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A sustainability assessment framework for the African green revolution and food sovereignty models in southern Africa

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Abstract: Two vastly different approaches to food security and sustainability have become increasingly prominent in Sub-Saharan Africa over the last decade. One is the African Green Revolution model, implemented by a consortium of partners comprised of African governments, the private sector, philanthropic donors, and multilateral institutions. The other is the food sovereignty model, headed by Africa's peasant unions and civil society organizations. This paper examines how the ontological backgrounds of these two agrarian models inevitably inform and influence their respective approaches to food security and sustainability in Sub-Saharan Africa. On one hand, the African Green Revolution favors modern rationalist notions of economic structural transformation and agricultural development. On the other hand, food sovereignty is inspired by historical structural ideas rooted in sociology that tackle issues of power and (in) justice embedded within global political and economic institutions. These diametrically opposed ideological foundations help to explain the polarization and tensions that exist between the two agrarian models. Such tensions, however, also hinder fruitful discussion about how to effectively address key concerns in food and agricultural systems. In response, this paper draws insights from sustainability assessment literature to propose a framework

ABOUT THE AUTHOR

There is consensus among academic scholars and policy-makers that the way we grow and distribute needs to be more sustainable. However, the best approaches to doing so remain unclear and are at times deeply contested. In sub-Saharan Africa, two vastly different production approaches to achieving food security and agricultural sustainability have become increasingly prominent. One is the African Green Revolution model, implemented by a group of partners comprised of African governments, the private sector, philanthropic donors, and multilateral institutions. The other is the food sovereignty model, headed by Africa's peasant unions and civil society organizations. These two agrarian models come from distinct ideological backgrounds that inevitably inform and influence their respective activities. Drawing insights from sustainability assessment literature, this paper proposes a framework for merging food security and sustainability goals in southern Africa.

PUBLIC INTEREST STATEMENT

The author's key areas of research are food security and food systems sustainability with a specialized focus on the region of southern Africa. This paper is based on the author's PhD dissertation titled: *The African Green Revolution and the Food Sovereignty Movement: Contributions to Food Security and Sustainability: A case-study of Mozambique*. In recent years, there has been a growing contentious debate about the capacity (and appropriateness) of the African Green Revolution and the Food Sovereignty models to address Africa's food security challenges (particularly for smallholder farmers) in a manner that is sustainable. Critical food scholars and activists in particular often present the two agrarian models in oppositional frames, with some actors claiming that the former's technical approach to agriculture is not suitable for Africa's smallholder farmers. The author's research engages with this broader debate.

comprised of key sustainable food system indicators that are important for merging food security and sustainability goals in southern Africa.

Subjects: Environment & Agriculture; Environmental Studies & Management; Development Studies, Environment, Social Work, Urban Studies

Keywords: African Green Revolution; food sovereignty; sustainability assessments; food security; southern Africa

1. Introduction

The last decade has seen growing consensus among academics and policy-makers about a need to foster greater sustainability in food and agricultural systems. Sustainability in this sector refers to practices that contribute to food security, social equity, and environmental benefits, while reducing ecological scarcities (FAO, 2012). A rich body of literature offers guidance on how to stimulate sustainability in the global food system in a manner that facilitates broad-based food security and equity for all (FAO, 2012, 2013; Garnett & Godfray, 2012; IAASTD, 2009; Lawrence, Lyons, & Wallington, 2010). In some regional contexts, however, the best approaches to merging food security and sustainability goals remain unclear and are at times deeply contested. An example is in Sub-Saharan Africa, where two vastly different agrarian models—the African Green Revolution and the African Food Sovereignty Movement—have emerged to offer distinct food security and sustainability solutions.

The African Green Revolution is being implemented by a consortium of partners comprised of African governments, the private sector, philanthropic donors, and multilateral institutions. The objective of this initiative is to increase crop productivity and income opportunities for smallholder farmers through investments in agricultural technologies and market value chains (AGRA, 2009; Denning et al., 2009; Rockefeller Foundation, 2006; Toenniessen, Adesina, & DeVries, 2008). A prominent partner in this consortium is the Alliance for a Green Revolution in Africa (AGRA), a philanthropic organization established in 2006 by the Rockefeller Foundation and the Bill and Melinda Gates Foundation. The food sovereignty model is supported by the continent's peasant and farmers' unions and associated civil society organizations. The Alliance for Food Sovereignty in Africa (AFSA) is a consolidation of the region's food sovereignty groups, launched in 2011 at the UN Framework Convention on Climate Change (UNFCCC) Conference of Parties 17 (COP 17), which was held in Durban, South Africa. Members of this movement seek to mobilize political activism around peasant rights to productive resources (land, water, seeds, etc.) and to revitalize Africa's food systems using the principles of agro-ecology (AFSA, 2011; AFSA and GRAIN, 2015; Anderson & Campeau, 2013).

