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The Role of Policy Brokers: The Case of Biotechnology in Kenya

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Abstract

Debates about biotechnology continue to be polarized despite its potential to improve the living standards of the poor in Sub-Saharan Africa. In the backdrop of this polarized scenario, this paper asked, is there a place for brokers in bringing about a productive debate that is pro-development? The paper argued that if potential intermediaries are analyzed from the perspective of understanding their role and stakeholding in the regulatory change process, this may help breakout the current polarized anti- and pro-biotechnology debates and thereby focus on how to enable productive biotechnology development. Informed by insights from innovation brokering, the functions of brokers in biotechnology regulation are analyzed through the lens of organizations involved in agricultural biotechnology debates in Kenya. The analysis found that policy brokering function attracts varying opportunities and challenges appropriate for informing relevant policy. The paper drew lessons from Kenya's experience to inform a productive policy brokering model for biotechnology regulation.

KEY WORDS: agricultural biotechnology, policy broker, regulatory policy process, Kenya, Africa, agricultural policy

Introduction

The purpose of this paper is to highlight specific activities of brokers in the biotechnology[1] regulatory process and to report on and critically examine their emergence in relation to what this might mean for a renewed pro-development debate spurred through intermediation.

Against the background of the biotechnology sector becoming more integrated and societal-driven (Gibbons et al., 1994), the role of intermediaries may be gaining importance to assist the multiple players in coping with challenges associated with biotechnology development. These challenges relate to the integrated knowledge production infrastructure as well as governance challenges (Fukuda-Parr, 2006; Tait, Chataway, Lyall, & Wield, 2006). The former is characterized by globalization effects including public–private partnership (PPP) arrangements under which biotechnology research and development is organized (Ayele, Chataway, & Wield, 2006; Fukuda-Parr, 2006). The latter is characterized by the growing global and domestic polarization in biotechnology debate linked to differing perspectives on risks and benefits toward biotechnology, thus influencing the emerging public policy debates (Aerni & Bernauer, 2006; Bernauer & Aerni, 2008; Fukuda-Parr, 2006). These challenges notwithstanding, it is now becoming apparent that agricultural biotechnology holds real promise for improving the food security of farmers and consumers in less developed nations including the poor in Sub-Saharan African (SSA) countries (Food & Agricultural Organization, 2004; Juma & Serageldin, 2007).

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Divergent views on whether biotechnological applications should be deployed to increase agricultural production in SSA have contributed to the slow development of requisite regulatory policies in the majority of these countries. As a result, use of agricultural biotechnology remains limited in SSA. Consequently, in the backdrop of the polarized debates linked to biotechnology regulation, on the one hand, and the need to embrace a biotechnology tool to combat food insecurity in SSA, on the other, this paper asks, what role could intermediary organizations play to enhance a productive debate and how might this be done? Arguably, intermediary organizations in biotechnology debates have been associated with unproductive and sometimes negative advocacy linked to nongovernmental organizations (NGOs) either opposing or promoting the technology (Aerni & Bernauer, 2006; Paarlberg, 2003). This notwithstanding, intermediaries have a role to play in spurring productive biotechnology innovation and regulatory policy (Karembu, Otunge, & Wafula, 2010; Shohet & Prevezer, 1996).

Recently, scholars have studied the role of organizations who act as intermediaries, connecting together different stakeholders involved in innovation and helping negotiate changes in working practices and policies (Howells, 2006; Klerkx, Hall, & Leeuwis, 2009a, 2009b; Klerkx & Leeuwis, 2008a, 2009; Winch & Courtney, 2007). Referring to these organizations as innovation brokers, Klerkx and colleagues (2009a, 2009b) described the way specialist forms of innovation brokers have emerged to, e.g., improve farmers' demand for new research or to negotiate for policy change. It is this last form of brokering for policy change that is the focus of this paper.

Taking the example of agricultural biotechnology in Kenya, this paper explores the different tasks that constitute policy brokerage using different types of organizations interested in biotechnology debates. The objective is to explore the opportunities that might exist for moving biotechnology debates to a higher level through regulatory policy intermediation, thereby enhancing biotechnology development for the benefit of the poor farmers and consumers in SSA. The discussion proceeds in several parts. First is an exploration of the brokering concept and how it might serve as a framework to analyze different brokering tasks in biotechnology regulation. This is followed by an overview of the context under which brokerage is expected to occur from both global and Kenya's perspectives. Next is an analysis of selected intermediary organizations based on their regulatory policy tasks in Kenya's biotechnology sector. The paper concludes with a discussion of the emerging dynamics in relation to Kenya's experience and how lessons drawn can inform a productive biotechnology debate through regulatory policy intermediation.

Brokering As an Analytical Framework: Insights from Innovation Systems

While the focus of this paper is regulatory policy brokering and related functions in biotechnology innovation, insights to build this framework are derived from innovation systems literature. In an attempt to unpack how different tasks are organized and articulated in practice, scholars interrogate the role of linkages and have noted the dynamic varying tasks performed by actors within an innovation system.[2] Howells (2006) referred to these actors as intermediaries and went on to define an intermediary as "an organization or body that acts an agent or broker in any aspect of the innovation process between two or more parties" (p. 720).

Through analysis of different sources of literature, Howells (2006) identified different functions performed by an intermediary in diffusion and technology transfer, innovation process management, and in systems and networks. He noted that intermediaries or brokers support innovation through "helping to provide information about potential collaborators, brokering a transaction between two or more parties, acting as a mediator between bodies or organizations that are already collaborating, and helping find advice, funding and support for the innovation outcomes of such collaborations" (p. 720). He, however, pointed out that an organization may perform an intermediary role as a subsidiary or secondary function, thus becoming a third party innovation agency.

From an innovation systems perspective, intermediaries are seen as brokers performing mediation, catalytic, or facilitation roles exhibited in the way knowledge is managed toward effective and harmonized operations of an innovation system (Klerkx & Leeuwis, 2008a, 2009; Klerkx et al., 2009a, 2009b; Winch & Courtney, 2007). With reference to agricultural systems in Netherlands, scholars have analyzed the different tasks performed by intermediaries. Klerkx, Aarts, and Leeuwis (2010) and Klerkx and colleagues (2009a, 2009b) described these tasks that include different elements of demand articulation, network brokerage, and innovation process management. Demand articulation is important during the emerging phase of a technology when the degree of uncertainty is high. Network brokerage helps to connect the suppliers and users of knowledge in order to address market and other failures associated with a respective innovation system. Innovation process management involves organizing and managing the network. With reference to biotechnology, Shohet and Prevezer (1996) used case studies in the United Kingdom to expose the role of intermediaries in relation to technology transfer. They suggested that intermediaries play an important role in stimulating flow of knowledge about markets while performing liaison functions for firms, acting as agents between institutions and providing access to complementary assets for the development of technologies internally.

Howells (2006, p. 719) made a distinction between intermediary organizations described in the preceding section and intermediation as a function process. The latter is composed of multiple tasks sometimes undertaken in phases in relation to innovation, for instance, information and technology transfer. In relation to information, this could be information scanning, gathering, and communication. In the case of technology transfer, an intermediary is perceived to have more knowledge about a technology and seeks to facilitate transfer between firms and organizations by establishing a linkage.

What brings about establishment of an intermediary organization or a broker depends on opportunities and needs within research and innovation sectors and is often contingent on the specific context (Van der Meulen, Nedeva, & Braun, 2005, cited in Klerkx & Leeuwis, 2009, pp. 851–852). However, brokering in dynamic innovations may bring about tensions. As summarized in Klerkx and colleagues (2009a, pp. 11–12), the intermediary role is confounded by practical challenges that may impact a productive intermediation process. These include tensions over legitimacy and neutrality of brokers, and questions about whether stakeholders or clients consider them to be honest in their deliberations, ambiguity of functions arising from different organizations articulating multiple and sometimes conflicting

and competing roles, and difficulties in evaluating the impact of brokerage function that may affect sustainability and withdrawal or lack of financial backing. These tensions may be likened to challenges associated with biotechnology innovation where varying interests spur emergence of brokers performing advocacy tasks that influence the attitude of stakeholders through strategic knowledge and information (Aerni & Bernauer, 2006; Herring, 2010; Paarlberg & Pray, 2007). These tensions should, however, provide practical lessons in relation to presence (or lack) of efficiency and effectiveness of a given intermediary. In this regard, practical evidence of the benefits of intermediation weighed against challenges needs to be made visible to actors in the knowledge infrastructure and to policy makers (Klerkx & Leeuwis, 2008b). This would consequently enhance setting up of viable innovation (or policy) intermediaries (Klerkx & Leeuwis, 2008a).

