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**Dynamics of biosciences regulation and opportunities for biosciences
innovation in Africa: Exploring regulatory policy brokering**

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DYNAMICS OF BIOSCIENCES REGULATION AND OPPORTUNITIES FOR BIOSCIENCES INNOVATION IN AFRICA: EXPLORING REGULATORY POLICY BROKERING

Ann Kingiri¹ and Andy Hall²

Abstract

Knowledge brokering has been explored in the innovation literature to understand how different innovation tasks are organised toward technological development. This paper reflects upon the role of different organisations as knowledge brokers in regulatory policy processes towards putting biosciences research into use. It identifies a practical function-based typology that describes four categories of policy brokers who perform different tasks, with the potential to impact biosciences regulatory policy change. The paper concludes with a brief exploration of how policy can support the different functions of regulatory policy brokerage to enhance the translation of biosciences research into use for the benefit of the poor. Using regulatory policy-making in Kenya as an example, it contributes to growing scholarship that seeks to link knowledge emanating from research with policy-making and economic development, particularly in an African context.

Key Words: Biosciences, Biotechnology Regulation, Knowledge Brokers, Policy Brokering, Africa, Kenya

JEL Codes: L26, L31, L33, N5, N57, O13, O19, O31, O32, O33, O34, O55, P48, Q12, Q13, Q16, Q28

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LIST OF ACRONYMS

AATF	-	African Agricultural Technology Foundation
ABNE	-	African Biosafety Network Expertise
ABSF	-	African Biotechnology Stakeholders Forum
ACTS	-	African Centre for Technology Studies
ASARECA	-	Association for Strengthening Agricultural Research in Eastern and Central Africa
ATDF	-	.African Technology Development Forum
ATPS	-	African Technology Policy Studies Network
BICs	-	Biotechnology Information Centres
BIOEARN	-	East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development
CABE	-	Centre for African Bio-Entrepreneurship
CABI	-	CAB International (Formerly Commonwealth Agricultural Bureaux)
CBD	-	Convention on Biological Diversity
CGIAR	-	Consultative Group on International Agricultural Research
CIN	-	Consumer International Network
COMESA	-	Common Market for Eastern and Southern Africa
CRT	-	Central Research Team, RIU
DFID	-	Department for International Development, UK
FAO	-	The United Nations Food and Agriculture Organization
GDP	-	Gross Domestic Product

GMO	-	Genetically Modified Organism
GTZ	-	Deutsche Gesellschaft für Technische Zusammenarbeit, now called the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
IAASTD	-	International Assessment of Agricultural Knowledge, Science and Technology for Development
ICTSD	-	International Centre for Trade and Sustainable Development
IDRC	-	International Development Research Centre
IFPRI	-	International Food Policy Research Institute
ILRI	-	International Livestock Research Institute
IPM	-	Integrated Pest Management
IPR	-	Intellectual Property Rights
ISAAA	-	International Service for the Acquisition and Application of Agri-biotech
KABP	-	Kenya Agricultural Biotechnology Platform
KARI	-	Kenya Agricultural Research Institute
KBC	-	Kenya Biosafety Coalition
KBioC	-	Kenya Biodiversity Coalition
KEGCO	-	Kenya GMO COncern Group
KENFAP	-	Kenya Federation of Farmers and Producers
KEPHIS	-	Kenya Plant Health Inspectorate Service
KNFU	-	Kenya National Farmers Union
KOAN	-	Kenya Organic Agriculture Network
KSTCIE	-	Kenya Standing Committee for Export and Imports

LINK	-	Learning INnovation Knowledge
MDGs	-	Millennium Development Goals
NBA	-	National Biosafety Authority
NBC	-	National Biosafety Committee
NEPAD	-	New Partnership for Africa's Development
NGOs	-	Non-Governmental Organisations
OFAB	-	Open Forum on Agricultural Biotechnology in Africa
PBS	-	Program for Biosafety System
PCPB	-	Pesticides Control Products Board
R&D	-	Research and Development
RABESA	-	Regional Approach to Biotechnology and Biosafety Policy in Eastern and Southern Africa
RIU	-	Research Into Use
S&T	-	Science and Technology
STEPS Centre	-	Social, Technological and Environmental Pathways to Sustainability Centre
UK	-	United Kingdom
UN	-	United Nations
UNEP-GEF	-	United Nations Environment Programme Global Environment Facility
UNU-INTECH	-	United Nations University Institute for New Technologies
UNU-MERIT	-	United Nations University Maastricht Economic and Social Research Institute on Innovation and Technology
USA	-	United States of America
USAID	-	United States Agency for International Development

WEMA

- Water Efficient Maize for Africa

1. INTRODUCTION

The Research into Use (RIU) programme, supported by the UK's Department for International Development (DFID), has been experimenting with how agricultural research may be better organised to impact positively on poor communities in different countries in Africa and Asia. One outcome of the programme has been the revelation of the renewed and revitalised role of innovation brokers or intermediaries in influencing significant institutional and organisational innovations in agricultural systems (Hall, 2010). The findings that are emerging from the RIU experience suggest that brokers perform a variety of innovation management tasks. This paper examines one of these tasks in detail — that of regulatory policy brokerage. By exploring regulatory policy brokerage in the agricultural sector, this discussion paper deals with a major challenge facing many development initiatives: that of linking knowledge production, policy-making and economic development. It focuses on the relatively unexplored new biosciences, biotechnology and biopesticides sub-sectors.

It is now widely accepted that agricultural research has fallen short of contributing effectively to development and poverty reduction (IAASTD, 2009). This has resulted in numerous efforts by development policy analysts and researchers to look for effective methodological tools that may help address this stalemate and lead to pro-poor innovation through improved innovation capacities. Frameworks that promote a systems approach to development, for instance, have revealed that innovation can be triggered by many factors that go beyond research knowledge, including policies, technology and markets (World Bank, 2006). Insights from such frameworks can further elaborate on the influence of actors who position themselves as intermediaries in the innovation system (Klerkx & Leeuwis, 2009). This may come about through the way innovation activities are organised and articulated, and what sort of influence policy has on ensuing practice.

Biosciences development is now accepted as key in addressing many developmental challenges (FAO, 2004, 2010). It is also now understood that for biosciences research to

translate into use in order to benefit society, an enabling environment is needed — this includes institutions, policy and markets (Fukuda-Parr, 2006). Some important elements of the enabling environment include intellectual property rights (IPRs) regimes, regulations for input markets (particularly seed and chemicals) and biosafety regulation (in the case of transgenic crops). As Fukuda-Parr contends, dealing with these elements poses a challenge to biosciences development, considering the organisational, institutional and social factors that influence the process. In addition, in the highly fragmented field of biosciences research and development, many organisations play different intermediary roles, including regulatory processes brokering, which may be seen as a minor role couched in other major innovation brokerage roles (see, for example, different organisations promoting biotechnology development in www.isaaa.org; www.ifpri.org; www.aatf-africa.org; www.nepadbiosafety.net). Arguably, this regulatory policy brokering role may be dynamic, determined by the situation, the suitability and the capacity of different knowledge brokers to perform certain tasks towards addressing the situation at hand. Consequently, this may be viewed as an opportunity for policy brokerage towards creating an enabling environment for agricultural innovation in a developing country context through:

- Addressing gaps that relate to institutional and regulatory capacities (Bananuka, 2007)
- Enhancing and promoting the complementary roles of public and private investment, not only in technological capacity development (Hall, 2005) but also in regulatory policy-making (Karembu et al., 2010)
- Fostering knowledge flow through linkages between different actors in the agricultural innovation system (Clark, 2002)
- Reducing the suspicion that exists between biotechnology developers, scientists and knowledge users (Kingiri, 2010)

All this suggests that it is crucial to start looking into the new and emerging roles of knowledge brokers in regulatory policy in light of the positive impact this may have on

innovation policy. This is important because different actors in the innovation process have different capacities, skills and resources, all of which need to be harnessed for development (Hall, 2005).

