

A 'Fresh' Look Forward for Tropical Vegetables

40th Anniversary Celebratory Colloquium
AVRDC @ 40: A 'Fresh' Look Forward

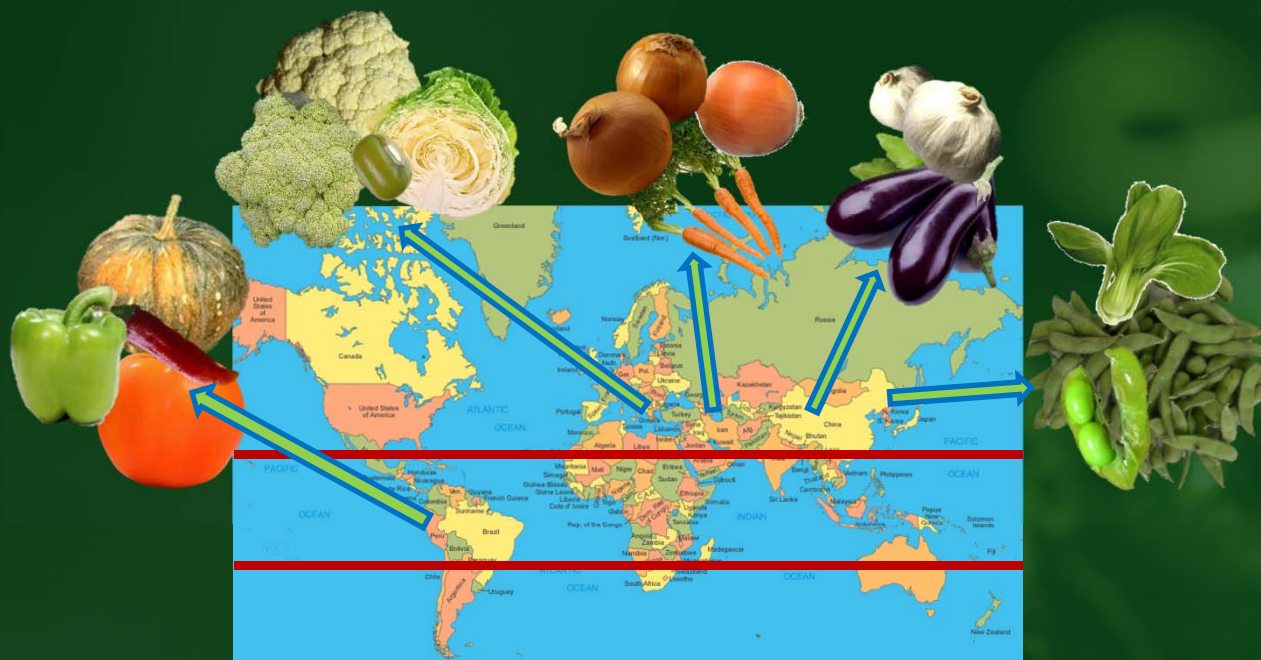


17 October 2013

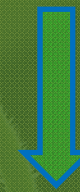


Global Vegetables

Vegetables introduced from other parts of the world (often temperate regions)



Temperate climate:
distinct cold and hot
seasons; no extremes
of temperature or
precipitation; maritime
and continental
influences



Tropical climate: 22°C
to 35°C, little variation
throughout the year;
seasons usually
distinguished by
variation of rainfall
and cloudiness.



Traditional Vegetables

Either endemic crops domesticated and cultivated where they originated

Or introduced crops that are now recognized through custom, habit and tradition as naturalized or traditional vegetables



Vegetables: the next 40th years

Challenges	Opportunities
Climate change and climatic events affecting production	Better understanding of the need for good nutrition
Increased urbanization and loss of arable land	New technologies for better production systems
Pests and diseases	Employment and income
Adverse policies	Empowering women
Wastage	Globalization



Climate change and climatic events



2011 East African drought
Oxfam East Africa



European cold wave 2012,
Sarajevo, Bosnia and Herzegovina
Dan Brickley, Amsterdam, The Netherlands