The brokering concept has been applied in analyzing different intermediary functions performed by assorted innovation firms in the United Kingdom (Howells, 2006), agricultural innovation systems in the Netherlands (see Klerk, Leeuwis et al. noted elsewhere), and agricultural innovation systems in Africa (Hall, 2010; Hall, Clark, & Frost, 2010). Apart from intermediation in relation to U.K. biotechnology research and development (Shohet & Prevezer, 1996), this concept has not been applied in policy processes associated with biotechnology regulation. In the science policy arena, Guston (1999) and Braun (1993) helped us understand the fundamental role of intermediaries as agencies in policy processes. Guston called these agencies boundary organizations.[3] Callon (1994) also made us see the role of intermediaries in causing relational change within science and public networks.

Brokering as an analytical framework would help us understand how intermediation in biotechnology regulatory policy dialogues occurs in a practical sense and the lessons that can be drawn to enhance productive biotechnology debates. In doing this, it attempts to illuminate the different functions different intermediary organizations play and how they can be supported in terms of policy and practice to facilitate effective dissemination of genetically modified (GM) technology. For the purpose of this paper, policy brokers are conceptualized as intermediary organizations that individually or as a group mediate between the demand side (e.g., farmers, government, civil society organizations) and supply side (research institutes, technology developers, policy makers, etc.) in the regulation of biotechnology knowledge infrastructure.

In the application of the framework, the discussion does not lose sight of the polarized debates that characterize biotechnology regulation. This calls for critical thought in the design of a brokerage model that takes cognizance of the benefits of intermediation toward causing a productive debate earlier.

Context for Brokering in Biotechnology Development and Regulation

Biotechnology in the Evolving Global Knowledge Economy

Factors that impact modern biotechnology development and deployment for economic usefulness stem from globalization reflected in the dynamic knowledge economy (Fukuda-Parr, 2006) and dynamic technological changes (Tait et al., 2006). The hitherto localized, discipline-based boundaries and operations under which

knowledge emerged have slowly been disorganized and replaced by increased collaborations (Gibbons et al., 1994). In relation to new biotechnologies, this integration is evident in form of public–private research not only in developed countries (Scott, 2005, pp. 12–16; Waterton, 2005) but also in developing countries (Ayele et al., 2006). Clearly, there has been a revolution with different disciplines integrating in a way that seems to portray biotechnology as a unique and different form of science and technology. One factor that has contributed to these institutional changes relates to the fact that the infrastructure and the large investments involved in biotechnology transfer are beyond the capacity of individual scientists and the public research institutes. Moreover, funding of public research by respective governments has been dwindling prompting scientists to seek collaborative ventures (Waterton, 2005). This notwithstanding, these inevitable collaborations have elicited conflicts, suspicion, and tension among proponents, opponents, and governments because biotechnology deployment is shaped by many interested actors at both national and international levels. These include multinational corporations that own the intellectual property, farmers, research scientists, policy makers, antiglobalization and environmental NGOs (Fukuda-Parr, 2006). All these actors are perceived to have diverse interests that sometimes work against development. This last part takes us to the challenges discussed next.

Polarization of Agricultural Biotechnology Debate

Major factors that have shaped biotechnology innovation relate to stakeholders' attitude toward the benefits and risks of genetic engineering (GE). This has taken a very political stance exhibiting polarization between those promoting GM technology and those opposing it by taking a "precautionary" stance. The first group is closely linked to the United States, while the second category is linked to Europe. This has culminated in what has become European Union (EU)–U.S. transatlantic debate associated with what is seen as a genetically modified organisms (GMOs) trade dispute (Bernauer & Aerni, 2008). This led to litigation in the World Trade Organization (WTO) by the United States and by major proponents of GMOs accusing EU of restricting GMOs trade through its stringent regulatory policy. The WTO verdict favored the proponents and urged the EU to align its GMOs policies with the WTO trade rules. What is important to note here is the inevitable negative (or positive) influence this dispute has on policies adopted by countries in SSA. There is now a wide body of literature looking at trade conflicts confounded by the EU–U.S. transatlantic regulatory policies leading to regulatory polarization (Bernauer, 2005; Bernauer & Aerni, 2008; Murphy, Levidow, & Carr, 2006; Paarlberg, 2001). One consequence attributed to this polarization is the slow application and spread of GM products in developing countries (Paarlberg, 2008).

From the biosafety front, application of modern biotechnology is poised to have varying environmental and food safety concerns and therefore attracts varying perceptions related to risk and uncertainties. To regulate environmental biosafety for instance, the Cartagena Protocol on Biosafety to the Convention on Biological Biodiversity establishes basic international principles to govern the transfer, handling, and use of GMOs, primarily for trade purpose. At the regional level, the African Model Law was pioneered by the African Union (AU) to harmonize African

states' approach to biotechnology regulation. Despite these instruments available as benchmark to SSA countries in formulating appropriate regulatory policies, the global biotechnology debate has influenced the trajectories being considered by these countries in trying to understand the controversies behind risks and benefits of GMOs. This is because they lack capacities to formulate homegrown policies, and most of them have received support (expertise and funds) from foreign countries including the EU and the United States for biopolicies development. This implies that they have been caught up in conflicting pressures from these trading blocks.

A different kind of politics has manifested in the case of Africa with respect to GM relief food versus food insecurity. The 2002 food crisis in Southern Africa rekindled debates over agricultural biotechnology. Some countries, having found themselves in the throes of food emergencies to feed many on the verge of starvation had issues with the food aid that was suspected to contain unspecified amounts of GM maize. Uncertainties around food and environmental safety, regulatory preparedness, among other challenges, meant that some countries were unwilling to accept the food aid (sourced mainly from the United States and South Africa), with some governments going on record to choose starvation rather than have their people consuming "poisonous food" (Omamo & von Grebmer, 2005; Panos Report, 2005, p. 30). The scenario created tension at various levels and regulatory measures had to be put in place to guide decision making, with some countries, e.g., Zimbabwe and Malawi, deciding to distribute only milled grain and Zambia refusing the grain outright. However, food aid has underlying politics where the United States has been accused of indirectly promoting GM products disguised as donation to the famine-stricken poor in Africa (Zerbe, 2004).

The polarized biotechnology debate is, however, more complex than can be explained by trade and biosafety imperatives alluded to earlier. It is attributed to differences in consumer perceptions, activity of NGOs, interests and behavior of biotechnology firms, farmers, processors, retailers, and scientists, and institutional characteristics of the political systems concerned (Aerni & Bernauer, 2006; Bernauer, 2005; Harsh, 2005). These differences have elevated the conflicts between proponents and opponents of biotechnology. On the proposing side, the multinational companies (MNCs) and their allies, mainly scientific communities, want to see biotechnology taken up by the farmers, citing its potential to address the chronic, poverty-related challenges confronting the African continent. They collectively support a policy that would spur biotechnology research and development toward commercialization and widespread use by the users. The opponents, on the other hand, have emphasized the need to take precautions because of uncertainty of biotechnology in relation to health and environmental risks. They have also leveled criticism against MNCs' monopolization of research and development through generation of proprietary technologies guided by strict patents that impact negatively on technology access by the poor producers and consumers (Herring, 2010). The groups opposing GMOs have been linked to environmental NGOs in Europe. Herring (2010) explored the powerful but negative impact of advocacy in agricultural biotechnology debates where opposing networks propagate information that evokes anxiety among publics.

Arguably, these polarized debates have not helped much in terms of ensuring that African poor farmers and consumers benefit from biotechnology through

appropriate regulatory policies (Paarlberg, 2008). This is despite the realization by African governments that modern biotechnology is a useful tool for addressing some of the agricultural production constraints. Consequently, the AU's panel on biotechnology has urged governments to support this endeavor, particularly homegrown biotechnology, in recognition of its potential as a developmental tool (Juma & Serageldin, 2007). This will, however, remain a dream unless viable ways of engaging in biotechnology regulation debates are developed and enhanced. Different milestones have been achieved and with foreign donor support, the majority of countries in SSA have engaged in development of effective regulatory mechanisms (Makinde, 2010; Mugwagwa, 2008). Most emerging frameworks aim at building biosafety institutional capacity for responsible implementation of GE activities. These include formulation of requisite biotechnology regulatory policies.

Clearly, the polarized biotechnology debate complicates the process of bringing about consensus in policy processes through intermediaries, an area that has not been given critical thought. In particular, less attention has been paid to dynamics related to controversial biotechnology regulation from the perspective of brokerage and how this can foster productive regulatory practice. Debatably, if we look at brokerage as an opportunity for creating an enabling regulatory policy environment for agricultural innovation, particularly in a developing country context, this may yield a productive debate for biotechnology development. This is important because different actors in agricultural innovation process including biotechnology subsector have different capacities, skills, and resources, which need to be harnessed for development (Hall, 2005).

