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## Does the New Alliance for Food Security and Nutrition impose biotechnology on smallholder farmers in Africa?

Siera Vercillo\*, Vincent Z. Kuire , Frederick Ato Armah  and Isaac Luginaah 

*Department of Geography, The University of Western Ontario, Social Science Centre, 1151 Richmond Street, London, Ontario, Canada N6A 5C2*

Almost one in three people who live in sub-Saharan Africa (SSA) are hungry, higher than anywhere else. This magnitude of food insecurity coupled with slow progress in regional integration, disease and epidemics, poor access to markets, gender disparities, lack of land tenure rights, and governance and institutional shortcomings on the continent have been used to justify a narrative for the inclusion of biotechnology in smallholder agriculture in SSA. The fact, however, suggests that even in the face of these challenges, smallholder farmers in SSA still produce 70% of the food on the continent. We critically examine the introduction of biotechnology in smallholder farming within the context of the New Alliance for Food Security and Nutrition and public–private partnerships in SSA. We explicitly address the bioethical concerns and implications for technology adoption goals in line with a neoliberal economic model that is encouraging smallholder farmers to adopt biotechnology as a way to secure more food for communities. This paper is not meant to pose a simplistic pro or anti stance on genetically modified (GM) crops or biotechnology, but rather to situate the debate about GM technology within issues of power, control in the global food agriculture systems, and point to the bioethical concerns that affect the lives of smallholder farmers and their families on a daily basis.

**Keywords:** biotechnology; food; production; food security; adoption; smallholder; Africa

### Introduction

From the early 1960s, world food production per person has increased by one-third. In Asia, the quantity of food produced has doubled, in South America food production has increased by more than 80%, and only in Africa has there been a slow increase in food production compared to the world average – although even here it has increased slightly more than population growth (Wiggins & Keats, 2013). However, by the mid-1980s, some food security experts in Africa had come to the conclusion that smallholder agriculture was in crisis (Cheru, 1992; Pretty, 1999). At the root of this claim was the magnitude of chronic hunger and malnourishment; even under good circumstances – in years with suitable rainfall – many smallholder farmers could not produce enough food to sustain their families until the next harvest (Wiggins & Leturque, 2010). At the same time, it was argued that traditional farming practices were leading to progressively worse soil degradation, erosion, and deforestation, which contribute to decreased production levels and food insecurity. Market-led economic development strategies, such as structural adjustment programs, were formulated to address these challenges.

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\*Corresponding author. Email: [svercill@uwo.ca](mailto:svercill@uwo.ca)

The impetus for structural adjustment programs came from a very distinct political economic problem: unsustainable debt, rooted in long-term balance of payments problems, and the ensuing policy prescription was informed by neoliberal ideology. In this neoliberal ideology, there has been a powerful association of smallholder farming with poverty and food insecurity. This association by development agencies and the Bretton Woods institutions was used to justify the need for agricultural “innovations” or new technologies in sub-Saharan Africa (SSA) in order to boost food production and by extension food availability (Yengoh, Armah, & Svensson, 2009). In the 1970s, food security was defined as a situation where there is enough food available (Food and Agriculture Organization of the United Nations [FAO], 2011). In the context of the neoliberal market economy, technology was seen by some as a panacea to food security challenges.

However, new agricultural technologies were not widely adopted, and they had a limited role in agricultural productivity and incomes of smallholders, as a way to mitigate issues of food insecurity in SSA. Agricultural technologies are diverse and include mechanical innovations (tractors and combine harvesters), biotechnological innovations (new seed varieties), chemical innovations (fertilizers and pesticides), agronomic innovations (new management practices), and informational innovations that rely mainly on computer technologies. With weak institutions, poor marketing infrastructure, and limited access to capital throughout much of the continent, the adoption of Green Revolution (GR) technologies such as improved seeds, fertilizer, and irrigation have been limited. Many have said the limits to irrigation potential was one of the most fundamental constraints on the expansion of GR in Africa, since the seeds were designed under conditions of considerable irrigation (Godfray et al., 2010). Fertilizer use averages 8 kg/ha in SSA compared to 190 kg/ha in the East Asia/Pacific region and a global average of more than 100 kg/ha (Alliance for a Green Revolution in Africa [AGRA], 2010). African farmers also pay 2–6 times the global average price for NPK (nitrogen, phosphorus, potassium) fertilizer due to poor transport, low trade volumes, and lack of local fertilizer production (AGRA, 2010). Irrigation is used on only 3% of agricultural land in SSA compared to more than 20% globally. These statistics reflect the low adoption rates of agricultural technology and innovations in SSA (Lado, 1998; Moser & Barrett, 2006).