Floods, Taiwan 2007

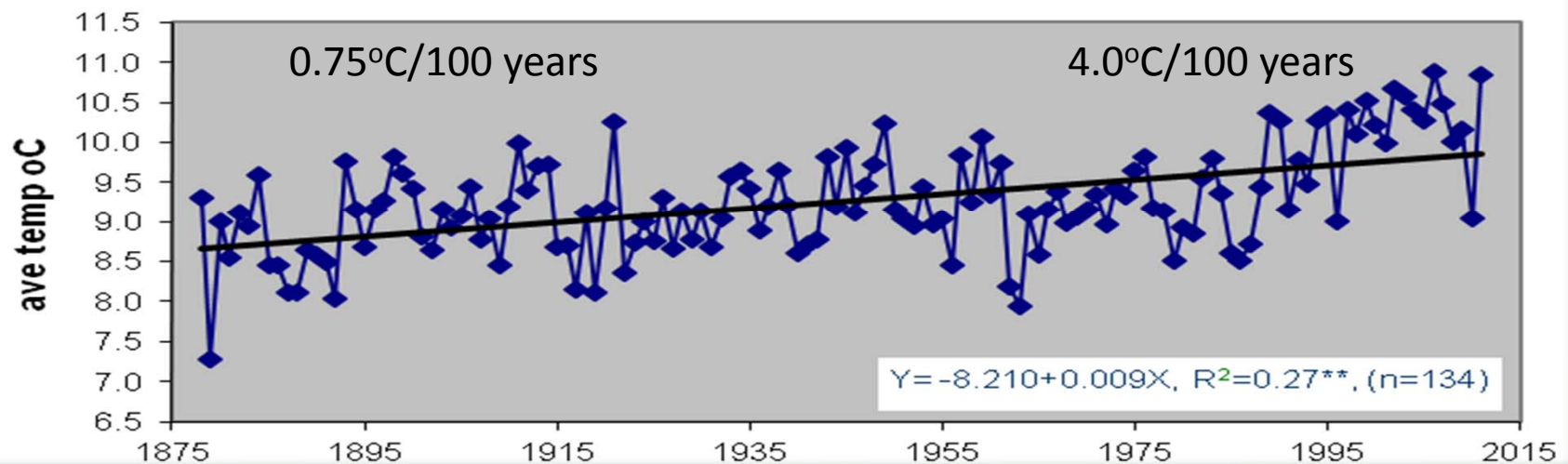


Global warming

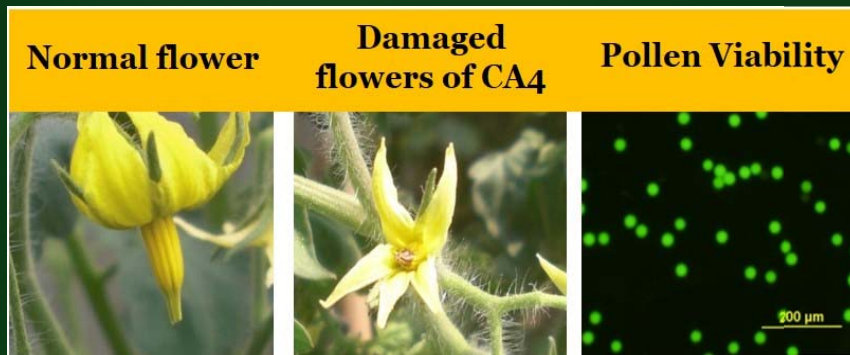
Historical context 1878-2011



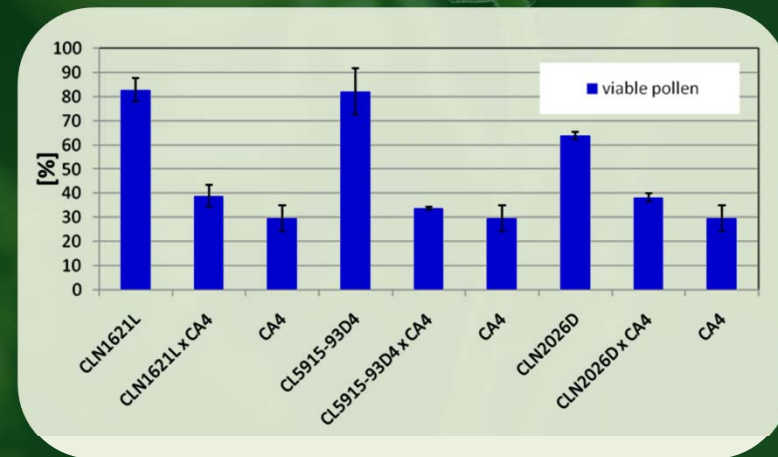
Ave temp - Rothamsted 1878-2011



Increased temperatures can affect fruit set and seed viability



parthenocarpic fruits of CLN2498E



Adapting to abiotic stresses

Studies to develop salinity-tolerant lines

Incorporate traits and genes from wild relatives

LA1606 - *S. pimpinellifolium* shows good levels of tolerance to continued salinity (200mM) stress



CA 4

CLN2498E

Arka Meghali

LA1579

LA1606



Screening vegetables for salinity-prone environments at ICBA, Dubai UAE



Seawater inundation - Funafuti atoll



Risks: biotic stresses



Cucurbit polerovirus

Tomato fruit worm

Bruchids



Powdery mildew



Anthracnose



Bacterial wilt



Pests - effect of climate changes on distribution and behavior

Pest distribution

- range expansion or contraction
- exploitation of new areas by invasive species
- higher temperatures can increase generations
- higher temperatures may enhance locomotion

Pest behavior

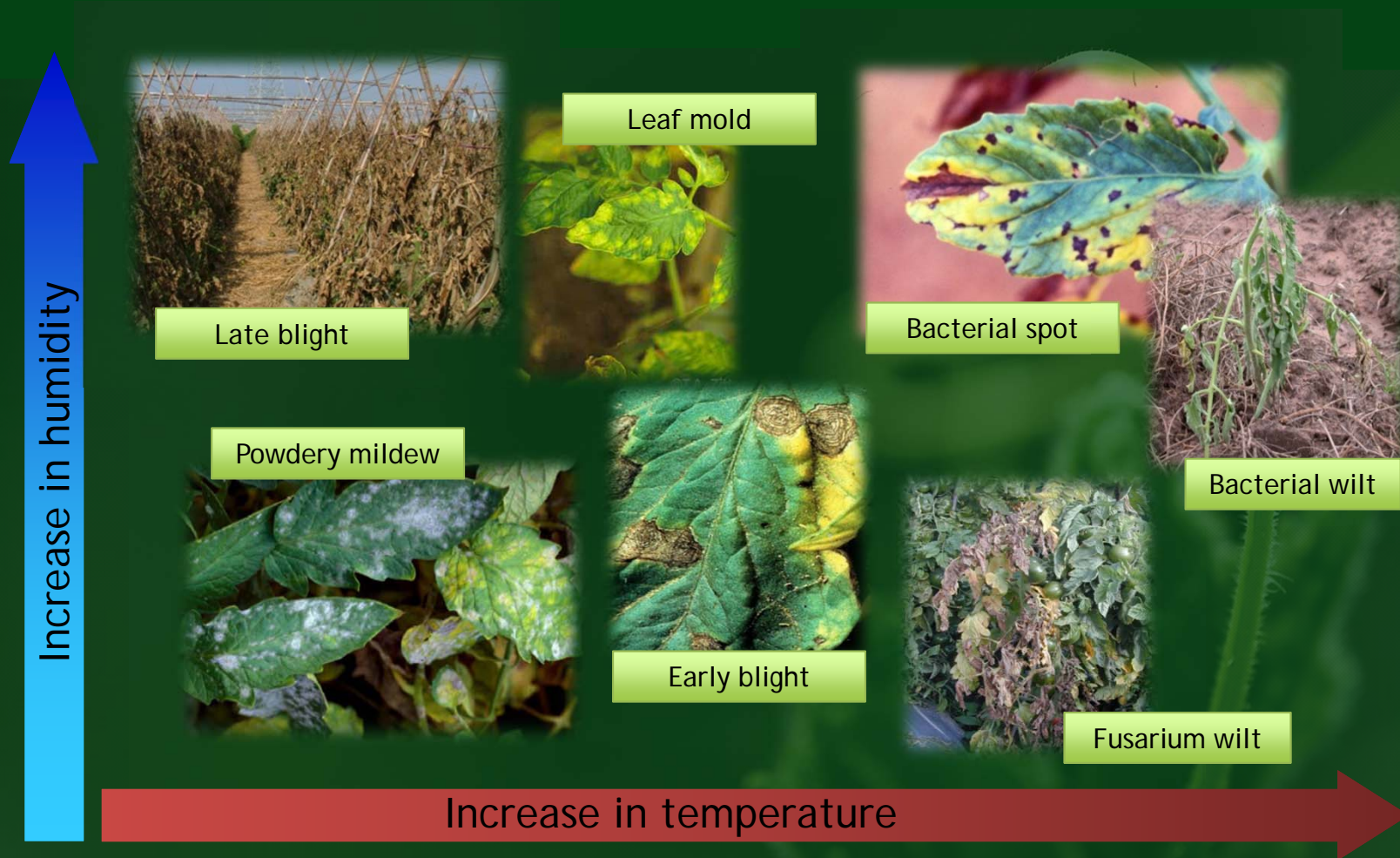
- death of dormant pupae at elevated temperatures
- unsuccessful mating

Species	Biotype	at 17°C	at 33°C
		Generation time	
<i>Bemisia tabaci</i> on sweet pepper	B	49 days	18 days
	Q	46 days	17 days
Natural enemies <small>(Munoz & Nombela, 2001)</small>			
Pollinators <small>(<i>Apis mellifera</i>)</small>			
Temp (°C)	Exposure time (min)	Eggs/female	Successful mating (%)
45	12.5	566	14
	15	213	0
46.5	5	361	0
	10	10	0

Mirondis et al., 2010



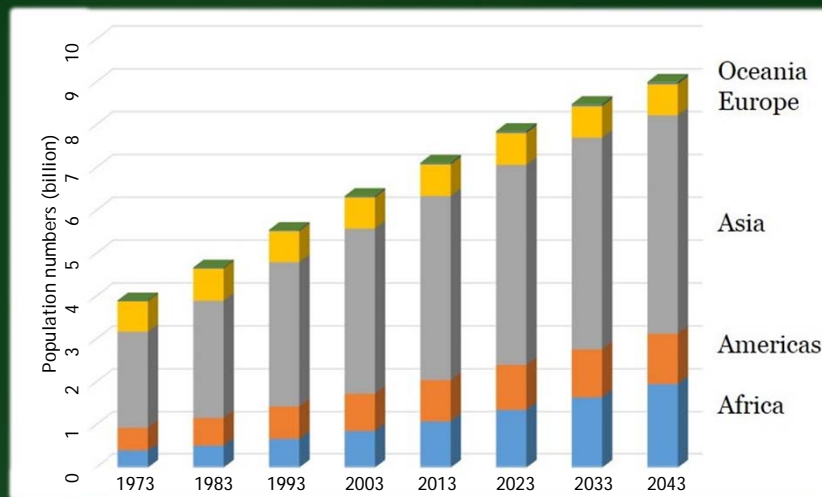
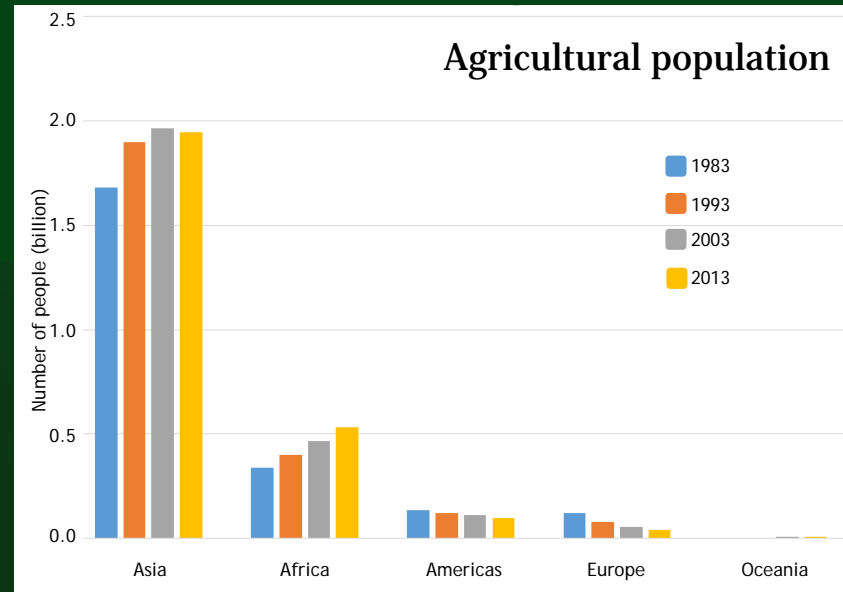
Conducive conditions for tomato diseases