Context for Regulatory Policy Brokering in Kenya

Actual research work involving biotechnology commenced in the early 1990s, which prompted the government to initiate establishment of a regulatory system for management of biotechnology research. This led to a successful establishment of a functional biosafety regulatory framework, making Kenya one of the few countries (after South Africa, Egypt, and Burkina Faso) to embrace biotechnology commercialization. It is important to note that the two processes, research and regulatory system development, coevolved. The controversies surrounding this coevolution process for almost two decades (from the early 1990s to 2011) provide a context for this paper that further strengthen the methodological approach to the selection of the intermediary organizations analyzed further on.

Modern Biotechnology in Kenya: An Overview

Modern biotechnology has revolutionized many sectors including agriculture and embraces a wide range of applications including tissue culture, markers-assisted selection, and GE. All these are being applied in Kenya, but the latter is the focus of this paper. Introduction of biotechnology research initiatives dates back to the 1990s when transgenic sweet potato was first approved for testing in the field. To date, over six GE research initiatives have been evaluated in public institutions in conjunction with local and international partners (see Kingiri, 2011a, for details). So far, no product has been approved for commercial use and the furthest the bio-

Table 1. Field trials being discussed or/and conducted in Kenya to date

Bt Maize	Several field trials have been conducted successfully. The aim was to contribute to the reduction of maize crop losses through the development of GE insect resistant maize for Africa.
Water Efficient Maize for Africa (WEMA)	This trial combines breeding and biotechnology to test efficacy of drought tolerant technology in African maize germplasm. Several field trials have been conducted.
Bt Cotton (Bollgard I and II)	Several field trials have successfully been conducted. Currently, the trials have moved to multiple locations in different parts of Kenya. The aim of the project is to contribute to the reduction of cotton crop losses through the development of GE insect resistant cotton. Main pest of concern is boll worm.
Transgenic sweet potato	This was the first field trial approved in Kenya. The objective was to transfer virus resistance traits via genetic engineering to Kenyan sweet potato varieties for use by subsistence farmers. Research still continues at a slow pace under containment in the laboratory.
Transgenic cassava	Two trials have been ongoing. The first involves genetic engineering cassava for resistance against viruses; the cassava mosaic disease and cassava brown streak disease. The second involves biofortified cassava where cassava roots have been enhanced with nutrients such as iron and zinc as well as elevated protein and β-carotene content.
Transgenic sorghum	This involves biofortified sorghum enhanced with nutrients.
The recombinant rinderpest vaccine	Successful on-farm trials were carried out in 2002–04 to test the efficacy against rinderpest disease and safety of the vaccine in the African cattle. The trial still continues under laboratory confinement in a small scale.
Note: *All these trials are PPPs with Kenya Agricultural Research Institute (KARI), the only public agricultural research institute taking the lead. There are more trials under containment in the laboratory & greenhouses which have not been included in this table.*	

Source: Compiled from primary and various secondary sources.

technology activities have gone toward a product is field trials (see Table 1). It is hoped that with the establishment of a functional biosafety framework, the situation will change. In addition, the food insecurity-related issues have prompted the government to take drastic policy measures approving temporary importation of GM maize to avert a food crisis in the country (see Appendix 1).

Kenya's Biosafety Regulatory Regime

The aforementioned technological revolution advanced parallel to regulatory policy developments requisite for management of related biosafety risks. This resulted in a number of regulatory instruments, the first being the draft Regulations and Guidelines of 1998 (Republic of Kenya [RoK], 1998). This instrument provided for establishment of a National Biosafety Committee (NBC) whose membership was drawn from different institutions composed of government regulatory agencies and departments, academic institutions, and a number of representatives from NGOs. This committee was until February 2009 responsible for charting a regulatory pathway for responsible biotechnology research in the country.

Kenya signed and ratified the Cartagena Protocol on Biosafety in May 2000 and January 2002, respectively. This obligated the government to put up regulatory structures to operationalize the protocol and legalize the aforementioned draft regulations and guidelines that were in use. This led to development of the Biotechnology Policy of 2006 (RoK, 2006) and Biosafety Act of 2009 (RoK, 2009).[4] The controversial developments surrounding the formulation of this act over the years

and its current implementation are at the center of this paper. Meanwhile, regulations to be appended to the Act became operational in July 2011 after approval by the Minister for Higher Education, Science and Technology.

How the Evolution of Kenya's Biotechnology Research and Regulatory Policy Subsystem Has Shaped the Role of Intermediary Organizations

The preceding sections provide an overview of Kenya's biotechnology development and regulatory subsystem. However, the factors that shape the role of different intermediaries in the regulatory process are, first, the pathways through which these organizations get engaged as stakeholders, and second, the underlying dynamics related to how actors are engaged in various biotechnology activities and their role in decision-making processes.

Three pathways through which intermediary organizations establish and emerge in Kenya's biotechnology innovation include the following:

1. Biotechnology projects where they either support particular projects as partners sometimes managing the multiple actors who include researchers, government, and donors (see Kingiri, 2010; Kingiri & Ayele, 2009) or campaign against biotech projects and prevent their commercialization through lobbying the government and mobilizing the public to reject them (see Kingiri, 2011a).

2. Biosafety regulation: many pro- and anti-biotechnology NGOs have influenced the development of regulatory frameworks in Kenya through involvement in biotechnology activities such as information dissemination, training, and sensitization of the public, journalists, political policy makers, scientists, and regulators. Others find themselves directly engaged in lobbying and/or support for the drafting of the legal regulatory policy documents (see also Kamau, 2010; Karembu et al., 2010).

3. Importation of GMOs as food or feed products: this is a pathway for involvement of various organizations in regulation of biotechnology products in addition to their other mandates. Examples include the Kenya Biodiversity Coalition (KBioC) network resisting introduction of unauthorized biotechnology products (Appendix 1; Mbaria, 2008; *The Standard*, 2010) and the Program for Biosafety System (PBS), creating a conducive regulatory environment for importation of GMO products through regulatory capacity building among different regulatory agencies in Kenya. This pathway is sometimes confounded by the prevailing politics. For instance, in February 2011, the Kenyan cabinet made a political pronouncement that approved immediate importation of GM maize to avert a looming food crisis. This development received considerable media reportage, which subsequently generated wide public protests led by civil society. In contrast, the proponents of biotechnology supported this move (Appendix 1).

Empirical research conducted in Kenya by Ayele, Kingiri, Harsh, and Sander provided a detailed analysis of the controversies that characterize Kenya's biotechnology regulatory process, and subsequently, how this shapes the behavior of different actors in regulatory decision-making processes.

Ayele and colleagues (2006) explained that Kenyan crop biotechnology activities are PPPs originating from outside the public sector. This work sheds some light on the contextual factors under which biotechnology development occurs in Kenya. PPPs are pivotal in influencing the direction and ultimate performance of expected or desired policy innovations through the choices scientists make and subsequent behavior and implications.

Sander (2007) looked at the construction of biosafety regulations and guidelines of 1998 (RoK, 1998), giving prominence to the role of international donor agencies in this process. Using the actor network theory, his study documented how the activities carried out by different institutional actors influenced and shaped the context and content of this legislation. Sander noted that establishment of intermediaries and their subsequent engagement in regulatory brokerage function was favored by a number of factors. These include the pressing need to establish institutional structures for governance of biotechnology research following the signing of the Cartagena Protocol, the high cost involved in putting up a regulatory infrastructure that the government could not immediately meet, and the international and political context in which this was being handled.

Harsh (2005, 2008) identified informal and formal governance of biotechnology where non-state actors (NGOs) take up the space of the government in policy deliberations. His work offered some insights in understanding the political environment under which biotechnology develops within NGOs as knowledge networks. NGOs are rich sources of policy-related knowledge and other varying resources that motivate actors, thereby influencing policy directions.

Kingiri (2010, 2011a, 2011b) revealed the engaged nature of actors between 2002 and 2011 during the formulation of the Biosafety Act and after. Kingiri (2010) exposed the important role of the scientific communities (in private and public arena) and their allies (who include biotechnology industry, NGOs, and donors) in shaping the Kenya's regulatory process trajectory as experts in biosafety and biotechnology. The government's reliance on this supposedly biased expertise generated protracted tension from the anti-biotechnology NGOs. This tension is captured by Kingiri (2011a), in which actors spurred by conflicting belief systems aligned themselves with opposing coalitions to advance and defend their interests. The government and the scientific communities formed a pro-biotechnology and pro-biosafety bill coalition, while the civil society groups formed an anti-biosafety bill coalition. The pro and anti groups used different avenues and spaces (mainly media) to express their viewpoints. The civil society also used the public space to attract public and political support.