Theory predicts that brokering knowledge or innovation includes multiple catalysing and intermediary functions, including: forming partnerships, advocacy, capacity building, mediating, gathering and disseminating information and knowledge, training and facilitation (Klerkx & Leeuwis, 2008; Klerkx et al., 2009a,b; Howells, 2006). These functions are, without doubt, important for putting research into use but have not received adequate attention empirically in the area of agricultural biosciences. In particular, less attention has been paid to dynamics related to controversial biosciences subsystems from the perspective of brokerage and how this could foster productive regulatory policy change. This is important because governance of biosciences, particularly biotechnology, is multifaceted and many interested parties in public and private sectors claim to be stakeholders (Harsh, 2005; Fukuda-Parr, 2006; Ayele et al., 2006). For instance, the role of “high profile” public-private partnerships in catalysing biotechnology innovation has received considerable attention, especially by researchers (Spielman et al., 2006; Spielman, 2007; Hall, 2005). In addition, nongovernmental organisations (NGOs) that work on biotechnology regulation have been linked to retrogressive “epistemic” brokerage (Herring, 2010). This has, at times, fueled major controversies that have slowed the translation of biosciences research products into use. Arguably, the regulatory policy brokering role that has been played by many organisations has not been given adequate research attention from the perspective of its impact on innovation. It is also important to understand the practical dynamics that govern the establishment and operation of such mechanisms, and how the respective contexts influence the brokering function (Hall, 2005).

This paper, therefore, aims to achieve several purposes. Firstly, using case studies of a number of organisations, it explores the circumstances that have led to their renewed role as regulatory policy brokers. Secondly, through the lens of biosciences regulatory policy

process, it explores how these organisations operate in practice and illuminates the factors that determine their effectiveness as policy brokers. Thirdly, it asks how policy can make better use of these types of organisations in its efforts to get research into use. This paper's research approach is in line with the emerging thesis that focuses on emerging agricultural innovation brokers, their unique functions and eventual impact on the overall innovation system (see, for example, Klerkx & Leeuwis, 2009; Hall, 2010). The embedded empirical analysis is spurred by a number of observations:

- Regulation of biosciences is influenced by political economy of biosciences and locality (Wield et al., 2010)
- Strategic state, non-state and international organisations are known to be agents of knowledge transfer for policy change (Stone, 2002). Recently, this role has been observed in regulatory policy-making as well (Karembu et al., 2010)
- There are opportunities/challenges presented by these organisations and the dynamics of operations for pro-poor biosciences research in Africa — an area that remains largely unexplored (Spielman, 2007).

The paper is structured in as follows: The next section outlines the analytical framework for this paper by exploring the brokerage concept as debated theoretically in the literature, the research approach and the context for brokerage in biosciences research and development. This is followed by a section that draws upon empirical material to analyse, discuss and classify the selected cases based on their potential to influence regulatory policy change. The paper concludes by drawing empirical lessons for policy on realistic strategies that can make better use of such broker organisations in order to get research into use.

2. CONCEPTUALISATION OF THE TERM ‘POLICY BROKER’

The aim of this paper is to understand how brokering occurs in regulatory policy dialogues in a practical sense and to draw lessons on how to stimulate the process of translation of bioscience research into use. Brokerage as a concept is not new in the innovation literature and different terms have been used to describe its meaning. Traditional and emerging organisations undertaking this role have been described variously in the literature as innovation brokers, intermediary organisations, systemic intermediaries, facilitators of innovation and boundary organisations (Winch & Courtney, 2007; Klerkx & Leeuwis, 2008a, 2009; Klerkx et al., 2009a, b; Howells, 2006; Guston, 2001). In biotechnology regulatory debates, the term epistemic broker has been used to describe those environmental NGOs that oppose biotechnology development (Herring, 2010). Winch & Courtney (2007, p. 751) define an innovation broker as “an organisation acting as a member of a network [.....], focused on enabling other organisations to innovate”. The brokerage concept — and its articulation from an agricultural innovation system perspective — has also been extensively discussed by Klerkx et al. (2010) & World Bank (2006). One key area of agreement in these debates is the point that innovation is a product of intense networking and interactive learning among multiple actors who play different complementary roles. This implies that the role of a broker or intermediary is about mediation towards strengthening the working and delivery of a system as a whole. But, as Howells (2006) observes, brokering may not necessarily be the main function of an organisation, which can push its function of an intermediary to a secondary role.

Klerkx et al. (2010) & Klerkx et al. (2009a,b) describe different tasks that a brokering organisation performs, which include different elements of demand articulation, network brokerage, innovation process management and knowledge brokering. Demand articulation is important during the emerging phase of a technology when the degree of uncertainty is high. It is defined as “an iterative, inherently creative process in which stakeholders try to unravel preferences for and address what they perceive as important

characteristics of an emerging innovation” (Boon et al., 2008, p. 645). It involves diagnosis and analysis of problems and articulation of needs. Network brokerage helps to connect the suppliers and users of knowledge in order to address market and system failures. Innovation process management involves organising and managing the network.

With this broad understanding of the brokerage concept, policy brokering has been applied to pursue the objective of this paper. In relation to biosciences regulation, some of the tasks policy brokers undertake include advocacy, lobbying policy-makers for policy change, training, information sharing among others (for details see Karembu et al., 2010; Action Aid, 2004; Kingiri, 2011). The use of the policy brokerage concept is based on the understanding that the emergence or setting up of an intermediary organisation depends on the prevailing institutional environment (Klerkx et al., 2010). Further, as Van der Meulen et al. (2005, cited in Klerkx & Leeuwis, 2009, pp. 851-2) note, “the establishment of an intermediary organisation is often contingent on the specific context or on typical opportunities and needs within research and innovation sectors.” This implies that different organisations may behave and impact policy differently in different contexts.

As summarised in Klerkx et al. (2009a, pp. 11-12), the brokerage role is confounded by a number of complex challenges that may impact the expected outcome. These include tensions over legitimacy and neutrality of brokers, and questions over whether stakeholders or clients consider them to be honest in their deliberations. There are also issues of ambiguity of functions arising from different organisations articulating multiple and sometimes conflicting and competing roles and difficulties in evaluating the impact of brokerage functions that may affect sustainability after withdrawal or lack of financial backing.