Population growth

Increasing world population

Greatest population growth predicted in Asia and Africa



Maximizing vegetable productivity

Oman - protected field production



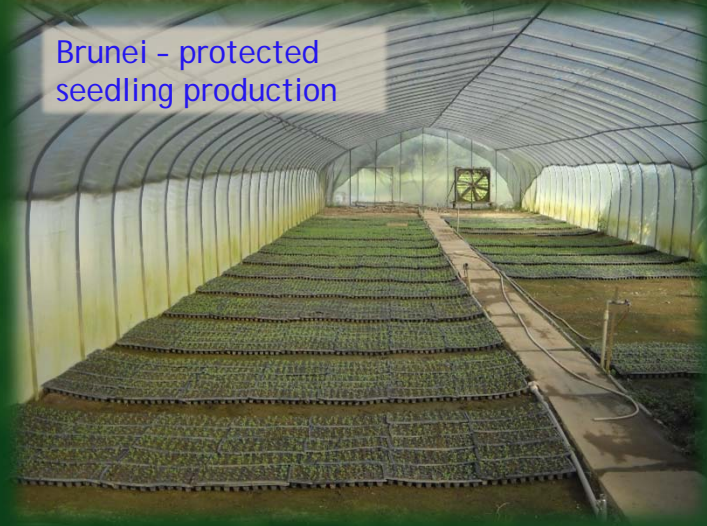
Vietnam - protected vegetable cultivation in Da Lat



Mauritius - protected tomato production

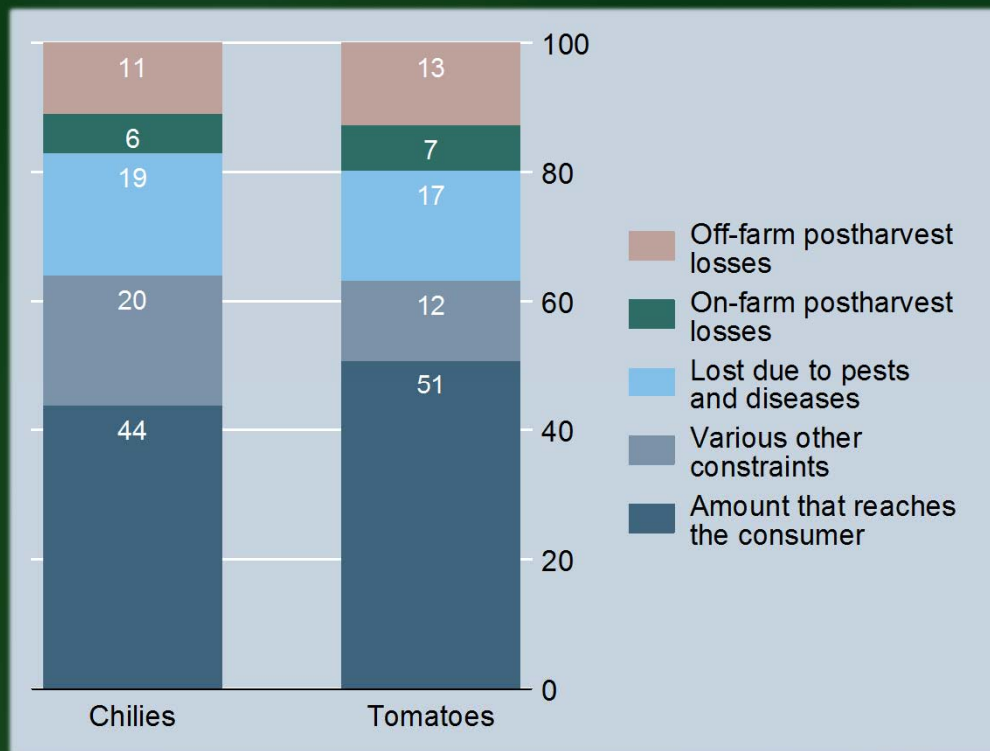


Brunei - protected seedling production



Minimizing crop losses

Pre- and postharvest losses in chili and tomato in India (Tamil Nadu) as percentage of potential yield



Sources: AVRDC-TNAU survey 2013 (pre-harvest losses); Viswanathan et al. 1998 Status of Harvest and Post Harvest Losses of Tomato in Tamil Nadu, Agricultural Engineering Today 22(5/6): 28-35 (postharvest losses)

