The Private Sector in Agricultural Input Markets: Do Smallholders Benefit?

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Based on joint work with
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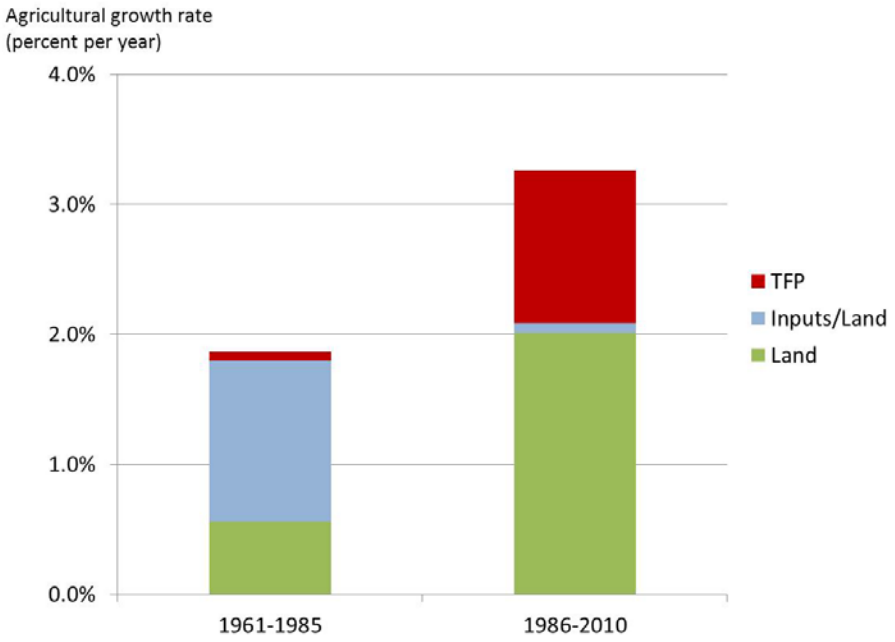
Low use of agricultural inputs constrains output

- To get higher rates of agricultural output growth, need more input use (intensification) and/or better input quality (more from less/TFP)



Evolution of Agricultural Input Markets

- Historically dominated by public sector firms
- Public sector success (a la Green Revolution) was not sustainable or replicable
  - Depended on heavy state intervention
    - Led to fiscal burden, governance challenges,
- Structural adjustment programs led to
  - Opening of input markets to private firms
  - Withdrawal of public sector from certain activities (marketing and distribution, breeding)

Evaluating the Private Sector in Input Markets

- Benefits
  - Private sector allocates resources more efficiently
    - Decentralized nature of markets ensure inputs
  - Private sector has access to better technology
  - Frees up public sector to focus on the provision of public goods (could still be agricultural inputs)
- Critics argue
  - Private firms will only cater to large commercial farmers, ignoring needs of smallholders
  - Need to appropriate returns implies that traditional practices such as seed saving will be threatened
  - Privatization will result in consolidation / concentration.

What is the Evidence?

- Look at changes in
  - Input supply
  - Input use
  - R&D expenditure
  - Innovation and new technologies
  - Productivity
- Presenting evidence from India (and some from SSA)—but with implications for SSA

India:
Growth of Input Industry

Ag-Inputs	1971	1981	1991	2001	2011
Quality seeds distribution ('000 tons)	52	450	575	918	2773
Consumption of fertilizers (N+P+K) (Million MT)	2	5.3	12	18	28.3
Consumption of pesticides ('000 tons)	25.8	47	72.1	43.6	55.5
Sale of tractors (Million Units)	0.52	0.75	1.4	2.5	5.5

Source: Pray and Nagarajan (2014)

India:
Evolution of Market Shares

	1985			2009		
Industry	Public sector	Indian private firms	MNCs	Public sector	Indian private firms	MNCs
Seed	35% (1991)	65% (1991)	small	20%	54%	26%
Pesticides	8%	72%	20%	<1%	70%	30%
Tractors	16% (1991-2)	84% (1991-2)	Small	1%	89%	10%
Fertilizer production	60% (pub 47, Coop 13)	40%	0%	50%	50%	0%

