Regional Center for South Asia helped to make the meeting a productive and positive experience for all participants.

The Year 2 BMZ/GTZ Project Workshop was hosted from 28 to 30 April 2009 at RCSA. Eighteen participants from AVRDC headquarters, Germany, Tanzania, Taiwan, Australia, and ICRISAT participated to finalize the year 2 workplan.

AVRDC's legume breeding program was re-located from headquarters to RCSA in 2010. Dr. Ramakrishnan M. Nair was appointed to lead the program on July 12. Mungbean, vegetable soybean and cowpea were listed as priority crops for future research.

RCSA and the ICRISAT Association for Community Development (IACD) organized a training course on home gardening and methods of cooking on January 30 2009. Twenty-five women participated in the course and a year-round home garden plot was established at IACD.

Strengthening relations with NARS partners

To identify the constraints to vegetable research and development in South Asia and to establish a network among South Asian NARS, I organized a number of visits to countries in the region. During these visits discussions were held with the officials engaged in the vegetable/horticulture sector.

Afghanistan: AVRDC implemented a Research in Alternative Livelihood Fund (RALF) with Afghanistan after my visit in 2006, which led to the successful introduction of improved vegetable varieties.

Bangladesh: I have worked closely with Bangladesh from the beginning of my career with AVRDC. My regular visits provided motivation to scientists and helped strengthen working ties with the key Bangladesh government officials. In collaborative meetings with the Director General BARI, Director (Horticulture), Vice Chancellor Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), and vegetable scientists, I shared the recommendations of the South Asia planning meeting. I participated in

the Third National Workshop on Pulses organized by BARI and presented AVRDC's role in expanding mungbean production in South Asia. On February 17-20, 2009, I participated in the International Conference on "Quality Seed and Food Security" held at Bangladesh Agricultural University (BAU), Mymensingh and presented the AVRDC perspective on nutritional security in South Asia through vegetables and vegetable legumes. More recent collaborations were with SAARC, Bangladesh; on February 16, 2010 I visited the SAARC Agriculture Centre and held a meeting with the Director, Executive Chairman (BARC), DG (BARI) and Secretary of Agriculture about the possibilities of developing a collaborative regional program on indigenous vegetables. SAARC also presented me with an award for my contributions to agricultural development in South Asia.

Bhutan: I helped scientists and technical staff capacity building, knowledge development programs on advance vegetable research and development and home gardening. A close relationship developed with the Ministry of Agriculture Science and Department of Agriculture, Bhutan.

India: I facilitated the organization of the First General Assembly of the Global Horticulture Initiative at Nikko Metropolitan Hotel, New Delhi, India. I developed strong partnerships with a number of universities in India, especially GB PUAT, Pantnagar; PAU, Ludhiana; BAU, Jharkhand; HAU, Hisar; TNAU, Tamil Nadu; RAU, Rajasthan; and HU, Hyderabad. Linkages with ICAR institutes were important to AVRDC's work, including IARI, New Delhi; IIVR, Varanasi; IIHR, Bangalore; and NBPGR, New Delhi. I also fostered dialogue with a number of private seed companies. Seventeen seed companies, three public institutes and more than 200 farmers attended the Bangalore Field Day and saw AVRDC's Tomato leaf curl virus (ToLCV) resistant varieties, hybrids and IPM technologies. I led a number of brainstorming session at meetings with various institutes, such as "Advances in chili research" at IIVR; a group meeting of tomato workers at IIHR, Bangalore; "Legume vegetables in India -Present status and future strategies" at IIHR, Bangalore; "Challenges, strategies and future prospects for Mungbean R&D in South Asia" at Ludhiana; group meeting of All India Coordinated Research Project (AICRP) on Vegetable Crops at ICAR, Research Complex for NEH Region, Shillong; meeting at Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad; National Institute of Nutrition (NIN); Indian Institute of Chemical Technology (IICT); and Solidarity and Action Against the HIV Infection in India (SAATHII). I also guided the expansion of work on home gardens in three states of India.

I was a regular participant in the annual Indian Horticultural Congress, where trends in the vegetable/horticulture sector were presented and discussed. I served as the Executive Councillor for the Horticultural Society of India (HSI) from 1996-2010. In January 2011 I was made Vice-President of HSI for three years. I was also elected as a member of the continuing committee for ISPUC VI (International Soybean Processing and Utilization Conference) VI in 2012. I received recognition from the following institutions for my contribution to vegetable research and development in India:

- XXVIII Group Meeting of AICRP (Vegetable Crops) at IIHR, Bangalore
- G.B. Pant University of Agriculture and Technology, Uttarakhand (2008) (Presentation: "Conservation and utilization of indigenous germplasm in improvement of vegetable crops")
- Punjab Agricultural University, Ludhiana (2009)
- Division of Vegetable Science, IARI, New Delhi (2010) (Presentation: "Designing Nutraceutical and Food Colorant Rich Vegetable Crop Plants: Conventional and Molecular Approaches")

Maldives: Maldives, being a very small country, lacked trained manpower and had negligible ongoing research and development programs. My visit to Maldives and subsequent meetings with the Minister, Deputy Minister, Executive Director and national research and development staff of the Ministry of Fisheries, Agriculture and Marine Resources clarified the status and needs of the country's vegetable sector. Participants from Maldives have been a part of our regional learning programs and have received exposure to current trends vegetable research.

