Technological trajectories and innovation systems in biotechnology

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Objective

An account of the technological change in biotechnology

What historical, political, economic and epistemic factors shaped the development of agbiotech in recent times (c. 1950 – present)
Biotechnology

• “Any technological application that uses biological systems, living organisms, or derivates thereof, to make or modify products or processes for specific purposes.” (1992 Rio Convention on Biological Diversity or CBD)

• The two phases of modern ag-biotechnology:
  • Green Revolution
  • Genetic Revolution

• Conceptualised as a package of artifacts, practices, and know-how to produce food crops.
Theories, frameworks...

• Technological trajectories: Technological change and development following a particular path ....

• Innovation system: Focus on systemic interdependencies between various agents of technological innovation

• Contextualism: Emphasis on social, political, economic, and epistemic factors in shaping technological change

• Contra: internalism, externalism, syntheticism, technology push, market pull and so on
Theories, frameworks...

- Contextualism: Enjoins contingent and emergent nature of technology development...
- Contextualist Spectrum: A Continuum of micro to macro socio-historical narrative
- We use the contextualist frameworks of modernization and globalization

What global-local political, economic, historical, epistemic and environmental factors influenced the shaping of the Green Revolution, and how a different set of such factors are now shaping the Gene Revolution
Modernization

- European Enlightenment
- Imperialism
- Colonialism
- Decolonization
- Europe had a Marshall Plan, but nothing of the sort for the Third World
- Social science (development and area studies) – instrumental rationality – knowledge/power nexus
- Traditional/underdeveloped society to modern
- Development as modernization
- Rostow’s take off (MIT’s CIS)
Food security and Cold War geo-politics

• Population ‘explosion’, declining agricultural productivity, hunger and near-famine situation in countries like India, Indonesia, Mexico, Philippines, etc.
• Fear of political insurrection, instability as potential strategic risk to the interests of the United States
• Food security became national security
• Avert famine and hunger to stop the Red Revolution
• Lost China but must not lose India
• Geo-strategic thinkers and academic intellectual in the US used the above arguments to justify agriculture modernization in the Third World
What is the Green Revolution?

- Green Revolution: Development as modernization mediated by Cold War geo-politics
- Significant rise in agricultural cereal (mostly wheat and rice) productivity experienced by some Third World countries, mostly in Asia and Latin America, roughly during the period, 1960s to 1980s.
- The term was attributed to William Gaud (Administrator of USAID) in March 1968.
- Considered one of the most ‘successful’ technology transfer programmes in history (dreadful legacies notwithstanding)
Green Revolution

- Changes in agriculture technology and modes of practice
- G.R. = HYVs + nitrogen + water + mechanical power
- From ‘traditional’ to ‘modern’
- Traditional seeds -- Hybrid high-yielding varieties (HYVs) of seeds
- Rain-fed water -- Irrigation and water management
- Manure or self-fertilized -- Chemical fertilizers and pesticides
- Human and animal power -- Forms of mechanized power
Green Revolution

• The Green Revolution story begins with the invention of a ‘miracle’ dwarf wheat variety in Mexico by Norman Borlaug in 1954 at what is now known as the International Maize and Wheat Improvement Center (CIMMYT).

• CIMMYT was established by the Rockefeller Foundation on land provided by the Mexican Government.

• Borlaug received the Nobel Prize for Peace in 1971.
Protagonists:

- International Donor Agencies
- International Agriculture Research Institutions
- Third World Governments
- Third World farmers and peasants
Green revolution trajectory & innovation system

- Selection environment (development & diffusion)
- Public capital
- Public knowledge
- Intellectual property rights not an issue
- Innovation system: state-led, not market driven, industry & university played subsidiary roles
Gene Revolution

- Some landmark events
  - Mendel’s theory of the inheritance of traits
  - DNA as the physical carrier of genetic information
  - Discovery of the structure of DNA molecule
  - Re-combinant DNA technique (Genetic Engineering)
  - Patenting life (Diamond versus Chakrabarthy)
  - University-Industry interaction
  - Privitization of science (enclosure of knowledge commons)
  - TRIPS
Gene Revolution

- Technological trajectory & innovation system
- Best explained by globalization framework
- Rise of the so-called knowledge-based economy
- Information capitalism
Key features of knowledge or informational capitalism

- Informational capitalism is not a continuation of industrial capitalism by other means
- Innovativeness as an anticipative economic behaviour & routinization and commodification of knowledge
- Intensification of intellectual property rights regime and consequent non-optimal allocation of resources (rent-seeking and monopolistic behaviour).
Consequences of the rupture

- Unravelling of much of the social contract of industrial capitalism (c. 1870 – c. 1970s)
- Informational capitalism portends the end of social democracy, welfare state and social labour
- The rupture is characterized by:
  - Rise of a new international division of labour
  - Valorisation of new technologies, specialization of scientific knowledge and the intermediation of expertise
  - Extreme income and wealth inequality
  - Globalization of R&D, production, etc. etc.
Innovation System

- Private capital, private gain and profits
- Withdrawal of the state from R&D
- New intellectual property rights regime in biotech
- State-Industry-University
- Globalisation and the rise of MNCs in the ag-biotech industry
- Future of bio tech: “Golden Rice”
Globalization and bio-tech

• Resistance to globalisation and its impact on bio-tech (GM food, Golden Rice etc)
• Role of civil society
• European resistance and the shaping of biotechnology
• Most developing countries lack clear regulatory regime on GMOs. Depend for guidance on an outdated Codex created by the FAO in 1962 (food safety and plant and animal safety)
Conclusion

• The state, public sector agencies and international donor institutions had a decisive role in shaping the Green Revolution.

• Politics of hunger, insurrection, communist threat and so on as catalyst for technology development & transfer.

• Private sector (MNCs), global finance, trade and IPR regime and so on and global risk concerns are going to be the decisive factors in shaping the emerging genetic and molecular-based ag-biotech and its transfer and diffusion.

• What about such concerns as food security, health, nutrition, and biodiversity issues?
THANK YOU!