With evidence of low adoption rates during the last half-century, policymakers are experiencing a growing sense of discomfort with technology adoption and diffusion, especially as they relate to increasing production of smallholder agriculture and food availability. This discomfort has gradually stimulated the need to critically assess both the assumptions underlying the deployment of these technologies and the traditional success indicators used in evaluating their adoption. Many economic analyses of agricultural technology adoption (or lack thereof) have focused on imperfect information, risk, uncertainty, institutional constraints, human capital, input availability, and infrastructure as potential explanations for adoption decisions, and more recently, social networks and learning have also been considered (McIntyre, Herren, Wakhungu, & Watson, 2009). Beyond these, a growing body of literature is being devoted to the effects of technology adoption on household incomes, other household assets, vulnerability, equity, consumption, nutrition, food security, poverty, and environment, etc. (FAO, 2007; McIntyre et al., 2009; Meilleur & Hodgkin, 2004).

The paper conducts a critical analysis of the current narratives on prospects of biotechnology as a mechanism for achieving food security and nutrition in SSA. It attempts to consider/assess the bioethical concerns and implications for technology adoption goals which stem from neoliberal economic prescriptions that encourage smallholder farmers to adopt biotechnology as a way to secure food for communities. In particular, the paper examines the multi-billion dollar strategy for poverty reduction, agriculture development, and food security through public–private partnerships under the New Alliance for Food Security and Nutrition. The analysis problematizes the framing, overgeneralizations, and assumptions underlying food production and consumption,

and the objectivity of the research used to support this narrative, highlighting the limits to generalized applicability and the unknowable long-term effects (and risks) of biotechnology. We also question the link between technology adoption and increased production for food security and nutrition that is typically taken for granted by biotechnology advocates, international financial institutions, and many development non-governmental organizations (NGOs). It must be emphasized that this paper is not meant to pose a simplistic pro or anti stance on GM crops or biotechnology, but to situate the debate about GM technology within issues of power and control in the global food–agriculture systems, with the goal of highlighting the bioethical concerns that affect the lives of smallholder farmers and their families.

The first section gives a brief overview of the New Alliance for Food Security and Nutrition, and discusses the creation of a structured food-governance system in which corporations are key stakeholders. This is followed by a review of the ethical implications of biotechnology and the politics of food and nutrition. Here, it is crucial to consider the implications of a “pro-innovation bias”, where technology provision is heavily skewed towards wealthier farmers who can afford the cost of GM seed, as well as the possibility of fostering increased differentiation in which vulnerable farmers get pushed out of agriculture, and made more liable to food insecurity, as the larger innovative farmers grow in scale. The paper concludes that the link between increased production and income from GM crops and broadly enhanced food security is not established because issues related to access to technologies and other means of production are paramount yet not sufficiently considered in dominant prescriptions. The importance of developing meaningful private sector partnerships that explicitly target food and nutrition goals by directly engaging with smallholder farmers, their communities, and civil society actors who represent their interests in the development, provision, and control of biotechnology as benefits are so context specific. The implications of the neoliberal economic model underlying the New Alliance could permit agro-input corporations to pursue their own agendas for pushing new technology for increased production that could raise the cost of inputs further marginalizing already vulnerable smallholders. Particularly, the recent push for biotechnology could have unforeseen detrimental effects on natural and economic systems by narrowing genetic diversity.

