

# Out-scaling of technologies along the vegetable value chain



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Feed the Future  
Scaling Agricultural Technologies  
Global Learning and Evidence Exchange

# Context: AVRDC - The World Vegetable Center

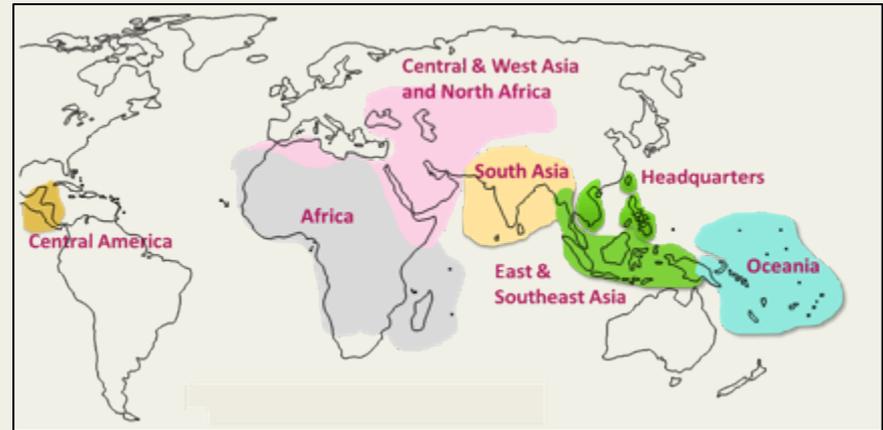


Germplasm conservation, strategic Plan evaluation and gene discovery 2025

Genetic enhancement, varietal development, selection of traditional vegetable lines, seed production

Safe and sustainable vegetable production systems

Postharvest management and market opportunities; nutritional security, diet diversification and human health



- Tomato, pepper, eggplant
- Onion, garlic
- Mungbean, vegetable soybean
- Pak choi, broccoli
- Cucumber, pumpkin, bittergourd
- Traditional vegetables



# Out-scaling successes



- Tomato grafting
- Integrated pest management (IPM) - eggplant fruit and shoot borer
- Vegetable accessions and breeding lines
- Home and school gardens
- Mungbean production



# Tomato grafting



- Preferred tomato varieties are grafted onto rootstocks (eggplant or tomato) resistant to bacterial (*Ralstonia solanacearum*) and fusarium wilt and/or nematodes (particularly *Meloidogynae incognita*), and tolerant of flooding.



Grafting a preferred scion onto a resistant rootstock using plastic tubing



Non-grafted (left) and grafted (right) tomato planted in bacterial wilt-infested field



# Tomato grafting

- Resistant to soil-borne diseases and tolerant of flooding
- Vietnam
- Honduras
- Bangladesh
- Indonesia
- Innovations



## Vietnam

- 1998: AVRDC trained Dr. Ngo Quang Vinh in grafting
- 2002-2006: Grafting introduced to farmers in Lam Dong and the Red River Delta to manage bacterial wilt
- 2012: Impact assessment
  - ✦ 100% adoption in Lam Dong province and 48% adoption in the Red River Delta
  - ✦ Red River Delta: average yield of grafted tomato is 31% greater average revenue is VND 409 million/ha higher than non-grafted tomato





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## Honduras

- 2000: Grafting introduced to control rootknot nematode
- 2012: AVRDC introduced bacterial wilt-resistant rootstocks in the Comayagua valley through FHIA\* (IPM-CRSP support)
- Tomato grafted onto AVRDC's rootstocks had a much lower mortality rate and higher yield compared to the available commercial rootstocks

\* *Fundación Hondureña de Investigación Agrícola*



# Tomato grafting

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## Bangladesh

- June 2012: Grafting introduced (USAID funding) with BARI to men and women farmers
- September 2012: 3 small nurseries formed managed by five women each selling 200 and 500 grafted seedlings sold at BDT6 each (10¢)
- The women adapted the grafting chambers to local conditions themselves





# Tomato grafting

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## Indonesia

- Late 2012/early 2013: Grafting introduced (USAID funding) to East Java (bacterial wilt control) and Bali (flooding)
- By late 2013, two nursery operators in Bali had successfully designed modified grafting chambers and one farmer in East Java has been planting and experimenting with grafting on his own





# Stakeholder grafting chamber innovations

## Tomato grafting

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# Integrated pest management (IPM)



