World Vegetable Center
1973-2023
Sowing seeds, meeting needs

Celebrating half a century of excellence in vegetable research and development

The story of the World Vegetable Center

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Acknowledgements

The global impacts of the World Vegetable Center have only been possible because of all of those who contributed to this effort over half a century - our funders, our research and development partners from the public and private sector, and our supremely dedicated staff, working so diligently, and sometimes under difficult circumstances.

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The story of the World Vegetable Center


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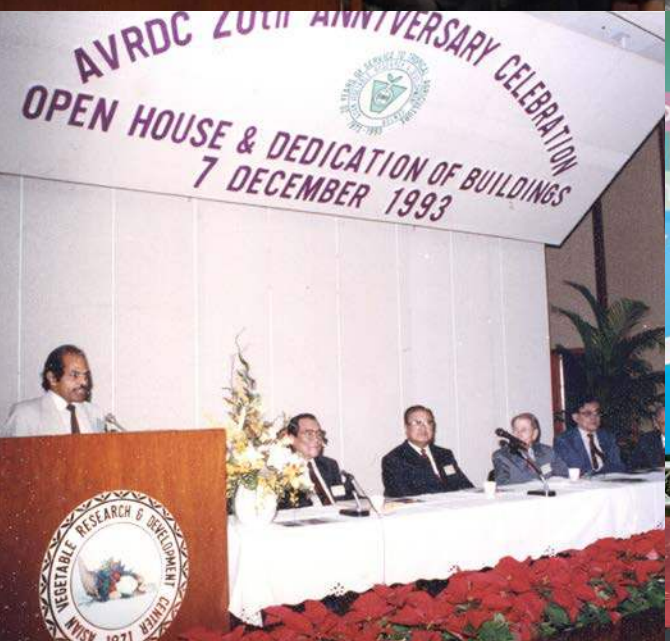
AVRDC 20th ANNIVERSARY CELEBRATION
OPEN HOUSE & DEDICATION OF BUILDINGS
7 DECEMBER 1993


AVRDC - The World Vegetable Center
Poor
40th Anniversary Cele

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Preface

In 1973, the Asian Vegetable Research and Development Center (AVRDC) was established to help meet the nutritional needs of half of humanity through plant breeding and the development of associated technologies. As part of the jubilee celebrations in 2023, we publish this commemorative booklet to provide a glimpse into AVRDC's establishment and evolution through five decades, including its transformation into the truly global World Vegetable Center in 2007 – or WorldVeg as we better know the organization today.

Over all those years, we have been 'sowing seeds and meeting needs' of an ever-increasing number of the world's population. Seed has always been our core business. We are proud to be the custodians of the largest publicly available collection of vegetable seed in the world, and that our breeding programs have resulted in many hundreds of new varieties of dozens of crops that are now grown over millions of hectares, for the benefit of millions of smallholder producers and consumers alike. We have also been sowing seeds of knowledge – knowledge about how to safely turn seeds into nutritious vegetables, how to get better yields and throughout the year, how to reduce postharvest losses, and how to reduce the environmental footprint of the vegetable sector.

In 'meeting needs', we refer to the needs of people for safer and healthier diets, income opportunities for farmers, youth and women working along vegetable value chains, for healthier soils, more resilient farming systems, and a healthier environment for all. We have had tremendous impact with our new varieties, production and postharvest technologies, working in partnerships and strengthening capacities, in particular in Africa and Asia. More and more, we are also placing our work in a food systems context, with adequate attention given to demand and policy considerations.

The mission of our Center is to realize the potential of vegetables for healthier lives and more resilient livelihoods. And this need is certainly more relevant and urgent today than ever before. Three billion people suffer from malnutrition, be it undernutrition or overnutrition, and many cannot afford a healthy diet. Our food systems and the way vegetables are produced is often not safe – not for the farmer, the consumer, or the environment.

Diversifying our food systems, shortening value chains by producing closer to consumers, reducing the environmental footprint of agriculture, reducing postharvest losses, and moving towards plant-based diets, will all help to improve our personal health and the health of our common planet. Nutritious foods like vegetables must have a much more prominent place around the world – on farms, on plates, in policies, and in research and development efforts.

Given the challenges and opportunities the world is facing to boost vegetable production and consumption in a safe and sustainable manner, much must be done, and immediately. But it is clear that these urgently required efforts require partnerships and networks, to more effectively achieve our major institutional objectives. Towards this aim, WorldVeg is transitioning towards an open science center, thereby helping to mobilize a much greater share of global research and development investments for nutritious foods, and vegetables in particular.

After half a century of service to these ends, this booklet gives readers an insight into our institutional journey. This will hopefully motivate you to join us too, as we move forward to better realizing the tremendous nutritional, economic and resilience power of vegetables.

Junne-Jih Chen
Chair, Board of Directors

Marco Wopereis
Director General


1973


2023

Preparing the ground – an introduction

In the early 1960s, the idea was born to establish a research center dedicated exclusively to vegetables. The 'green revolution' was underway, with massive yield increases in cereal crops as a result of plant breeding in dedicated research centers; CIMMYT in Mexico working on maize and wheat since 1943, and IRRI in the Philippines working on rice from 1960. Norman Borlaug was a leading light, and millions of extra mouths were being fed thanks to new high yielding crop varieties, leading to huge benefits across the world.

But while addressing supply gaps of staple crops was contributing to alleviating hunger, this was not addressing malnutrition. Frank Parker saw this need, then Assistant Director for Research and Technology for USAID, the United States Agency for International Development. He gathered like-minded professionals together to push for greater production and consumption of vegetables, to provide the essential vitamins, minerals, plant proteins and edible fibers that are essential for healthy diets.

After much discussion, a survey in 1966 across eight Asian nations led to a proposal that recommended a new vegetable center. It was decided that this should be based in Taiwan, because of the high level of scientific and technical skills there, the excellent infrastructure and services, and the full support offered by the Taiwan government. The island also has a wide range of climates from temperate mountains to subtropical and tropical lowlands, and more than 100 vegetables are widely grown on the island with high average yields.

The decision was taken to establish the Asian Vegetable Research and Development Center (AVRDC), with headquarters in Taiwan. On 22 May 1971, representatives of sponsoring countries (Japan, Korea, the Philippines, Taiwan, Thailand, Vietnam and the USA) and the Asian Development Bank, met in Taipei to sign a memorandum of understanding for its establishment, and a Charter for the Center. The signatories recognized the importance of working across national boundaries, sharing improved breeding lines, technologies and information, with the aim of fostering the improvement of the health and welfare of Asian peoples.

The AVRDC Board of Directors first met on 24 May 1971. Tsung-Han Shen, Commissioner and Chair of the Taipei-based Sino-American Joint Commission on Rural Reconstruction (JCRR), was elected as the first Chair, and Robert F Chandler Jr was appointed as the first Director General, seconded by the Rockefeller Foundation. The government of Taiwan generously offered a 116-hectare research facility in Shanhua, and on 17 October 1973, the Center was officially opened.