### **The New Alliance for Food Security and Nutrition**

Much attention has been devoted to the critique of the traditional neoliberal economic model of technology adoption, but the ethical implications have not yet been given much consideration, particularly regarding the use of biotechnology for increasing smallholder production. Several theoretical, empirical, and practical drawbacks underpin the blanket introduction of biotechnology in agriculture for increasing production. For instance, there is a “pro-innovation” bias. It is generally assumed that all new technology is inherently good although, in fact, there may be negative consequences. In addition, there is a bias toward larger and wealthier farmers. These are the individuals who are most receptive and most likely to adopt the new idea, so most of the information has been targeted at them. Those smallholder farmers who need help the most are missed. On the other hand, those who do not adopt a technology quickly are termed “laggards” and are blamed for their lack of adoption, what amounts to an “individual-blame” bias (Rogers, 2010). There are equality issues which inherently give rise to pressing questions: will an innovation cause unemployment or migration in rural communities? Will the rich get richer and the poor get poorer? Have the negative impacts of an innovation been considered? These questions are pertinent given the fact that the planet today is home to 500 million smallholder farmers. Together, these farmers support over 2 billion people, account for 97% of agricultural holdings, and produce food for a substantial proportion of the world’s population (IFAD & UNEP, 2013). Most of these

people operate outside the formal business economy, farming for subsistence and selling small surpluses for extra income (Hazell, Poulton, Wiggins, & Dorward, 2007).

In 2012, the G8 led the way for development actors to reinvest in smallholder agriculture as a mechanism for food security in SSA. The New Alliance for Food Security and Nutrition in Africa was established to move forward commitments to develop small plots of land to support enterprise, serve as a safety net, or provide subsistence in support of the Comprehensive Africa Agriculture Development Programme (CAADP) to a new “phase of investment in food security and nutrition.” Development partners, including private companies, African governments, and donors, are now committed to provide billions of dollars over the next 10 years to support a country-driven approach for the development of smallholder agriculture through public–private partnerships for food security. Councils of leaders led by the African Union, World Economic Forum, and US Government ensure that the New Alliance’s commitments to establish a business-enabling environment for private investment in African countries remain “inclusive, accountable and invests responsibly to support smallholder farmers” for improved access to markets for food security (New Alliance, 2013).

The New Alliance new phase for investment is in line with a neoliberal framework that hopes to transition smallholder agriculture from “traditional to the modern by linking them to the commodity markets” with the goal of increasing production and therefore income of smallholders (McKeon, 2014, p. 8). The New Alliance is currently launched in 10 countries in SSA with more than 200 policy commitments, including regulatory changes that ease export controls and tax laws. It is understood that through instilling a more enabling business environment in African countries, private investors will help speed the adoption of new technologies through the provision of infrastructure and capital, many of which are some type of biotechnology. To move this strategy forward, more than 55 international and African companies have signed on to provide roughly \$7.2 billion to agriculture investments in SSA. The private companies’ responsibilities are varied with some being vague, such as the commitments by the Norwegian company Yara to invest \$1.5–2 billion in fertilizer production, while others are more specific, such as the US company Cargill to commit \$1.35 million to improve agricultural education in Northern Mozambique farming communities (Obenland, 2014, p. 4). New technologies, such as genetically modified (GM) seed, are evidence of the agriculture development approach underlying the New Alliance as providing new means for production for smallholder farmers who are expected to adapt to become more advanced farmers (McKeon, 2014, p. 8). This new phase or model of increased production differs from historical approaches in that it accounts for the environmental impacts of industrialized agriculture by rolling out modern technologies for sustainable intensification.