Despite the tensions, the catalytic and facilitation role played by innovation brokers adds value through efficacy and harmony in an innovation process. Drawing insights from the features and nature of brokering functions discussed here, policy brokerage can serve as a

conceptual framework for analysis of related functions that public and private organisations undertake in regulatory policy processes. The focus of this paper is the new biosciences that are knowledge-intensive and the backdrop of a difficult terrain to navigate, given the numerous actors involved in the field. The role of brokerage may be critical here and can help complement other advancement and developmental goals. Moreover, there is also a need to analyse how the different innovation brokerage tasks relate to biosciences development. This is in line with the objective of the Research into Use (RIU) programme that seeks to enhance knowledge generation and utilisation for the purpose of impacting development and requisite social change in poor communities.

Using selected organisations as case studies, this paper analyses and predicts the sorts of roles policy brokering organisations might play relative to the tasks alluded to above and draws implications for policy. Drawing on insights discussed this far and for the purpose of this paper, the organisations identified as policy brokers are intermediary organisations that individually or as a group mediate between the demand side (e.g., farmers, government, etc.) and the supply side (research institutes, technology developers, etc.) in the regulation of the new biosciences knowledge infrastructure in Kenya, where research to support this paper was carried out.

3. CONTEXT FOR POLICY BROKERAGE: AN OVERVIEW OF BIOTECHNOLOGY REGULATION

In the last two decades, milestones in the new biosciences, particularly agricultural biotechnologies, have revolutionised the agriculture sector in developing countries (FAO, 2010). However, biotechnology development has since been slow and an inadequate regulatory framework has been one of the contributing factors. In Kenya, for instance, research efforts in the field date back to the 1990s when transgenic sweet potato was first approved for testing in the field, but since then no other product has been approved for commercial use. The aforementioned revolution had advanced in tandem with regulatory policy developments requisite for management of related biosafety risks (Nang'ayo, 2010). This had caused both organisational and institutional changes and realignments in line with the integrated mode of operations that these sciences demand (Smith, 2009; Kingiri, 2011).

Triggered by this unprecedented revolution, NGOs started to broaden their roles beyond traditional ones to look at biosciences research and innovation (Herring, 2010; Karembu et al., 2010; Harsh, 2005). In biotechnology development, Harsh (2008) identifies a number of roles that NGOs have started to perform, including helping farmers and the public experiment with biotechnologies by facilitating their participation in the public understanding of the term and engagement in the development of biotechnologies. Consequently, NGOs are considered to be knowledge nodes in the agricultural innovation systems around biotechnologies. However, given that biotechnology is a controversial science, Harsh (2008) cautions that such roles must be analysed in context and contingency. In addition, the moves to establish organisational structures for biosafety regulation to manage biotechnology research and development following the Cartagena Protocol convention (CBD, 2000) as well as the cost involved and the international and political context of the debates all provide a context for intermediary organisations to articulate the brokering role prominently as activists. Thus, a variety of brokers have recently emerged in response to social, economic and political challenges and

opportunities experienced by different actors. They have become strategic channels for knowledge and information flow as central policy brokers (see Herring, 2010 for a detailed analysis of the function of epistemic brokers in biotechnology revolution). Moreover, the evolving policy and institutional environment based on context has a role to play in shaping the brokering functions (Klerkx et al., 2010).

Organisations dealing with new biotechnologies tend to take on a brokerage role in three overlapping areas:

- Biotechnology projects where they either a) support particular projects as partners, sometimes managing multiple actors, including researchers, government and donors (Kingiri & Ayele, 2009; see also ISAAA's brokerage role in virus-resistant sweet potato and tissue culture banana projects at www.isaaa.org;) or b) campaign against biotech projects and prevent their commercialisation by lobbying the government and mobilising the public to reject them (Herring, 2010; Kingiri, 2011)
- Biosafety regulation. Many NGOs have influenced the development of regulatory frameworks in Africa by getting involved in activities around biotechnology, including information dissemination, training and sensitisation of the public, journalists, political policy-makers, scientists and regulators. Other organisations find themselves directly engaged in lobbying and/or support for the drafting of legal regulatory policy documents (for details of this see Karembu et al., 2010; Kamau, 2010)
- Importing GMOs food/feed products. This is a pathway through which various organisations start to get involved in the regulation of biotechnology products in addition to their other mandates. Examples include the Kenya Biodiversity Coalition Network, which has resisted the introduction of unauthorised biotechnology products (Sunday Nation, 2008). The Program for Biosafety System (PBS) has taken on the role of regulatory capacity building in African

countries towards the harmonious implementation of biosafety regulations (www.pbs.org).

As alluded to elsewhere, the systems failures slowing biotechnology development are linked to the lack of appropriate regulatory frameworks for governance of biotechnology. As Ikiara (2004) notes in reference to the failure of transgenic sweet potato in Kenya, these governance aspects include the management of biosafety, intellectual property rights regime, lack of trust between public and private sectors, and poor coordination between the national agricultural research organisations, donor agendas, farmers and national and international research collaborators, etc. To enhance better and more effective governance, regulatory policy brokers can play a pertinent role in strengthening linkages between political policy actors, biotechnology scientists, researchers, civil society actors, pro-biotechnology organisations, industry, farmers, consumers and regulators.

4. METHOD FOR DATA GENERATION AND CASE STUDY ANALYSIS

The empirical data to support this paper was derived from in-depth analysis of a number of organisational cases, all of which have links to the biotechnology and biopesticides agricultural sub-sectors. The criterion for selection of these cases was based on the organisations' documented roles in biosciences research and related activities (literature), and interviews with stakeholders in the sub-sectors conducted in Kenya between 2007 and 2011. The interviews focused on the roles of these organisations, including the involved scientists in bioscience regulation in Kenya and Africa in general. Guided by primary data from interviews and secondary material, these cases were analysed to understand the regulatory policy brokerage function of the organisations. The information obtained through the analysis further helps in developing a function-based typology. Drawing insights from Klerkx & Leeuwis (2009), a number of features have aided this endeavour:

- History of the organisation, including its outlook (global versus local)
- Agenda, including the cluster of activities that relate directly or indirectly to regulation and policy orientation with the assumption that a diversified policy orientation is likely to have more influence on policy
- Public trust and support in relation to public engagement
- The nature of partners/linkages
- Source and stability of funding

In the context of controversial biosciences — namely biotechnology and biopesticides — policy brokers seek to provide solutions to regulatory system failures arising from the institutionalisation of new biosciences knowledge infrastructure (Gibbons et al., 1994). Consequently, it is important to know how these brokers emerge, operate and eventually are embedded in the overall innovation system whose functioning they wish to improve

(Klerkx & Leeuwis, 2008b). What follows in the next section is a discussion and analysis of the selected case studies.

5. CASE STUDIES: ANALYSIS OF SELECTED ORGANISATIONS AS POLICY BROKERS

Eight organisations were picked as case studies for the purpose of this paper based on their policy brokerage role. The results of empirical-based analysis are presented in several forms. Firstly, each case is discussed in line with different brokerage functions, detailing what this entails for regulatory policy and practice. The effectiveness of each organisation as a policy broker is also explored. Secondly, the emerging narrative is presented in the form of a table (Table 1) and thirdly, a function-based typology of these cases is presented in another table (Table 2).