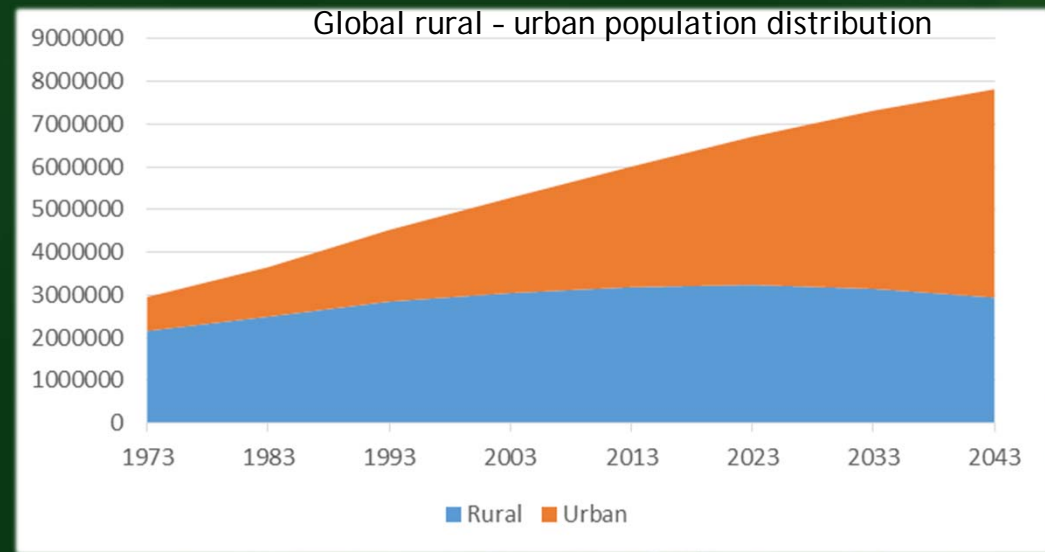


Rural - urban population shifts

Decreasing predicted rural population

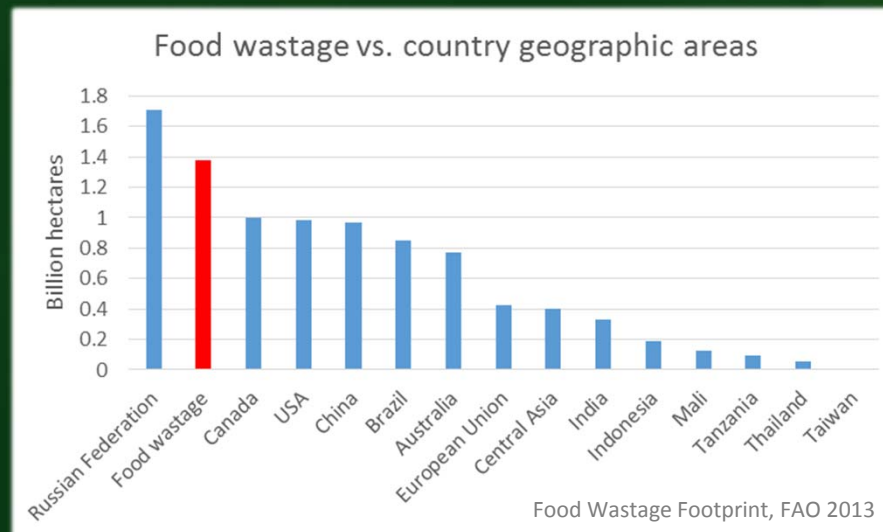
Increasing pressure on urban land

Potential misuse of resources



Food waste

In 2007, the total amount of food wastage occupied almost 1.4 billion hectares (about 28% of the world's agricultural land)



OpenUser2 [GFDL (<http://www.gnu.org/copyleft/fdl.html>)], via Wikimedia Commons



Wastage and losses

In Oceania

- Within 48 hours 27% of harvested eggplant is unsalable due to dehydration
- After 4 days 38% of the tomatoes that reach market are lost due to rots.

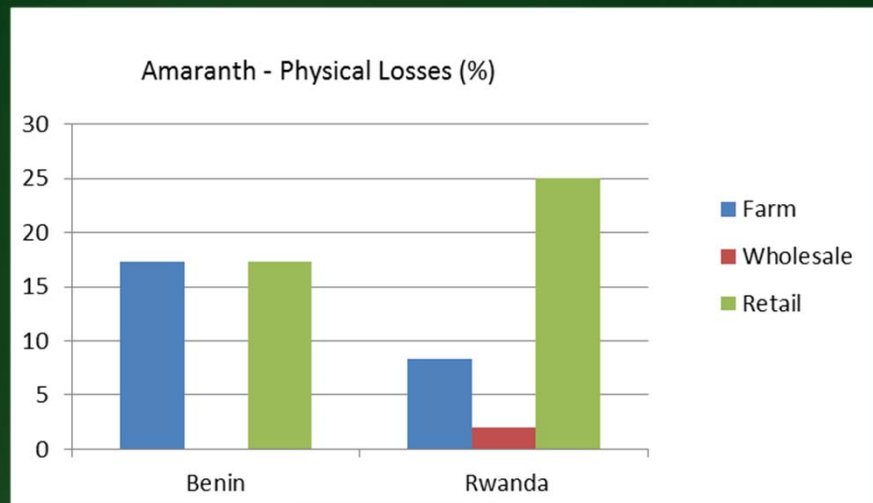
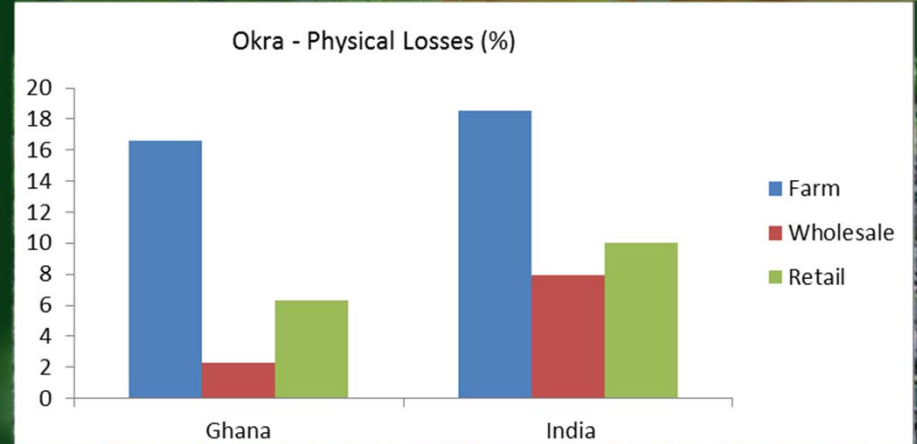
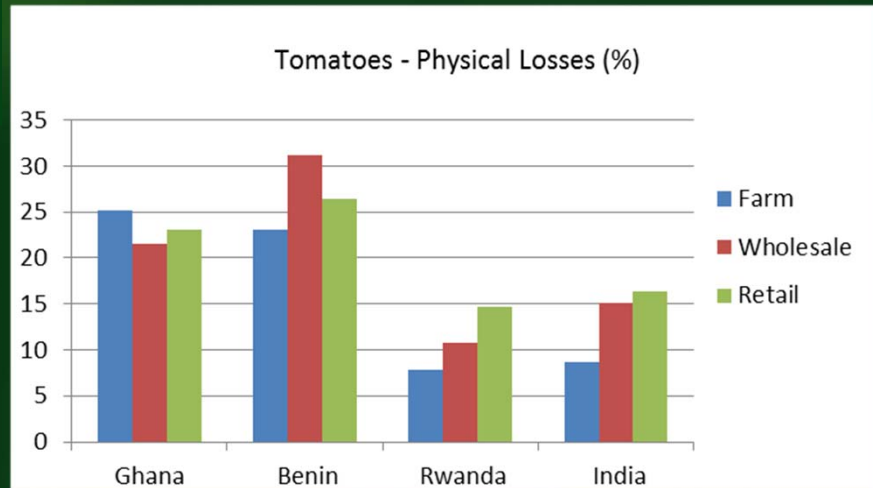


In the Greater Mekong

- Poor packaging/transport
- Adverse storage condition
- Poor quality
- Cannot sell all produce



Wastage and losses



Slide Deck - WFLO Appropriate Postharvest Technology Planning Project (<http://ucce.ucdavis.edu/files/datastore/234-1848.pdf>)



Transportation issues

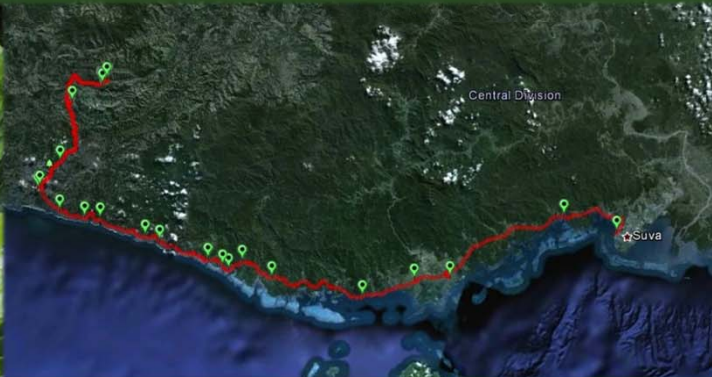
Getting vegetables

- Where they are needed
- When they are needed, and
- In good condition



Thursday morning

Typical route for produce from the Sigatoka valley to Suva, Fiji



Sunday morning



Adverse policies

Often inappropriate or non-existent policies, which may be poorly enforced:

- Seed sector
- Land tenure
- Agricultural input supply
- Good agricultural practices
- Support for marketing fresh produce
- Food safety
- Availability of information



Common global food and nutrition issues



Low nutrient
starch-based
diets



Low
vegetable
consumption



Low
vegetable
diversity

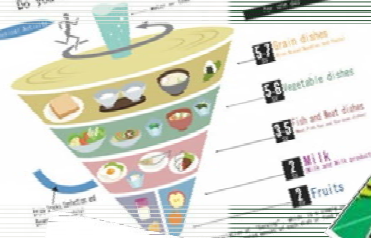
Few basic
skills and
inputs



Balanced diets



Japanese Food Guide Spinning Top
Do you have a well-balanced diet?