### **Neoliberalism and technology adoption among smallholder farmers**

Scholars generally agree that neoliberalism as a framework or political ideology is the most powerful and spatially ubiquitous force since the decline of Keynesian theory (Higgins, Dibden, & Cocklin, 2008; McCarthy & Prudham, 2004; Peck & Tickell, 2002). The core pillars of the neoliberal framework including promotion of free market competition, privatization, and deregulation among others have received considerable critiques relating to overgeneralization and assumptions of the efficiency of free markets from both scholars and development practitioners across disciplines (see Bakker, 2010; Dibden, Potter, & Cocklin, 2009). Yet, the hegemonic posture of neoliberalism – and its commodification of everything approach – remains unwavering and persists in all aspects of society including agriculture. This framing has resulted in the conclusion that the global food and agriculture sector should be driven by the interests of large corporations and multinationals (Campbell & Le Heron, 2007; Freidberg, 2004; Higgins

et al., 2008; Reardon & Timmer, 2007; Weis, 2007). In the global agriculture and food system, this is increasingly evidenced in attempts to harmonize regulations – at all spatial scales – usually through third-party certifications (Hatanaka, Bain, & Busch, 2005). This creates a structured food-governance system starting from food production to consumption, which has become strictly monitored and regulated by corporations.

The role of large global actors in the form of corporations, multinational organizations, and governments in the global trade in food as well as agricultural production has had enormous impacts on local food systems for several decades. The actions of these actors have resulted in increased interest and concentration by scholars on the commodification of food in particular and the agricultural system as a whole. In particular, it has led to the enactment of numerous laws which are supposed to guide trade in food and agriculture production items with the interests of protecting capital investments (Hatanaka, Bain, & Busch, 2006). Scholars argue that this has created food chains and networks culminating in the creation of artificial barriers between producers and consumers of food (Morgan, Marsden, & Murdoch, 2006). It is further argued that the increasing capital investment in agricultural related inputs by large corporations has further exacerbated the commodification of agriculture (Clapp & Helleiner, 2012; Weis, 2007). The need to recoup profits from such investments as well as the desire to increase food production in poorer countries partly drives attempts to coerce smallholder farmers into adopting the technologies.

Although governments are the face and indeed the most important channel responsible for facilitating the drive towards technology adoption by smallholder farmers in developing countries of SSA, large corporations and multinational organizations are often the unseen forces operating in the background. The latent influence of multinational organizations is evident in at least three ways. First, SSA remains one of the regions in the world with high levels of food insecurity. The attempt to remedy this situation has created a perfect platform where various actors with diverse interests come to play. Second, towards the last decades of the twentieth century, the burdens of heavy indebtedness of most governments in SSA culminated in the adoption of structural adjustment reforms in the attempt to attain development (Clapp, 2009). The adoption of structural adjustment reform strategies mooted by the Bretton Woods institutions signified the official christening which marked the beginning of the creation and entrenchment of conditions necessary for the flourishing of the neoliberal model of development in these developing countries. For example, the dawn of this new era brought with it a situation where governments in SSA, at the direction of the Bretton Woods institutions, championed a system of agricultural production based on the profit-making logic of neoliberalism by cutting support to the sector – ultimately leading to the collapse of the sector and ruining of livelihoods and deepening of food insecurity (Clapp, 2009; Reardon & Timmer, 2007).

The third related issue is that corporations do not have structures or are restricted from direct engagement with locals in respect to technology adoption at the level of smallholder farmers. This means that corporations need governments to create enabling environments where they appear as partners in devising solutions to the problems at hand. Politics must actively intervene to create the organizational and idiosyncratic conditions for flourishing of public–private partnership (Rose, 1999) which is, essentially, an interplay of public policy and market (Buller & Morris, 2004). As evidenced in the case of SSA in the last three decades, this relationship has been dominated by multinationals who dictate details of policy in their advisory roles to governments. This sort of relationship between governments and external actors legitimizes governments clamouring for specific actions including technology adoption in agriculture, although the real force behind this posture is foreign (i.e. corporations and multinationals).