To celebrate 50 years since this date, this commemorative booklet traces the history of AVRDC, and the World Vegetable Center that it became in 2007. It walks through some key moments, activities and achievements in these five decades, recounting the evolution of the Center. It also looks forward, and offers a selection of the impacts that the Center's work has had, that resulted in benefits to many millions of producers, processors, retailers and consumers around the world.

◀ Photo (bottom): LIN Wei-yan ©Taiwan High Speed Rail In-Train Magazine《TLife》

1970s – The early years

By the time operations started in October 1973, 116 hectares of prime agricultural land had been secured, and buildings for research, administration and accomodation, along with greenhouses and warehouses, had been constructed. A total of 18 professional and around 80 support staff had been recruited, and state of the art research equipment and facilities procured.

Six priority crop commodities were chosen at the outset for research and scaling. These were Chinese cabbage, mungbean, soybean, tomato, sweet potato and white potato. Selection was based on their prospects of benefitting smallholder farmers, and their potential for improving nutrition in balanced diets with starchy carbohydrates, due to their protein, vitamin and mineral content.

Initial research focused on screening varieties for yield gains, multiple disease and pest resistance, and their ability to thrive under hot and humid environments. In collaboration with national partners, efforts began immediately and in earnest, to collect, characterize and conserve vegetable genetic resources. By the end of 1979, the Center had already acquired and conserved 21,372 accessions of germplasm of these six priority crops, and established a firm basis for the breeding of these crops at the Center and worldwide.

The first AVRDC training course was held early 1976 at the headquarters in Shanhua, with 12 trainees from Indonesia, the Philippines and Taiwan. By the end of the 1970s, 200 trainees from 20 nations had already studied at the Center, and returned to their home countries to apply what they had learned.

1970s

Capacity strengthening – a core of WorldVeg since the start

The Center initiated training programs on various topics related to vegetable production at its headquarters in the 1970s. These developed over the years. Starting in 1983, the Center's Regional Office for East and Southeast Asia in collaboration with Kasetsart University in Thailand has organized the annual international vegetable training course (IVTC) on a wide range of topics for researchers and trainers. To date, 982 people have benefitted from this course (30% women), from 59 different countries. The 40th edition of the IVTC will be held in November 2023. A similar training course started in 1993 in the Eastern and Southern Africa regional office. This ended in 2006, but WorldVeg is now planning to reintroduce the training program for Africa as well.

During the 1970s, the Center also established outreach programs in Korea (1974), the Philippines (1975) and Thailand (1975), to diffuse knowledge and to transfer technologies generated by the Center, with financial support from the Asian Development Bank. Outreach project offices were established with resident scientists at national institutions that were already engaging in vegetable research and development. Activities included on-site testing of the Center's improved varieties and technologies for adaptability, training of national researchers and trainers, and multiplication and distribution of improved varieties and technologies for adoption by farmers.

By the end of the 1970s, the Center's improved varieties had been tested and adopted across South and Southeast Asia, the Pacific, sub-Saharan Africa, North America, Latin America and the Caribbean. The Center had successfully selected white potato clones with heat tolerance and bacterial wilt resistance, that led to a near doubling of yields across the lowland tropics in Asia. But its work with this crop came to end, when it was agreed that all of the Center's white potato genetic material would be transferred to the CGIAR's International Potato Center (CIP) headquarters in Lima, Peru.

1980s – Sowing seeds in Asia

In 1981, the Center started experimentation in various types of home gardens. This was later extended to include school gardens, and branched out into the outreach programs established later. It was found that a 4 x 4 m plot could supply a family of five (two adults and three children) with their daily requirement of vitamin A and C, and a significant percentage of daily calcium, iron and protein needs. And a 10 x 20 m school garden would provide more than 140 children with half a cup of vegetables every day, throughout the year.

Home gardens in Cambodia

A USAID-funded project in 2015-2018 trained 3,507 households in home gardening and nutrition in four provinces of Cambodia. Surveys before and after the intervention of a sample of 500 rural households with children under five and women 16-49 years old showed major impacts one-year after the training, with substantial adoption of promoted gardening practices. More households (+33%) produced vegetables, and the production period was extended by 4 months. There was a significant increase in vegetables harvested (+16 kg) and consumed (+7.5 kg), so integrated home garden interventions clearly contributed to nutrition outcomes.

After consulting with its partners in Asia, Africa and the Americas, the Center added capsicum peppers to its list of priority crops in 1986. Both sweet pepper and chili pepper are rich in vitamins A and C. Used in both fresh and processed forms, they generally have a longer storage life and transport more easily than many other vegetables. And hot peppers, fresh, dried or powdered, also add zest to healthy diets beyond nutritional benefits. Research and technology development focused on raising productivity with high levels of resistance to major viral diseases, anthracnose, bacterial spot, bacterial wilt and phytophthora blight; and heat tolerance in sweet pepper, using hot pepper genes as the source of heat tolerance.

The Center's soybean research program branched out in 1987, to 'tropicalize' vegetable soybean, that is harvested when the pods and seeds are still green. Green pods with physiologically mature seeds are boiled and used in diverse ways. They are highly nutritious with excellent taste properties. The Center's vegetable soybean research program aimed to overcome production constraints in the tropics, and improve quality traits for the consumers.

Based on the success of the first three outreach programs, the Asian Development Bank provided additional support to establish two more, in Malaysia in 1984 and Indonesia in 1985. And although the bank's financial support for all five outreach programs came to an end in 1989, respective host governments provided their own funding to maintain collaborative research with the Center. Indonesia, Malaysia, the Philippines and Thailand proposed the formation of the Southeast Asian Collaborative Vegetable Research Network (AVNET) to further enhance the sharing of expertise and resources, and in 1987, requested the Center to serve as the executing agency. The Asian Development Bank approved the proposal in 1989, and supported AVNET for the next six years.

At the end of the decade, the Center's genebank maintained 31,617 germplasm accessions, mostly of soybean, mungbean, tomato, sweet potato, Chinese cabbage, and peppers. The International Board of Plant Genetic Resources (IBPGR) entrusted the Center with the global base collections of mungbean and peppers. And of the many successes, the tomato breeding program had already released 67 improved cultivars in 28 countries that were being readily adopted by farmers.

The Center also made its first research and development activities beyond Asia. With USAID funding, a 3-year project beginning in 1988 tested the home garden concept near Niamey, Niger to address in particular the vitamin A deficiency prevalent in the West African Sahel region. Project activities included variety trials of culturally acceptable garden vegetables with high levels of vitamin A, and training of staff from Burkina Faso, Mali, Mauritania and Niger.

1990s – Going global

To effectively tackle problems related to malnutrition and inadequate development of the horticultural sector in low-income countries, AVRDC started to embrace a collaborative research network model, following the AVNET example. These networks capitalized on the complementarity of national institutions, provided access to new information and technologies, saved time and resources, offered training for young researchers, and created opportunities to develop leadership skills.