It is noted that empirical research reported here tends to portray the brokering function primarily from a political stance. Consequently, it is possible for controversies generated by politics of biotechnology to blur the dynamism as well as the positive attributes of intermediation undertaken by regulatory brokers in Kenya. The only reference that comes close to exposing this dynamism is Karembu and others (2010), albeit from an implicit stance. The subsequent sections attempt to expose empirically the different tasks undertaken by different brokers in practice. This consequently paves the way for a discussion that opens up a different kind of debate that seeks to spur a productive dialogue through intermediation.

Policy Brokering Tasks by Selected Intermediary Organizations

The empirical data to support this paper were derived from an in-depth analysis of a number of intermediary organizations that have been, and continue to get involved, in agricultural biotechnology regulation in various ways. It is important to point out that many other organizations could have qualified for analysis in this context, but the research under which this paper is grounded was confined within a defined scope and criteria. First, this was part of a larger post-doctoral research project undertaken by the first author that primarily focused on the role of technical experts in regulation of the biotechnology subsector in Kenya in a period of political controversies surrounding formulation of the biosafety bill (between 2002 and 2009). Consequently, this research was grounded in the narratives of the interviewees (scientific communities in the scientific, regulatory, policy arenas as well as nonscientific communities in the pro-biotechnology and civil society arenas). Forty-one interviews were conducted between 2006 and 2009 focusing on the role of different intermediary organizations and the involved communities of practice in Kenya's regulatory process. The majority of the interviewees were linked to these organizations either as employees or collaborators. Second, the analysis is informed by data emanating from a U.K. Department for International Development (UK-DFID)-funded Research into Use program (between 2010 and 2011), which had specific objectives, one being to understand brokerage function in relation to biotechnology innovation. Under this program, more than 15 key biotechnology stakeholders were interviewed between 2010 and 2011 on different brokerage functions performed by organizations identified during the post-doctoral research.

Guided by primary data from the interviews (reported as personal communication where used in the paper) and secondary materials, organizations that featured prominently are analyzed for their regulatory policy brokerage function. The information obtained through the analysis further aids in developing a function-based typology based on the degree to which these organizations function uniquely as policy brokers. Drawing insights from Klerkx and Leeuwis (2009), a number of features have aided this endeavor: history of the organization, including its general outlook; agenda pursued, including cluster of activities that relate directly or indirectly to regulation and policy orientation; nature of partners/linkages; and source of funding.

Analysis of Selected Organizations as Regulatory Policy Brokers

The analysis presented in this section helps us understand more generally how brokerage in biotechnology regulation occurs in practice rather than make comparisons across different organizations. To enhance clarity, the analysis is presented in several forms. First, each case is briefly discussed in line with different brokerage functions detailing what this entails for regulatory policy and practice. The effectiveness of each case as a policy broker is also explored. Second, the emerging narrative is presented in form of Table 2, and third, a function-based categorization of these organizations is presented in Table 3. This sets the scene for further in depth analysis and discussion in the subsequent sections.

Table 2. Classification of Organizations Involved in Biotechnology Regulation and Indicators of Policy Influence

Case	Type	Policy Brokerage Roles/Activities	Agenda/Focus	Potential to Influence Regulatory Process	Challenges
NBA	Government regulatory and policy agency on biotechnology and biosafety matters.	• Oversight of the biosafety system including monitoring and approval of genetically modified organism (GMOs) applications, coordination of actors enforcing the regulations, advising the government on biotechnology and biosafety matters, developing biosafety implementation protocols. • Undertaking policy process management tasks as a primary role.	• Establishing a framework for implementation of the Biosafety Act. • Implementing the dual role of the Kenya government (biotechnology transfer and safeguarding the health and environment).	• Impartiality in the demand articulation and network brokerage process. • Legal backing with mandate for repository of biosafety information, public education, and other capacity-building activities. • Brings a wide range of players together.	• Inadequate capacity that leads to masking of policy brokerage role by private actors. • Requires scientific, public, and political support. • Pressure from researchers and other technology developers interested in quick research and development process. • Some demand articulation roles are unaccountable confounded by government bureaucratic administrative procedures. • Competition of some policy management process tasks with other knowledge brokers.
ISAAA	International NGO	• Brokerage of corporate technologies as intermediary organization. • Capacity building at both supply and demand side in the biotechnology development. • Biotechnology advocacy and public awareness. • Performing liaison function through brokering information and knowledge flow between public and private actors.	• Promoting biotechnologies research and trade. • Influencing regulatory policy environment for conducive biotechnology research and trade.	• Established network of technology developers, users, and researchers and scientists in both academic and policy arenas. • Potential to forge technological and policy alliances. • Well-funded strategies.	• Obligation to donors raising impartiality tensions. • Competition of some policy management process tasks and funding sources with other knowledge brokers.
ABSF	Regional NGO	• Brokering knowledge flow through biotechnology public awareness and education activities.	• As a lobby network spearheaded by scientists, it seeks to promote biotechnology uptake through education and biopolicy capacity building.	• Focus on academics and policy makers including media as policy agents.	• Donor funding may create tensions linked to conflict of interests, impartiality, and neutrality, thus damaging its credibility as an honest broker. • Competition of some policy management process tasks and funding sources with other knowledge brokers. • Obligation to donors, raising impartiality issues. • Inadequate and sustained funds.

Table 2. *Continued*

Case	Type	Policy Brokerage Roles/Activities	Agenda/Focus	Potential to Influence Regulatory Process	Challenges
African Agricultural Technology Foundation (AATF)	Regional NGO	• Brokering acquisition of intellectual properties through negotiation of license agreements on behalf of farmers and researchers, thus acts as intermediary "honest broker" between technology developers and users. • Brokering knowledge through biotechnology public awareness and education activities.	• Create an enabling environment for trade in biotechnologies through negotiating access to intellectual property rights and biotechnology stewardship.	• Established network of technology developers, users, and researchers and scientists in both academic and policy arenas. • Well-funded strategies.	• The policy brokerage role as a means to achieve AATF's ultimate technology development goal may create tensions linked to conflict between clients' agenda (farmers and funding organizations).
KBioC	Local association of NGOs	• Warn against adoption of GMOs on account of threats to environment and biodiversity, and monopolization of seeds by large companies. • Lobby government for restrictive regulations as safeguards against uncontrolled trade in GMOs. • Educate public on negative aspects of GMOs, citing the unbalanced and biased education by scientists and technology developers.	• Public policies that take cognizance of public interests and concerns.	• Engage proactive strategies to attract political support. • Commands a wide following of those alleged to be public.	• Obligation to donors with links to environmental lobbyists raising impartiality issues. • Potential to communicate biased messages to public.
KOAN	National local NGO & farmers organization	• Lobbying against GMOs citing the threat to organic agriculture. • Advocacy and public awareness.	• Farmer network broker facilitating sustainable agricultural practices, hence against GMOs production.	• Commands a wide following of those alleged to be public. • Established links with policy and farming communities.	• Seen as a threat to biotechnology development by proponents of biotechnology. • Conflicting government policies (pro-biotechnology) and pro-diversity protection. • Potential to communicate biased messages to the public.

Table 3. Function-Based Typology of Intermediary Organizations as Policy Brokers

Type	Tasks	Features	Pros	Cons	Example
Embedded brokering: third-party technology agencies	Demand articulation, network formation, visionary, regulatory capacity building, communication and information dissemination, advocacy, and lobbying for policy change.	• Policy brokering is a secondary function intended to influence broader technology policy development. • Present themselves as neutral agencies.	• Stimulate significant institutional and organizational innovations (systemic value) and linkages. • Readily available resources including avenues to pursue policy actions.	• Failure of clients to see the immediate value of intermediation owing to politics. • Uncertainty of outcome of brokerage to steer effective reformism/policy change. • Undeclared or hidden vested interests leading to neutrality and credibility tensions, conflicting objectives impacting impartiality.	ISAAA, AATF, ABSF, KOAN
Proactive activism	Demand articulation and network formation advanced through active advocacy and lobbying for policy change, public awareness, client representation, information gathering and dissemination, regulatory policy capacity building.	• Active, direct, and confrontational engagement of clients in policy dialogues.	• Prompt attention of policy actors; clients trust (pro- and anti-technology).	• Neutrality and credibility tensions linked to pro- and anti-technology lobby groups.	KBioC, ISAAA, ABSF, KOAN
Boundary spanning	Demand articulation, network formation and policy process management tasks advanced through public awareness and communication, advisory services, creation of platforms for negotiation, liaison and mediation, steering and coordination of clients.	• Balancing of different interests through mediation.	• Potential to exercise objectivity, neutrality, and credibility.	• Skills and competences needed to mediate between different interests confounded by political bioeconomy landscape linked to agro biotechnology.	NBA, AATF

AATF, African Agricultural Technology Foundation; ABSF, African Biotechnology Stakeholders Forum; KOAN, Kenya Organic Agriculture Network; ISAAA, The International Service for the Acquisition and Application of Agri-Biotech; KBioC, Kenya Biodiversity Coalition; NBA, National Biosafety Authority.

