

India's agrarian transformation – fifty years of personal experience

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Lecture on December 5, 2012, by
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Indian sub-continent – 1947



Population – 350 million

http://www.geographic.org/maps/india_maps.html

“Everything else can wait, but not agriculture”*



Farm production not keeping pace with a huge & fast-growing population

	1950
Population	361 million
Foodgrain production	50.8 million mt
Foodgrain import	4.8 million mt
Buffer stock	Nil
Total	55.6 million mt [#]

A new democracy could not afford to face another famine

* Prime Minister Nehru in 1948.

Net foodgrain availability = 154 kg per person per annum.

Bitter memories: last famine



The Great Bengal Famine, 1943-4

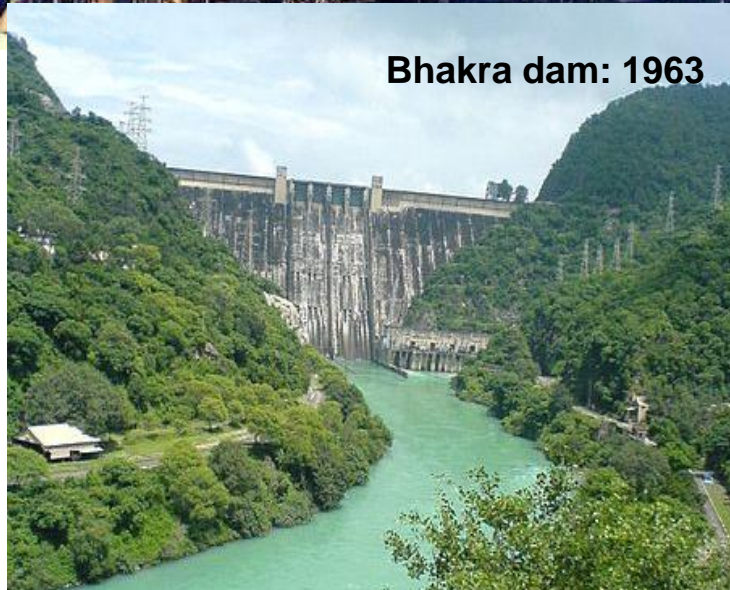
- 1.4 - 4 million deaths
- Triggered by damage of rice crop
- Aggravated by policy failure

1st Five-Year Plan makes agriculture a priority

“Temples of resurgent India”



Sindri fertilizer factory: 1951



Bhakra dam: 1963

- High investments in
 - Improvement of agriculture infrastructure &
 - Application of science to agriculture
- So, during the Plan period (1951 – 56)
 - Foodgrain production increased by 22%*
- Significant role was also played by new nationwide Extension (= transfer of knowledge) Service system started in 1951
 - ‘Community Development Program’ (CDP) evolving into ‘National Extension Service’ (NES) .

***1957 was a good time
to join agriculture school!***

* Aided by good rains.

1957 – 62: learning science & practice of agriculture

At College of Agriculture, Banaras Hindu University

- Learning basics of agri-sciences at undergraduate level



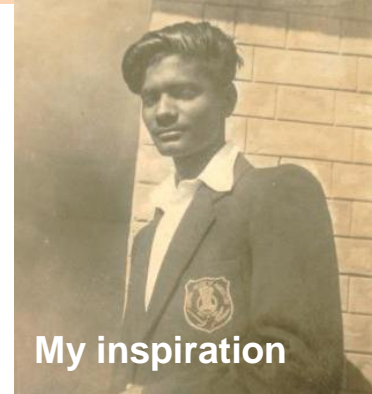
Principal
Jaswant Singh

- From a learned faculty;
- In well-equipped labs and a large research farm.