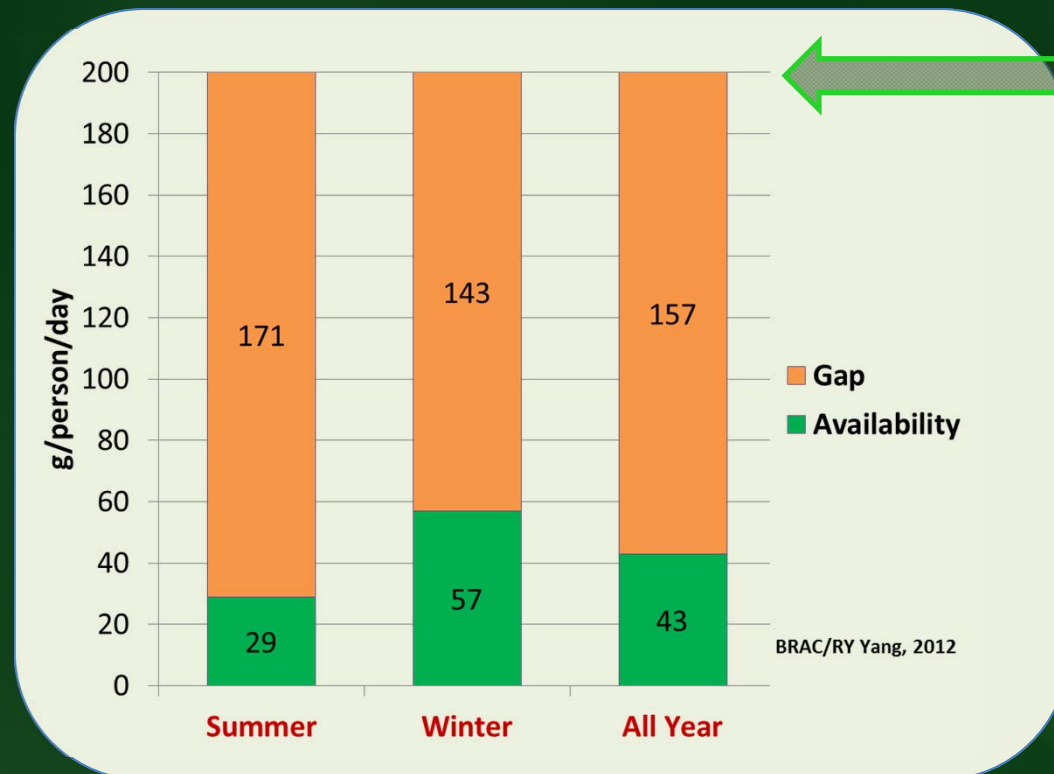
The eatwell plate



Oh My Gulay!

Vegetable availability and gaps

Food may not always be available when it is needed



FAO/WHO recommended daily consumption of vegetables

Seasonal and year-round availability of vegetables in Bangladesh



Potential solutions to improve nutrition

Block A	Block B	Block C	Block D	Block E
Bitter gourd July-October	Brinjal July-December	Bottle gourd July-October	Carrots July-February	Lablab July-February
Onion October-March	Kasuri methi January-March	Garlic November-March	Chim July-February	
Amaranthus April-June	Bottle gourd April-June	Sponge gourd April-June	Irrigation Channel	
Kangkong July-September	Tomato July-December	Amaranthus July-September	Irrigation Channel	
Spinach October-February	Lettuce January-February	French bean September-January	Irrigation Channel	
Tomato March-June	Brinjal March-June	Okra February-June	Irrigation Channel	

Garden nutrient supply

Year-round home gardens



Improved processing and recipes

Enhanced skills of partners

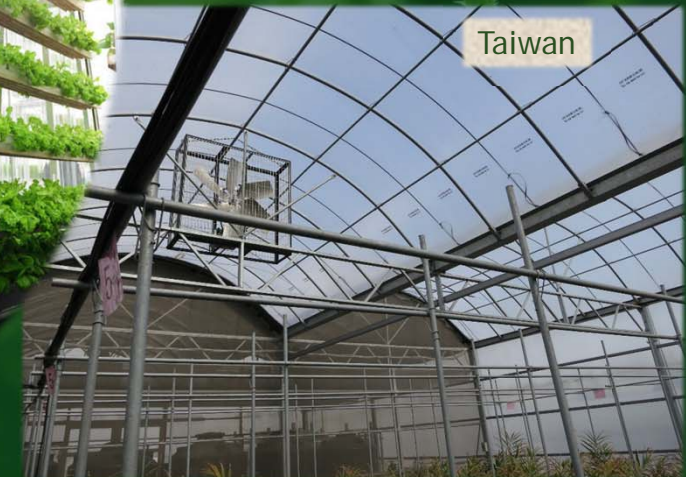


Protected vegetable cultivation

Protected production of vegetables in Punjab, India



Expansion and mechanization of protected cultivation



Vegetables improve incomes

net houses



Ten times the income from open field production

new varieties



Tripled yields; profits quadrupled

mungbeans



Additional US\$600/ha instead of leaving the land fallow

vegetable soybeans



Extra US\$28 income per kg of seed sown



Improving the value chain



Better quality vegetables in the market



Careful harvesting



Sanitary preparation for market



Proper marketing and care of produce



Quality, attractive products for the consumer



Engagement of the private sector

Best-practice hubs
Working towards common goals



Market chains

Processing industries

Linking vegetable production to processing industry will increase the demand and eventually the production and consumption of vegetables



Appropriate postharvest technologies

Solar dryers (IITA)



Simple evaporative cooler constructed from bricks and sand, no cement



Commercial freeze dryer



Empowering women

High-value crops

Smaller land areas

Small-scale enterprises

Contribute to family and community nutrition



Farmers can earn \$1,000/ha of African eggplant per season



Empowering women - business opportunities

Nurseries specialized in production of grafted tomato and other vegetable seedlings for sale to farmers