Source: Pray and Nagarajan (2014)

India:
Growth in Agricultural R&D

			2008/2009‡		
	1984/1985†	1994/1995†	Total	Indian firms	MNCs
Industry	*Millions of 2005 US$*				
Seed	1.3	4.9	88.6	49.3	39.3
Pesticides	9.0	17.0	35.7	24.4	11.3
Fertilizers	6.8	6.7	7.9	7.9	0.0
Agricultural machinery	3.7	6.5	40.5	20.5	20.0
a. Private input industry R&D	20.8	35.1	174.0	100.4	70.6
b. Public-sector R&D	206.0	348.0	538.9	-	-

Source: Pray and Nagarajan (2014)

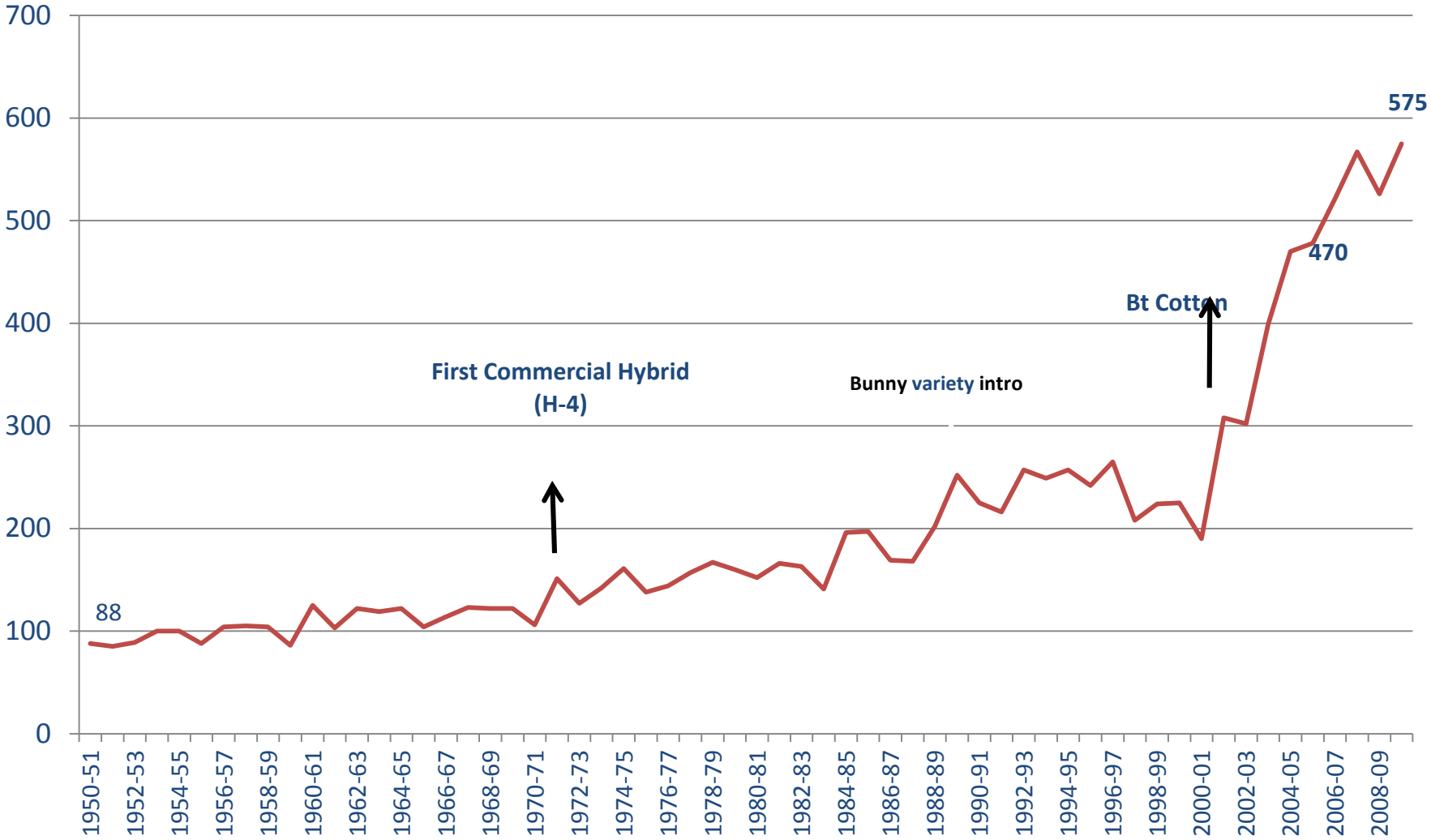
India:
Innovations in Agricultural Inputs