Both agrarian models make important contributions in their efforts to improve the performance of Africa's food and agricultural sectors. However, debates are highly polarized in academic and public forums about the suitability of each model to serve the needs of the poor. Critics view the African Green Revolution as promoting the corporatization of Africa's agriculture through a market-led ideology and an implementation model based on high-priced input packages that carry heavy economic risks for farmers (AFSA, 2015; Bellwood-Howard, 2014; Holt-Giménez & Altieri, 2013; Koopman, 2012). The food sovereignty model is also critiqued by various scholars coming from different philosophical backgrounds. While the food sovereignty movement clearly rejects the tenets of agricultural liberalization under the World Trade Organization's Agreement on Agriculture (cf. McMichael, 2014), there appears to be confusion about what alternative trade model is acceptable (cf. Burnett & Murphy, 2014). Whereas food sovereignty places emphasis on self-reliance at the household and local level, critics raise doubts about whether smallholders can generate a sufficient marketable surplus to supply even local markets (Agarwal, 2014; Bernstein, 2014). These polarizing views of the African Green Revolution and the food sovereignty movement make it difficult to have fruitful engagement about how to effectively address concerns in Africa's food and agricultural systems.

This paper examines the debates surrounding how best to merge food security and sustainability goals in southern Africa's food systems. Informed by farmers' perspectives in Mozambique,¹ it draws insights from sustainability assessment literature to outline a framework comprised of key sustainable food system indicators that are important for meeting these two goals. These are access to quality seeds, activities to improve soil health, income opportunities, land rights and policy engagement. Taken together, these indicators can help to address both the technical aspects of meeting food security (issues of production) and engage with political economy issues that facilitate (or hinder) the means of achieving it. A sustainability assessment of the African Green Revolution and food sovereignty models' potential contributions to these indicators, from the vantage point of farmers, is an attempt to get the respective camps to appreciate the value of both the technical aspects of food security and the political economy concerns surrounding it.

2. Diametrically opposed ontological backgrounds

2.1. African Green Revolution

The African Green Revolution emerged at the turn of the millennium with ideas to jumpstart economic structural transformation in Sub-Saharan Africa through agriculture-led growth. The institutions, scholars and actors behind this agrarian model share an ontological perspective that favors modern rationalist ideas about agricultural development (DeVries & Tonniessen, 2001; Paarlberg, 2000; World Bank, 2000). In 2006, the Rockefeller Foundation and the Bill and Melinda Gates Foundation established the Alliance for a Green Revolution in Africa (AGRA), a philanthropic organization, to coordinate African Green Revolution activities in Sub-Saharan Africa by promoting:

scientific development of more productive crops and fertilizers; cultivation of local talent in plant science, farming, agricultural policy, and business; strong commitment from national governments; and public-private collaboration on infrastructure, water and irrigation, the environment, and building markets for the inputs and outputs of a revolutionized farm sector (Rockefeller Foundation, 2006, p. 4).

Today, the African Green Revolution is supported by a wider group of actors beyond the Gates and Rockefeller Foundations. Among these is the Grow Africa Partnership, founded in 2011 by the World Economic Forum, the African Union and the New Partnership for Africa's Development (NEPAD). Grow Africa works with governments to facilitate private sector investments in agriculture on the continent—partner companies include Monsanto, Syngenta, Cargill and Yara International. Investments from these companies are expected to create local jobs and increase rural incomes (Grow Africa Secretariat, 2013). Another, similar African Green Revolution initiative is the G8's New Alliance for Food Security and Nutrition in Africa, launched in 2012 as public-private endeavour that seeks to accelerate agriculture-led growth in Africa and lift 50 million people out of poverty by 2022. In southern Africa, several countries, such as Mozambique and Malawi, have introduced national strategies and legislation to implement their Green Revolution activities (see GoM, 2007).