Training and support to women nursery entrepreneurs



Simple beginnings can lead to profitable outcomes



Empowering women - nourishing families

Understanding the need for good nutrition

How to prepare nutritious meals

Using home-grown vegetables

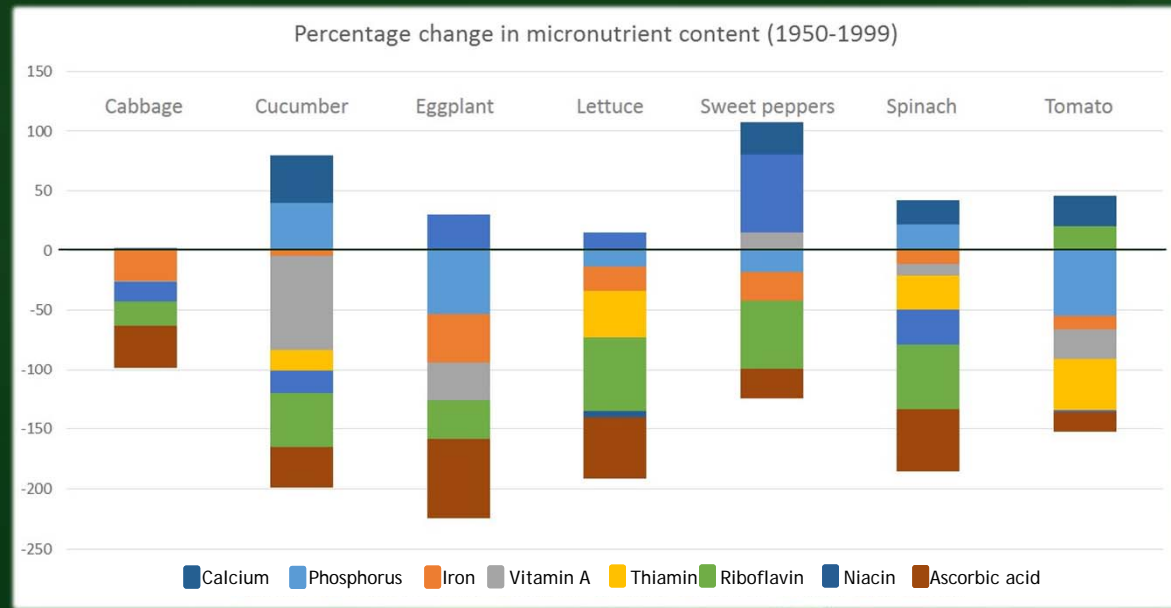
Opportunities to sell extra produce



Improving the quality of our crops

Nutrient dense crops

Focus on nutritional quality not shelf life, size and color



	Ranges	Tomato	Cabbage	Moringa	Amaranth	Aibika	Sweet potato leaf
β -carotene (mg/100g)	0.0 - 22	0.40	0.00	15.28	9.23	5.11	6.82
Vitamin C (mg/100g)	1.1 - 353	19	22	459	113	82	81
Vitamin E (mg/100g)	0.0 - 71	1.16	0.05	25.25	3.44	4.51	4.69
Iron (mg/100g)	0.2 - 26	0.54	0.30	10.09	5.54	1.40	1.88
Folates (mg/100g)	2.8 - 175	5	ND	93	78	177	39
Antioxidant activity (TE/100g)	0.6 - 82,000	323	496	2858	394	560	870



Globalisation

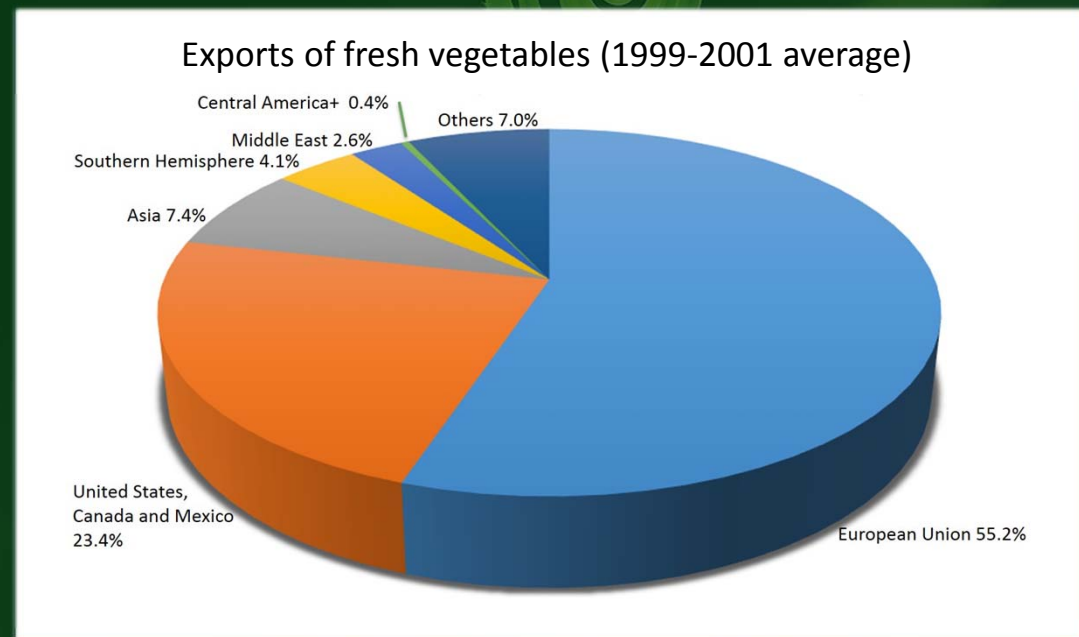
World Trade Organization

- Eliminate non-tariff trade barriers (sanitary and phytosanitary measures)

Codex alimentarius

- Quality, size, tolerances, presentation, labelling, contamination and hygiene

Export opportunities Competition



Information, business skills and job creation

Increased bargaining power
 Reducing cheating by middlemen
 Locating forwards sales contract opportunities

Sustainable solution to agricultural poverty and regular good quality supply of produce to the market



Mobile telephony - data sharing

Picture-based local language price details at market (Sri Lanka)

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පිටි කැපුම් 3.0 - 4:01: PM 3.0 4:01: PM A1-8 0.0-	පිටි කැපුම් 6.0 - 5:38: PM 6.0 5:36: PM A1-8 0.0-	පිටි කැපුම් 16.0 - 5:51: PM 16.0 5:45: PM A1-8 0.0-

Harsha de Silva
 LIRNEasia and Director, e-development labs (private) limited



Tackling seasonality

Is seasonality a problem, or a solution?

An advantage, or a disadvantage?



late autumn - April/May

Autumn fruits - perfect for preserving and are delicious desserts: apples, mandarins, valencia oranges, passionfruits, pears, persimmon, plums, po^r rockmelons, strawberries, watermelons.

Autumn vegetables - delicious roasted and in wonderfully warming soups sprouts, cabbage, capsicums, carrots, celeriac, celery, cauliflower, eggplant onions, parsnips, peas, potato, pumpkin, shallots, silverbeet, spinach, swec

Nuts and other things: chestnuts, pistachios



early winter - June/July

Winter fruits: avocados, apples, grapefruit, lemons, limes, mandarins, nave rhubarb, tangelos, tangerines.

Winter vegetables: asian greens (bok choy & choy sum), beetroot, broccoli, celeriac, celery, fennel, garlic, ginger (grown in tropical weather, not in SA), h kohlrabi, okra, olives, onions, parsnip, peas, potato, pumpkin, daikon radish potato (not grown in SA), turnip, witlof, zucchini.

Nuts and other things: chestnuts, hazelnuts, walnuts, pecans.



late winter - July/August

Winter fruits: Avocados, apples, grapefruit, lemons, limes, mandarins, nave rhubarb, tangelos, tangerines.

Winter vegetables: asian greens (bok choy & choy sum), beetroot, broccoli, brussels sprout, cabbage, carrots, cauliflower, celeriac, celery, fennel, garlic, ginger (grown in tropical weather, not in SA), horseradish, jerusalem artichokes, kale, kohlrabi, okra, olives, onions, parsnip, peas, potato, pumpkin, daikon radish, shallot, silverbeet, spinach, swede, sweet potato (not grown in SA), turnip, witlof.

<http://www.adelaidefarmersmarket.com.au/www/content/default.aspx?cid=972>

THE EAT SEASONABLY CALENDAR

EVERY FRUIT OR VEGETABLE HAS ITS SEASON, THE TIME OF THE YEAR WHEN YOU CAN ENJOY IT AT ITS VERY BEST. THIS SIMPLE TOOL WILL GUIDE YOU THROUGH WHAT'S IN SEASON WHEN SO YOU CAN ENJOY FRUIT AND VEG THAT TASTES BETTER, IS BETTER VALUE AND IS BETTER FOR THE PLANET.