The South Asian Vegetable Research Network (SAVERNET) was established in 1992 with funding from the Asian Development Bank, including Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka. Four years later, the bank supported the initiation of the Collaborative Vegetable Research and Development Network for Cambodia, Lao PDR and Vietnam (CLVNET). The Center also established a presence at the Bangladesh Agricultural Research Institute with support from USAID to implement a 10-year project to strengthen national research capacity, develop vegetable seed production systems, promote homestead gardening to improve family nutrition security, and to further scale the Center's improved varieties and technologies for year-round vegetable production and consumption.

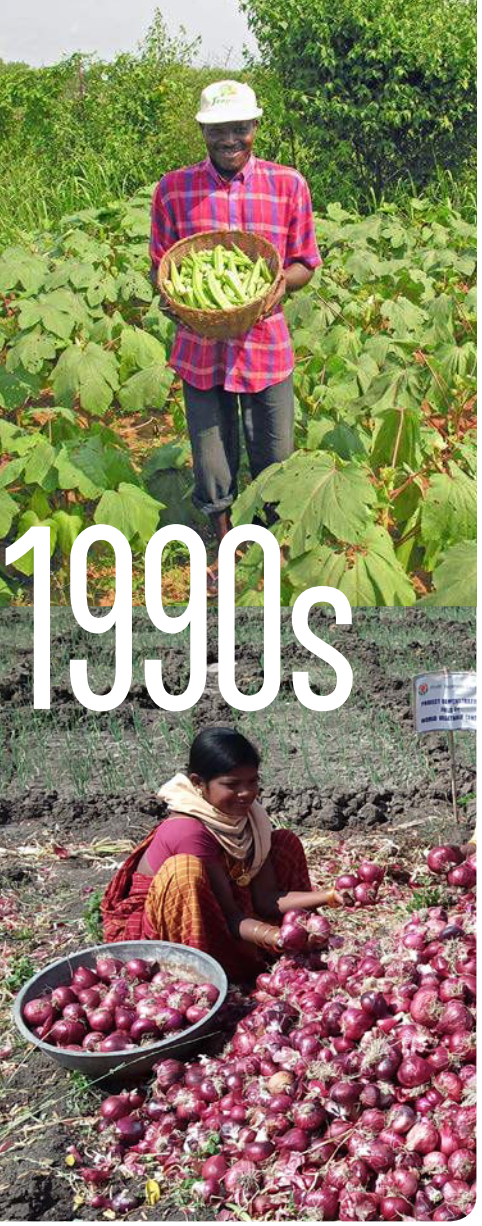
Integrated pest management and off-season production in Bangladesh

Training vegetable farmers in integrated pest management (IPM) methods in Bangladesh in the 2010s, resulted in a significant increase in farmers' knowledge about pest management, an increase in the adoption of IPM practices, and a reduction in pesticide use. For eggplant, but not for bitter gourd, trained farmers also achieved a significantly higher crop yield and gross margin. Training farmers in off-season tomato production also increased net household income by about 48% during the summer, but pesticide use also increased by 56%, which shows that integrated training is needed.

The Center's regional office in Thailand was upgraded into the Asian Regional Center in 1992, with a mandate to strengthen collaborative research and development activities with China's national agriculture research system, and to coordinate AVNET, SAVERNET and CLVNET under the direction of the Center's International Cooperation Program.

The Center also began to expand its activities in Africa, and in 1992, opened a new research station in Arusha, Tanzania. Also in 1992, the Center established the Collaborative Network for Vegetable Research and Development in the Southern African Region (CONVERDS), in collaboration with the Southern African Center for Cooperation in Agricultural Research (SACCAR). This focused on nine countries, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe, with support from the German Federal Ministry for Economic Cooperation and Development (BMZ), USAID, and UK's Department for International Development (DFID). The focus of the network was on training, conducting surveys of production constraints, promoting improved technologies, tomato breeding, and the collection and evaluation of traditional African vegetable species.

Activities also spread across the Pacific. In 1996, the Center established the Collaborative Network for Vegetable Research and Development for Central America (REDCAHOR) in collaboration with the Inter-American Institute for Cooperation on Agriculture. Its aim was to engage national institutions from Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua and Panama to enhance production of safe vegetables in their respective countries. Research and development activities included development of disease resistant varieties, integrated pest management, organic production, protected cultivation, and training. The network was funded by the Central American Bank for Economic Integration and the Inter-American Development Bank, and a coordinating office was established at the Inter-American Institute for Cooperation on Agriculture in Costa Rica.



The 1990s also saw a change in the crops the Center worked on. After nearly two decades of work, the Center had developed sweet potato cultivars that were high in beta-carotene and dry matter as high as 40%, and established the tissue culture system for virus-free micropropagation and germplasm preservation. However, with the decision of the International Potato Center in the late 1980s to also engage on research needs of sweet potato, AVDRC transferred its entire germplasm collection of 1,500 tissue culture clones to the potato germplasm bank in Peru, in 1991, following the transfer of its white potato material in 1979.

In 1992, the Center added onion, garlic and shallot as a priority group of crops for research and development. Early research focused on the development of short-day onions resistant to stemphylium leaf blight, anthracnose, purple blotch and major viruses, tolerance to high temperature and moisture stress, extended storability, and enhanced seed set in garlic and shallot. Also in 1992, the Center included eggplant (aubergine, brinjal) for research and development, focusing on resistance to bacterial wilt, aphids, fruit and shoot borer, and desirable horticultural traits.

Based on achievements in developing both open-pollinated and hybrid varieties of heat tolerant Chinese cabbage with desirable horticultural traits and resistance to turnip mosaic virus (TuMV), the Chinese cabbage research program branched out. In 1998, it was decided to include other brassicas, including common cabbage, broccoli and cauliflower for heat tolerance and TuMV resistance.

During the 1990s, a number of outreach programs ended. These had been first supported by the Asian Development Bank before being financed and coordinated by the countries themselves. Those in Indonesia and Malaysia ended in 1993, and Korea and the Philippines in 1999. By this time, however, these had made the desired impacts, with in-country capacity significantly strengthened, to be replaced by more appropriate mechanisms.

A further development came in 1998 at the 20th Senior Officials Meeting of ASEAN Ministers of Agriculture and Forestry held in Hanoi. They endorsed the formation of the ASEAN-AVRDC Regional Network on Vegetable Research and Development (AARNET), to coordinate and facilitate development and implementation of research and development projects on vegetables in ASEAN member countries, in collaboration with the Center.

By the end of the decade, the Center's genebank collection has expanded, reaching 45,806 germplasm accessions of 75 genera and 191 species from 137 countries, most of which were soybean, mungbean, tomato, pepper, eggplant, brassicas and alliums (onions, garlic and shallot).