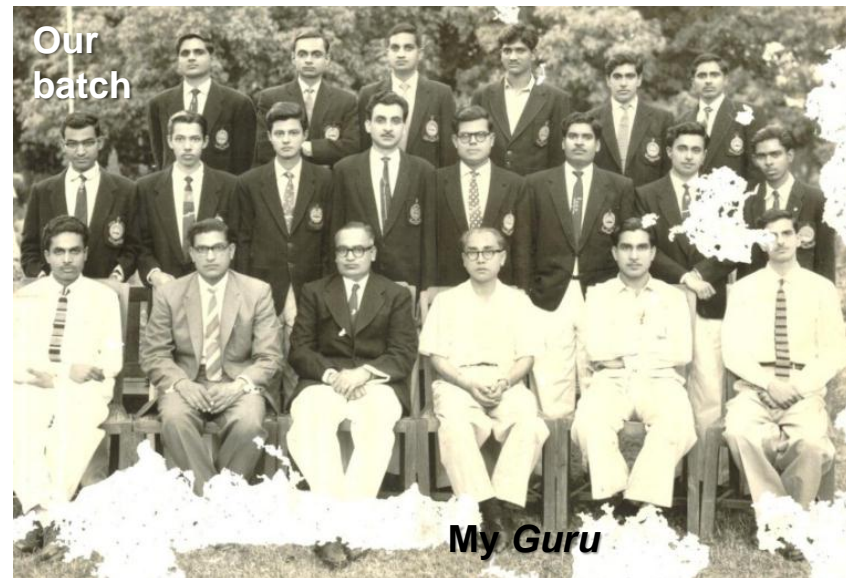
Increasing farm productivity seemed doable

- Advancements in agronomy at Master's
 - About potential & limitations of modern varieties

Ready to join agri-profession



My inspiration



My Guru

India: Food shortages reappeared in the sixties

- Triggered by monsoon failures during 2nd Five-Year Plan (1957–62)
- Aggravated by war and other factors
- Acquired serious proportions in mid-sixties
 - Personally experienced hardship from '64
 - Limited & erratic supplies under “statutory rationing” in Calcutta metro area.
- Limitations of “improved” crop varieties were exposed, e.g. “lodging”.
- Fertilizer-responsive high-yielding varieties were needed to meet the challenge
 - New varieties brought for nation-wide testing
 - 1965: Rice from IRRI;
 - 1966: Wheat from CIMMYT.

Initial results? Encouraging!

	1950	1960	1970
Population (mio.)	361	439	548
Food prodn (mt)	50.8	82.0	108.4
Imports (mt)	4.8	10.4	7.5
Buffer (mt)	Nil	2.0	Nil

A breakthrough in sight

Swaminathan and Borlaug



- Taiwanese rice varieties gave high yields, but not good for cooking
 - Not acceptable
- Mexican wheat varieties performed well, but flour colour was not ideal
 - A solution had to be found*
- In 1967, farmers planted large areas with ‘Mexican’ wheat – mainly in the Indo-Gangetic plains.

A bumper wheat harvest in 1968 kicked off the ‘Green Revolution’.

* Indian scientists quickly switched the husk colour to amber, making the flour colour desirable for chapati-making.

Better varieties “stamp” their authority



Annual wheat production exceeded the total quantity since cultivation began on the sub-continent

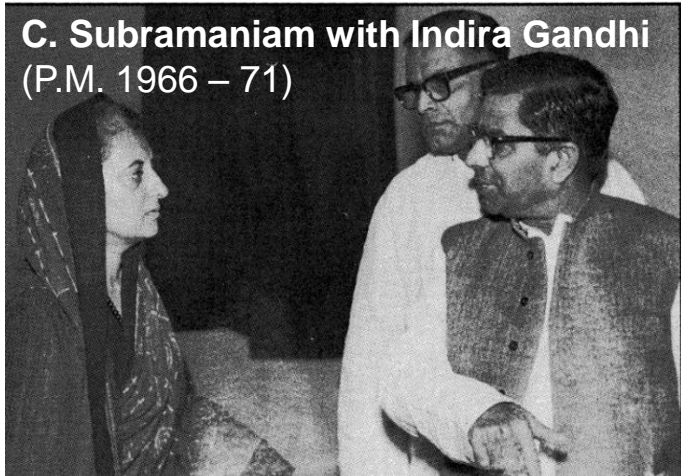
Key elements of success

Lal Bahadur Shastri

Prime Minister of India (1964 – 66)



C. Subramaniam with Indira Gandhi
(P.M. 1966 – 71)



1) Policy & implementation

- PM Shastri put agriculture on top priority
- *Subramaniam took this up strongly*
 - Realized that science must play a greater role
 - Agri-scientists needed to be incentivized
 - Encouraged Swaminathan and team to go for wide testing of Mexican wheat;
 - Price incentives (to farmers) also played a positive role.
- *Borlaug's unstinting support.*

2) Science – important role of “dwarfing” genes e.g.,

- ‘Gaines’ – the first semi-dwarf high yielding wheat in 1961;
- ‘Taichung’ and ‘Tainan’ varieties in 1960.