(i) The International Service for the Acquisition and Application of Agri-biotech (ISAAA) Africenter

ISAAA (www.isaaa.org) is non-profit international NGO that brokers agri-biotechnology technology transfer more generally. It is well-known for its consistent annual reports on the global status of commercialised biotechnology crops, which are referenced widely in relation to progress in biotechnology adoption (Clives, 2009). ISAAA AfriCenter is one of the regional networks of ISAAA and was established in 1994 in Zimbabwe, but later relocated to the International Livestock Research Institute (ILRI) campus in Nairobi, Kenya. Although it has an international orientation covering the whole of Africa, most of its activities are confined to Kenya — perhaps because of its location — and neighbouring East African countries, with limited activities in a number of other African countries.

ISAAA AfriCenter has varying brokering missions. Firstly, it brokers access to technologies, genes and protocols owned by the private sector and/or international research organisations. It had some success in this role over the clonal tree biotechnology programme trust, virus-resistant sweet potato and the tissue culture bananas projects (personal communication, 2007; Wambugu, 2001; ISAAA, 2010). Secondly, ISAAA has been at the forefront of brokering biosafety regulatory policy development in Kenya

(Karembu et al., 2010) and neighbouring African countries through sharing Kenya's experience at conferences, training and visits (personal communication, 2010) and organising "seeing is believing" field tours to neighbouring countries, where biotechnology products are already commercialised. These tours have largely involved politicians, regulators and journalists and were meant to influence the fast approval of biosafety policies (Karembu et al., 2010; personal communication, 2007). Specifically, ISAAA has been playing a steering role, coordinating the many actors — both in the public and private sectors — in the regulatory policy development process. Another way ISAAA has brokered the biosafety regulatory process is through outreach and communication. This is undertaken through biotechnology information centers (BICs), which are sources of free information and education materials on biotechnology released regularly to interested parties. In 2000, at the height of the biosafety bill development in Kenya, ISAAA (and AATF) brokered the initiation and launch of a biotechnology knowledge sharing platform — the Open Forum on Agricultural Biotechnology in Africa (OFAB). OFAB brings together stakeholders in biotechnology and enables interactions among scientists, journalists, the civil society, industrialists, lawmakers and policy-makers. ISAAA has since brokered similar platforms in Uganda, Tanzania and Nigeria (www.ofabafrika.org/country).

ISAAA is currently engaged in informing the public about biotechnology out of the realisation that scientists are poor public communicators. It thus bridges the communication gap in the field of biotechnology by training regulators, scientists and journalists in appropriate and effective communication skills. To reach out to the general public, ISAAA is exploring the use of mass media (radio) as a tool for public awareness through a programme that is broadcast in local dialects in Kenya and Burkina Faso (personal communication, 2010). By bringing together different stakeholders in the Regional Approach to Biotechnology and Biosafety Policy in Eastern and Southern Africa (RABESA), ISAAA has brokered a policy outreach initiative that to examine if there were any major trade implications if Africa adopted biotechnology products

(Paarlberg et al., 2006). This study was intended to influence positive biosafety policy developments in Africa.

ISAAA articulates its mission and the wide range of activities largely through an extended network of partners at the local, regional and international levels (public and private organisations, researchers, multinational companies, donors, seed companies etc.). It has several partners in the biotechnology seed industry, mainly in the US and India and is mainly funded by US Agency for International Development (USAID), the Rockefeller Foundation and Canada's International Development Research Centre (IDRC), among others. At the local level, ISAAA has developed a network of partners to perpetuate its biotechnology promotion mission. For instance, at the advent of biotechnology in Kenya in 1990s, it partnered with the Kenya Agricultural Research Institute (KARI), Monsanto, Danforth Center, US and Roodeplaat Vegetable and Ornamental Plant Institute in South Africa to promote a virus-resistant sweet potato project (Harsh, 2005).

ISAAA seems to have both social and environmental policy orientations embedded in its technology transfer implementation portfolio. However, its proactive approach to biosafety policy development attracted criticism from NGOs, who cited potential bias and influence from the biotechnology industry (personal communication, 2008 and 2010). In addition, the agenda being pursued by ISAAA may have been construed as being that of biotechnology promotion with biosafety policy brokerage roles being a means to achieve an end more generally. Although the organisation's ultimate goal is to impact social change through biotechnology innovation, promote safer environment and more sustainable agriculture by decreasing dependency on water, pesticides, and fertilisers, the undisputed promotional approach may have had a negative impact on intended policy outcomes. The fact that the funding agencies also seemed to pursue the same mandate may have led to impartiality, credibility and legitimacy challenges.

ISAAA may be perceived to be influential in terms of bringing together key actors associated with respective policy innovations. This perception has come about given the

organisation's efforts in projects around brokering, particularly biotechnology promotion dating back to the 1990s through its established network of banana tissue culture stakeholders. Other factors that have contributed to the organisation's credibility and influence include fairly stable financial support from donors and multinational seed companies; strong links with regional bodies promoting common trade interests like the Common Market for Eastern and Southern Africa (COMESA) and Program for Biosafety Systems (PBS); and a strong communication and awareness programme, particularly its Forum for Agricultural Biotechnology (OFAB) that attempts to make the private and public sectors and the general public dialogue on matters of biotechnology innovation. In Kenya, ISAAA has established a strong link with government agencies through the lobbying for the biosafety bill enactment (Karembu, et al., 2010; www.isaaa.org/kc).

(ii) African Agricultural Technology Foundation (AATF)

AATF (www.aatf-africa.org) is a nonprofit nongovernmental organisation with a regional focus. It was launched in Nairobi, Kenya in June 2004 with the aim of increasing productivity and use of biotechnology products for the benefit of resource-poor farmers in Africa (AATF, 2010). To achieve this objective, it is involved in a variety of brokerage activities, which are operationalised during brokerage of intellectual property rights (IPRs) currently in the hands of a few players, and making them accessible royalty-free for use in activities geared towards benefiting the poor. Thus, AATF plays a catalytic and brokerage role, fostering partnerships between the multiple actors involved, while articulating the demands and interests of each stakeholder. Examples of projects that AATF has been involved in include the Water Efficient Maize for Africa (WEMA) and the nutritionally enhanced sorghum varieties (for details of these projects, including actors involved, see AATF, 2010).

AATF also brokers regulatory policy development as a means to achieve its biotechnology developmental goal. Through its regulatory affairs office, it has been supporting biosafety capacity building, gathering and providing information on regulatory milestones in the world for the benefit of the African regulatory regime, and

has also been involved in public education and awareness. An initiative that fulfills this role is the knowledge sharing platform, OFAB, which AATF and ISAAA actively brokered. The two organisations have continued to finance monthly meetings (personal communication, 2008) of the platform. During the development of Kenya's biosafety legislation, AATF and ISAAA brokered the lobbying of its enactment through proactive awareness creation, targeting policy-makers and regulators (Karembu et al., 2010). Due to rising resistance from civil society actors, AATF and ISAAA brokered the founding of the National Biotechnology Awareness Strategy (BioAWARE) and Kenya Biosafety Coalition (KBC) through demand articulation and network formation (for detailed accounts of institutionalisation of these initiatives, see Kingiri, 2011). Arguably, these are supposed to be government initiatives but these two brokers brought in much needed resources — namely technical knowledge, finances, network formation skills and lobbying the ministry of agriculture — towards the inclusion of the private sector in biotechnology debates (personal communication, 2008; Kingiri, 2011). AATF brokering activities are funded by the Rockefeller Foundation, DFID, USAID, the Bill & Melinda Gates Foundation and the Howard Buffett foundation. Debatably, some of these entities are perceived locally as promoting new biotechnology innovations, which may have affected the credibility and neutrality of AATF and ISAAA as policy brokers.