Besides working on key global vegetable crops, in 1999, the Center also launched the collection, conservation and utilization of traditional vegetables indigenous to Asia, with support from the Asian Development Bank, covering Bangladesh, Cambodia, Indonesia, Lao PDR, Malaysia, the Philippines, Thailand, and Vietnam.

2000s – The World Vegetable Center emerges

The Center formally changed its name in 2007 to AVRDC - the World Vegetable Center, to reflect the global geographical scope of its work.

In 2003, WorldVeg started a small seed repository at its center in Arusha, Tanzania, with the very first collection missions conducted under USAID and BMZ funded projects in 2002-2007. This was the start of WorldVeg's African-based genebank, dedicated mainly to African traditional vegetables.

The Collaborative Network for Vegetable Research and Development for Central America (REDCAHOR) came to a close in 2000 after fulfilling its objectives. In 2001, the CONVERDS project ended, but the AVRDC station in Arusha, Tanzania, had been established as a Regional Center for Africa. This led to an expansion of activities in sub-Saharan Africa as a whole, with support from Rockefeller Foundation, UN Children's Fund, Swiss Agency for Development and Cooperation (SDC), amongst others.

To promote year-round vegetable production and consumption, the Center established the West Africa Vegetable Network in 2003 with the West Africa Rice Development Association (now AfricaRice), in close collaboration with national research institutions in Benin, Burkina Faso, Chad, Côte d'Ivoire, the Gambia, Mali, Niger, Senegal and Togo. Generous funding came from the government of Taiwan and USAID, and an office with a resident scientist was established at the regional hub of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) near Bamako, Mali.

In 2005, the Center also initiated the Regional Network for Vegetable Research and Development in Central Asia and the Caucasus (CACVEG), including Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. An office with a scientist and support staff was established in CGIAR's Program Facilitation Unit in Tashkent, Uzbekistan, with a focus on policy and strategy development, testing of the Center's improved varieties and production technologies, and training in breeding methodologies.

Based on the achievements and well-established partnerships built up during SAVERNET activities in the 1990s, the Center established its Regional Office for South Asia on the ICRISAT campus near Hyderabad, India in 2006. The office aimed to extend the Center's improved technologies, promote home gardens and urban/peri-urban vegetable production, foster good agricultural practices for production of safe vegetables, and engage in the Center's legume breeding program focusing on mungbean and vegetable soybean, with additional work on cowpea and yard-long bean.

Networking

An evaluation study report published in 2000, commissioned by the Asian Development Bank, indicated that through networking among national institutes, collaborative activities within AVNET, SAVERNET, and CLVNET had enhanced national research capacities and institutional strengthening through training, meetings, and infrastructure development. The networks increased a spirit of cooperation among researchers by working on common goals and concerns, with a focus on vegetable production and consumption in low-income countries through improved varieties, technologies and information that had driven nutrition and health benefits. It was estimated that these networks led to overall vegetable yields in South and Southeast Asia increasing by an average of 110% across all vegetables surveyed, with production costs falling by an average of 27%, leading to high internal rates of return of 91% (39-139%). The success of this networking highlighted the importance of mechanisms for effectively sharing improved crop varieties, resources and technologies among national and regional institutions, and international organizations.

Activities also expanded in Southeast Asia during this decade. To respond to increasing urbanization, BMZ/GIZ sponsored a 3-year peri-urban project starting in 2001 in the Philippines. A project office was set up with a resident scientist, and interdisciplinary approach employed to work on the supply of safe and nutritious vegetables to metropolitan Manila. Subsequently, the French Agricultural Research Centre for International Development (CIRAD) initiated a 5-year project in 2002 in collaboration with the Center and CLVNET partners, focusing on Hanoi, Ho Chi Minh City, Phnom Penh and Vientiane.

Grafting tomato in Vietnam

WorldVeg started working on tomato grafting in 1992 as a means to overcome bacterial wilt, and introduced the technique to Vietnamese scientists in September 1998, during a one-month training course at the Center's headquarters in Taiwan. From 2002-2006, the technique was introduced to Lam Dong province in southern Vietnam in collaboration with the Potato, Vegetable and Flower Research Center, and to the Red River Delta in northern Vietnam in collaboration with the Fruit and Vegetable Research Institute in Hanoi. A survey in 2012 showed that there was 48% adoption in Red River Delta, but 100% adoption in Lam Dong. Based on difference in yields, costs and total area under tomato, the estimated total profit for tomato farmers in Lam Dong province was US$41.7 million higher than if they had continued with non-grafted tomato.

The Center also further expanded the crops it was working on. In 2006, trials were conducted on seven species of the Cucurbitaceae family to evaluate for nutrition value and resilience, and to identify species that would benefit from crop improvement. Based on various criteria, the selected priority crops were bitter gourd, pumpkin and cucumber, and a breeding program was initiated in 2007.

In 2008, the Center was among the first institutions that started to deposit seed for long-term safety backup in the Svalbard Global Seed Vault. By the end of 2009, the Center's genebank maintained 57,175 germplasm accessions, comprising 168 genera and 418 species from 154 countries. Among them, 79% were soybean, mungbean, tomato, peppers, eggplant, brassicas, alliums and cucurbits.

2000s

2010s – New agendas, expanding impact

In the early 2010s, WorldVeg facilities in Tanzania and Thailand were upgraded, and the genebank in Taiwan was expanded, with support from the government of Taiwan.

In 2011, the breeding program for bitter gourd and pumpkin was transferred from headquarters in Taiwan to the Center's Regional Office for East and Southeast Asia in Thailand, and luffa was added in the program in 2019.

In 2012, the World Vegetable Center became member of the Association of International Research and development Centers for Agriculture (AIRCA), a network of international centers operating outside the CGIAR system.

Expansion of activities in Africa during this decade led to the creation of regional centers. In 2014, the West Africa Vegetable Network was transformed into the Regional Center for West and Central Africa, based in Bamako, Mali, and the WorldVeg office in Arusha, Tanzania, was renamed as the Regional Center for Eastern and Southern Africa. Three years later, the Regional Center for West and Central Africa – Coastal and Humid Regions was established in Cotonou, Benin, and the Bamako office was renamed as the Regional Center for West and Central Africa – Dry Regions. WorldVeg now had three regional centers in Africa.

Tomato and African eggplant breeding in Africa

WorldVeg has been breeding improved tomato and African eggplant varieties for Africa since 1990. A 2014 study revealed that WorldVeg varieties then accounted for an astounding 50% of all tomato commercial seed production in East and Southern Africa, and 98% for African eggplant. For Tanzania alone, breeding research generated economic gains of US$255 million for tomato and US$5 million for African eggplant up to 2014. The internal rate of return is 26% for tomato and 12% for African eggplant. These findings support the view that agricultural policy and investment reoriented towards contemporary nutritional challenges give high returns to investment.