1980 – 90: Period of most favourable growth*

Growth rate of crop production in India

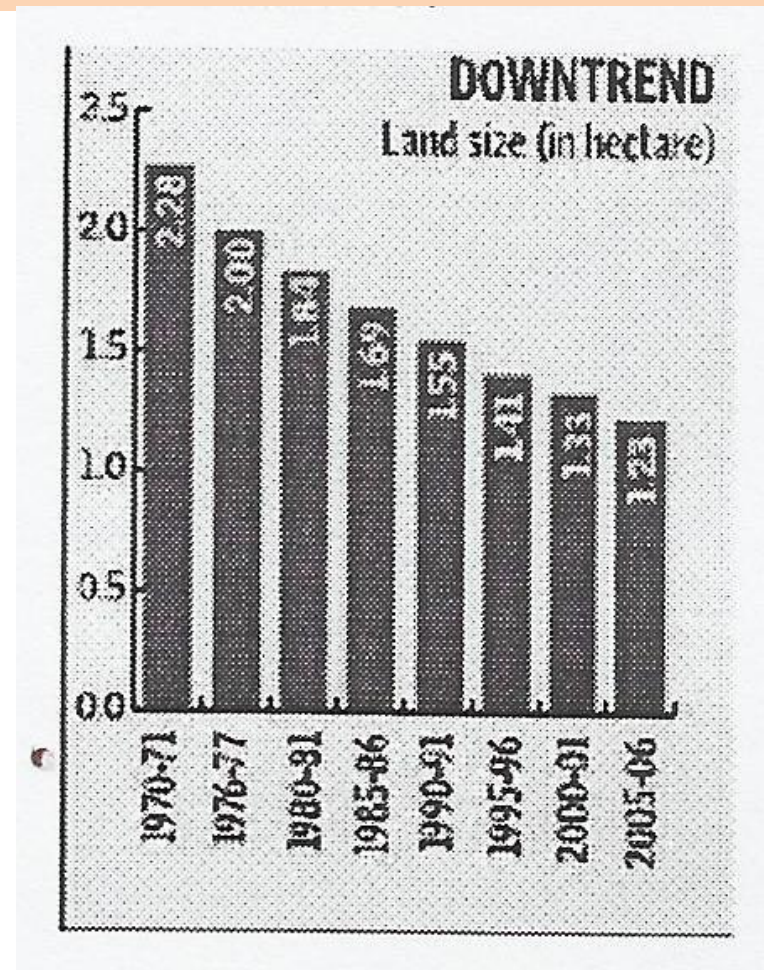
	1950~60	1960~70	1970~80	1980~90	1990~96
Rice	4.53	2.12	1.73	4.08	1.60
Wheat	5.79	7.73	4.15	4.29	3.64
Coarse grains	3.76	1.67	0.55	0.71	-0.99
Maize	7.84	3.90	0.64	3.20	1.30
Total	4.45	3.10	2.07	3.38	1.81
Pulses	3.80	-0.47	-1.18	2.45	-0.07
Total Foodgrains	4.35	2.63	1.76	3.31	1.66
Oilseeds	3.05	2.41	1.34	6.01	4.16
Sugarcane	5.62	2.54	2.27	4.38	3.72
Cotton	4.54	2.03	2.69	3.23	4.51
Jute/Mesta	5.60	0.32	2.13	1.28	2.18

Note. The data are three year moving averages.

* Ref. Fujita, Koichi (2010) jaica-ri.jica.go.jp/publication/assets/JICA-RI_WP_No.17_2010.pdf

Indian agriculture: new emerging issues

- **Post-1990**
 - “Technology fatigue”
 - Declining returns on input use;
 - Better solutions not forthcoming.
- Shrinking size of holdings and viability of smallholder farming
 - 85% of farms are smallholdings
 - They occupy 44% of land area;
 - Rest = 15% medium & large farmers.
 - State-to-state differences in average size of holdings – also an issue, e.g.,
 - Punjab 3.77 ha; Haryana 2.25 ha,
 - West Bengal 0.77 ha; Kerala 0.22 ha.