The foregoing raises ethical issues around the coercion of smallholder farmers into adopting new technologies, particularly biotechnology, which they have not contributed to its development

nor have requested. In the current case of biotechnology adoption advocated by the New Alliance for Food Security and Nutrition, a critique of the neoliberal framework remains important to analyse the strategies being used in making claims for the approach to agricultural production as a food security strategy. This is particularly important in the case of SSA because corporations who are the promoters and developers of biotechnology are also their own regulators (Chambers et al., 2014). Additionally, smallholder farmers in SSA may be categorized as “standards takers” (Hatanaka et al., 2006, p. 56) because they have no choice but to adhere to standards prescribed by external actors. Under such circumstances, the claims of interested actors facilitated by government are portrayed and promoted as sacrosanct. From this perspective, and in the specific case of adoption of biotechnology in agriculture, it is important to examine the role of governments in facilitating schemes where the actors serve in a self-regulatory capacity over their own products. This power over the implementation of biotechnology has broad implications for food security and nutrition targets, as well as smallholder farmers’ capacity to control their production dynamics.

### **Is the G8–New Alliance imposing biotechnology?**

Although the New Alliance has facilitated large financial commitments to reinvest in smallholder agriculture development, and some coordination by multiple development partners have been made, there is a push back from civil society both in SSA and globally who represent and advocate for smallholder farmer interests. Over the past year, there have been a number of important critical reports published by African civil society and supported globally about the implications of the New Alliance’s strategy for private-sector-led agriculture investment for food security. Most notably, working papers developed by the Transnational Institute (McKeon, 2014), German NGO Forum on Environment and Development (2013), Future Agricultures (Sulle & Hall, 2013), Global Policy Forum (Obenland, 2014), Oxfam America (Munoz, 2013), and FoodFirst Information and Action Network (Herre et al., 2014) have issued concerns about the current processes undertaken by the New Alliance. Civil society has pointed to the fact that there are no specified targets for food security and nutrition or publically accessible strategies for oversight of public–private partnerships conducted by the Leadership Council (Obenland, 2014, p. 5). There are no plans for how commercialization of African agriculture or how out-growers will be engaged in new value chains (Provost, Ford, & Tran, 2014). Since there is no clear theory of change, Herre et al. (2014) argue that the implied food security and nutrition strategies have become narrowed actions that tackle food availability through increased production and not structural issues of access, in which these systems widen.

The New Alliance is built on the assumption that problems of hunger and malnutrition in SSA can be tackled by more production and growth vis-à-vis corporate private sector investment, however, the link between technology adoption and increased production is not straightforward. Embedded in this link is the notion that increased production necessarily translates into food security or improved nutrition. However, the link does not explicate the assumptions and context-specific limits to applicability that often plague the diffusion of technology. Cases exist where industrial agriculture pushed by large corporate investment and their respective technologies have contributed to decline in community development (Patel, Torres, & Rosset, 2005, p. 434). The criticisms by civil society are not pointing to the public–private partnerships per se, but to the actors’ “respective interests and power, and the regulatory frameworks within which they operate” (McKeon, 2014, p. 10). Herre et al. (2014, p. 3) argue that although African governments are major partners in the New Alliance, in reality their obligations to citizens take second priority to providing services that are in line with the private sector or corporations. Despite governments’ duty to uphold responsible investment, services are provided to

reduce the “risks and insecurities of investors” (Herre et al., 2014, p. 3). This is due to the fact that the New Alliance does not explicitly mention government or other third-party actors, such as private corporation obligations to the well-being of citizens. This is where the agenda for reducing malnutrition and hunger is politically taken up by national and international corporations who historically conduct a biased facilitation of resource allocations that excludes the most marginalized smallholders even though they are part of the agriculture production systems. Related neoliberal economic models of deregulation policies have weakened government services that regulate production prices, inputs, and markets, which push vulnerable smallholder farmers to give up farming and migrate (Kuuire, Mkandawire, Arku, & Luginaah, 2013).

