Some sustainability issues surrounding biotechnology innovation in emerging economies: the case of biotechnology in Kenya

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Ann Kingiri
AfricaLics/African Centre for Technology Studies (ACTS)
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Knowledge for Better Livelihoods

Outline

1. Introduction
2. Some lessons from Kenya's Biotechnology innovation system
3. Conclusion & recommendations

Introduction

- Ensuring sustainable development is one of the main challenges of today and the future.
- Technological change usually portrayed as a threat to sustainable development because it creates risk and uncertainty which challenge sustainable social planning.
    - There are assumptions and very deep beliefs that nature conservation is better than technical innovation.
- Overall, research is lacking that exposes how economic growth can be reconciled with social and environmental sustainability through technological innovation.

Introduction

- Biotechnology is an enabling technology, and hence has potential to offer new perspectives for sustainable development.
- Modern tools of biotechnology can contribute to economic, social and environmental areas in different ways.
  - Economic pillar: Biotechnology is a vibrant industry in many respects
  - Social progress pillar: e.g. Biotechnology research and industry may be linked to high-productivity jobs; milestones in the health and industrial sectors.
  - Environmental pillar: Adopting processes that have evolved in nature (bio-processes), results in lower economic and environmental costs, the use of cleaner and more efficient production processes and cheaper and more environmentally friendly products for consumers.
- Biotech could play an important role in climate change mitigation (e.g. nutrient-efficient plants) and adaptation (e.g. drought-tolerant plants), renewable energies, biodegradable products, agro-biodiversity conversation, rural development and global food security.
- Synergies between nanotechnologies, biotechnology and information technology (ICT) will provide further multiplying effects on technological innovation, well being and sustainable development.
  - Biotech is one of the technologies poised to contribute to 4IR (particularly new emerging applications like gene drives, synthetic biology etc)

Introduction

However, potential for Biotech to offer sustainable solutions is confounded by challenges:

- Some view biotech applications as potentially risky for a sustainable future on this planet
  - Why? the practices and technologies we use today might not be able to cope with the sustainability challenge we will face in the near future.
- Biotechnology is often perceived to be more of a threat than an opportunity.
  - E.g. Perception that some of its products are inherently risky and damaging to human health and the environment.
- Biotech innovation for sustainable development highly regulated – Conventions & biosafety regulatory measures have been put in place at international and national levels to guide in biological conservation & biosafety risk assessment (CBD, Cartagena Protocol etc)

Kenyan Biotech innovation system – context

- There is an increasing recognition of the potential role of biotechnology innovation to revolutionize sustainable economic growth in developing countries
  - E.g. Bt Cotton in Burkina Faso – perceived to have demonstrated economic, social and environmental benefits (Vitale Jeffrey, Ouattarra Marc and Vognan Gaspard, 2011).
- Kenya stands among the few African countries to embrace modern biotechnology to enhance the productivity of its agriculture.
- Despite all the collaborative efforts to enhance technical and bio-policy capacities to harness this innovation since 1990's, no biotechnology product has been commercialized.
- The modern biotechnology context in Kenya - technology development (experimentation, R&D, field trials) and institution of a governance ecosystem (includes policies for biosafety assessment & public engagement).
  - This context enables a meaningful analysis of development and diffusion terrain of a knowledge intensive technology and the embedded dynamism linked to biotechnology knowledge management and diffusion more generally (Kingiri and Ayele 2012).
- Our research attempted to explain the embedded dynamism linked to biotechnology knowledge management and diffusion more generally;
  - Focus was the role of the scientific community in the biotechnology innovation process.

Analytical framework

- Innovation systems framework
  - Institutions, actors & interactions/linkages
    - How learning occurs & knowledge produced thereof impacts innovation
    - Focused on technological & policy innovations
- Technology innovation system (TIS) framework
  - The analysis focused on a technological knowledge field (biotechnology research, development and transfer) which also defines the boundaries of this system.
- Limitations/Drawbacks
    - Learning linked to policy innovations (e.g. biosafety regulations bounded up in the broader technological innovations)
    - Role of individual social actors (e.g. scientists) somehow underplayed
    - Used advocacy coalitions framework to complement the innovation systems oriented analysis (this is not articulated in this presentation)

The functional systems of Biotech innovation (analysis)

Function 1: Entrepreneurial activities

-Entails "technology development and testing/trials stage – commercialization stage" continuum.

-Key triggers for this function include available capital/funding for biotech projects piloting at different scales,

-Role of industry actors (e.g. Monsanto)

-Evidence of entrant of firms and testing of multiple traits, some fail and exit while others get established.

Functions 2 & 3: Knowledge development & diffusion

-R&D knowledge = mainly for testing & products development

-Commercialization and post-C phases = mainly lead to market innovation & includes business models

-Traits are selected and products undergo continuous adaptation in response to specific contexts and new information/evidence

-learning & capabilities development at multiple scales

Function: Guidance of search

-Ability of lead organization/s to act as boundary spanners

-Biotech organisations have played a critical role (and anti-biotech grps too)

-The Kenyan government/regulators – NBA excellent support in creation of a regulatory infrastructure

-Extent of regulatory pressure. A PPP approach to formulation of biosafety regulations (Kingiri 2014).