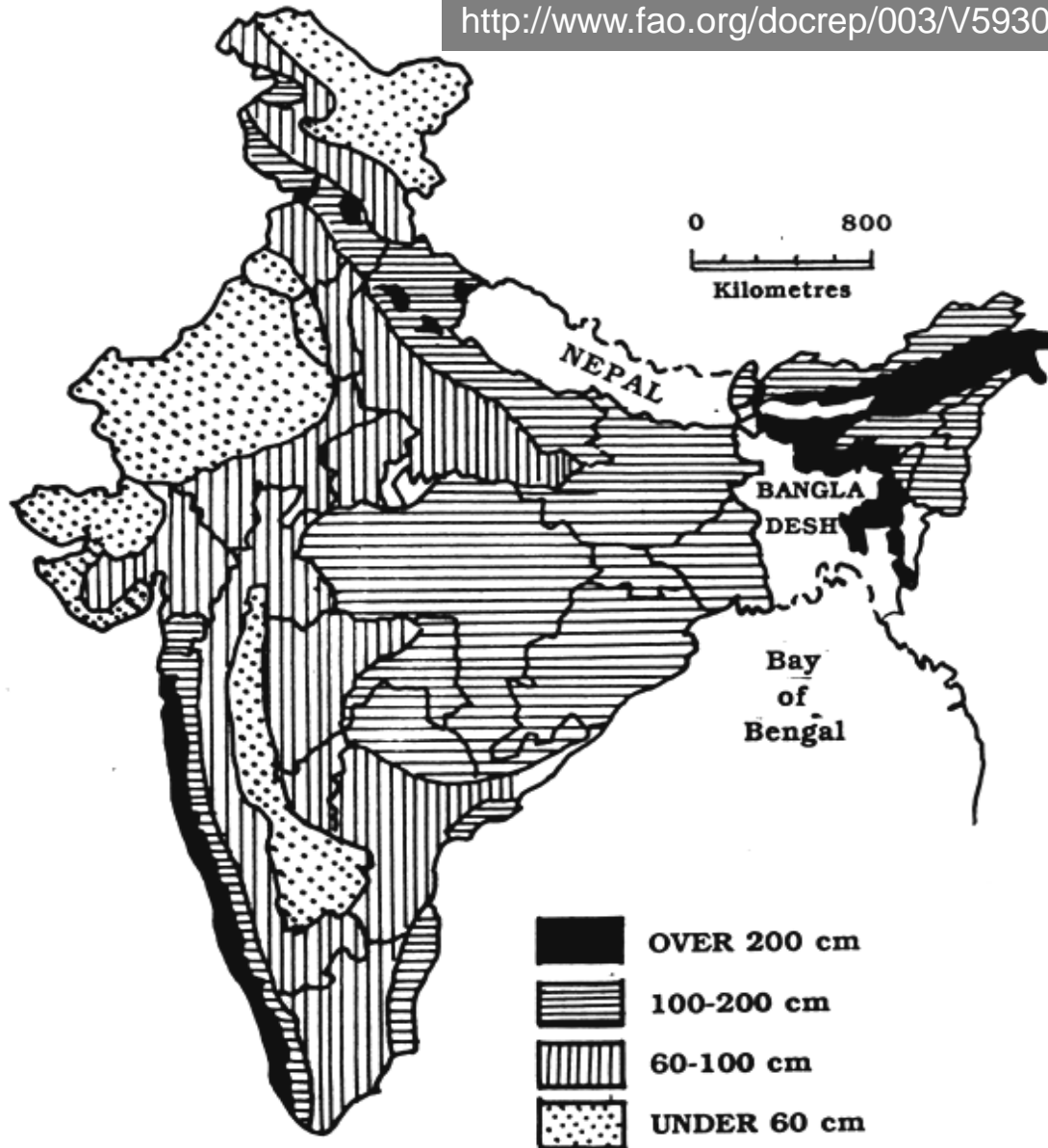


Policymakers are aware of the challenge

- Propose to offer new schemes and incentives to promote aggregation of small farmers in 12th Five Year Plan, starting this year.