A major six-year program also took place in Mali, funded by USAID, starting in 2014 and running until the end of the decade. The project established 59 Vegetable Technology Immersion Clusters (VTICs) and Best Practice Hubs (BPHs) equipped with solar powered irrigation systems, in Sikasso, Mopti and Timbuktu, allowing the project to cover 255 villages. More than 65,000 farmers were involved (77% women) and results showed that they benefited financial and nutritionally. In addition, 78,000 children under five years old benefited directly from improved nutrition, and 74,000 people gained access to basic sanitation.

Based on an external review of the Center in 2015 and partner consultations in 2016, WorldVeg introduced a new research structure in 2017 in which discovery research, piloting innovations, and scaling best technologies and practices continuously inform and improve future work and impact. WorldVeg transformed its science for development agenda, to work through four outcome-oriented flagship programs: 'safe and sustainable value chains', 'healthy diets', 'vegetable diversity and improvement', and 'enabling impact'. The choice of these flagship programs was based on relative strengths, identified trends, and potential for impact.

Realizing the enormous need to work on nutritious food, like vegetables and the relatively small size of the center, the 'Open science center concept' was introduced in April 2016, and debated in the Global R&D week in November of that year. The idea behind the Open Science Center concept is to drastically increase work in partnership, to enable diversification of farming systems with vegetables, and to advance the vegetable science agenda; by welcoming partners to work at WorldVeg headquarters and in its regional centers and projects and by WorldVeg staff joining others in their respective projects and initiatives.

2010s

Although taking the name World Vegetable Center in 2007, AVRDC was still included in the full title until 2016 when it was dropped entirely, in recognition of the Center's expanding global reach. It was also agreed that it would be known as WorldVeg for short, but would not be referred to by an acronym. In the following year, a new logo was also adopted, that highlights the color and vitality of vegetables, and emphasizes the importance of horticulture to the world. In addition, this brighter perspective serves as a reminder of the Center's dedication to the Sustainable Development Goals.

Amaranth breeding in Kenya and Tanzania

WorldVeg has conducted amaranth breeding in Tanzania since 2004, as one of several traditional vegetables that are very important for food and nutrition security in sub-Saharan Africa but otherwise receive little attention in crop improvement. One study on the adoption and impact of this research estimated the adoption of WorldVeg amaranth varieties to be 20% in Kenya and 47% in Tanzania, benefitting 231,000 farm households. And of 2.9 tonnes of amaranth seed sold in 2016, 59% was of WorldVeg varieties. DNA fingerprinting in Tanzania showed that adoption of WorldVeg amaranth varieties in Tanzania to be 66%. These varieties had a mean vegetable yield 6.1 t/ha higher than other varieties, indicating the tremendous impact of genetic improvement research in traditional vegetables.

In 2015 and 2016, with funding from the government of Taiwan the WorldVeg facility in Hyderabad, India was constructed, and formally opened on 18 October 2016. Additional funding in 2017 then allowed WorldVeg to also build its own research facility in Bamako, Mali on the ICRISAT campus, and which was officially inaugurated by the Malian Minister of Agriculture on 2 March 2018.

In 2017, the Taiwan government agreed to fund a major research infrastructure modernization project (the 'RIM project') for WorldVeg headquarters, in line with the Open Science Center concept, and the first of such scale since the Center's establishment in the 1970s. To be completed at the end of 2023, this will add state of the art equipment, new buildings, and new surroundings. This includes a high throughput field phenotyping system that is generating valuable research results on pepper, mungbean, okra and amaranth, two controlled environment greenhouses for virology and entomology research, and a three-story laboratory building with new equipment and amenities.

During this decade, a wave of projects started up in India with support from state governments, including Assam, Jharkhand, Karnataka and Odisha, and agencies such as ACIAR, BMZ/GIZ, and Sir Ratan Tata Trust. These projects focused on introduction of improved varieties, off-season vegetable production, good agricultural practices, post-harvest handling, capacity strengthening, and linkage to markets. Improved bitter gourd varieties were developed and introduced to increase incomes, manage type 2 diabetes, and promote health. Pest and disease resistant tomato, chili pepper and mungbean varieties were developed and introduced, alongside integrated disease management packages. Vulnerable communities in Odisha improved their resilience to recurrent floods through vegetable cultivation and livelihoods of smallholder farmers in Eastern India were improved through the introduction of vegetables and legumes in innovative cropping systems. Other projects in Karnataka and Jharkhand promoted packages of good agricultural practices and postharvest practices, and strengthened the capacity of agriculture extension agents and farmers, increasing resilience, yields, incomes and opportunities.

The 'mungbean revolution'

WorldVeg developed high-yielding, early maturing and disease resistant mungbean varieties that revolutionized production in Asia. More than 150 WorldVeg varieties were released in 35 countries since 1973, and that are now grown on 32% of the total mungbean area (over 2 million hectares), benefitting 1.7 million farm households. Most impact was achieved in India (498,000 farm households) and Myanmar (433,000), followed by Indonesia (233,000), Pakistan (198,000), Vietnam (176,000) and Bangladesh (101,000 households). In Myanmar alone, a study showed that four WorldVeg varieties released by the national agricultural system created aggregate economic gains of US$1.4 billion from 1980 to 2016, and that gains are projected to increase to US$3.7 billion by 2030. Each dollar invested in mungbean research and development by international donors and the Myanmar government generated US$92 in economic gains up to 2020, and is expected to increase to US$181 by 2030. The study also indicated a 20-year time lag between the start of investment and the realization of economic benefits, confirming the need for long term considerations.

In addition, public and private sector partners are collaborating with WorldVeg to build on these achievements and develop sustainable seed systems for mungbean in Asia and to expand into Africa through the International Mungbean Improvement Network (IMIN), funded by the Australian Centre for International Agricultural Research and convened by WorldVeg.

WorldVeg also introduced the packhouse model in Bangladesh, Cambodia, Nepal and Tanzania, where farmer cooperatives can aggregate, clean, sort and label vegetable produce for marketing in cities nearby. The packhouse is an open area with a roof, equipped with a cold room powered by a 'coolbot' – a device that tricks a regular air-conditioner unit in cooling to 6°C. This investment reduces postharvest losses, and improves the harmonizing of demand for and supply of vegetables.

In Central Asia, the CACVEG office in Tashkent closed in 2017. But by this time, vegetable research institutes in eight countries took advantage of increased regional collaboration, access to WorldVeg germplasm of traditional and non-traditional crops, new technologies, and training for research staff. In East Asia, WorldVeg opened a Korea Office in 2019 for adaptability evaluation of improved pepper and tomato lines, and to coordinate training programs in Bangladesh, Bhutan, Cambodia, Indonesia, Korea, Kyrgyzstan, Lao PDR, Mongolia, Myanmar, Nepal, the Philippines, Sri Lanka, Thailand and Vietnam.

In 2013, the Center adopted the Standard Material Transfer Agreement, to distribute seed samples of genebank accessions in compliance with the policies and regulations of the Plant Genetic Resources for Food and Agriculture, in alignment with the community of international genebanks. By the end of 2019, the WorldVeg genebank in Taiwan maintained 63,498 germplasm accessions, of 456 species from 158 countries, and its genebank in Tanzania maintained 2,707 accessions of 72 species from 38 countries. By this time, WorldVeg conserved, and continues to conserve, the largest public international collection of vegetable germplasm that is accessible for researchers and breeders worldwide.