The International Service for the Acquisition and Application of Agri-Biotech Africenter

The International Service for the Acquisition and Application of Agri-Biotech (ISAAA) is a nonprofit international NGO with the ISAAA AfriCenter having varying brokering missions. First, it brokers access to technologies, genes, and protocols owned by private sector and/or international research organizations (ISAAA, 2010; Wambugu, 2001). Second, it has been playing a steering role, coordinating the many actors both in the public and private sectors in Kenya's regulatory policy development process (Karembu et al., 2010). Third, it has been coordinating the "seeing is believing" field tours to neighboring countries where biotechnology products are already commercialized. These tours have largely involved politicians, regulators, and journalists with the purpose of influencing the quick approval of the biosafety law and subsequent smooth implementation (personal communication with a pro-biotechnology activist, 2007 and 2011; see also Karembu et al., 2010). Finally, due to the rising biotechnology resistance from the civil society, the ISAAA, in conjunction with other players, brokered the founding of the National Biotechnology Awareness Strategy (BioAWARE) (RoK, 2008) and Kenya Biosafety Coalition (KBC) through demand articulation and network formation. Arguably, these are supposed to be government initiatives, but the ISAAA brought in the much-needed resources, namely technical knowledge, finances, network formation skills, and lobbying the ministry of agriculture for inclusion of private sector in biotechnology debates (personal communication with a biotechnology researcher, 2008; see also Kingiri, 2011a).

The ISAAA has been able to effectively broker biosafety regulatory process through outreach and communication and is a source of free information and education materials on biotechnology released regularly to interested parties. The ISAAA is currently engaged in improving the communication aspects of biotechnology to the public out of realization that scientists are poor public communicators (personal communication with a research scientist, 2010). It thus bridges the communication gap through training of regulators, scientists, and journalists on appropriate and effective communication skills. To reach out to the general public, the ISAAA is exploring the usage of mass media (radio) as a tool for public awareness, a program that is being experimented in Kenya and Burkina Faso using vernacular languages.

The ISAAA articulates its mission and wide range of activities largely through an extended network of partners at the local, regional, and international levels (public and private organizations, researchers, MNCs, donors, seed companies, etc). It is mainly funded by the U.S. Agency for International Development (USAID), and The Rockefeller Foundation, USA, among other donors.

The ISAAA may be perceived to be influential in terms of bringing together key actors associated with respective policy innovations. This has been favored by its credibility in project brokering, particularly biotechnology promotion dating back to the 1990s through its established network of banana tissue culture stakeholders. Others factors include fairly stable financial support from donors and multinational seed companies, strong links with regional bodies promoting common trade interests such as Common Market for Eastern and Southern Africa, and a strong

communication and awareness program that attempts to make the private, public, and the general public dialogue on matters of biotechnology innovation.[5] The ISAAA also established a strong link with various government arms during the lobbying for the biosafety bill enactment (Karembu et al., 2010). The ISAAA seems to have both social and environmental policy orientations embedded in its technology transfer implementation portfolio, but the overall agenda being pursued may be construed to be biotechnology promotion. In relation to being an honest policy broker, this may bring about impartiality tensions.

African Agricultural Technology Foundation

The African Agricultural Technology Foundation (AATF) is a nonprofit NGO with a regional focus. It aims to increase productivity and use of biotechnology products for the benefit of the resource poor farmers in Africa (AATF, 2010). To achieve this objective, it is involved in a variety of brokerage activities. It actively brokers access to agricultural technologies through negotiating for use of intellectual property rights (IPRs) royalty-free, which is geared toward benefiting the poor. Thus, the AATF plays a catalytic role, fostering partnerships between the multiple actors involved while articulating the demands and interests of each stakeholder.

In partnership, the AATF also brokers regulatory policy development as a means to achieve its biotechnology developmental goal. For instance, the AATF and the ISAAA were instrumental in the formation and establishment of the knowledge-sharing platform, Open Forum on Agricultural Biotechnology in Africa (OFAB). Although OFAB has public and private partners, the two organizations have continued to finance the monthly meetings that have been held for over two years. During the development of Kenya's biosafety legislation, the AATF brokered the lobbying of its enactment through proactive awareness creation targeting the political policy makers, regulators, researchers, and the public. Just like the ISAAA, the AATF was also instrumental in the formation of BioAWARE and KBC lobby platforms, providing the requisite resources for this function.

The activities of the AATF are oriented toward social change through poverty reduction but this is yet to be seen as most biotechnology products in the pipeline are still under research and development. The potential to broker knowledge (IPRs) that is currently unavailable to many developing nations, making it available to the researchers and resource poor, is a strong factor for negotiating and influencing policy change. In addition, the fostering of partnerships (networks formation skills) has made the AATF a significant influence on institutional change linked to technological innovations.

The AATF brokering activities are funded by the Rockefeller Foundation, DFID, the Bill & Melinda Gates Foundation, the Howard Buffett foundation, and USAID. Debatably, some of these donors are known to be promoting new biotechnology innovations that may affect credibility and neutrality of the AATF as an effective policy broker.

African Biotechnology Stakeholders Forum

The African Biotechnology Stakeholders Forum (ABSF) is an NGO with a regional focus targeting the African region, although most of its activities are localized in

Kenya where it is based. It works closely with regional and international organizations such as the ISAAA and national research and academic institutes. ABSF's mission is to create an innovative and enabling biotechnology environment in Africa through education, enhanced understanding, and awareness creation on all aspects of biotechnology, biosafety, and IPRs (ABSF, 2010). Overall, it facilitates communication, improving public understanding, supporting policy development, creating capacity for information generation and dissemination on biotechnology and related issues. Just like the ISAAA and the AATF, the ultimate goal of ABSF is oriented toward pro-trade biotechnology policies. This is based on the conviction that biotechnology can reduce social challenges affecting the poor in Africa.

ABSF was a key actor in the development of Kenya's biosafety law where it played a role of lobbying and advocacy. It provided a strong political link between the politicians in the parliament and the pro-biotechnology NGOs (personal communication with a staff from a funding agency, 2008). Previously, it partnered with other players such as Biotechnology Trust Africa (previously Kenya Agricultural Biotechnology Platform) and local universities in biotechnology projects.

ABSF is strategically placed to influence policy and institutional change because it is managed by influential scientists who have political connections with the current coalition government system. In addition, the majority of the members are also practicing scientists at the Kenyan universities where they conduct research, teach, and supervise students. ABSF for a long time has been a member of the government decision-making organ, the NBC whose function has been taken over by NBA discussed elsewhere..

ABSF receives funding from Rockefeller Foundation, and previously, it obtained funding from the United Nations Environmental Programme—Global Environment Facility (UNEP-GEF) for biosafety and biotechnology policy advocacy. It has also been associated with a number of pro-biotechnology organizations such as USAID and Monsanto, who in particular supported lobbying and advocacy work linked to the enactment of the Biosafety Act (personal communication with a staff from a funding agency, 2008). In policy brokering endeavors, this may bring about impartiality tensions.

Kenya Biodiversity Coalition

This is a coalition of over 70 members (as of November 2010). Most of the members are NGOs within the civil society arena, farmers associations, and consumers' associations. This coalition was previously known as Kenya GMO Concern Group (KEGCO) composed of 12 members (as of September 2004). KEGCO was formed in 2004 as a coalition of NGOs to campaign against the research, development, and commercialization of GMOs in Kenya. Advocacy and lobbying activities, however, started prior to its formation. For instance, individual members such as the Intermediate Technology Development Group based in the United Kingdom were already actively engaged in advocacy work in Kenya (Harsh, 2008). Notably, the secretariat to this coalition is the powerful Kenya Federation of Farmers and Producers alternating with Consumer Information Network (CIN). CIN has links with Consumer International based in the United Kingdom. Action Aid with links to

environmental NGOs in the United Kingdom is known to have been a strong supporter of the KBioC on matters to do with biotechnology legislation policies (Action Aid, 2004).