IPM strategy to control eggplant fruit and shoot borer (*Leucinodes orbonalis*)

The strategy:

1. Sanitation of planting area (to eliminate crop residue)
2. Prompt excision and disposal of all borer-damaged shoots
3. Installation of traps baited with sex pheromone lures
4. Withholding pesticide use for as long as possible





# IPM - eggplant fruit and shoot borer

- Sanitation, traps and withholding pesticide application
- Strategy
- India
- Bangladesh
- Private sector participation

## India

- Introduced 2000-2003 (DFID-funded)
- Dissemination through
  - ✦ Farmer field days
  - ✦ Dialog meetings
  - ✦ Farmer training
  - ✦ Mass media
  - ✦ Brochures and posters
  - ✦ News releases in local languages
  - ✦ Documentary films
  - ✦ Radio and TV interviews
  - ✦ Puppet shows





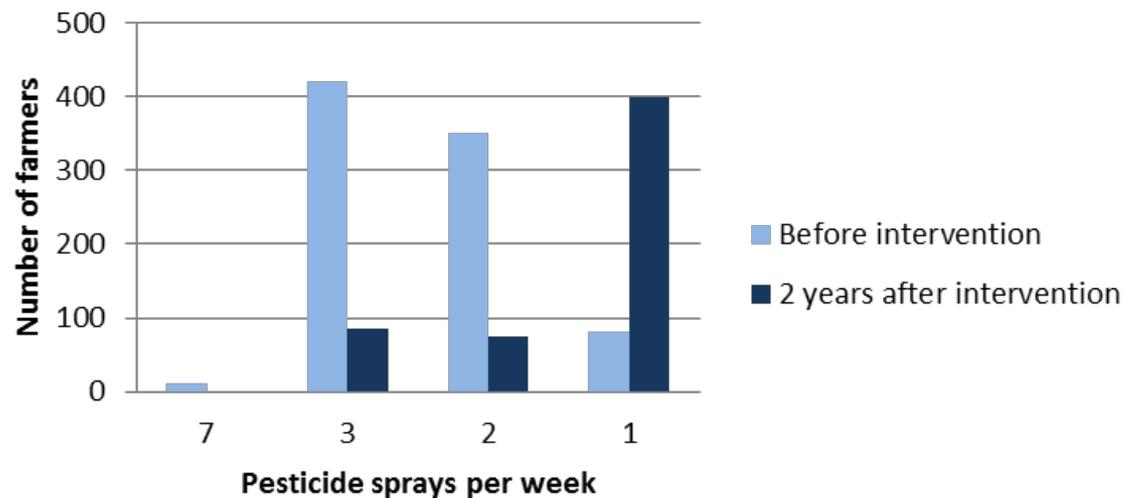
# IPM - eggplant fruit and shoot borer

- Sanitation, traps and withholding pesticide application
- Strategy
- India
- Bangladesh
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## India

- Prior to IPM introduction, 88% of farmers in Gujarat used only pesticides
- Early impact assessment in 2005: none of the farmers relied solely on pesticides

**Reduction of pesticide use in eggplant cultivation**





## IPM - eggplant fruit and shoot borer

- Sanitation, traps and withholding pesticide application
- Strategy
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## Bangladesh

- 500 farmers in Jessore; 130 farmers in Narsingdi practiced IPM after its introduction to control eggplant fruit and shoot borer

	IPM adopters	IPM non-adopters
Fruit damage in winter	30%	75%
Average gross margin	Tk 264,517/ha	Tk 155,261/ha
Pesticide spray	21 times (winter) 33 times (summer)	90 times (winter) 110 times (summer)
Labor use (days/ha)	237 (winter) 291 (summer)	303 (winter) 340 (summer)



## IPM - eggplant fruit and shoot borer

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## Private sector participation

- Pheromone-baited lures were very effective
- 2003: 3 small / medium enterprises commercialized the lures
- 2005: 9 enterprises selling the lures throughout India
- Between 2003 and 2005 sales from two of the pioneering enterprises tripled from 5,278 units to 16,529 units
- Unit cost fell from US\$1 per trap to US\$0.10 per trap



# Vegetable accessions and breeding lines



- Continuous improvement of vegetable breeding lines
- Incorporating genes for resistance to biotic and abiotic stresses
- All of AVRDC's breeding lines and genebank accessions are international public goods
- Working with both the public and private sectors