African Green Revolution scholars and actors make several key assumptions about how to achieve food security and agricultural development in Africa. One is that technology transfers, e.g. hybrid seeds plus insertion of farmers into market value chains, represent a primary means to tackle hunger and poverty (Sanchez, Denning, & Nziguheba, 2009; Toenniessen et al., 2008). For example, Sanchez et al. (2009) argue that most African smallholder farmers, producing maize or staple crops on less than one hectare, are unlikely to escape absolute poverty unless they diversify to high-value (marketable) crops, e.g. onion, sunflower, hibiscus, chili peppers, etc. (p. 40). The African Green Revolution scholarship also assumes that modern biotechnology can deliver win-win solutions by addressing the challenge of low crop productivity while helping farmers adapt to climate change (Paarlberg, 2008). With some regions of the continent especially vulnerable to droughts, e.g. southern Africa, Paarlberg (2008) explains that farmers in such areas can benefit from bio-engineered drought-tolerant crops. Such crops offer stable yields under adverse climatic conditions, which can deter farmers from resorting to various impoverishing strategies, such as selling off household assets (p. 154).

The African Green African Revolution scholarship also assumes that farmers have limited knowledge about the use or benefits of modern technologies, but that such a gap can be addressed by better extension services (AGRA, 2013; Otsuka & Kijima, 2010). Otsuka and Kijima (2010) assert that a possible explanation for low crop yields in Africa is that “many farmers do not know or have never heard of hybrid maize variety [and] do not know the highly positive effect of fertiliser on hybrid maize production” (p. 62). Scoones (2002, p. 116) provides a similar analysis of some of the key assumptions made by pro-poor biotechnology advocates. Nonetheless, these ontological assumptions are vastly different from those of food sovereignty.

2.2. Food sovereignty

Food sovereignty is rooted in a peasant-led resistance to neoliberal economic policies that incorporated agriculture into the international trade regime during the 1990s (Clapp, 2015). A prominent actor in this agrarian model is La via Campesina, which introduced the concept of food sovereignty in 1996 at the World Food Summit: “the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agricultural systems ... [to put] those who produce, distribute and consume food at the heart of the food system, rather than the demands of markets and corporations” (via Campesina 2007 in Patel, 2009, p. 666).

In Sub-Saharan Africa, food sovereignty was taken up by peasant groups that joined La via Campesina in 2004. The Network of West African Peasant Organisations and Producers (ROPPA) and the National Union of Mozambican Peasants (UNAC) were among Africa’s first food sovereignty movements. ROPPA was established by peasant unions from ten West African countries in 2000. The movement emerged as a response to trade liberalization policies that weakened the position of Africa’s produce on world markets, and defeated farmers’ competitiveness in their own markets because of heavily subsidised imports (ROPPA, 2003). Long-term food-aid to the region through the 1980s and early 1990s also undermined domestic markets, e.g. by discouraging local production due to market gluts and low producer prices (Blein & Jeudy, 2007). According to ROPPA, the impoverishment of Africa’s peasants was not merely a result of unfavorable climatic or economic conditions, but of “logical outcome of the rules of the game negotiated and then imposed on producers” (ROPPA, 2003, p. 5).

The ontological perspectives of food sovereignty scholars and actors are inspired by historical structural ideas rooted in sociology that tackle issues of power and (in) justice embedded within global political and economic structures. McMichael (2014) explains that the agrarian and crises we face are associated with 20th century governance structures that globalized food and agricultural systems via liberalized agricultural markets, structural adjustment policies, large-scale industrial production, etc. (see also Akram-Lodhi, 2013; Friedmann & McMichael, 1989; Weis, 2007; Wittman, Nettie, & Desmarais, 2010). A globalized food system, however, has failed to adequately feed the world in a manner that is socially and ecologically sustainable (Clapp, 2016; Weis, 2007). Reversing some of the problems associated with the globalized food system, according to food sovereignty scholars, requires creating more localized food systems.