Seed consortia – the benefits from private sector links

Linking with private sector seed companies has seen an increase in the impact of the Center's vegetable breeding programs. These help companies to learn about latest developments in vegetable breeding research from the WorldVeg team of internationally renowned plant breeders, and obtain improved breeding material (varieties, inbred lines and hybrids) to enhance their cultivar catalogs. They meet with breeders, pathologists, entomologists and other researchers to strengthen knowledge networks, share experiences with other vegetable seed companies, and can invest in joint projects with other consortium members to meet specific needs of their companies. The Asia and Pacific Seed Association (APSA) – WorldVeg Vegetable Breeding Consortium was established in 2017. In 2022, WorldVeg processed 2,326 seed requests from 40 consortium members, and has shipped a total of 10,456 seed samples to members since 2017. Consortium members had at least 158 vegetable varieties on the market in 2022 that were wholly or partially based on WorldVeg germplasm, with estimated seed sales of 50 tonnes (increasing from 15 tonnes in 2018). This quantity could potentially benefit 703,000 farming households. In parallel, the Africa Vegetable Breeding Consortium (AVBC) was established a year later, in 2018, as a joint initiative of Worldveg and the Africa Seed Trade Association (AFSTA). In 2022, 58 consortium members together ordered more than 200 samples of WorldVeg breeding lines of tomato, pepper, onion, okra, habaneros, pepper, African eggplant, amaranth, mungbean and pumpkin.

Huge impacts of new Worldveg varieties in Asia

WorldVeg vegetable breeding programs have made a large contribution to the availability of high-quality vegetable seed to farmers in Asia. Surveys of private seed companies in Asia found that an estimated 1 million smallholder vegetable farmers annually buy tomato and chili pepper seed that contain material developed by WorldVeg such as resistance to bacterial wilt and tomato yellow leaf curl virus. The role of the private sector has dramatically increased in Asia and studies suggest that WorldVeg can make the largest impact through pre-breeding research and capacity strengthening. In Taiwan alone, the Center also contributed to the release of 42 improved varieties, jointly with Taiwan institutions. These include 8 fresh market tomato, 6 cherry tomato, 2 processing tomato, 4 sweet pepper, 2 chili pepper, 4 grain soybean, 4 vegetable soybean, 2 mungbean, 3 broccoli, 2 Chinese cabbage, and 3 pumpkin varieties.

2010s

New varieties for Central Asia and the Caucasus

Thanks to efforts of WorldVeg and the Central Asia and the Caucasus Vegetable Network (CACVEG Network), more than 100 varieties were released across the region. A study confirmed the release of 91 vegetable varieties from 2007 to 2017, with 19 more that were then in the pipeline, developed from 2,103 genebank accessions and breeding lines supplied by WorldVeg since 2005.

Home gardens in Bangladesh

Training women in home gardening and nutrition has led to a significant increase in household vegetable production and consumption. At an annual cost of about US$23 per year, interventions appeared to be a cost-effective approach to abate the vitamin A intake gap and micronutrient deficiencies. But the benefits of gardening go well beyond micronutrients. Repeated studies over a 7-year period (2013–2019) showed that the impact of home garden training is largely sustained. For instance, while training led to an immediate increase in the quantity of harvested vegetables (+30 kg/year), the effect was higher (42 kg/year) after three years, and 37 kg/year after six years. Effects on nutrition knowledge, food preparation practices, and women's empowerment also remained significant after six years. There are also clear signs of gradual increases in women's empowerment as they gain more control over food supplies and income, increasing in self-confidence and role in the community as husbands and outsiders begin to recognize their agricultural skills.

2020s – Increasingly meeting needs, worldwide

In November 2020, the concept of the Open Science Center introduced for the first time in 2016 was approved at a Board of Directors meeting, as an institutional objective defined in its 2021-2025 priorities plan, of "Transitioning WorldVeg towards an open science center, thereby helping to mobilize a much greater share of global research and development efforts for nutritious foods, including vegetables."

WorldVeg also highlighted the importance of working in a food systems context, using a pull (demand), push (supply), and policy (3P) approach to boost vegetable consumption and production, alongside the urgency for safeguarding and using fruit and vegetable biodiversity, that formed the basis of two influential contributions to the UN Food Systems Summit in 2021. These paper focused on healthy diets and to rescue, and on safeguarding and utilizing vegetable and fruit biodiversity globally.

The beginning of the 2020s also saw the start of three large projects in Africa.

The Taiwan Africa Vegetable Initiative (TAVI) is a landmark project in the conservation and use of African vegetable biodiversity to address malnutrition by increasing production and consumption of nutritious vegetables. It works in four countries: Benin, Eswatini, Madagascar and Tanzania. In Eswatini for example, the project improves child and household nutrition by establishing school gardens and home gardens, supported by technical training and the distribution of 10,000 seed kits. Champion farmers supply African vegetables to schools, neighborhood care points and orphanages, with more than 10,000 children having already benefitted. TAVI also rescued almost 15,000 landraces and crop wild relatives from 25 vegetables species in the four project countries, which are hotspots of vegetable biodiversity in Africa. To safeguard seed accessions for the next century, and make them available for research, breeding and cultivation for current users and future generations, TAVI funded the upgrading of the national genebank in Eswatini at the Ministry of Agriculture, and the WorldVeg regional; center in Tanzania, both now approaching completion. This three-year project funded by Taiwan's Ministry of Agriculture and Ministry of Foreign Affairs ends in 2023, and a second phase to begin in 2024 is in the final stages of development.

The Veggies for Planet and People (V4P&P) project contributes to enhanced youth employment, healthier ecosystems, and better nutrition in Ethiopia and Kenya through increased vegetable production and trade using the 3P approach. It enables young people to produce and sell diverse vegetables, particularly traditional African vegetables, through training and mentoring, strengthening capacity, and linking youth to financial institutes, input suppliers and traders. It is establishing 120 vegetable business networks in Kenya and 80 in Ethiopia, to engage at least 4,000 women and youth in market activities to improve their livelihoods and diets. New production technologies are also being introduced that improve soil health, reduce production costs and postharvest losses, and enhance product quality. A parallel approach promotes vegetable consumption, and raises awareness of the importance of vegetables in healthy diets to the public and policy makers. It funded by the IKEA Foundation (2020-2025), and implemented with SNV, with complementary project support from the Biovision Foundation. A particular emphasis is on reducing environmental footprints and introduce an agroecological approach to vegetable farming.