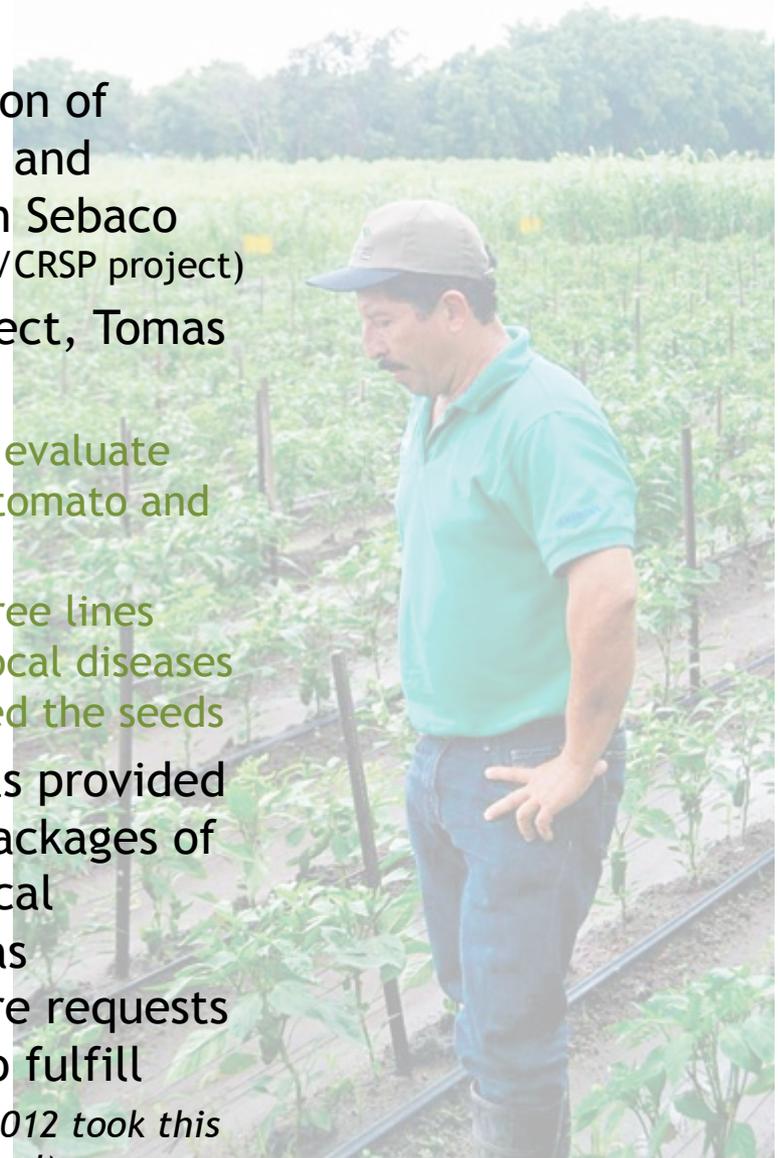
## Vegetable accessions and breeding lines

- International public goods; resistant to biotic and abiotic stresses
- Nicaragua
- Distribution of AVRDC's genetic resources
- Variety releases
- Public-private partnerships

## Nicaragua

- 2000: Evaluation of AVRDC tomato and pepper lines in Sebaco (REDCAHOR USAID/CRSP project)
- After the project, Tomas Laguna
  - continued to evaluate hundreds of tomato and pepper lines
  - identified three lines tolerant to local diseases and multiplied the seeds
- By 2012: Tomas provided 80,000 seed packages of the lines to local farmers; he has thousands more requests he is unable to fulfill