The activities of AATF are oriented towards social change through poverty reduction, but the effects of these activities are yet to be seen, as most of the projects in the pipeline are still under research and development. The potential to broker knowledge that is currently unavailable to many developing nations and making it available to researchers and the resource-poor all are strong factors for negotiating and influencing policy change. In addition, the fostering of partnerships (networks formation skills) has meant that AATF has had a significant influence on institutional change linked to technological innovations, as evidenced by its OFAB and BioAWARE initiatives mentioned elsewhere (see www.ofabafrika.org and Kingiri, 2011). This notwithstanding, the biosafety policy brokerage role in itself is a means to achieving its ultimate technology development goal

and may create some tensions linked to conflict between clients agenda (farmers and funding organisations).

(iii) African Biotechnology Stakeholders Forum (ABSF)

ABSF (www.absfafrica.org) was founded in 2000 as a nongovernmental organisation with a regional focus targeting the Africa region. It is based in Kenya and hence many of its activities have been localised to Kenya. It works closely with ISAAA and other regional organisations such as AATF 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 intellectual property rights (ABSF, 2010). Its major programme areas are: capacity building in biotechnology, and public awareness and participation. It has been involved in creating awareness among policy-makers and policy analysts of the role of biotechnology in development. Its specific activities include biosafety policy and advocacy work, and engaging with biotechnology development projects by partnering with other organisations — for example, Biotechnology Trust Africa (previously Kenya Agricultural Biotechnology Platform, KABP) — and local universities. Also, it facilitates communication, improving the public understanding, supporting policy development, creating capacity for information generation and dissemination on biotechnology and related issues.

ABSF — even if it has not declared this openly in its mission statement — endeavors (albeit indirectly) to influence biotechnology policies and implementation. It has done this through conducting biotechnology awareness and training sessions for members of the Kenyan parliament, government officials involved in legislating and regulating biotechnology activities, journalists and other media actors. Just like ISAAA, ABSF's ultimate goal is oriented towards pro-trade biotechnology policies. This is based on the conviction that biotechnology can reduce social challenges affecting the poor in Africa.

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, a majority of its members are also practising scientists at Kenyan universities, where they conduct research, teach and supervise students. For a while now ABSF has been a member of the government decision-making organ, the National Biosafety Committee (NBC), now the National Biosafety Authority (NBA). It has also been associated with a number of pro-biotechnology organizations, such as USAID and Monsanto, who have supported its activities in numerous ways. Because of these relative advantages, ABSF was a key actor in the development of Kenya's biosafety law, where it played a role of lobbying and advocacy (personal communication with a staff member of a donor agency, 2008).

It receives funding from the Rockefeller Foundation and, previously, from UNEP-GEF for biosafety and biotechnology policy advocacy. It also receives funding from USAID and Monsanto for advocacy and lobbying work. This may create tensions linked to impartiality and neutrality issues as well issues over credibility of ABSF as an honest broker.

(iv) Kenya Biodiversity Coalition (KBioC)

This is a coalition of over 70 members (as of November 2010). Most members are nongovernmental organisations (NGOs) within the civil society arena, farmer associations and consumer associations. This coalition was previously known as the Kenya GMO COncern Group (KEGCO), comprising 12 members (as of September 2004). KEGCO was formed in 2004 as a coalition of NGOs to campaign against the research, development and commercialisation of genetically modified products in Kenya. It is important to note that some of the NGOs that make up KBioC are themselves coalitions of other NGOs. The secretariat to this coalition is the powerful Kenya Federation of Farmers and Producers (KENFAP), previously the Kenya National Farmers Union (KNFU), with representatives from all over Kenya. On matters of biosafety, the coalition has, on a number of occasions, been represented by another powerful

organisation, the Consumer International Network (CIN). During the development of the biotechnology policy in Kenya, this coalition was financed and technically supported by Action Aid International. Even after the enactment of the Biosafety Act — that it proactively lobbied against (see media reports, Action Aid, 2004) — the coalition has continued to front the concerns of the public through the media on matters of GMOs (numerous media reports are available to support this).

Biotechnology and related issues are not the primary objectives of KEGCO/KBioC, since the constituent members have got other activities commensurate with their core objectives. They are, however, brought together by their conviction to protect Kenya's biodiversity. They perceive unregulated biotechnology to be a threat to agriculture and the environment and are particularly concerned with the public participation aspects of regulation (personal communication with a staff from a civil society NGO, October 2010). They are involved in biosafety work, primarily that of advocacy, education, awareness creation, and lobbying against legislation that does not promote biological safety. They lobby the government as opposed to particular biotechnology organisations and projects. However, when lobbying the government, they take cognisance of hidden interests pursued by particular biotechnology projects, multinationals and funding bodies. It is important to note that a key role this organisation plays is that of public education, albeit from motives of activism and sometimes without sound scientific basis.

Most members of KBioC frame their focus as being around issues of environmental and community safety, sustainable agriculture, food security and sustainable livelihoods. With regard to biotechnology, the key agenda of KBioC has been lobbying for responsible deployment of biotechnology products, taking into consideration the views of the majority — the non-scientific communities. One particular member of this coalition (Kenya Organic Agriculture Network, KOAN), however, advocates for GMO-free zones to protect the interests of organic farmers. This means they are often at loggerheads with pro-biotechnology players, who perceive KBioC members as anti-biotech activists (personal communication with a number of scientists in pro-biotech NGOs and the

academic arena). As much as both groups agree on responsible science, they disagree on the strategies that should be employed to achieve a balance between science and biological safety.

KBioC works closely with farmers and community-based organisations. It is also able to consolidate finances to achieve their collective agenda, public awareness, education, advocacy and lobbying. This is in addition to its ability to attract funding from financing agencies who agree with its views, thus supporting its advocacy work. Action Aid is known to have been a supporter of KBioC on matters to do with biotechnology legislation policies (Action Aid, 2004). These connections present this coalition as a strong advocate of policy, institutional and social change within government and local communities. The fact that it is not affiliated to the government in any way removes the organisational and institutional barriers that may hinder it from acting proactively. There is, however, a danger of neutrality and independence, considering that the funding agencies linked to this coalition includes environmental lobbyists who are sometimes known to fight biotechnology development in Africa (personal communication, 2007). It is also unclear whether the brokerage role can be sustained outside private funding.

(v) Kenya Organic Agriculture Network (KOAN)

There has been an organised organic farming network in Kenya that dates back to the 1990s. KOAN (www.koan.co.ke), however, was 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”. It has over 200 corporate members as well as individual members who, through the integrated network, serve over 50,000 people (KOAN, 2010). The organisation has a technical secretariat that oversees the implementation of its objectives in collaboration with its local and international partners and networks.

KOAN is engaged in a number of activities that include: developing key competencies, skills and strategies in the areas of organic agriculture production, marketing certification and standards, training extension and information, networking, policy and advocacy. According to its strategic plan, KOAN aims to continue with these activities, but with the major aim of ensuring that the organic sub-sector increases incomes among small-scale producers through sustainable land use and improved marketing.