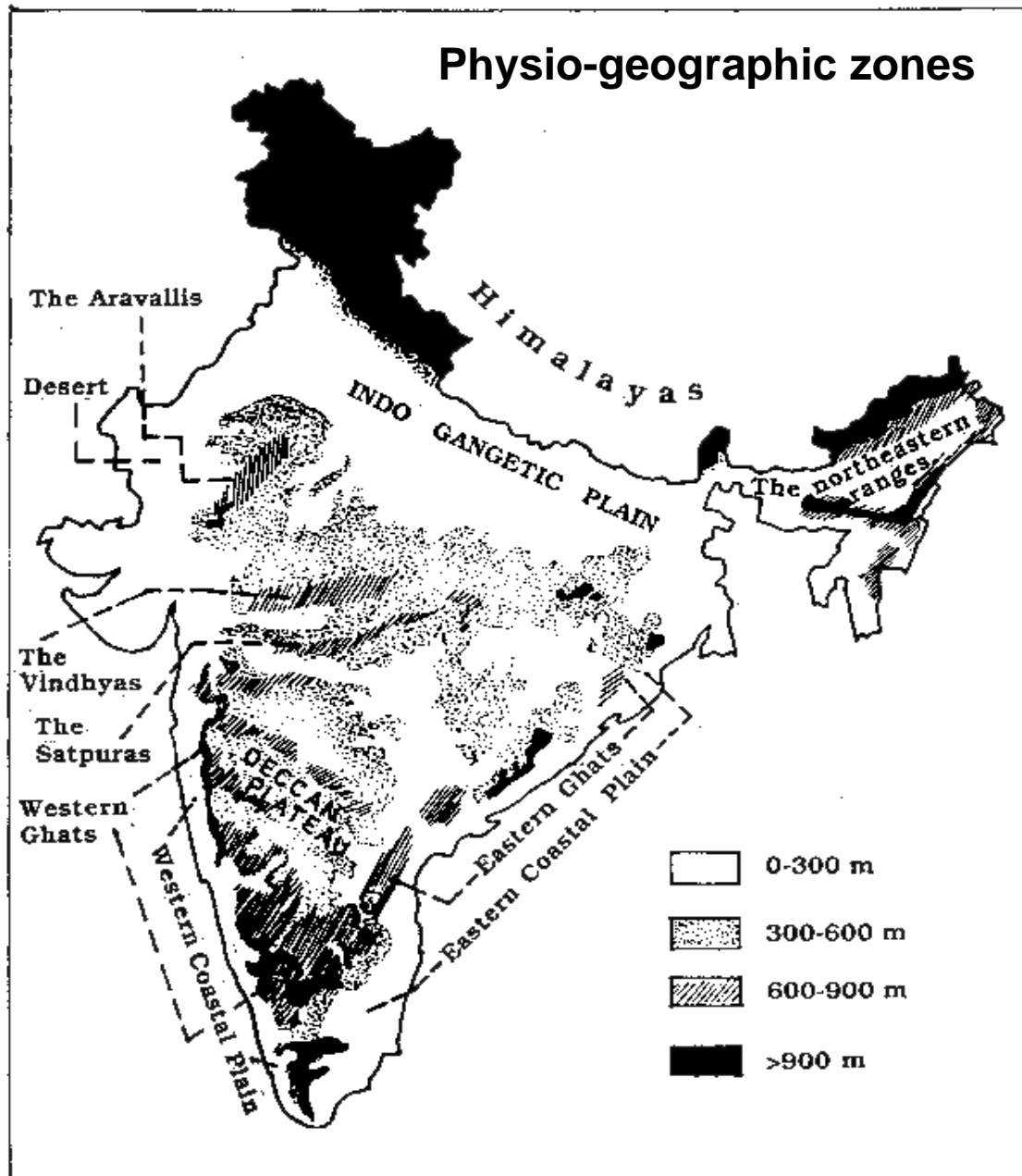
Indian agriculture issues: more than half is rainfed

<http://www.fao.org/docrep/003/V5930E/V5930E01.htm>



- Technologies offered to farmers are the same as those meant for irrigated agriculture – not suitable.
- Generous rainwater resources of eastern states not harnessed.
 - 'BGREI' – the answer?