*(A new CRSP project in 2012 took this effort to a new level)*



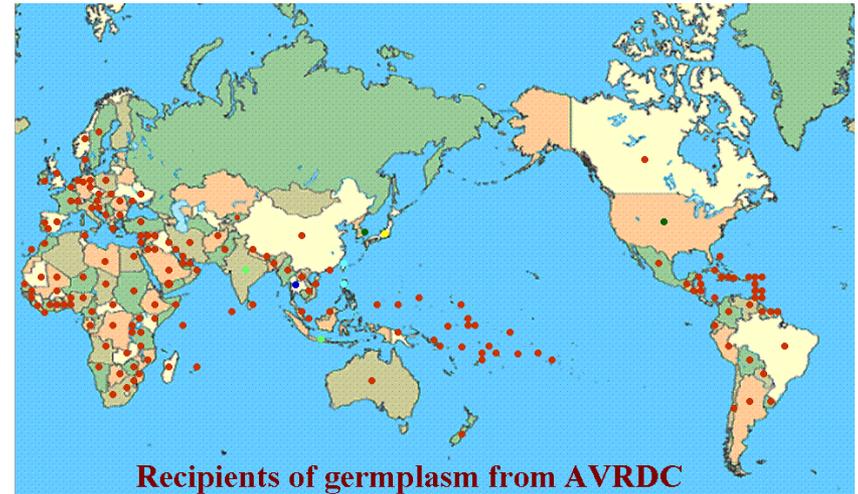
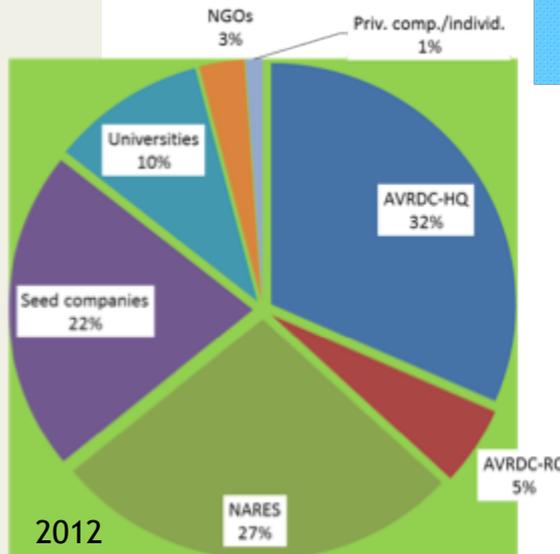


# Vegetable accessions and breeding lines

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## AVRDC's genetic resources

- 5,000 - 7,000 samples of dispatched annually



Between 1972 and 2011, over 590,000 seed samples of accessions / breeding lines were distributed to 200 countries





## Vegetable accessions and breeding lines

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## Varietal releases

- Released by government variety release agencies



Crop (since 1978)	No. of varieties	No. of countries
Tomato	183	46
Mungbean	123	29
Soybean	38	14
Vegetable soybean	43	18
Pepper	31	9
Chinese cabbage	35	8
Traditional vegetables	19	5
Broccoli	2	1
Onion	1	1



## Vegetable accessions and breeding lines

- International public goods; resistant to biotic and abiotic stresses
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## Public-private partnerships

- Partnership with seed companies is a strong mechanism to ensure AVRDC's lines are incorporated into products for the consumer
- Since 2000 AVRDC has worked closely with the Asia & Pacific Seed Association and its members
- From 2012 formal linkages with the African Seed Trade Association have also been strengthened

Today, 75% of seed companies in Asia use improved lines from AVRDC in their breeding programs



# Home and school gardens



- Providing accessible nutrition around the house
- Empowering women to make decisions about food and their families
- Teaching children about agriculture, good agricultural practices and proper nutrition
- Income opportunity





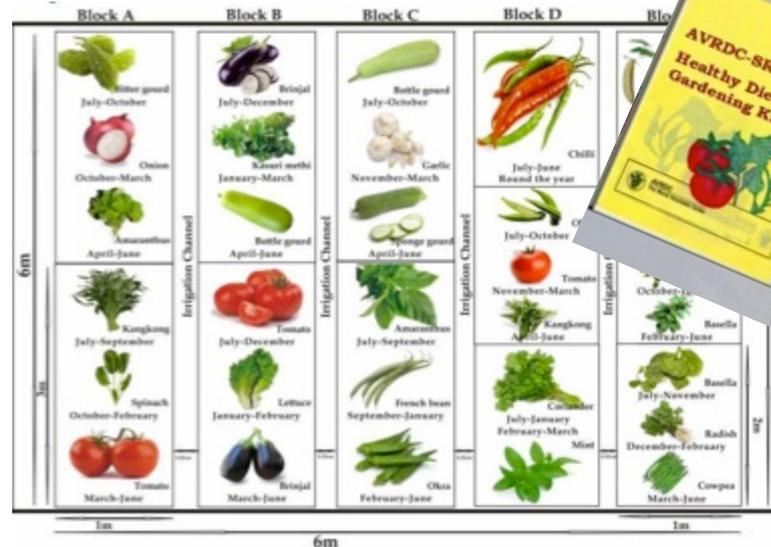
# Home and school gardens

- Not just food security, but nutritional security
- India
- Bangladesh
- Indonesia
- Thailand, Cambodia, LaoPDR, Vietnam, the Philippines, Myanmar and Uzbekistan
- ‘Vegetables go to School’