- Several ways to measure innovations in agricultural inputs
  - New seed variety registrations
  - PBRs
  - Patents
  - New chemical
- Pray and Nagarajan (2012) show increase in these indicators corresponds to private firm entry.

Determinants of Ag R&D Growth

- RD=f(Market and Firm Size, Appropriability, Technological Opportunity, Industry Structure)
- Results
  - Firm size, appropriability, technological opportunity (public sector research, biotech) and increased competition all increase RD

India Cotton Yields (1950-2010)



India:
Productivity Impacts – Cotton I

- Using market research surveys (Francis Kanoi) of 20,000+ of mostly smallholder farmers, find that average yields of private hybrids have been consistently higher

Cultivar type	1998	2000	2002	2004	2009
Bollgard I				1,880	1,510
Bollgard II					1,520
Private hybrids	720	830	1,070	1,360	1,520
Public hybrids	610	700	890	1,190	1,110
OPVs/local varieties	430	890	930	1,400	1,200

Source: Nagarajan, Pray and Naseem (2015)

India
Productivity Impacts – Cotton II

Specification

$$\textbf{Yield}_{(C,S)} = f\,(\text{Private/ Public Hybrids, Priv.Bt Dummy}_{(C,S)} + \text{Fertilizer use}_{(C,S)} + \text{Pesticide cost}_{(C,S)} + \text{Irrigation Cost}_{(C,S)} + \text{Location or regions Dummy}_{(C,S)} + \text{Time fixed effects})$$

$$\textbf{Pesticide cost}_{(S)} = f\,(\text{Private/ Public Hybrids, Priv.Bt Dummy}_{(C,S)} + \text{Fertilizer use}_{(C,S)} + \text{Yield}_{(C,S)} + \text{Irrigation Cost}_{(C,S)} + \text{Location or regions Dummy}_{(C,S)} + \text{Time fixed effects})$$

c= cultivar(hybrids or varieties or Bt), s=state

India
Productivity Impacts – Cotton II

- Results
  - The yields of hybrids are significantly higher than desi/public varieties over years
  - The yields of private hybrids (with & without Bt) are significantly higher than desi/public varieties
  - Yields of private Bt hybrids are higher than private hybrids without Bt
  - Fertilizer, irrigation, and pesticides also have significant and positive impact on yields of cotton
  - Private Bt hybrids have significantly lower pesticide costs per hectare is all specifications
  - Returns to private R&D calculated at 16% and social returns 38-41%

Other Studies

- Pray and Ramaswami (2001)

Crop & State	*PVT*	*HYV*	*Estimation Technique*
Sorghum, Andhra Pradesh	.0027*	−.09	Random Effects
	(1.92)	(1.54)	
Sorghum, Karnataka	.0083**	.44**	Random Effects
	(2.34)	(2.99)	
Sorghum, Maharashtra	0.008	.23*	Fixed Effects
	(1.54)	(1.88)	
Pearl Millet, Andhra Pradesh	0.0007	−.084	Fixed Effects
	(.27)	(1.1)	
Pearl Millet, Karnataka	−.0002	.39**	Random Effects
	(.11)	(3.2)	
Pearl Millet, Maharashtra	.01*	.02	Fixed Effects
	(1.91)	(.32)	
Maize, Andhra Pradesh	.023**	−.11	Fixed Effects
	(2.27)	(.7)	
Maize, Karnataka	.005	.77*	Random Effects
	(.48)	(1.7)	
Maize, Maharashtra	.04**	.13	Fixed Effects
	(3.33)	(.96)	

t-values in parentheses. *Denotes estimates significant at the 10% level and **denotes estimates significant at the 5% level.