Although the New Alliance has drafted the “Shared Responsibilities and Mutual Accountability” of all actors, including civil society and smallholder farmer interests, its vague responsibilities and actions risk not maintaining accountability to terms that favour smallholders (Herre et al., 2014, p. 2). In the agreements made in Ghana and Ethiopia by their governments, for example, there are no commitments to smallholder farmers, particularly women, which point to the inadequacies in practice of vague terms in commitments (Obenland, 2014, p. 13). When it comes to private company accountability, according to Oxfam, companies detail commitments to:

... expand market presence for inputs such as seeds, chemicals, and mechanized farming and irrigation equipment ... that can increase crop yields, but they will not contribute to poverty reduction unless they are situated within a broader context of regulations and policies to protect and promote the interests of agricultural workers, small-scale producers and the environment. (Munoz, 2013, p. 10)

Multinational corporations are linked to worsening environmental conditions, limiting the food quality and availability, and worsening of socioeconomic conditions of smallholder producers because they have no mechanisms or incentives to ensure basic rights (Carney, 2012; Patel et al., 2005, p. 430; Shepherd, 2012; Yengoh & Armah, 2014). In this perspective, the New Alliance continues to emulate the structural adjustment programs of the 1980s that took away control from government.

As Monbiot (2013) argues, incentives in favour of private sector actors only makes sense if smallholder farmers are functioning in a formal, cash economy, which they are for the most part not. Although there is a misconception that the New Alliance is only negotiating large business deals by non-African companies, when half of the companies involved are small to medium size, public–private partnerships, or business allocations (One, 2013), initiatives are lacking in dimensions related to gender, nutrition, and post-harvest loss which need to be addressed for equitable development. The focus on technical and short-term fixes by the public–private partnerships shifts funding away from fundamental structural problems, such as gender related to poverty and inequality (DFID & Wiggins, 2004, p. 15). Assets and access to services and markets are rarely just a function of size; they also are influenced by social, economic, and political factors. Thus, for instance, gender norms often result in women farmers having less access to assets, services, and markets than their male peers, and therefore lower productivity and incomes (FAO, 2011). Even the focus on incorporating the smallholder farmer into the value chain has been found to work for only the top 2–20% of small-scale producers, who are often only men (McKeon, 2014, p. 10). Insufficient engagement of smallholders and civil society in technology development is a defining characteristic of the existing value chains. “This suggests the need to understand the local context, and thorough consultation at the grassroots level to enable communities to develop sustainable business models to suit their own socio-cultural and economic needs” (Sulle & Hall, 2013, p. 5).



### **Insufficient engagement of civil society or smallholders**

African civil society, supported by global civil society movements, is currently speaking out against the agreements deemed to be skewed in favour of formal sector goods and services, and middle-income consumers that miss the context of the informal economy in which most vulnerable smallholder farmers operate (African Centre for Biosafety, 2013; Herre et al., 2014, p. 4). Marginalized groups who are disproportionately affected by hunger and malnourishment have been insufficiently included, or not at all, in negotiations at the international level and between national governments and private corporations (Herre et al., 2014, p. 2). This lack of involvement has been problematized:

“When are you people going to stop coming into our continent with your recipes for solving our problems rather than supporting our own solutions?” – USAID Administrator Rajiv Shah in Rome in May 2012 speaking to the National Alliance. (McKeon, 2014, p. 13)

Munoz (2013) maintains that there is a lack of country-level civil society participation in planning negotiations that infers the interests, requests, and needs of farmers are not adequately addressed. An example is highlighted by Oxfam America in Mozambique where many farmer organizations have never been consulted or made aware of the seed, land, and fertilizer regulations completed until the launch of the New Alliance. Moreover, it has been admitted that more consultation with civil society on investment strategies should take place (Provost et al., 2014). McKeon (2014, p. 13) outlines an example of when the Leadership Council accountability and transparency meeting only included the African Union, all G8 countries, seven agribusiness companies, and only the large-scale commercial farmer organizations represented by the East African Farmers Federation and the Southern African Confederation of Agricultural Unions. Insufficient consultation is made with smallholder unions, such as the West African Network of Peasant and Agricultural Producers’ Organizations who represent the interests of smallholders (McKeon, 2014, p. 13). There is lack of consultation and consideration for “local knowledge, participatory research, traditional seed conservation systems, soil fertility enhancing measures or gender sensitivity” (Herre et al., 2014, p. 6).