One activity that KOAN has passionately pursued under the remit of policy, lobbying and advocacy on behalf of organic growers is that of 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.

The main agenda of KOAN is healthy living and sustainable agriculture, while re-orienting farmer practices towards agribusinesses around organic farming (KOAN, 2010). Its activities are orientated toward special sustainable policies that encompass environmental and social livelihood issues. KOAN has been influencing agricultural policies in various ways. Organic agriculture is now regarded as a strategy that offers a wide range of environmental (biodiversity, soil fertility, etc.), social and economic benefits to communities, contributing to poverty reduction and sustainable development (IAASTD, 2009). In recognition of this, the ministry of agriculture works closely with KOAN and organic growers. This has contributed to key notable policy milestones: the national soil fertility policy contains an elaborate section on organic farming (concerning organic sources of soil nutrients and the value of organic fertilisers in rehabilitating heavily degraded soils); the food and nutritional draft policy paper also acknowledges the role of organic produce in food and nutritional endeavours.

With regards to food safety concerns linked to GMOs, KOAN has partnered with other players under the KBioC coalition to lobby the government against GMO policies out of concerns for the public in Kenya. Due to the strategies adopted by the coalition to lobby the government — mainly through mass media and public demonstrations — the public

is now aware of GMOs, albeit from a non-balanced perspective. Members of this coalition, including KOAN, also receive widespread support from several politicians, especially on matters of GMO policies (Karembu et al., 2010, pp. 35-36) and due to its established connections with rural farming communities. The challenge for KOAN as a policy broker is the sustainability of the momentum of activities, considering that the government has declared biotechnology as one of the tools for development (RoK, 2006). If public stakeholders are to support the agenda of KOAN as a broker, then a trade-off has to be negotiated for balance to be achieved.

(vi) Real IPM

Real IPM (www.realipm.com) is a private company set up in Kenya in 2004, with operations in East Africa, Ethiopia and Ghana to promote integrated pest management (IPM) practices. It is linked to Dudutech Limited, a subsidiary of Homegrown horticultural company, and was set up to respond to the growing pesticides regulatory demands imposed on horticultural exports to Europe. Consequently, it pioneered the commercial production of bio-pesticides, initially targeting horticultural farmers, but it has expanded its clientele base to include small-scale farmers. Its research has generated regional and international interests (Biosight, 2009). The company's mission is to provide horticultural production companies with the technology and training required to reduce reliance on pesticides and fulfill customer expectations in Good Agricultural Practice. It has received support from the Research Into Use (RIU) programme to promote the production of a mycoherbicide to control the parasitic weed striga and promote seed priming. The focus on small-scale farmers and a cumbersome weed re-orientes Real IPM's agenda towards a production problem that has affected poor farmers for many decades.

In the process of registering products for commercial application Real IPM has encountered major regulatory hurdles. As a consequence of this, Real IPM has been pursuing policy brokering activities and agendas that include engaging with the government and scientists in registration, marketing and use of biopesticides. Previously, Kenya's legislation for agricultural inputs did not include biopesticides — a gap that

became apparent when Dudutech applied to the regulatory agencies for importation approval. This triggered a series of activities that include capacity building of regulatory officials through exposure to regulatory systems of other countries (personal communication, entrepreneur, 2011). This caused the Kenya Standing Committee for Export and Imports (KSTCIE) — made up of different organisations in the agricultural sector under the Ministry of Agriculture and KEPHIS secretariat — to consider reviewing existing laws to address the identified regulatory vacuum. Consequently, Real IPM's working relationship with players in the regulatory chain has evolved over the years.

Through its longstanding experience in securing registration of biological products with Kenya's regulatory agencies — Pesticides Control Products Board (PCPB) and Kenya Plant Health Inspectorate Service (KEPHIS) — Real IPM has been in a position to influence changes in regulatory policy processes. It brokered relationships leading to a review of import regulations and consequent drafting of Kenya's regulations for biological inputs in 2003. These relationships include between research and academic institutes undertaking the pre-registration efficacy trials, regulatory agencies under the ministry of agriculture (PCPB and KEPHIS), key policy actors in the ministry of agriculture, the network of actors in the rural farming system (including provincial administration, extension workers and farmer groups). It has also been able to provide guidance on what sorts of approaches work and what sort of regulatory capacity needs to be built for the biopesticide sub-sector to flourish.

Despite its larger goals of pursuing the interests of poor farming communities, Real IPM is profit-driven and expects to reap benefits in the short-run. There is a danger that if this is not realised it may need to shift its focus to other initiatives that have fewer regulatory hurdles. In addition, the issues of impartiality are likely to emerge during information dissemination and training activities.

(vii) Army worm control consortium

This consortium comprises researchers, NGOs and government ministries and departments that have come together to find ways of controlling the migratory African armyworm pest. Its aim is to oversee implementation of community-based armyworm prediction or forecasting, and ultimately production and marketing of a simple low-cost and environmentally-safe biopesticides. These two initiatives are funded by RIU due to the economic importance of tackling armyworm in the Kenya and Tanzania agricultural systems.

Forecasting focuses on a pheromone that is meant to attract female moths. Based on the outcome of the forecasting, control of the armyworm is done through the use of a bio-control agent that is marketed by private firms. The pheromone and the biopesticide require registration by the respective government agencies. This has slowed the translation of armyworm control technologies to the poor. The consortium is led by a not-for-profit science-based development and information organisation, CAB international (CABI), which is, therefore, engaged in various policy brokering activities to enhance a speedy registration process. CABI (<http://www.cabi.org>) has been able to persuade respective governments to support this initiative while securing their political and policy support. A number of significant achievements have been recorded. Firstly, the consortium has been brokering relationships with key players in the armyworm value chain. Secondly, the involvement of business-focused private actors has contributed to the mobilisation of the public sector to develop protocols for registration of biocontrol agents in Kenya. Consequently, a draft regulatory document for pheromones has been drafted and is being discussed by stakeholders. These developments have actually revolutionised how policy-makers think, operate and act to support promising innovations (Africanpress, 2010; RIU press release, 2010). Thirdly, the public arm linked to the biopesticides sub-sector has been strengthened through capacity building. The actors who have benefited include extension officers and the entire regulatory arm of the government, as well as farmers.

The consortium has, within a short period of time, created requisite innovation capacity to effect significant policy change in Kenya's ministry of agriculture. As a result senior officials have promised to fast-track the hitherto tedious registration process, while ensuring clarity and efficiency. They have also indicated that there is a possibility of waiving registration costs, initially borne by entrepreneurs. This suggests that such a consortium has what it takes to influence requisite institutional change for technological milestones to be recorded. There is, however, the danger of private sector members taking the lead in the brokering role, which may be seen as an invasion of government mandates. In addition, it is uncertain whether the private sector can be impartial in its undertakings, particularly where business is the motivating factor.

(viii) National Biosafety Authority (NBA)

Kenya's NBA is a regulatory body formed under the provisions of the Biosafety Act, 2009 (RoK, 2009). Although the Act was instituted by the president in February 2009, it was not till June 2010 that the NBA Board was launched. NBA is constituted of individual members appointed by the Minister for Higher Education, Science and Technology, and representatives of key regulatory agencies and government departments. Previously the NBA's work was undertaken by an ad-hoc National Biosafety Committee (NBC) that periodically brought together a wide range of stakeholders to ostensibly deliberate on GMO applications. 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 UNEP-GEF and PBS, funded by USAID (personal communication with a staff member of NBA).