-Sustained beliefs in Biotech growth potential (which has been the case with scientists and policy makers).

-Articulation of demand or interest by scientists & policy makers. This can be attributed to the increased capabilities and learning built around Biotech TIS.

Function 5: Market formation

-Biotech TIS is at nursing and bridging phases and is yet to attain maturity (commercialization of biotechnology products).

-Milestones relate to pro-biotech development policies (GoK 2006, 2008, 2009) and the intense capabilities building and learning (for instance actors' strategies in negotiating policies, forging partnerships, advocacy) as a growing trend in this TIS (Kingiri 2014).

Function 6: Resource mobilization

-process of Biotech development & diffusion has been characterized by formation of advocacy coalitions aggregated around belief systems

-The unique nature of Kenya's biotech TIS relates to how resources have been mobilized around the two conflicting coalitions (pro-biotechnology coalition and anti-biotech coalition) to counter each other's efforts (Kingiri 2014).

-Scientists and industry control scientific resources, play a key role in provision of technical and scientific information.

-Actors in biotech TIS command substantive amounts of resources directed towards policy, technical and biosafety research, as well as advocacy

Function 7: Creation of legitimacy

The Biotech legitimization process has involved a wide range of stakeholder.

-The biotech industry, the government before Biosafety Act (GoK 2009) and after, following formation of NBA have played a critical roles in legitimization of biotech TIS.

-Continued frantic and relentless attempts by NBA to legitimize biotechnology development and diffusion despite opposition (Andae 2016c; Kakah 2015ab).

Role of scientific community in biotechnology innovation and related sustainability debate

- Heterogeneous community of scientists engage in various ways
  - social scientists, ecologists and molecular biologists in their joint objective to combine the potential of new technologies with existing sustainable practices.

- Multiple & conflicting roles of scientific community
  - Knowledge drivers as experts (biosafety, conservation proponents, molecular biologists)
  - Policy actors in formulation and enfrocement of biosafety and biodiversity policies including risk assessment

➢ The debate requires interdisciplinary and progressive approach in research.

➢ It also calls for public-private partnerships in both the fields of biotechnology and sustainable development.

Sustainability issues for scientists as contemporary actors…

- Biotech innovation and emerging new applications & related biosafety (risk assessment) are technical in nature thus may be implied that they engage scientific community who understand *(there is potential to exclude non-scientific communities of practice)*
- Biodiversity & Biosafety have got social & value laden components (e.g. different interpretations of risk)
- Political economy of biodiversity & biotech: includes social accountability and legitimacy of regulatory and biosafety processes

Sustainability issues for contemporary actors like scientists cont'd..

- Increased challenges associated with globalisation- around social, economic and environmental issues including informed society demanding increased accountability & transparency
- Dwindling research funds, implying inadequate capacity for biotech research resulting in increased collaborative research (public and private partnerships – which has implications for emerging economies like Kenya)
  - Biotech research and sustainability science have become trans-disciplinary in nature with increased integration & cooperation (engaged scholarship)
- For policy scientists, inadequate capacity for putting in place sustainable regulatory systems (this attracts collaborative & donor support – with implications)
- Regulatory pressure and demands (risk assessments, management and communication) that constitute complex forms of knowledge

Issues for contemporary scientists cont'd…..

- The new institutional and knowledge production terrain has affected the role & practice of contemporary actors (scientists and mode 2 research)
- In addition, biodiversity & biosafety regulation as a means to manage controversies and embedded uncertainties is also linked to certain complex & politically driven forms of knowledge (regulatory, policy, institutional etc); scientists inevitably get entangled in this

……politicised regulatory process & tension

- Articulation of multiple roles confounded by conflicting obligations, values and interests (individual and institutional levels)
- Proliferation of coalitions and collaborations of knowledge groups (eg professional, disciplinary, academic, NGOs) to achieve different interests
  - Within these coalitions, interests and beliefs' driven knowledge is produced & used (politically charged policy coalitions-Sabatier, 2007)
- Communicating science to public
  - Fear of misinterpretation thro media & public hype
  - Bias reporting (benefits versus risks)
- Compliance with regulation
  - Attitude of scientists towards cumbersome regulations & regulators
  - Regulations not users' friendly
- Undemocratic expertise informing biodiversity, sustainablity debates as as well as regulatory policy (lacking public input)
  - Skewed towards scientific expertise

Conclusion

Challenges

- Overall, biotechnology deployment and its potential as a tool for sustainability is hampered by complex social & institutional challenges
- Innovation process driven by diverse types of knowledge & expertise (scientific & non scientific)
- Immediate setback relates to the management of diverse forms of knowledge emanating from a collborative, trans-disciplinary and multi-actor setting

Recommendations

- Governace approach to biotech development and sustainability debates calls for learning and rethinking of actors roles in innovation policies - where social robustness, legitimacy, innovative goals etc may be desired.
- Success of new biotech applications depends on adequate organizational and institutional support that encourages public and private actors to collaborate in efforts to address sustainability problems and to tailor the technology to local needs.
- The debate will require a more advanced and collaborative view of science that take into cognizance sustainable development and combine the potential of new technologies with existing sustainable practices.
- There is need for adaptation (reflexivity) of actors including scientists to deal with the dynamic & challenging institutional terrain associated with biotech innovation and sustainability