The five-year Safe locally produced vegetables for West Africa's consumers (SafeVeg) project is contributing to expanding competitive vegetable sectors in Benin, Burkina Faso and Mali through both supply, demand and governance interventions using the 3P approach. A market-oriented approach is establishing 70 'vegetable business networks' that channel innovations to increase vegetable production, and is a model that offers new opportunities to transform livelihoods through coaching and capacity strengthening, connecting farmers to consumers, and reducing postharvest losses. SafeVeg is also stimulating quality seed supply, a major barrier to vegetable production in West Africa, and is creating conditions for vegetables to be more accessible, affordable and acceptable to consumers. SafeVeg mainstreams an equity approach that promotes effective engagement of different social groups, with a focus on youth and women. This is funded by the European Union and the Ministry of Foreign Affairs of the Netherlands.

In 2020, WorldVeg contributed pandemic relief seed kits containing seed of six fast-growing, nutritious traditional vegetables to 1,020 families vulnerable to the impact of Covid-19 in southwestern Luzon, the Philippines. In 2022, WorldVeg also contributed 10,000 seed kits of traditional African vegetables to internally displaced people in Burkina Faso. These were given to Ministry of Agriculture and FAO for distribution to farmers who had fled areas affected by terrorist attacks. This was so they could produce nutritious vegetables using the sack gardening technique, to complement grains provided by the humanitarian organizations.

'Sowing seeds' of WorldVeg varieties

Over the past five decades, there are records for a total of 771 of the Center's improved varieties having been officially released of 30 different vegetable species, in 55 different countries with a particular impact in low-income countries. Of those, 264 are tomato varieties, 147 mungbean, 112 chili pepper, 85 soybean, 48 sweet pepper, 36 diverse brassicas, 15 amaranth, 10 eggplant, 7 bitter gourd, and 6 onion varieties.

2020s

▲ Graduates of the first IVTC training in 1982, and of the 39th IVTC in 2022

‘Meeting needs’ of new knowledge and skills

2020s

Based on data from reports from 2011 to 2022, a total of 207,893 farmers were trained on packages of good agricultural practices, integrated pest management, healthy seedling production, off-season vegetable production, regenerative agriculture practices, agroecological approaches, postharvest management and processing, vegetable business and market linkages.

Also, from 2017 to present, 152 undergraduates and 63 graduates from 27 countries undertook training at WorldVeg headquarters, of which 63% are women. From 1982 to 2022, 982 young researchers and trainers from 62 countries attended international vegetable training courses (IVTCs) conducted in the East and Southeast Asia regional office. From 2007 to 2023, 1,938 other training programs were conducted at the South and Central Asia regional office, on topics such as seed and seedling production, disease and pest diagnosis and control, cultural practices, etc., with participants from 14 countries, 49% female. Since 1992, 357,828 participants (55% female) from 23 countries have also attended various training courses organized by the Eastern and Southern Africa regional office.

In the Americas, WorldVeg initiated varietal trials in 2020, of some of its improved varieties in Belize, Guatemala, Haiti and Paraguay, as part of the LAC Vegetable Network: Promoting vegetable diversity for more resilient livelihoods and healthier diets in the Latin America and Caribbean Region, supported by the government of Taiwan. In 2022, 30 participants from public and private sector research programs gathered in Honduras to discuss challenges and opportunities for improved vegetable diversity in the project countries. So far, 10 WorldVeg-developed pepper lines have already been evaluated, with three showing consistent tolerance to local stresses with stable yields.

In line with the Open Science Center concept, WorldVeg reached out to CGIAR centers during the transition into One CGIAR that started in 2018, to diversify staple-based food systems with vegetables. This resulted in active involvement by WorldVeg in seven One CGIAR initiatives that started up in 2022: in particular the FRESH (Fruit and vegetables for sustainable healthy diets) initiative, Resilient Cities, and Plant Health.

In 2022, the three-year Taiwan Asia Vegetable Initiative (TAsVI) was launched to strengthen international collaboration to rescue and safeguard vegetable biodiversity in Asia for climate resilient and healthy food systems. Funded by the government of Taiwan, the project will repatriate seed of more than 3,000 accessions of unique and lost vegetable varieties collected in the 1990s and 2000s by national genebanks and the WorldVeg, back to Malaysia, the Philippines, Thailand and Vietnam. It will establish a platform among national genebanks in Southeast Asia, the Taiwan Agricultural Research Institute, and WorldVeg, and connect them to seed users including researchers, seed companies, and farmers. It will also undertake genomic characterization to better understand diversity and support awareness on the importance of rescuing vegetable biodiversity, in line with the Fruit and Vegetable Global Rescue Plan presented by WorldVeg and partners during the 2021 UN Food Systems Summit.

In 2023, WorldVeg completed an AARNET-endorsed two-year project funded by the Japan ASEAN Integration Fund to strengthen capacity to deal with the invasive insect *Phthorimaea [Tuta] absoluta*.

And there have been more projects, many more… There is no space in this summary history booklet to introduce the hundreds of projects that been successfully completed over the last five decades and others that are just starting. Part of all its projects is capacity strengthening, and WorldVeg continues to ensure that diverse learning experiences to empower and impact all stakeholders in the vegetable value chain are always offered. The Center's training programs include non-degree short courses, on the job training, and internships focusing on knowledge and skills around vegetable science and technologies to address gaps in vegetable production, marketing, and consumption. The Center also hosts graduate students and post-doctoral fellows undertaking research, and who work collaboratively with WorldVeg experts and scientists.

WorldVeg's other regional and project offices also conduct on-the-job training to effectively implement activities that are specified in special projects. In addition, WorldVeg-organized conferences and workshops provide a unique opportunity for young scientists to gain exposure to new ideas, learn about cutting-edge research, and build relationships that can help building networks for collaborative research and scaling.

Cultivating competence and confidence

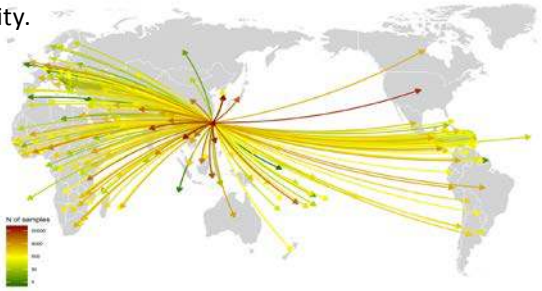
For 50 years, WorldVeg has been training thousands of scientists and extension workers all over the world. Personnel trained at WorldVeg's HQ, regional and project offices, and partner institutions have made a critical contribution to improving vegetable production and achieving nutrition security in less developed countries, particularly in Southeast Asia, South Asia and sub-Saharan Africa where vegetables are less produced and consumed. Every national institute in these regions with a responsibility for vegetable-related research and extension has at least one WorldVeg-trained staff member, and a number of former WorldVeg trainees and employees have gone on to leadership positions in academia, government and the private sector in Taiwan.

By mid-2023, there were 352 staff working for WorldVeg, of 30 different nationalities. They are spread across the world, in its Taiwan headquarters, regional offices in Benin, Mali, Tanzania, India, and Thailand, country offices in Eswatini, Kenya and Korea, and in other countries where WorldVeg has project activities. Of WorldVeg staff, 50% are women, including 35% of all international recruitments.