## India

- 2009: ‘Home gardens for household diets’ in Jharkand and Punjab (Sir Ratan Tata Trust) on 36m<sup>2</sup> - provide >100% of daily vitamins A and C for a family of four, and significant amounts of calcium, iron and protein
- Scaling out is being done by local non-governmental organizations. More than 1,100 gardens have been established

Adapted for Jharkhand, India





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## Bangladesh

- 1990: started with Helen Keller International
- 2010: AVRDC's homestead garden activities continued (USAID funding); with support of NGOs there are now 3,800 gardens in 10 upazillas in Barisal, Jessore and Faridpur
- To ensure sustainability of seed supply for small-scale gardeners, two seed companies have agreed to sell seeds in small size, affordable packages



Seeds  
Watering can  
One day of instruction  
Vegetable preparation  
Nutrition  
Follow-up



## Home and school gardens

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- ‘Vegetables School’



## Indonesia

- 2011: Small part of a project in East Java and Bali (USAID funding)
- Cooperates with the governmental program on ‘Sustainable household food security’ which includes school gardens
- East Java: in addition to Blitar and Kediri, four neighboring district governments requested participation: Malang, Probolinggo, Lamongan and Mojokerto
- Bali: the Assessment Institute for Agricultural Technology is taking the school gardens beyond the project framework of Denpasar and Tabanan (30 school gardens are established in all nine Bali districts)





## Home and school gardens



## Other countries

- Thailand: vegetable gardens for orphans, street children and children (Mercy Centre) and school gardens (part of Kasetsart University's outreach program)
- Cambodia: Integrated student field schools on home gardens
- Lao PDR: Home garden initiative in urban Vientiane.
- Vietnam: Home garden demonstration models in Gia Lam district, Hanoi.
- Philippines: School based garden models in flood-prone areas. Strong contributing factor to the Philippines Presidential Executive Order 77 (2009) and Administrative Order 5 (2011) mandating school gardens in 42,000 public schools





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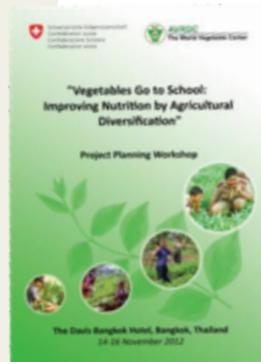
- Myanmar: School-based gardens in the rural area of Nay Pyi Taw.
- Uzbekistan: AVRDC school garden development, advocacy and promotion catalyzed the Cabinet of Minister to decree ‘Healthy Nutrients in All Education Organizations of the Republic of Uzbekistan’ (2010)





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**‘Vegetables go to School’**  
(Swiss Agency for Development and Cooperation)

**Bhutan, Burkina Faso, Indonesia, Nepal, the Philippines and Tanzania**

Validating the correlation between school gardens and nutritional status of school children, before scaling out and up

2012-2015: randomized controlled trials with 120 schools in the four countries

2015-2018: the project will reach 2,400 schools

2019-2020: establishment of a policy framework for nationwide implementation in the target countries; replication and adaptation in neighboring countries



# Mungbean production



- 1970s mungbean was a marginal crop

- Low yield, non-synchronous maturity, shattering, long growth period, susceptible to pests and diseases



- Potential to provide micronutrients and protein, opportunity for income generation, improve soil fertility, diversify cropping
- 1992: AVRDC embarked on a breeding program to make mungbean a crop of choice; a network (SAVERNET) established (Bangladesh, Bhutan, China, India, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand)