The work of the KEGCO/KBioC on biotechnology and biosafety has been a secondary function, and constituent members have other primary activities commensurate with their core objectives, mainly on environment and livelihood/food security. They are, however, brought together by their conviction to protect Kenya's biodiversity. They perceive unregulated biotechnology to be a threat to agriculture and environment and are particularly concerned with the public participation aspects of regulation (personal communication with a staff from a civil society NGO, 2010). They are involved in biosafety work, primarily that of advocacy, education, awareness creation, and lobbying against legislation that does not promote safety of biodiversity (Kamau, 2010). They lobby the government as opposed to particular biotechnology organizations and projects.

The KBioC works closely with farmers and community-based organizations. It is also able to consolidate finances to achieve its collective agenda, public awareness, education, advocacy, and lobbying. This is in addition to its ability to attract stable funding for its advocacy work from financing agencies (albeit environmental lobbyists). These connections present this coalition as a strong advocate of policy, institutional, and social change within government and local communities. There is, however, a danger of neutrality and influence from these funding agencies sometimes known to fight biotechnology development in Africa (personal communication with a biotechnology researcher, 2007; see also Paarlberg, 2008). This may impact the suitability of this coalition as an effective policy broker.

Kenya Organic Agriculture Network

There has been an organized organic farming network in Kenya that dates back to the 1990s. The Kenya Organic Agriculture Network (KOAN) was, however, established in 2004 as a national coordinating body for organic agriculture activities in Kenya. Its vision is to establish and coordinate "a vibrant organic agriculture industry that contributes to a healthy environment, livelihood security and responsive to a growing consumer market" (KOAN, 2010). It has more than 200 corporate members as well as individual members who, through the integrated network, serve more than 50,000 people. The organization has a technical secretariat that oversees the implementation of its objectives in collaboration with its local and international partners and networks.

KOAN activities are orientated toward special sustainable policies that encompass environmental and social livelihood issues (KOAN, 2010). One activity that KOAN has passionately pursued as a secondary role under policy, lobbying, and advocacy function on behalf of organic growers is resisting introduction of biotechnology. One reason for pursuing this activity is food safety concerns and possible interference in organic farming and marketing through GMO contamination (Kamau, 2010).

KOAN has been influencing agricultural policies in various ways. Organic agriculture is now regarded as a strategy among others that offer a wide range of environmental (biodiversity, soil fertility), social, and economic benefits to communities contributing to poverty reduction and sustainable development (International

Assessment of Agricultural Knowledge, Science and Technology for Development [IAASTD], 2009). In recognition of this, the ministry of agriculture works closely with KOAN and organic growers (personal communication with KOAN staff, 2010). This has contributed to key notable policy milestones; the national soil fertility policy contains an elaborate section on organic farming (organic sources of soil nutrients; the value of organic fertilizers in rehabilitating heavily degraded soils). The food and nutritional draft policy paper also acknowledges the role of organic produce in food and nutritional endeavors.

With regard to food safety concerns linked to GMOs, KOAN has partnered with other players under the KBioC coalition to lobby the government against GMO policies that assume the concerns of the farmers and general public in Kenya. Members of this coalition including KOAN also receive widespread support from politicians especially on matters of GMO policies (Karembu et al., 2010, pp. 35–36) due to their established connections with the rural farming communities. The challenge for KOAN as a policy broker is the viability of its environmental policy agenda. For instance, the Kenyan government has declared biotechnology as one of the tools for development through enactment of biotechnology policy (RoK, 2006). This implies that if public stakeholders are to support the agenda of KOAN as a policy broker, then a trade-off has to be negotiated for a balance to be achieved. In addition, the organic market for Kenya is primarily Europe, supposedly home to known environmental lobbyists. This may bring about partiality issues and credibility tensions in articulation of the brokerage function.

National Biosafety Authority

Kenya's National Biosafety Authority (NBA) is a regulatory body formed under the provisions of the Biosafety Act 2009 (RoK, 2009). Although the act was assented to by the president in February 2009, it was not until June 2010 that the NBA board responsible for the implementation of the act was instituted. NBA brings together individual members appointed by the Minister for Higher Education, Science and Technology, representatives of key regulatory agencies, and government departments. Previously, the work of the NBA was undertaken by an ad hoc NBC that periodically brought together a wide range of stakeholders to ostensibly deliberate on applications for biotechnology research. The work of policy drafting was largely a responsibility of technical committees appointed through the NBC under the terms of the funding agencies such as the UNEP-GEF and USAID.

After the launch of the NBA board, this authority became operational. According to the act, the NBA is mandated to license GMO activities in Kenya following well-spelled-out procedures of risk assessment. This activity is still being contracted out to experts in academic and research institutes, perhaps because the NBA is still establishing itself. Public awareness and education is now provided for under the act, but it is still too early to speculate how this activity will be implemented. Previously, this activity was left to mainly pro-biotechnology NGOs who masqueraded as funding agencies, government partners in biotechnology policy making, policy brokers, experts in biotechnology and biosafety, among other functions. Biosafety information generation and dissemination will be achieved through the Biosafety Clearing House, but the NBA is yet to operationalize this information portal.

The overall agenda being pursued by the NBA relates to responsible transfer of GMOs, promoting a dual role, that of technology promotion for development, on the one hand, and safety, on the other. Arguably, this broad mandate may be perceived to have economic, social, and environmental orientations. This implies that the NBA may be spearheading a regulatory policy process in pursuit of public interests more generally, but whether this is the case is debatable. From the experience of Kenya's biosafety regulatory policy making, it is clear that the NBA cannot on its own influence policy change (see Karembu et al., 2010). It requires support from the private, public, and research/academic fraternity.

The NBA has received funding previously from the UNEP-GEF, the Sweden-funded Eastern African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development (BIOEARN), African Biosafety Network Expertise (ABNE) of New Partnership for Africa's Development (NEPAD), and the USAID-funded PBS. PBS is still funding the regulations implementation component of biosafety capacity building, while ABNE continues to support regulatory capacity building through training of regulators on biosafety matters and information dissemination. It is, however, unclear how these agencies may influence the NBA's policy brokering role and the resultant regulatory policy outcomes from an empirical perspective.

The administrative structure of the NBA and legal mandate according to the act and policy situate it in a position to coordinate an independent and impartial policy brokering process. Whether this has been the case is not within the scope of this paper.

Discussion

In this section, we discuss the main findings in view of tasks regulatory policy brokers undertake in biotechnology regulation and what this means for establishing a dynamic and responsive regulatory policy subsystem. The individual cases' narrative and Table 2 focused on brokerage tasks, agenda pursued, potential to influence regulatory process, and challenges. This further helps in exposing the dynamism that embeds regulatory policy brokering in the biotechnology subsector. Consequently, a further function-based analysis leads to Table 3 that identifies three overlapping categories brokers are engaged in: embedded brokering, proactive brokering, and boundary spanning. These categories are explored further on in detail.

Broad Analysis

Empirical analysis of the selected organizations reveals different regulatory tasks and embedded dynamics around how regulatory policy brokering occurs in practice and the implication this may have for biotechnology development. These tasks constitute a wide range of activities that entail demand articulation, networks formation, and policy process management.

Demand articulation is key at the early phase of technology development when the level of uncertainties and need for flexibility are high. In Kenya, biotechnology is a dynamic innovation. This being the case, development of requisite regulatory

policies engaged Kenya's stakeholders in different ways, and it is not surprising that the majority of the organizations articulated the demand articulation role on behalf of different clientele. In doing so, they promoted better mutual understanding of needs, visions, goals, and ethical issues while empowering clients through intense awareness creation and information dissemination (Boon, Moors, Kuhlmann, & Smits, 2008, p. 645).

Networks' formation tries to mobilize actors through, for instance, organizing a negotiation platform or avenue for various policy actors, provision of information to bridge the knowledge gaps, funding policy-related activities, among others (Klerkx et al., 2010). The ISAAA, ABSF, KBioC, and NBA brokered network formation at various stages of Kenya's regulatory policy evolution process through capacity building, information sharing, and resources mobilization. The NBA (previously NBC), for instance, was a perfect platform for stakeholders to network as experts in risk assessment and other regulatory decision-making activities.

Policy process management tasks tend to mobilize different groups of actors perceived to have different interests. In the biotechnology arena, the level of uncertainty is high, and therefore, the AATF, ISAAA, and NBA proactively articulated a liaison role, catalyzing change and stimulating cooperation while also building the requisite regulatory capacity that is needed to support biotechnology development in Kenya. NBC, e.g., perpetually acted as a lead operator and caretaker, endeavoring to maintain the integrity of the regulatory process in transition (Klerkx et al., 2010).