Nepal: I assisted Nepal in capacity building and vegetable research and development meetings in line with South Asian regional priorities and AVRDC themes. I guided the Seed Entrepreneur's Association of Nepal (SEAN) along with Wageningen University. I also attended meetings with the Executive Director, NARC; Director and senior scientists of NARI; and Dr. Madhav Karki, DDG, ICIMOD to discuss AVRDC collaboration and future activities.

Pakistan: Overtures were made from 12-17 May 2008. During the visit, I met the Secretary of Agriculture; CEO, Punjab Agriculture Research Board (PARB);



Training courses and workshops developed the capacity and skills of local partners and AVRDC staff alike.



Director, Vegetable Research Institute; Chairman, PARC; Director General, NARC; Project Incharge, Facilitation Units for Participatory Vegetable Seed and Nursery Production Program and other scientists working in vegetable research and development programs and shared AVRDC's strategies for South Asia. I also identified germplasm and training needs, along with facilitating linkages with the Asia Pacific Seed Association (APSA) and other multinational seed companies.

Sri Lanka: Sri Lanka has been a strong partner in implementing a number of joint research activities/projects and also an active participator in learning programs. After meetings with the Director, Horticulture Research and Development Institute (HORDI) and Executive Director (CARP), I realized the need to sign a memorandum of understanding between AVRDC and the Ministry of Agricultural Development and Agrarian Services, Sri Lanka to efficiently implement research and development activities. I was invited to Sri Lanka to facilitate discussions pertaining to the logistics for signing a MoU and to discuss a suitable location for establishing an AVRDC office in Sri Lanka. I participated in the ASDA Meeting in 2006, and again from September 15-17, 2010 as the Guest of Honor, where I delivered a keynote address on "AVRDC – The World Vegetable Center: Vegetable research and development programs to alleviate poverty and malnutrition in South Asia."

Collaboration with AVRDC's host institute and other sister organizations

AVRDC and the International Crops Research Institute for the Semi-Arid Tropics have been partners since the mid-1980s, especially in the areas of legumes to enhance human nutrition, crop diversification, and sustainability of production systems. The two institutes also work together with other international agricultural research institutes in the Rice-Wheat Consortium for the Indo-Gangetic Plains on crop diversification using legumes.

Participation in joint activities has been one great advantage of being hosted by ICRISAT. The regional learning programs have shared facilities and staff resources of both organizations. With full support and cooperation from ICRISAT, AVRDC was able to construct a new building for its Regional Center for South Asia within the campus. To further strengthen the working relations, a Collaborative Research Agreement (CRA) was signed between the two organizations. A BMZ/GTZ project was jointly undertaken and quite a number of projects were jointly submitted for possible funding. I participated in the Asian In-House Review Workshop of ICRISAT and the Tata-ICRISAT-ICAR project planning meeting. In March 2007 CGIAR Science Council participants visited ICRISAT and I gave an overview of AVRDC, its future research and development activities, and highlighted the Center's partnerships with CG centers in South Asia. CGIAR and ICRISAT board members held discussion about AVRDC's activities implemented in South Asia .



AVRDC and ICRISAT have their major collaboration through the Cereals and Legumes Asia Network (CLAN). The Asia Pacific Association of Agricultural Research Institutions (APAARI) in its general assembly meeting held at Penang, Malaysia in December 2002 recommended that lentil (ICARDA) and mungbean (AVRDC) should be included in CLAN; CLAN was expanded in 2003 to include those crops. CLAN is now co-facilitated by ICRISAT, ICARDA and AVRDC with support from APAARI and is hosted by ICRISAT. AVRDC has been participating in the Asia-Pacific Association of Agricultural Research Institutions (APAARI) and Cereals and Legumes Asia Network (CLAN) meetings.

A joint project on diversification through legumes in South Asia has been submitted by ICRISAT to IFAD through APAARI under the Cereals and Legumes Asia Network (CLAN). In September 2010, a book I wrote entitled "Short duration mungbean: a new success in South Asia" was published by APAARI. I also contributed articles regarding AVRDC's vegetable networks to the APAARI Newsletter.

AVRDC was a part of the 35th anniversary celebrations of ICRISAT held from 22-24 November 2007. Along with Dr. Jacqueline Hughes, I participated in the anniversary symposium on "Climate-Proofing Innovation for Poverty Reduction and Food Security." Delegates from 15 CGIAR centers, NARS and partner organizations participated in the event.

ICRISAT and RCSA collaborated to develop projects for watershed home gardening. From 25-27August 2009, I participated in the consultation workshop at ICRISAT, which was organized to enhance the awareness about a new integrated watershed development program.

Conclusion

Throughout my 20-year career at AVRDC – The World Vegetable Center I had the good fortune to work with many talented and dedicated people who devoted their knowledge and expertise to improving the livelihoods of poor farmers, their families and communities in Africa and Asia. Although I retired from the Center in April 2011, as AVRDC Director General Dyno Keatinge said in a speech at my retirement dinner, "A man cannot retire from his experience." Horticulture to improve livelihoods was and remains my abiding interest in life.