### **Neoliberal economic implications for the benefits of biotechnology**

In the context of the neoliberal models of agriculture systems, transfer of biotechnology control over seed reproduction and decision-making from smallholder farmers to multinational corporations that do not account for smallholder farmers’ skills and knowledge may pose a threat to agricultural resilience and sustainability. Performance of biotechnology depends on a range of technical, environmental, and institutional factors, such as soils and irrigation, supported by infrastructure and institutions, which the poorest farmers typically lack. These factors are essentially context specific and bring into sharp focus limits to applicability.

Some studies attempt to establish a link between increased production of GM crops and income of farmers compared to more conventional varieties. In a most recent meta-analysis, Klümper and Qaim (2014) detail that herbicide-tolerant crops have lower production costs although insect-resistant crops have higher seed prices. Production levels of GM crops for herbicide tolerance rose by 9 and 25% above that for insect resistance. For example, average yields for GM cotton in South Africa from 1998 and 2001 were 25% higher than for conventional cotton with average increased earnings of 77%. Additionally, in Burkina Faso Bt (*Bacillus thuringiensis*) cotton hectares increased by 126% in 2010 from the level in 2009. Biotechnology is being obtained more by SSA farmers independently of large corporations. Ezezika, Barber, and Daar (2012) argue that this adoption in Burkina Faso by Africa’s largest producer of cotton has been

because of strong collaboration between research, industry, and farmers, which contributes to the trust between actors necessary for adoption. According to Clive (2013), biotech cotton in low-income countries increased the income of 16.5 million smallholder farmers in 2013, including success in India (Kathage & Qaim, 2012). The first human trial of GM nutritionally enhanced vitamin A bananas jointly developed with scientists in Uganda is currently underway (Waltz, 2014). This evidence must be put in context as the impacts of GM technology on production vary especially by modified crop trait and geographic region (Klümper & Qaim, 2014).

Beyond geographical and crop issues, several other pertinent questions arise about the link between increasing production, incomes, and food security. For instance, which group of farmers did the studies involve? Were the farmers using the technology involved in its development? Understanding the impact, effects, and technical concerns of biotechnology needs to consider the investment and value on return and the farmer's own context. For example, smallholder farmers seldom have the capacity to track their investments and often do not account for the cost of their labour. Although average yields for GM cotton in South Africa were higher than conventional forms, the political economy of cotton production has resulted in inequitable profit-sharing, coerced eviction, and widespread indebtedness of the Bt cotton farmers (Witt, Patel, & Schnurr, 2006). It is unclear in the range of studies accounted for in the meta-analysis (Klümper & Qaim, 2014) whether these factors are considered and how they relate to food security or nutrition.

Generally, smallholder farmers are unable to afford traditional agriculture technologies and especially not the more costly new biotechnology (Patel et al., 2005). Biotechnology needs to perform locally, embedded within agro-ecological settings and cultivation systems that are shaped and influenced by multiple dynamics or else their effects could be detrimental. Dowd-Uribe, Glover, and Schnurr's (2014) contribution makes clear that contextual factors such as governance and policy frameworks, credit availability and seed markets, as well as local agro-ecological factors such as insect pests, shape food security outcomes of biotechnology. Due to the monopoly of power on biotechnology by certain major corporations, GM crops would result in the costs of inputs increasing and the diversity of seed choice declining, forcing poorer farmers out and allowing a form of uniform, corporate-capitalist agriculture to dominate. In particular, civil society has issued concerns about seed in SSA because negotiations have not included smallholder farmers. Current policies "systematically cease the distribution of free and unimproved seeds" (Herre et al., 2014, p. 5). Scoones and Glover (2009) point out that most biotechnology crops that are used for commercial purposes are insect-resistant varieties of maize and cotton, as well as herbicide-tolerant varieties of soybean have been designed for large-scale commercial farms, and not for smallholders. The push for GM seed could skew the market and destroy hopes to maintain local seed (Shiva, Jafri, Emani, & Pande, 2000). Although farmers are not always obliged to buy new seeds each year, *if* poor farmers are deprived of access to seeds it could lead to increasing prices of food, resulting in possibly making food less affordable for the poorest (Herre et al., 2014, p. 5). An example of this is currently happening with GM bananas and cassava that are being tested without consultation with smallholder farmers who have concerns about their impacts and preference to use more local varieties (Chandrasekaran, 2013).