Function-Based Typology

Critical analysis of the tasks performed by the organizations helps in developing a function-based typology composed of three overlapping categories. This brings to the fore the dynamics associated with regulatory policy brokering more generally.

Embedded Brokering—This category exposes a policy brokerage function that is heavily integrated in the overall routine activities of the intermediary organizations, hence the embedded nature. These organizations assume a policy brokering role as part of the agenda to improve transfer and access to their preferred technological products. As demonstrated in the analysis, they engage in crucial secondary tasks that stimulate a dynamic and systemic engagement that leads to useful policy change. The cases falling under this category have primarily a broad-based focus, expanding their functions to facilitate in regulatory policy processes. The ISAAA, AATF, and ABSF, for instance, pursue policy brokerage in order to enable biotechnology access and use and thus remain technology-focused in their approach as third-party technology agencies. They thus engage in regulatory policy brokerage as a means to achieve an end more generally. KOAN is a different type of special apex organization that has taken up the policy brokering role as an embedded advocacy function on behalf of the inadequately placed members, mainly small-scale farmers' groups engaged in organic farming as a business enterprise.

Perhaps not deliberately, the organizations in this typology present themselves as neutral policy brokers, but there are underlying impartiality, neutrality, and credibility tensions related to brokering function. As espoused further on, these are

critical challenges that cannot be ignored when thinking about brokerage as a platform for enhancing a productive biotechnology debate.

Proactive Activism—This category describes agencies that engage in intense advocacy and lobbying to pursue a predetermined policy perspective. The KBioC, ISAAA, and KOAN demonstrate how proactive activism can spur policy change through advocacy and direct lobbying for clients' engagement in policy dialogues. For example, strategies adopted by KBioC to lobby the government mainly through mass media and public demonstrations sensitized the public about GMOs, albeit from a nonbalanced perspective (see also Kingiri, 2011a). On the other hand, lobbying and advocacy strategies adopted by the ISAAA may be attributed to the passing of the Biosafety Act (Karembu et al., 2010). This notwithstanding, there is a positive aspect about this proactive activism associated with both anti and pro groups. Arguably, because brokers tend to identify with particular needs of clients, they generate relative trust and credibility amongst their members. In addition, they command clients' attention that augments the dynamism involved. Moreover, they command authority from their positions at junctures of networks, enabling intense learning and diffusion of different knowledge claims. The fact that they are not directly affiliated to the government partly removes the organizational and institutional barriers that may hinder them from pursuing their policy objectives without fear. These factors are potentially enough to cause a prompt and significant institutional and policy change.

The ensuing intense lobbying and advocacy, however, may be detrimental to pro-poor biotechnology deployment especially in the cases of uncertainty and politics (Herring, 2010; Paarlberg, 2008). The emerging tensions and suspicion confound efforts to reconcile public interests and politics, which further weaken the ability of opposing groups to work together toward promoting pro-poor development initiatives. All the organizations in this category are susceptible to pressures emanating from politics of the EU–U.S. transatlantic GMOs debate. KOAN and the KBioC are purportedly linked to funding organizations in Europe that subscribe to restrictive approach to GMO policies, although interviewees from these organizations denied this claim. The ISAAA, on the other hand, has links with pro-biotechnology actors that subscribe to the U.S. permissive regulatory policies. This is not unexpected because as discussed previously, the EU–U.S. transatlantic debate has been shown, albeit implicitly, to affect regulatory policy decisions in developing countries such as Kenya. This is a challenge that may hamper a productive brokerage function and is revisited in the subsequent sections.

Boundary Spanning—This category is characterized by the mediation, communication, and coordination tasks to bring about consensus among clients situated at different sides of the policy boundaries. In Kenya, regulatory boundaries were brought about by different agenda and opinions around how biotechnology research should be regulated (see Kingiri, 2011b). Based on the cases analyzed, boundaries exist between two groups of actors: those proactively lobbying against the technology (KOAN and the KBioC) and those proactively promoting the technology (ABSF, ISAAA, and AATF). Based on this understanding, NBC thus provided a forum for discussion and negotiation and, hence, was accountable to the

groups on both sides of the boundary. In this way, it exhibited characteristics of a boundary spanner.[6] The AATF also exhibits characteristics of a boundary spanner. It has effectively created a platform for negotiating IPRs royalty-free and thus represents the interests of technology users, on the one hand, and those of the developers, on the other.

Kristjanson and others (2009) argued that a boundary spanner is well-placed to command trust from clients on both sides due to the expected nonbiased approach to negotiation. This may enhance credibility while minimizing chances of tensions linked to neutrality and impartiality issues that were identified as potential challenges in achieving an effective policy brokering function. The boundary spanning role in agricultural development has been identified as a way of linking knowledge with action through creating and sustaining relationships, building trust, communicating information needs, and bridging gaps between various stakeholders groups (Kristjanson et al., 2009).

Boundary organizations (undertaking boundary spanning work) have been popularized in science policy debates. It is argued that they have the potential to mediate between science and public in controversial policy arenas (see, for instance, Jasanoff, 1990, in regulation of biotechnology in the United States). Boundary spanners also play a critical role in bringing about social order in knowledge brokering (Guston, 2001). Because of challenges associated with biotechnology regulation as exemplified by governance scholars (cf. Lyall, Papaioannou, & Smith, 2009; Lyall & Tait, 2005), some implications for policy in relation to a productive brokerage for biotechnology development are explored in the subsequent section.

Challenges and Opportunities for Effective Brokerage Function: Implications for Policy

From the foregoing analysis, it is emerging that biotechnology policy brokering is a pervasive and dynamic function that brings about positive and negative implications. This empirical context provides a basis for exploring how a productive brokerage function may be designed and articulated through policy support by paying critical attention to the opportunities (or pros) and challenges this function presents to the brokers. This being the case, a brokering model for biotechnology regulation should involve all players in the private and public sector including farmers and NGO groups and should be based on several principles.

First, empirical analysis should identify different tasks performed by candidate stakeholders and acknowledge strengths and weaknesses. There is a need to acknowledge the different tasks that entail policy brokerage and that regulation of biotechnology constitutes a wide range of these tasks that are important and require a wide range of skills, resources, and well-orchestrated strategies. This is where policy support needs to be directed toward strengthening and harnessing the positive impacts brought about by brokering where the government could choose the tasks it wishes to promote irrespective of the organization. For example, the government may consider facilitating or supporting the third-party technology brokering agencies as policy brokers because they tend to engage in a wider set of brokerage roles (capacity building, mobilization of resources, communication and information dissemination) very crucial for technology development. This does not,

however, imply that the government should support a certain specialized agency to perform these purportedly special policy brokering tasks. It could support an assorted collection of different organizations or initiatives performing different policy brokerage tasks (Hall, 2010; Hall et al., 2010). For instance, ISAAA could be supported to pursue the communication and information dissemination role. The government might also decide to engage the services of trusted scientists and researchers in coordinating different tasks within respective intermediary organizations. Scientists in academic institutions, for instance, are perceived to be credible (Aerni, 2005).

Second, polarization in biotechnology debate cannot be wished away and must be factored in the design. The analysis presented in this paper raises pertinent questions around the different roles that brokers can play to facilitate transfer of GM technology. Evidently, brokering attracts significant challenges that confound efforts to steer a productive biotechnology debate. The challenges linked to neutrality, credibility, and impartiality issues further reinforce the political nature of biotechnology knowledge infrastructure as has been debated by governance scholars mentioned elsewhere. Arguably, biotechnology governance challenges are linked to different values and interests held by biotechnology stakeholders (Lyall et al., 2009). Dealing with these challenges would require policy makers to invest in productive activities to safeguard against potential negative influence. This raises questions around how a productive brokerage function may be developed and implemented. We can draw insights from different scholars. Science policy researchers, for instance, promote participative biotechnology policies informed by evidence based social and scientific research (cf. Lyall et al., 2009; Tait et al., 2006). Proponents of boundary spanning argue that this is an instrumental tool to bridge gaps between various stakeholders groups (Kristjanson et al., 2009). In this respect, boundary spanning could provide checks and balances to counter embedded value-based challenges while tapping the resources that brokering agencies contribute to the policy brokering function. The broker that takes up the role of a boundary spanner (e.g., a government agency such as the NBA or a private-based NGO such as the AATF) could orchestrate the tasks performed by the proactive activists that would ensure that the negative activism is controlled and confined within the respective boundaries. Eventually, this translates to a moderated, productive activism that would enhance a productive development agenda. Boundary spanning as a proposed feature of biotechnology policy brokering model requires further empirical research because depending on the policy being pursued, the government may decide to be partisan as evidenced in the early stages of the Kenya's biosafety policy formulation process (see Kingiri, 2011a).