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 spelt out procedures of risk assessment. This activity is still being contracted out to experts in academic and research institutes, perhaps because NBA is still in the process of 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 mainly to pro-biotechnology NGOs who masquerade as funding agencies, government partners in biotechnology, policy-makers, policy brokers, experts in biotechnology and biosafety, etc. Biosafety generation and dissemination is poised to be achieved through the Biosafety Clearing House. NBA is yet to operationalise this information portal.

The overall agenda of NBA relates to responsible transfer of GMOs, promoting a dual role of technology generation and safety. Orientation is basically social and environmental based on this broad government mandate. Thus, NBA may be perceived to be spearheading regulatory policies for public interests. Whether this is the case is debatable. The structure of NBA and its legal mandate situates it in a position to influence policy. However, from the experience of Kenya's biosafety policy-making, it is clear that NBA, though a government agency, cannot on its own influence policy change. It requires support from the public and the research/academic fraternity.

NBA has received funding previously from 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 NEPAD and the USAID-funded PBS. PBS is still funding the regulations implementation component of biosafety capacity building, while ABNE continues to support human regulatory capacity building.

Table 1. Classification of Organisations Involved in Biosciences Regulation and Indicators of Policy Influence

Organ	Type	Policy brokerage roles/activities	Agenda/focus	Potential to influence regulatory process	Challenges
NBA	Government regulatory and policy agency on biotechnology and biosafety matters	--Undertaking innovation management tasks as a primary role -Oversight of the biosafety system, including approval of GM applications, coordination of regulatory agencies that enforce the regulations, advising the government on biotechnology & biosafety matters through the Ministry of Higher Education, Science and Technology, develop biosafety implementation policies	-Establishing a framework for implementation of the Biosafety Act -Implementing the dual role of the Kenya government (biotechnology transfer and safeguarding the health & 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 -Require public and political support	-Inadequate capacity that leads to the masking of policy brokerage role by private actors -Pressure from researchers and other technology developers interested in a quick research and development process -Some demand articulation roles are unaccountably confounded by government bureaucratic administrative procedures -Competition over some policy management process tasks with other knowledge brokers
ISAAA	International NGO	-Brokerage of corporate technologies as an intermediary organisation -Biotechnology advocacy and public awareness -Performing a liaison function through brokering information and knowledge flow between public and private actors -Capacity building at both supply and demand sides for cooperation in biotechnology development	-Promoting biotechnologies and trade -Influencing the regulatory environment for biotech 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 over some policy management process tasks and funding sources with other knowledge brokers
ABSF	Regional NGO	-Brokering knowledge flows through biotechnology public awareness and education activities	-As a scientists lobby network, it seeks to promote biotechnology uptake through information dissemination	-Focus on academics and policy-makers, including media, as policy agents	-Competition over some policy management process tasks and funding sources with other knowledge brokers -Obligation to donors raising impartiality issues -Adequate and sustained funds
AATF	Regional NGO	-Brokering acquisition of intellectual properties through negotiation of licence agreements on behalf of farmers and researchers, thus making it possible for	-Create an enabling environment for trade in biotechnologies (intellectual property rights)	-Established network of technology developers, users, and researchers and scientists in both academic and policy arenas	--Obligation to donors raising impartiality issues

		<p>them to use proprietary technology without paying royalties. Acts as intermediary “honest broker” between technology developers and farmers</p> <ul style="list-style-type: none"> -Brokering knowledge flow through biotechnology public awareness and education activities 	-Biotechnology stewardship	-Well funded strategies	
KBioC	Local NGO association	<ul style="list-style-type: none"> -Warns against adoption of GMOs on account of threats to environment and biodiversity, hidden risks such as monopolisation of seeds by large companies -Lobbies government for restrictive regulations and safeguards against uncontrolled trade in GMOs -Educates public on negative aspects of GMOs, citing unbalanced and biased education by scientists 	Public policies that take cognisance of public interests and concerns	<ul style="list-style-type: none"> -Message to public comprises warnings of threats to biodiversity, potential monopolisation by multinational companies among others -Commands a wide following -Engages in pro-active strategies to attract political support 	-Obligation to donors raising impartiality issues
KOAN	National local NGO & farmer organisation	<ul style="list-style-type: none"> -Lobbying against GMOs citing the threat to agriculture -Advocacy and public awareness 	-Farmer network broker facilitating sustainable agricultural practices, hence against GMOs production	<ul style="list-style-type: none"> -Message to public comprises warnings of threats to biodiversity, potential monopolisation by multinational companies among others 	<ul style="list-style-type: none"> -Seen as a threat to new biosciences development -Conflicting government policies (pro-biotechnology) and pro-diversity protection
Real IPM	Regional private company with international orientation	-Reinvigorating the agricultural sector through promotion of IPM practices as environmentally feasible options; generating regulatory relevant data for policy decisions	-Hybrid development and commercial entrepreneurs with social and environmental orientations	<ul style="list-style-type: none"> -Established interaction & relationship with policy actors, researchers, and horticultural growers network; links with government agencies in the Ministry of Agriculture -Impartiality in demand articulation. -Popularity of products in terms of social and environmental concerns 	-Bureaucracies within the government agencies that slows the development process
Army worm consortium	An ad-hoc group of interested partners in development and business sectors	Advocacy and lobbying the government and regulators for regulatory policy change, brokering relationships in the biopesticides sector value chain, training players in various capacities for delivery of the technology and policy change	-Development and commercially-oriented with community-based approach	-The capacity to mobilise the key policy actors situates it in a position to influence policy change at another level	-Uncertainty of the lead agencies to remain impartial. Competition with the public arms of government

Table 2. Function-Based Typology of Intermediary Organisations as Policy Brokers

Type	Tasks	Features	Pros	Cons	Example
Embedded brokering: 3rd party technology agencies	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 organisational 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 & credibility tensions, conflicting objectives impacting impartiality -Heterogeneous functions and competition among knowledge brokers	ISAAA, AATF, ABSF
Embedded brokering: business & development organisations	Advocacy for regulatory change, data collection to generate evidence to support regulatory policy and to bring about change in regulatory practice	Economic and social orientation spurs the policy brokerage function pursued in a less structured way	-The shifting role of NGOs and private sector to spur significant institutional and organisational innovations and linkages (systemic value)	-Uncertainty of funding to sustain the policy brokerage function -Uncertainty of outcome of brokerage to steer effective reformism/policy change	REAL-IPM, Armyworm consortium, KOAN
Proactive activism	-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 & credibility linked to pro and anti technology lobby groups.	KBioC, KBC
Boundary spanners	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	-Objective, neutral and credible	-Inadequate skills and competencies needed to span boundaries confounded by political bio-economy landscape	NBA

Description of the Different Types of Policy Brokers based on typology

Table 2 identifies four categories of brokers, two of which are closely interrelated.