The Situation in SSA

Private R&D Expenditures SSA, South Asia

Measures	Kenya	Senegal	South Africa	Tanzania	Zambia	Bangla Desh	India
Private R&D (In 2008 Mill.US$)	1.6 -3.2	3.6-4.7	41.0 – 50	0.9 -1.8	1.3-2.5	10-20	251.0
Private R&D as % of Ag GDP	0.25-0.05	0.18-0.24	0.49-0.60	0.015-0.03	0.05-0.09	0.07-0.13	0.12
# of Scientists	12	61	201	32	25	119	2190

Seed industry about 40% of R&D

Processing industry 30% of R&D

Sources of innovation from Private Sector:1/3 own R&D, 10% public R&D, ½ imported

Activities	**# of organizations reporting innovations**	**Source of innovations** (number of organizations with each source; organizations may have >1 one source)			
		Developed in-country		**Imported from**	
		Own R&D	**Other R&D***	**Parent firm**	**Other source**
A. Inputs supply					
Seeds	31	12	4	12	10
Fertilizers	4	2	1		1
Pesticides	12	3		6	5
Ag Machinery	7	3	3	3	1
Livestock, fisheries inputs	9	4		3	4
B. Large scale production					
Crops Livestock Fisheries	6	2	2	3	2
C. Processing					
Crops	5	3			2
Livestock	3	2	1		
Fisheries	3	3		1	
Totals	**80**	**34**	**11**	**28**	**25**

Number of Cultivars Registered

Crops	Kenya		Senegal		South Africa*		Tanzania		Zambia	
	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public
Maize	67	70	2	8	482	16	37	10	105	8
All others	4	76	6	23	528	76	7	44		
Total#	71	146	8	31	1010	92	44	54	155	39

Productivity Impacts

- From Kathage et al (2012)
- Put table in here

- Next couple of slides from carl. Need to say something similar

Could African agribusiness research accelerate like India since the mid 1990s?

Indian Agribusiness R&D Expenditure

Industry	**1984-85**	**1994-95**	**2008-09**
	Millions of 2005 US$		
Seed and Biotechnology	1.3	4.9	88.6
Pesticides	9	17	35.7
Fertilizers[#]	6.8	6.7	7.9
Agricultural Machinery	3.7	6.5	40.5
Biofertilizers & Biopesticides	na	na	1.3
Poultry and feeds	na	3.5	7.8
Animal Health	0.9	2.7	18.6
Sugar	0.9	2.5	10.8
Biofuels	0	0	13.1
Food, Beverages & Plantations	1.3	10.3	27.0
Total	**23.9**	**54.1**	**251.3**

It is possible that growth will accelerate

- Currently Agribusiness in 5 African countries spend as much as $62 million: > the $54 million India spent in mid 1990s
- Market for new technology is growing:
  - Harmonization and regional integration has helped to open up bigger markets but they still are limited relative to India's
  - A few African firms are globally competitive – SABMiller in beer, SAPPI and Mondi in paper & forestry, South African citrus – but are not exporters like Mahindra and Mahindra in tractors and UPL in pesticides
  - Regional and national companies are competitive – Tropicasem, Seedco, Pannar, Illovo.
  - Some investments by science based MNCs (which account for 40% of India private R&D) – Pioneer and Monsanto.
  - Investments by MNCs land-based or generic technologies from South– Indians investing in sugar mills & tea plantations; Brazilians in biofuel, Indians & Chinese in generic pesticides and machinery
- Appropriability (IPRs) getting stronger but still weak outside South Africa

Policy options – Some more general policies – some Science and Technology Policy

- Further reductions of trade barriers to technology introduction and trade leads to larger markets and more incentive to invest in innovation and research
- Development of universities, public research, and training of scientists is essential
- Privatization along with anti-trust increases competition, technology transfer and eventually technology development
- Public private partnerships can stimulate the development of appropriate research and technology development
- Gradual strengthening of IPRs when agriculture and agribusiness have started to grow is important