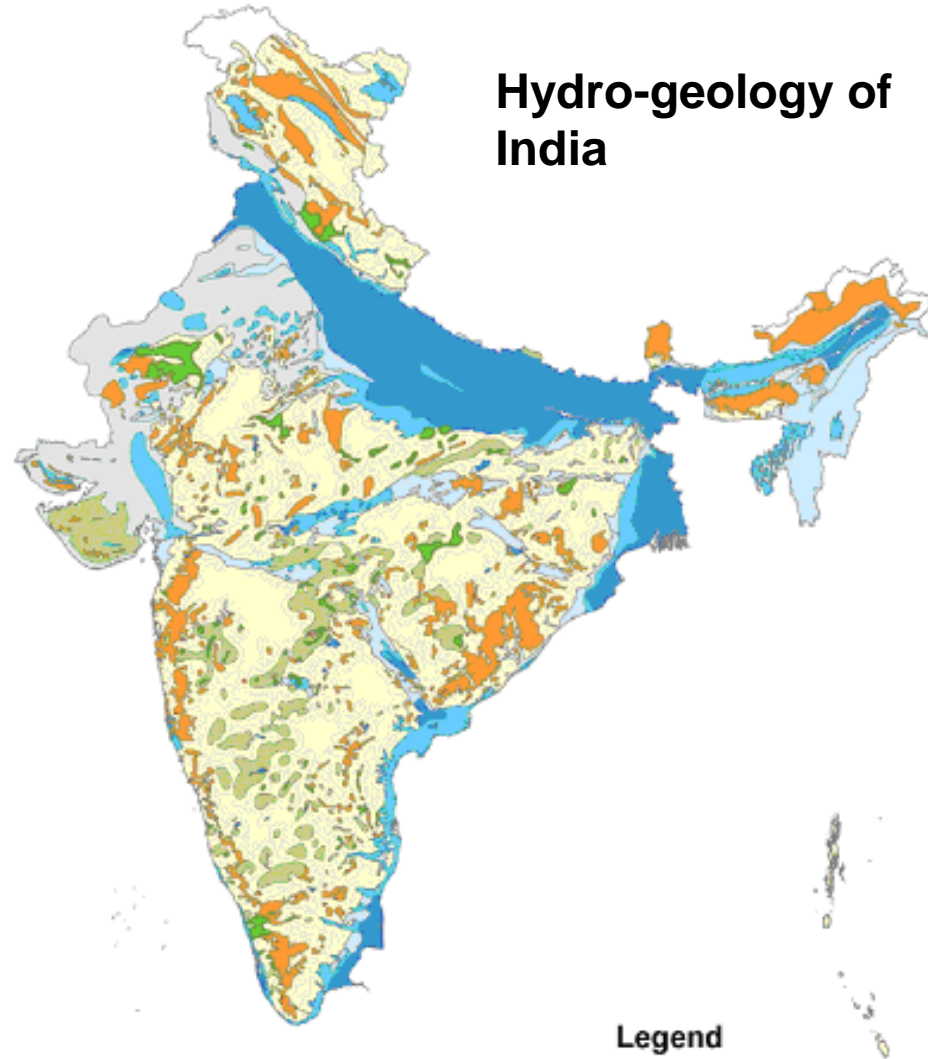
Indian agriculture issues: half the area is plateau



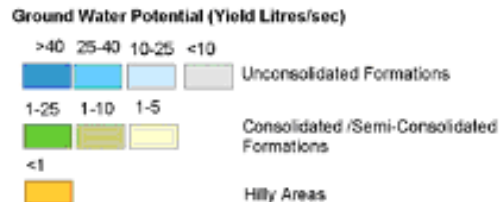
- Rolling topography makes monsoons hard to harness
- Land-leveling is costly
- Top soils get eroded from upper levels – become less fertile/ unfit for farming
- Farmers lack knowledge of suitable technology.

Indian agriculture issues: groundwater badly used

Hydro-geology of India



Legend



- In states like Punjab, Haryana, Gujarat, etc.
 - Low groundwater recharge, excessive withdrawal
 - Plus: electricity provided free.
- In states like West Bengal
 - Rainfall >1200 mm, hence adequate recharge, yet
 - Official permission to draw groundwater is hard to get, and
 - Electricity is neither easily available, nor free.

Regional unbalance needs to be corrected.

The years roll by... a career with plants

1968: University of Saskatchewan

1972: Completed Ph.D.

1973: Into the world of flowers (and vegetables):

Joined Suttons, India's oldest seed company

1994: Sandoz Seeds India

1998-2004 Novartis / Syngenta

From 2004: **Syngenta Foundation**



Can smallholders also make money?

Syngenta Foundation – in search of answers:

Objectives

- To find sustainable ways of raising farm productivity, and
- Improve farmers' access to market.

Still a challenge in rural India!

- Ideas needed to be tested
- First pilot with a partner in Anandwan:
 - Vegetable production with advanced agronomy, for cash income
 - Best practices were followed;
 - Big yields were obtained;
 - INR 100k (CHF 2k) net from ~1.25 ha.

Success opened up scope for further expansion.