A. Embedded brokering

This typology describes a brokering function that is part of the innovation process, where policy brokering is embraced to achieve a certain agenda. For the cases analysed in this paper, two types of embedded brokers have been identified.

a) Third party technology agencies: These have assumed a policy brokering role as part of an agenda to improve access to biosciences. As demonstrated in this paper, they engage in crucial secondary innovation tasks that stimulate a dynamic and systemic engagement that leads to useful policy change. This role is embedded in the overall technological development goal, which implies that the resources needed to drive the policy process are readily available. Perhaps not deliberately, these actors present themselves as neutral policy brokers. This may have ramifications that relate to impartiality.

b) Business and development organisations: These are agencies that present themselves as entrepreneurs and development agencies at the same time. They engage in policy brokering as part of an agenda to create an enabling environment for business and social development in agri-based innovations. Because of their business orientation, neutrality tensions may arise as well as challenges in sustaining the policy brokerage function to a point where significant policy change is experienced.

B. Proactive activism

This typology describes agencies that engage in intense advocacy and lobbying to pursue a pre-determined policy perspective. They command authority from their positions at

junctures of networks enabling intense learning and diffusion of different knowledge claims. In addition, they command clients' attention and trust that augment the dynamism involved. These factors are potentially enough to cause a prompt and significant institutional and policy change. However, the ensuing intense lobbying and advocacy may be detrimental to innovation, especially in cases of uncertainty and politics (see Kingiri, 2011; Herring, 2010). This may affect impartiality, bringing about protracted tension that may further delay the innovation process.

C. Boundary spanners

This typology is characterised by the mediation, communication and coordination tasks to bring about consensus amongst clients situated at different sides of policy boundaries. The boundaries may be brought about by differences in agenda being pursued or different opinions around how policy should be pursued like in the case of biosciences. Boundary spanners, thus, provide a forum for discussion and negotiation, and are accountable to groups on both sides of the boundary. Although the one case considered in this paper is not conclusive enough to describe this typology, boundary spanners command trust from clients on both sides due to the expected non-biased approach to negotiation (Kristjanson et al., 2009). This may enhance credibility while minimising chances of tensions linked to neutrality. One main challenge that boundary spanners may encounter relates to the high-level skills and competencies needed to perform this role.

6. DISCUSSION

As shown in Tables 1 and 2, the analysis of the cases has revealed four broad categories of policy brokers in Kenya's biosciences knowledge infrastructure. One key characteristic cutting across the four categories is the articulation of policy brokerage as a secondary function to achieve a larger aim. The two distinct embedded brokerage categories expose a policy brokerage function that is heavily integrated into overall routine activities. The cases falling under these categories have primarily a broad-based focus, expanding their functions to facilitate regulatory policy processes. 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. Business and development organisations like Real IPM and the Army worm consortium engage in policy brokering as a means to pursuing their social and economic endeavors as entrepreneurs. Arguably, their starting point is farmers' access to technology, initially structuring their activities around bringing the right players together. Along the way regulatory hurdles impede their developmental goal, which prompts them to lobby support from influential partners in public arena. These types of brokers are emerging in an unprecedented way, causing significant disruptions in the agricultural sub-sectors (see Hall et al., 2010). KOAN is a different type of special apex organisation that has taken up the policy brokering role as an embedded advocacy function on behalf of inadequately placed members, mainly smallscale farmer groups engaged in organic farming as a business enterprise. KBioC and KBC demonstrate how proactive activism can spur policy change through advocacy and direct lobbying for clients' engagement in policy dialogues. Because they tend to identify with particular needs of clients, they generate relative trust and credibility.

The four categories of brokers discussed here attract different challenges in articulation of the policy brokerage function. These include neutrality and competition issues made worse by the political nature of new biosciences, particularly biotechnology. The features of the proactive activism typology, for instance, reinforce the political nature of the new

biosciences knowledge infrastructure, as has been debated by governance scholars (Tait et al., 2006; Herring, 2010). The analysis presented in this paper, however, goes beyond the embedded governance rhetoric and opens up new thinking around how intermediary organisations can function as policy brokers for positive influence through proactive activism. Thus, productive policy brokerage calls for some sort of “boundary spanning” effectively performed by a boundary spanner. Of all the cases analysed in this paper, NBA is the only one that qualifies as a boundary spanner. Arguably, as the analysis suggests, in the Kenyan context a public organisation is best suited to mediate between the different interests of different clients and the controversies this generates. It thus serves as a credible and neutral platform where impartiality may be pursued towards attaining a balance of views. 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 stakeholder groups (Kristjanson et al., 2009). Boundary organisations have also been popularised in science policy debates, mediating between science and the public in controversial policy arenas (Jasanoff, 1990 and regulation of biotechnology in the US). Jasanoff (1990) notes that this form of brokerage may be hampered by credibility tensions — considering that the policy process in controversial biotechnologies is value-based. This notwithstanding, boundary spanners play a critical role in bringing about social order in knowledge brokering (Guston, 2001).

7. CONCLUSIONS AND IMPLICATIONS FOR POLICY

This paper has shown that different intermediary agencies perform policy brokerage roles, albeit as third party agencies, but with significant influence on regulatory policy needed to impact economic change in biosciences research. But what does this mean for public support to the policy brokering function?

- There is a need to acknowledge the different tasks that entail policy brokerage and the fact that regulation of biosciences constitutes a wide range of these tasks (see Table 1 and 2). These tasks are important and require a wide range of skills, resources and well-orchestrated strategies (Kingiri, 2011, Kingiri, 2010). This does not, however, imply that the government should support a certain specialised agency to perform these purportedly special policy brokering tasks. It could, however, support an assorted collection of different organisations or initiatives performing different policy brokerage tasks. For instance, the government may consider facilitating or supporting the role of enterprise development agencies as policy brokers because they tend to engage in a wider set of brokerage roles crucial for innovation to take place (Hall, 2010; Hall et al., 2010). This is, however, a challenge for any government as some of these organisations embed in policy brokering as part of a broader objective — for example, technology or enterprise development. This presents further governance challenges already identified as problematic in some biosciences research and development.
- Policy brokering is a pervasive and dynamic function as alluded to above, which brings about positive and negative impacts (see Tables 1 & 2). This is where policy support needs to be directed towards strengthening and harnessing the positive impacts where government could choose the tasks it wishes to promote. It might be that policy change may be achieved by packaging together the tasks performed by different organisations, backed by embedded strengths and skills.

- The governance challenges relating to neutrality and impartiality issues need to be addressed and this is where the government must invest in counter activities. The role of boundary spanners ought to be that of providing checks and balances to counter neutrality while tapping into the resources that these brokering agencies contribute to the policy brokering function. The boundary spanners could also orchestrate the tasks performed by the proactive activists that would ensure that the activism is controlled and confined within the respective boundaries. Eventually this translates to productive activism.

The purpose of the typology developed in this paper is draw attention to the different agencies and initiatives emerging to play different sorts of policy brokerage roles. It also brings to the limelight the pros and cons of each category of policy broker described. Consequently, policy-makers can make informed decisions regarding what agencies and/or tasks to support, and the likely implications for putting biosciences research to use. Policy-makers need to harness the opportunities presented by these intermediary agencies in order to stimulate positive policy change that will impact biosciences development and innovation. This implies that the policy brokerage function needs to be given critical thought during the start-up and development of biosciences innovations in order for this to be integrated into the strategic objectives upfront. Consequently, this is likely to impact a systemic value to the development of the sub-sector and the agricultural sector as a whole.

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