Providing biotechnology to certain farmers and not others could also widen inequality, putting more vulnerable smallholders in more risk of food insecurity. Poorer part-time or older farmers and farmers in more isolated places or varied ecological setting will be unable to continue farming. As this happens many more crop types and farmer developed crop varieties will no longer be cultivated because corporations prevent farmers from saving their seeds. Terminator technologies that have yet to be used could be designed to ensure that farmers must either purchase new seed for each season or buy chemical keys to activate bioengineers' crop traits,

which will also put certain farmers at a disadvantage. “Should genetic constructs that cause plants to produce sterile seeds find their way to populations of wild crop ancestors and local varieties grown for subsistence the results could be devastating” (Bagavathiannan, Spok, & Van Acker, 2011). Engineered genetic constructs may be transferred from one species to another or contaminate other farms unintentionally although not necessarily more easily than endogenous genes (Bailey, Willoughby, & Grzywacz, 2014). Evidence with herbicide-resistant canola in Canada shows that GM seed has often escaped cultivation contaminating farms without. This contamination could create more biodiversity by crossing GM crops with local varieties. There could also be a potential problem with herbicide GM technology runoff from treated farmland, for example, as this can contain residues that can kill other plants and may pollute groundwater. Leakages of GM crops into the food and feed supply have been reported with Prodigene corn, Syngenta Bt10 corn, and Liberty Link rice pointing to larger implications if done in places with poor infrastructure regulation (Bagavathiannan et al., 2011).

Most capacity-building programs portray partnerships with private enterprises as the best way for public institutions to gain access to biotechnology because of ownership patents (Chambers et al., 2014). Private corporations have patented or hold exclusive licences for many of the enabling technologies and genetic data needed to engineer new crop varieties (McAfee, 2004). If biotechnology is owned or controlled by foreign companies, this takes away control from local farmers and businesses. Many countries, especially those in SSA, do not have laws or enforcement mechanisms to protect propriety claims on plant varieties and some forbid private ownership of living things. Such countries will miss the opportunity to participate in the benefits of biotechnology. Private firms will be unwilling to establish joint ventures. Moreover, public agencies that use privately patented methods or materials risk legal issues by patent holders.

## **Conclusion**

In this paper we provide a critique of the current narratives on prospects of biotechnology as a mechanism for achieving food security and nutrition in SSA. We focused on the multi-billion dollar strategy for poverty reduction, agriculture development, and food security through private–public partnerships under the New Alliance as an example of how biotechnology is pushed on smallholder farmers, going beyond the technology itself to explore the interplay of the forces promoting its adoption in SSA. The bioethical concerns over GM crops and other biotechnology needs to be situated in the much wider related issues of poverty, inequality, and social justice that puts the vulnerable smallholder farmer at the centre of analysis, which is why debates of biotechnology must be understood within the broader context of neoliberal agrarian policies.

The New Alliance is a powerful way that the neoliberal economic development model is being reinforced, as it favours wealthier farms and skews incentives for technology adoption in a way that imposes technologies on vulnerable populations affected by food insecurity. This current public–private partnership strategy is not going to solve issues of food security because it does not actually address the under-investment in vulnerable smallholder agriculture, but favours wealthier farmers. This development model in line with a “pro-innovation bias” is imposing certain techniques, such as certified GM seed, without consulting those smallholders they are intending to help. Without the inclusion and authority of smallholders in the development and implementation of these technologies, adoption rates will remain low and could potentially exacerbate wider inequality where large corporations control the biotechnological (and commodified) basis of production.

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## ORCID

Vincent Z. Kuuire  <http://orcid.org/0000-0003-2782-3915>

Frederick Ato Armah  <http://orcid.org/0000-0002-9371-5683>

Isaac Luginaah  <http://orcid.org/0000-0001-7858-3048>

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