Third, the design of this model must be demand-driven, informed by the local context in terms of politics and agricultural production and product consumption needs of the citizens. This principle would aim at promoting domestic policies that are in line with the needs of its citizens. An empirical study such as the one pursued in this paper should guide future biotechnology debates with lessons learned over the years informing the design (Kingiri, 2012). The recent food crisis experienced in Kenya and some promising technologies being tested through the Kenya Agricultural Research Institute (KARI) stewardship might enhance a productive dialogue among opposing interest groups. For instance, the Water Efficient Maize for

Africa biotechnology initiative pursuing drought tolerance being brokered by the AATF and the *Bt* cotton (see Table 1) is one of the initiatives that seems to have received widespread public support (see Njoroge & Musyoka, 2011). This is where the KARI and the extension arm of the government could take a lead in advising on local production needs appropriately. In addition, the BioAWARE strategy for public awareness might need to be re-designed to consider local interests (see Kingiri, 2011b, for details of the dynamics surrounding this public awareness instrument in reconciling the polarized regulatory debate).

The principles discussed earlier should not be taken as a blueprint. Instead, a policy brokerage model for biotechnology regulation needs to be flexible to accommodate the dynamic and evolving nature of the biotechnology sector. This may require brokers to learn about using strategic intelligence and organizing their demand articulation process (Boon et al., 2008). In addition, in order to become client-oriented, an institutional change will be required toward a demand-driven way of working (Levidow, Sogaard, & Carr, 2002; World Bank, 2006), including forming effective linkages with relevant actors such as the farmers (Gibbons et al., 1994).

Conclusion

The analysis presented in this paper acknowledges governance challenges associated with impartiality, credibility, and neutrality tensions linked to biotechnology regulation. The paper has, however, gone beyond biotechnology governance rhetoric to open up a new thinking around how biotechnology debates can be enhanced through policy brokering.

Through the lens of different intermediary organizations and Kenya's overall experience in regulatory policy process, the analysis has identified several policy and practice implications that the policy brokering function brings to the process of promoting pro-poor biotechnology development. The paper has argued that if potential brokers are analyzed from the perspective of understanding their role and stakeholding in the regulatory change process, this may help breakout the current polarized anti- and pro-biotechnology debates and thereby focus on how to enable productive biotechnology development. It has noted that policy makers can make informed decisions regarding what agencies and/or brokering tasks to support and the likely implications for putting biotechnology research to use. The motivation behind this is to harness the opportunities presented by these intermediary agencies in order to stimulate positive policy change that will impact biotechnology development. This implies that the policy brokerage function needs to be given critical thought during the start up of development initiatives in order for this to be integrated in the strategic objectives upfront. Consequently, this is likely to impact a systemic value to the development of the biotechnology subsector.

Due to the pervasiveness and dynamism of the brokering function that presents implementation challenges, the effectiveness of a policy brokering framework to deliver success in the biotechnology sector rests on a much wider set of principles such as, e.g., taking cognizance of the local politics, demands of the citizens, and the perceptions of the role and the value of brokers in the society. This being the case, the incorporation of policy brokers in the overall biotechnology innovation process

is dependent on a process of institutional and policy learning and is likely to be a long-term process. It is nevertheless a different way of engaging stakeholders in a meaningful and informed way.

Notes

1 Here, we use the term biotechnology to mean the manipulation of living organisms to produce goods and services useful to humans. However, we make a distinction between traditional (or conventional) and modern biotechnologies. The traditional approach allows the development of new products (such as seed varieties) by the process of selection from genetic material already present within a species, while the modern (transgenic) approach develops products (such as seed varieties) through insertion of genetic material from different species into a host plant. These products are known as genetically modified organisms (GMOs).

2 Innovation from an Agricultural Innovation System perspective is considered to be the result of a process of networking and interactive learning among a heterogeneous set of actors such as farmers, input industries, processors, traders, researchers, extensionists, government officials, and civil society organizations (World Bank, 2006).

3 Boundary organizations are sites of simultaneous production of knowledge and social order facilitating collaboration between scientists and nonscientists. They create a combined scientific and social order through the generation of boundary objects (e.g., regulations) and standardized packages (Guston, 2001).

4 The interim National Biosafety Committee (NBC) has since been replaced by the National Biosafety Authority (NBA) formed under the provisions of this act. This agency is responsible for all biosafety matters in relation to GMOs.

5 In 2006, at the height of the biosafety bill development in Kenya, the International Service for the Acquisition and Application of Agri-Biotech (ISAAA), in conjunction with other players, brokered the initiation and launch of a biotechnology knowledge-sharing platform, the Open Forum on Agricultural Biotechnology in Africa (OFAB) (http://www.ofabafrica.org/country_chapter.php?id=1). OFAB meetings continue to be held monthly through the coordination of ISAAA.

6 Previously, the credibility of the NBC was questioned on the basis of the long periods taken to approve GM research applications (personal communication with research scientists involved; see also Ayele et al., 2006). This situation has improved, which may be attributed to familiarity with technology and a legally binding regulatory framework that led to the establishment of the NBA.

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Appendix 1: Selected Media Reports Showing the Never Ending Controversies Surrounding Kenya's Biotech Regulatory Process

Source	Media Report Title	Summary of Issue(s)	Remark/Writer
Online Sunday Nation (SN), 25 Apr. 2010.	Move to shield Kenyans from GMOs	Report claims that appointment of officers of NBA by the Minister for Science and Technology would enhance safety of GMOs through vetting using proper importation procedures.	Article prompted by fear that GM maize seed had illegally been imported.
Online SN, 13 Mar. 2011.	United States pushed for passing of the Biosafety Act	A diplomatic cable from U.S. ambassador to Kenya sent to American Secretary of State in March 2009, revealed by whistle blowing "wikileaks" noted that American government was the main force behind the speedy enactment of the Biosafety Act that paves way for introduction of GM products in Kenya.	Writer G. Gatonye
Daily Nation (DN), 14 Mar. 2011	Millers brush off claims of GMO cereal imports	Protests in Nairobi by KBioC network & Unga revolution groups urging the government not to permit importation of GM crops prompts the Cereals Millers Association chairman to refute claims that millers have imported GM maize.	Article by a Nation Newspaper correspondent
Nature News, 11 Jul. 2011	Kenya set to give green light to GM crops	Signing of the draft regulations by Minister for Science and Technology making them operational. For scientists, commercialization of GM products is soon becoming a reality. Dissidents' voices from KBioC network expressed concern that this will lead to patenting of seeds which to farmers is unethical and undermines their right to save seeds.	Writer N. Gilbert
DN, 14 Jul. 2011	Kenya approves import of GMO maize	The Cabinet through the President issues a statement that approved importation of GM maize to avert a food crisis. Importation would be done under conditions, namely, to be used for production of flour only; to be clearly labelled; millers to seek authorization from NBA.	Article by Nation reporters. This approval sparks diverse reactions some in support and others opposing the move.
http://www.allaafrica.com 11 Jul. 2011	Kenya: The shocking reality about GMOs	—	Article by D. Opiyo

Appendix 1: Continued

Source	Media Report Title	Summary of Issue(s)	Remark/Writer
The Standard newspaper, 18 Jul. 2011	Minister vows to block "unfit" GMO imports.	A cabinet minister objects the cabinet approval of GM importation citing political interests where importers want to cash on duty free imports as a result of food crisis. Another cabinet minister expresses her concern regarding safety of the intended GM imports. She praised organic farming as an effective tool of fighting food insecurity and urged the government to engage in sustainable and safer ways of increasing agricultural production.	Reports from the counties by E. Cheserek and V. Kimutai
DN, 18 Jul. 2011	Leaders split on bid to import GM maize	Some members of parliament express dissatisfaction with the cabinet approval to import GM maize. Other policy makers react to this move by supporting GM technology openly.	Article by Nation Newspaper reporter
Business Daily, 20 Jul. 2011	Kenya: State plans drive to popularize GMOs amid raging debate	—	Article by G. Omondi
Civil society, 21 Jul. 21 2011	Kenyans are faced with a serious crime against humanity—feeding GMOs?	An open letter to the Kenyan government and copied to relevant key Ministries and individuals in biotechnology arena. Letter endorsed by two civil society groups.	Article distributed by S. Kinuthia

Source: Various secondary sources including media current reports in local newspapers. For media reportage involving biosafety bill formulation process between 2005 and 2009, see Kingiri (2011a).