In 2021, during the international year of fruits and vegetables, WorldVeg signed an MoU with the Global Crop Diversity Trust to strengthen cooperation to obtain long-term sustainable funding for its genebank operations, and to implement collaborative activities to safeguard and use vegetable biodiversity globally. In September 2023, the WorldVeg genebank in Taiwan contained 61,838 germplasm accessions, of 330 species from 155 countries including globally important vegetables such as tomato, mung bean, onion, pepper, eggplant and cabbage, as well as more than 12,000 accessions of traditional African and Asian vegetables including amaranth, cucurbits, yardlong bean, and okra. The genebank in Tanzania held 5,623 accessions, with the aim of increasing to at least 15,000 by 2027 after the new genebank upgrade is complete at the end of 2023. Collection and conservation are carried out in collaboration with national partners who maintain duplicate collections. More than 75% of the genebank collection is now backed-up at least at one other genebank. In 2022 for example, the World Vegetable Center was the largest single contributor to the Svalbard Global Seed Vault, depositing 11,113 unique seed accessions of precious vegetable germplasm for future use, and 4,000 accessions were sent to the Rural Development Agency genebank in Korea. The aim is to have all material safety duplicated or triplicated by 2025 in line with international genebank standards.

Seed conservation and distribution

Since its foundation 50 years ago, WorldVeg has distributed more than 700,000 seed samples of genebank accessions or breeding lines from its genebank in Taiwan, to public and private researchers and breeders in more than 200 countries and territories. These have led to the release of many hundreds of new vegetable varieties that have had particular impacts in low- and middle-income countries. Since 2013, the WorldVeg genebank location in Tanzania distributed over 100,000 seed kits with over 450,000 seed samples of breeding lines or genebank accessions to farmers and schools in more than 21 African countries. Finally, the genebank collection provides genetic resources to the WorldVeg breeding programs for variety development. In this way, WorldVeg connects to the private, public, and societal seed sector with the aim of delivering quality vegetable seed to farmers worldwide. Indeed, crop diversity is the foundation for food and nutrition security.



◀ Distribution of seed samples from the WorldVeg genebank in Taiwan (1972-2019). During this time, a total of 691,178 seed accessions were sent to 204 countries and territories.

Modern genebank facilities ensure the long-term preservation of this important diversity. Genebank management, including germplasm collection, acquisition, conservation, information management, distribution, regeneration, characterization and safety duplicates, follow standard operating procedures developed by WorldVeg under the guidance of the Global Crop Diversity Trust. Molecular characterization and genetic diversity analysis of selected accessions identify markers and map genes linked to important agronomic traits such as disease resistance, stress tolerance, or high nutritional value. This significantly enhances the efficiency of breeding programs, as key genes can be identified for introgression into improved lines. All information is shared through Genesys PGR, the global genebank data repository.

And looking ahead…

Every country in the world is affected by malnutrition, and three billion people – more than a third of humanity - suffer from poor quality diets. A quarter of all children under five are affected. And these are all avoidable problems, with the right investments and attention. Too much of the wrong food is also a tremendous public health problem, leading to obesity and all of the many associated health problems of which diabetes is just one.

The consumption of 'protective foods' including vegetables, fruits, beans, nuts and seeds, is tremendously important for improving health as they are excellent sources of vitamins, minerals, nutrients, and dietary fiber. The World Health Organization recommended daily intake of vegetables per person for a healthy diet of 3 portions or about 240 grams per day. In most sub-Saharan African countries, actual intake is only around 70 grams – 30% of the recommended amount. Only in a few East Asian countries do people, on average, actually consume sufficient vegetables.

The production and trade of vegetables are also huge employment and income generators. Per square meter, net benefits from growing vegetables are 5-7 times what can be earned from staple crops such as rice, maize or wheat. In addition, the ability to produce large amounts on relatively small areas, makes vegetables especially attractive to youth, women and marginalized groups who so often have only limited access to land.

Vegetables are crucial for resilience to climate and economic shocks, and production for family consumption and local sale helps survive and recover from shocks. A key strategy for farmers is to diversify, and growing vegetables is one way to hedge their risks. Including traditional vegetables in the mix is especially beneficial, as they are generally well-adapted to local conditions, more resistant to pests and diseases, and often need less water. This must also be accompanied by appropriate crop management that builds soil and plant health, and reduces postharvest losses.

Importantly for mitigating climate change, more local production for local consumption – increased circularity – reduces 'food miles' and associated carbon emissions from transport. Fresher vegetables are also higher in nutritional content than those that have spent weeks in transit. And those grown in agroecological farming systems tend to have higher nutritional content and increased shelf life. Benefits have to be equitable too, and as such, it is critical to recognize and address power disparities and trade-offs among nutritional, livelihood and environmental food system outcomes.

Vegetables have a key role to play in all five areas identified by the 2021 UN Food Systems Summit. These are (i) nourish all people, (ii) boost nature-based solutions, (iii) advance equitable livelihoods, decent work and empowered communities, (iv) build resilience to vulnerabilities, shocks and stresses, and (v) support means of implementation. To realize the true power of vegetables, actions are needed at the food system level, to make vegetables more available, accessible, affordable and desirable through push (production and supply), pull (demand and activism) and policy (legislation and governance) mechanisms. These must also be undertaken at macro (global and national) meso (institutional, city and community) and micro (household and individual) levels.

Vegetables have huge nutritional and economic potential. But to realize this, there is a need to act now, to conduct research and collective action on supply, demand and policy issues. Climate change is making supply more tenuous, and diet-related health issues are an increasing economic drain on governments and families.

Four foundational game changers need to be addressed.

+ Mobilize a much greater share of global R&D efforts for nutritious foods, like vegetables.
+ Raise awareness of the value of vegetables and fruit for human and environmental health.
+ Create business opportunities by diversifying food systems with fruit and vegetables.
+ Rescue and safeguard rapidly declining fruit and vegetable biodiversity to ensure future options for resilience.

In this decade, WorldVeg will also accelerate the implementation of its Open Science Center vision, to realize the potential of vegetables for healthier lives and more resilient livelihoods.

We look with confidence into the future and we hope you join us, as we move forward to better realizing the tremendous nutritional, economic and resilience power of vegetables.

The **World Vegetable Center** is an international non-profit institute for vegetable research and development. It mobilizes resources from the public and private sectors to realize the potential of vegetables for healthier lives and more resilient livelihoods.

WorldVeg's globally important genebank, improved varieties, production and postharvest methods help farmers to increase their vegetable harvests, raise incomes in poor rural and urban households, create jobs, and provide healthier, more nutritious diets for families and communities. With headquarters in Taiwan, field operations are led from regional centers in Benin, India, Mali, Tanzania and Thailand, and through offices in other countries.

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Sowing seeds, meeting needs

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