Scale-up and water management

400k-litre tank built at the highest point of farm for delivering water by gravity



- Objective
 - To demonstrate that large-scale vegetable production can generate substantial income.
- Main features
 - a) Developing water resources for irrigation;
 - b) Selecting suitable plots around reservoir;
 - c) Applying scientific production techniques.
- Outcome
 - In three months, fresh vegetables started going to market – first time in local history!
 - Net income of INR 300k from <6 ha (= income from >24 ha of rice).
- Lessons learned
 - Irrigation's role in commercial veg growing;
 - Advanced agronomy enhances productivity;
 - Profitable marketing requires special skills.

The first four extension projects



Chandrapur
Demonstrating ridge method of soybean cultivation



Kalahandi
Baisakhu Patel sells his own produce in village market



Bankura
Potato crop grown using quality seed & modern agronomy



Jawhar
Building low -cost check dam

Syngenta Foundation: basic approaches



Knowledge transfer by training



Hands-on demonstration – of nursery raising



Low-cost rainwater harvesting



Facilitating marketing by producers' groups

Eight years of Foundation in India: What do we know?

- Technology can increase smallholder productivity:
 - Transfer of knowledge;
 - Farmers need access to inputs.
- Even very small farmers can earn cash with vegetables:
 - Irrigation is crucial;
 - Credit is required;
 - Special commercial skills are necessary.
- Marketing is a task for teamwork, not individuals:
 - Formation of farmer groups is essential;
 - Direct links between groups and bulk buyers can benefit both.
- Foundation needs to “snowball” what works well
- Foundation can also help policymakers achieve food security.

Finally, a word about projections

Table 1. Grain production, consumption, and net trade in the 'Big Four' countries, 1950 and 1990 with projections to 2030.

Country	Year	Grain production	Grain consumption	Net trade
			Million tonnes	
United States	1950	133	121	+12
	1990	290	214	+76
	2030	377	295	+82
China	1950	109	109	0
	1990	329	325	-6
	2030	263	479	-216
India	1950	57	55	+2
	1990	158	158	0
	2030	222	267	-45
Former Soviet Union	1950	79	80	-1
	1990	182	219	-37
	2030	237	262	-25

(Source: Data from U.S. Department of Agriculture, cited by Brown and Kene, 1994).

.... And the reality

- Record foodgrain production of 241 mt in 2010-11 (+12 %)
- But:
 - PM Singh stresses need for second Green Revolution



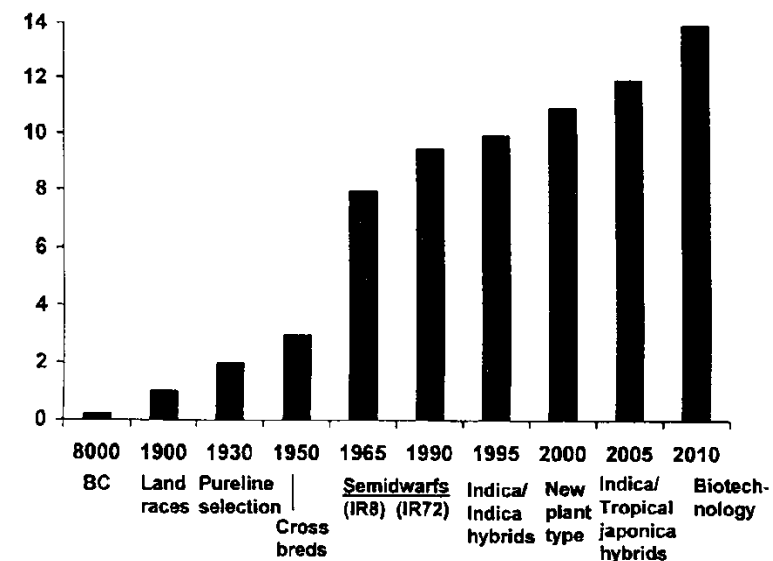
- Total demand for foodgrains is projected to be 281 mt by 2020-21.
- "Meeting this demand will necessitate a growth rate of nearly 2 per cent per annum".

Can India do it?

Technology offers great hope

- Existing technologies are yet to be fully exploited
 - Wide gaps between yields in research and farmers' fields;
 - Technology transfer has to be stronger & more effective;
 - Large-scale adoption is necessary.

Potential yield (t/ha)



- Yuan Longping's new super rice

- DH 2525 has yielded 13.5 t/ha in farmer's field!



Science is capable of finding solutions

A look back: salute to my parents*



* With only a quarter of my extended family.