FOR TIPS, RECIPES AND MORE VISIT EATSEASONABLY.CO.UK






Grafting

Rootstocks and scions grafted to produce high-yielding, biotic stress resistant and/or abiotic stress tolerant plants

High-throughput automation



Types	Species	Comments
 <p>Semi automated machine</p>	Cucurbits and tomato	The first model that can graft both cucurbits and tomato. Widely marketed in Asia and North America. 650 - 900 grafts per hour at 95% or better success rate. Needs 2-3 workers to assist the machine.
 <p>Semi automated machine</p>	Cucurbits	Introduced to Asian and European market. One machine has been introduced in U.S. for trial use. 900 grafts per hour at 95% or greater success rate. Needs 2-3 workers to assist the machine.
 <p>Semi automated machine</p>	Tomato and eggplant	800 grafts per hour at 95% or greater success rate. However, seedlings size required for grafting was too large for Japanese standard, limiting the market. However, the seedling size is acceptable for US standard. Needs 2-3 workers to assist the machine.

Lam Dong Province, Vietnam: 100% uptake by farmers - grafting with resistant eggplant and tomato rootstocks to manage bacterial wilt of tomato

<http://cals.arizona.edu/grafting/grafting-robots>



Supergrafting

Grafting multiple scions onto one rootstock

Opportunities using perennial rootstocks for annual or biennial crops



POMATO
It's a Tomato
on a Potato

<http://www.pomatoplant.com/>

What Is a Fruit Salad Tree?

A Fruit Salad Tree bears up to 6 DIFFERENT FRUITS all on the ONE TREE. They are multi-grafted trees the same "family" and all the fruits retain their own characteristics e.g. flavour, appearance and ripening time.

Click on any of the 4 Tree types below.

<http://www.fruitsaladtrees.com>

Citrus Fruits	Stone Fruit	Multi Apples
<ul style="list-style-type: none">OrangesMandarinLemonTangeloLimePomeloGrapefruit	<ul style="list-style-type: none">PeachesNectarinesPlumsApricotsPeachcots	<ul style="list-style-type: none">RedGreenYellow

Special Offer



Supergrafting

Multiple
scions onto
one
rootstock:

cherry tomato,
processing tomato,
multiple eggplant types
and sweet/chili peppers



Dr Sirikul Wasee, Kasetsart University



Environmental management

Protected cultivation

- nets, plastic, glass

Lighting to extend production

- LEDs, day-length

Power will be an issue

- solar, wind, water

Management

- computers, smartphones

Postharvest management

- targeting consumers



Too hot, too cold
Too humid, too dry
Keep insects out
Let pollinators in



Technologies for the home

Production technologies and components must be

- simple
- affordable
- easy to use



Technologies for the home

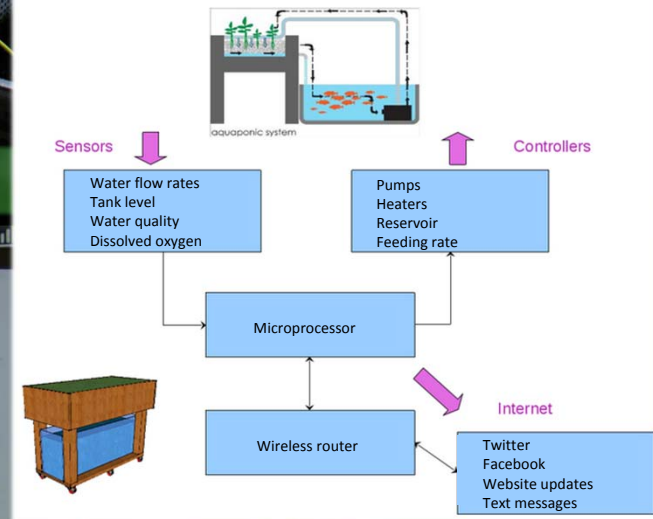
Aquaponics

- At home - an indoor system, lit by a window and grow lights, using standard aquaria or fish tanks and a small hydroponic grow bed can produce vegetables

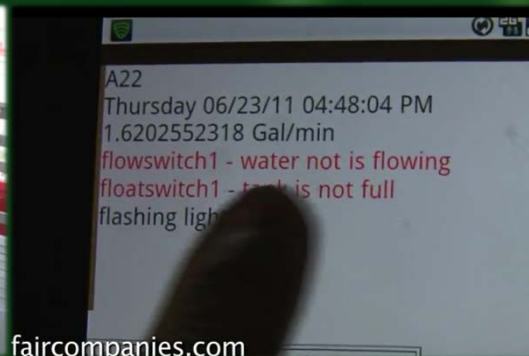


Components Of A Smart Aquaponics Garden

Aquaponic gardens, sensors, microprocessors, clouds and social media



faircompanies.com



faircompanies.com



Module farming

High input, high output

Economies of scale for intensive production

Streamlined, reduced labor costs

Potential risks



Module farming

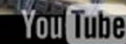
'The Volksgarden'



Farmdominium TM Vertical Farming Design



Omega Garden's Farmdominium TM Vertical Farming Design



<http://urbanledgrowth.wix.com/urbanledgrowth#!>



Developing improved, adapted vegetables

Genetically-modified vegetables:

- Courgette - virus resistance
- Eggplant - insect resistance
- Sweet pepper - virus resistance
- Tomato - delayed ripening/fruit softening/senescence, insect resistance



www.semisweetonline.com

Commercial approval:

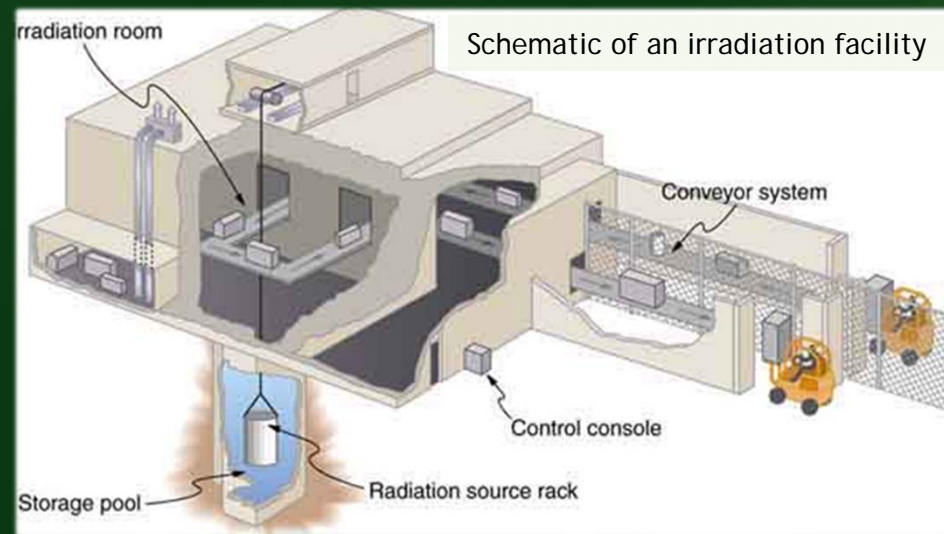
- Canada - tomato FLAVR SAVR™ [courgette/zucchini]
- China - [sweet pepper, tomato]
- Mexico - tomato FLAVR SAVR™
- USA - chicory Seed Link™, tomato FLAVR SAVR™ [courgette/zucchini]