Powdery mildew susceptible (left) and resistant (right) lines

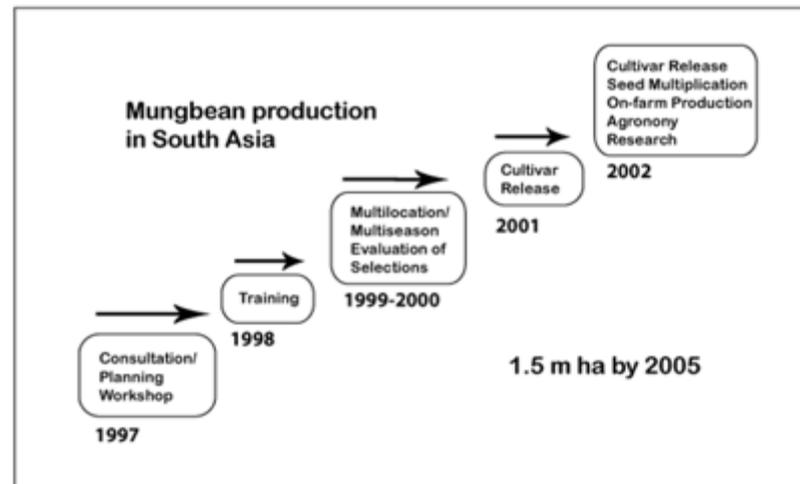


## Mungbean production

- Was a marginal crop
- Out-scaling through collaboration
- Increase in area under mungbean cultivation

## Out-scaling accelerated by collaboration:

- Shuttle breeding program with Pakistan
- SAVERNET sub-network for mungbean in South Asia
- Seed village program in India (270 farmers produced seeds on 0.4 ha each, to supply 2,700 t high quality seeds for other farmers)
- Seed multiplication and distribution by public and private seed companies



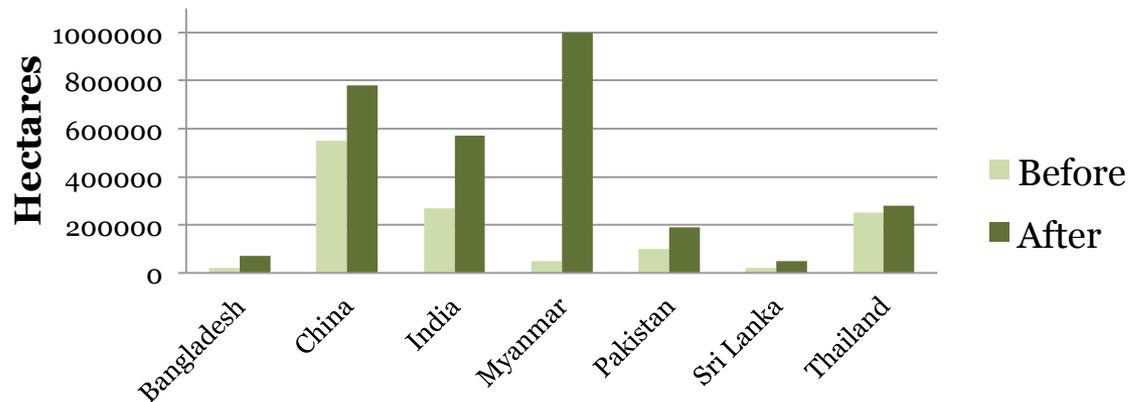


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Today, improved mungbean varieties occupy 90% of cultivation area in Pakistan and Thailand, 85% in China, 50% in Bangladesh and Myanmar.

**Estimated area under mungbean before and after intervention**





## For successful scaling

- Tomato grafting
- Self-motivation of the partners
- Target a specific need; build upon what is there
- Provide an income-generation opportunity
- Create demand; support mechanism to provide inputs
- Support adaptation for sustainable adoption



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  - **Scaling target along the research and development continuum**
  - **Work with the private sector to fill supply gaps (proof is needed)**



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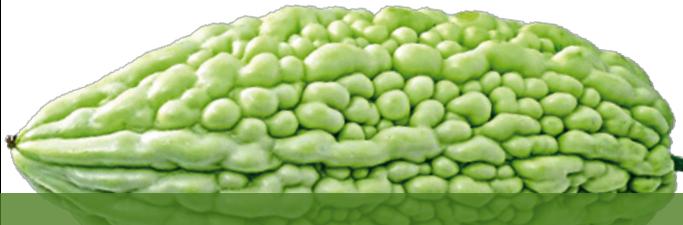


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No single solution or mechanism;  
It takes time, patience and perseverance;  
Adaptation is often needed for sustainable adoption; and  
Sustainable impact may take years to assess, so factor in  
some short-term impact opportunities too.

Thank you!



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