Preserving vegetables

Irradiation

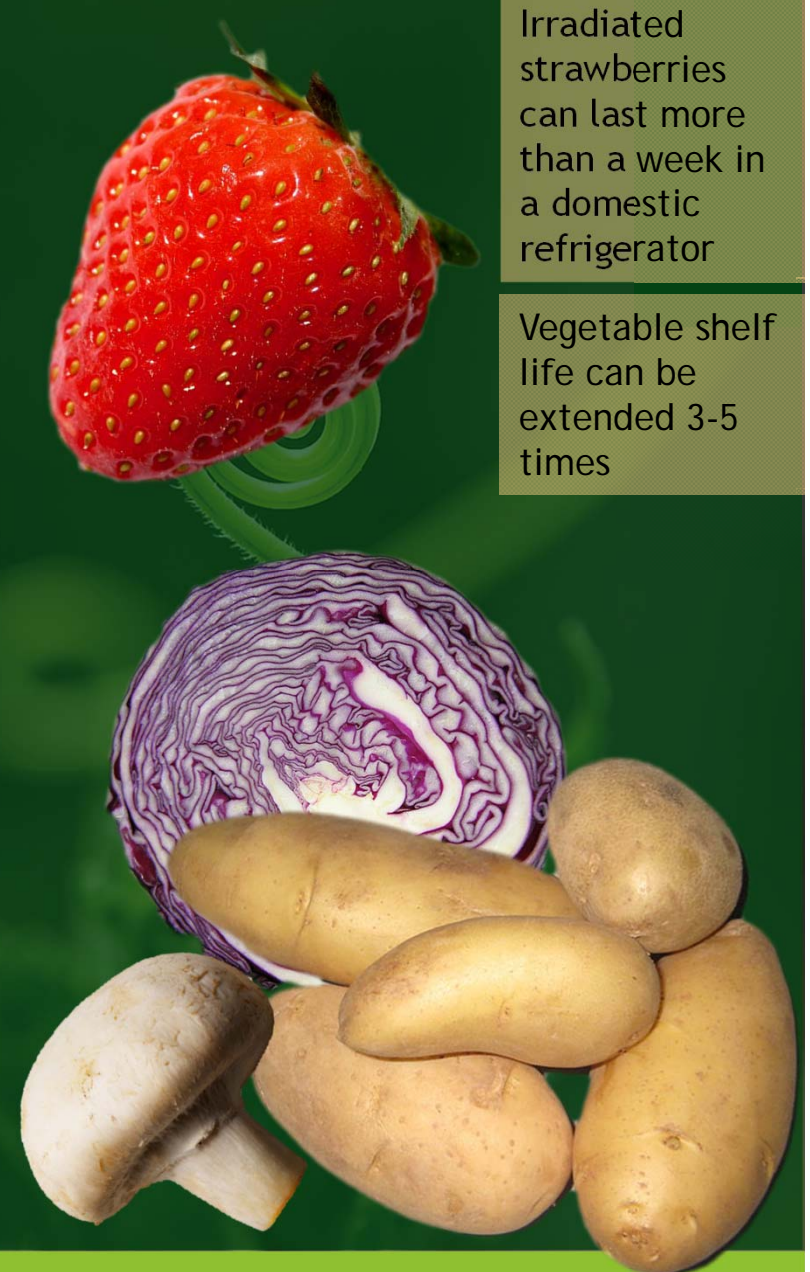
- destroys harmful bacteria
- extends shelf life
- retards maturation of vegetables
- reduces spoilage by organisms that can grow under refrigeration
- can also be used in place of fumigants and other quarantine procedures



Preserving vegetables

Gamma irradiation of food

- permitted by over 50 countries
- 500,000 metric tons of food treated annually worldwide
- clearances vary: single food category in many European Union countries to any food in Brazil
- Pakistan and Brazil: any food may be irradiated to any dose



Irradiated strawberries can last more than a week in a domestic refrigerator

Vegetable shelf life can be extended 3-5 times



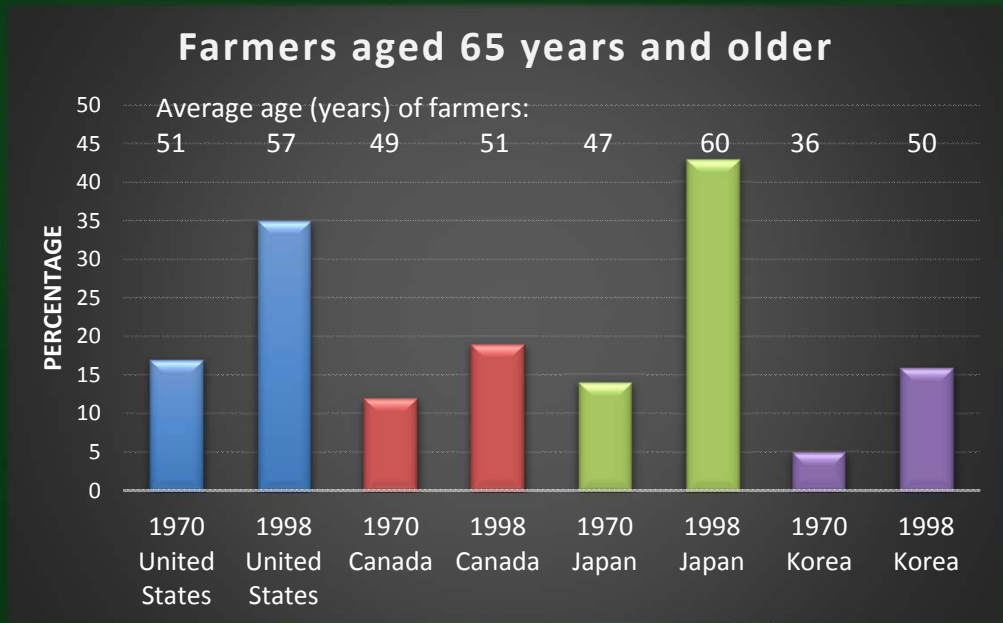
Changing mindsets

Influencing populations

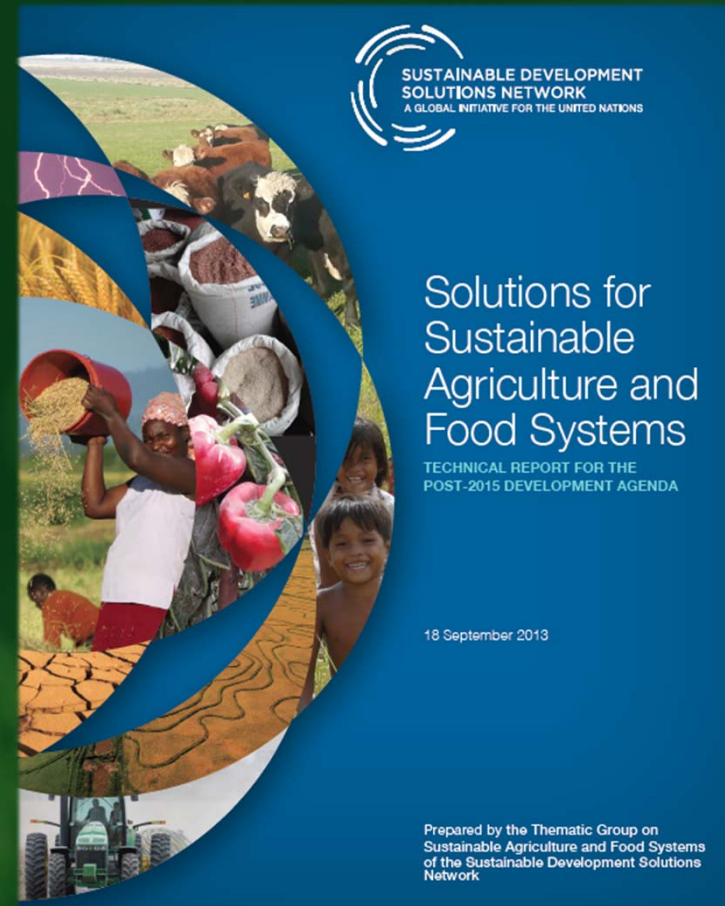
Linking education, health, agriculture

A new generation of agricultural scientists

A new generation of farmers to feed a growing population



www.unsdsn.org



Goal 6: Improve agriculture systems and raise rural prosperity

Shifting towards healthier diets;
Ensuring the supply of safe, nutritious food;
Preserving the environment;
Reducing food losses and waste;
New visions and business models for smallholders;
Empowering women along the value chain; and
Coherent policies at all levels.



Prosperity for the Poor and Health for All



17 October 2013