In 2011, at the UNFCCC Conference of Parties 17 (COP 17) in Durban South Africa, Africa’s food sovereignty groups consolidated to establish the AFSA. Today, AFSA is comprised of 21 member networks² that share a common concern over the various agricultural development strategies being pushed by external entities, such as the New Alliance for Food Security in Africa, the Grow Africa Partnership, and AGRA (AFSA, 2015). AFSA fears that such initiatives stand to corporatize Africa’s agriculture, and intensify problems of land grabbing and bio-piracy of genetic resources (AFSA, 2016). AFSA’s mission is aligned to that of the international food sovereignty movement (led by La via Campesina). As such, AFSA has adopted the Declaration of Nyéléni,³ which spells out the agenda for food sovereignty.

Several key assumptions from food sovereignty actors are also applied to food security efforts in Sub-Saharan Africa. One is that the social control of food systems predominately entails adopting agro-ecology as a means to foster people's dignity and ecological viability (Menser, 2014). Agro-ecology replicates the microcosms of traditional agriculture to improve the productivity of rural ecological landscapes, using a diversity of crops and low-input technologies (Altieri & Nicholls, 2005; Amekawa, 2011; Scherr & McNeely, 2007). In particular, agro-ecology seeks to scale-up agricultural innovations through farmer-to-farmer exchanges (Holt-Giménez, 2006) and to conserve and regenerate ecological resources using mainly natural inputs. The principles of kinship, cooperation, reciprocity, mutual well-being, etc., are at the center of agro-ecology, which stand to foster dignity and social reproduction in rural communities (Menser, 2014, p. 61). Altieri and Nichols (2005) assert that agro-ecology has already proven successful in meeting the food security needs of thousands of resource-poor farmers living in marginal environments in Africa, Asia and Latin America (p. 134).

Another assumption of the food sovereignty perspective is that seed sovereignty, which is farmers' rights to save, exchange, reproduce, and grow their own seeds, is a primary means to achieve autonomy and self-determination in food production (Kloppenborg, 2010). La via Campesina (2013) argues that smallholders' capacity to choose what food to grow and how to produce it will disappear if governance structures do not recognize and respect seed sovereignty. Kloppenborg (2010) similarly emphasizes that seeds sit at a critical nexus of both foodstuff and production, and whoever controls them gains a substantial measure of control over the shape of the entire food system (p. 152). Food sovereignty also assumes that farmers should grow food for self-sufficiency purposes and be embedded in locally-based markets as opposed to global value chains (AFSA, 2011; Nyéléni, 2007, 2015).

3. Ideational impasse

Fostering sustainability in the agricultural sector requires efforts that mitigate potential adverse consequences and enhance positive outcomes, particularly for the people who rely on this sector for their livelihoods and the biospheric systems upon which viable agriculture depends. As such, it is important to consider whether the activities of the African Green Revolution and the Africa food sovereignty movement are designed and carried out to contribute to sustainability. Current tensions surrounding the two models are necessarily linked to questions about the extent to which their activities contribute to progress toward sustainability (political, social, economic and environmental). Thus, a discussion that looks at the models' respective impact on sustainability is helpful to bridging the ideational divide between them.

For example, critics of the African Green Revolution argue that this model has a "universalizing" narrative that favors technocratic interventions (i.e. hybrid seeds plus insertion of farmers into market value chains) (Amanor, 2011; Scoones & Thompson, 2011; Thompson, 2014). But critics say such interventions primarily serves the interests of a small but powerful set of actors in the public and private domains (cf. Tansey, 2011). State interests are driven by a need to deliver "quick fixes" for low-crop productivity and food insecurity in a political process obscured by electoral gains and patronage (Chinsinga, 2011). In Malawi, for instance, elected officials have gradually shifted the government agricultural input subsidy programs, in place since the late 1990s, from providing farmers with maize open pollinated varieties (OPVs) to hybrids (Brooks, 2014; Chinsinga, 2011).

Although hybrid seeds and related technologies used in the African Green Revolution may improve crop productivity and boost food security numbers, such inputs are often proprietary to powerful agro-corporations. In southern African seed markets, multinational companies, such as Monsanto, Syngenta and Dupont, are gaining prominence through mergers and acquisitions. For example, Malawi's National Seed Company (MNSC) was bought up by Cargill in 1989, and was subsequently sold to Monsanto in 1996 (African Centre for Biodiversity [ACB], 2015a). Monsanto also purchased two of South Africa's largest seed companies at the time, Carnia Seed and Sensako. The largest remaining domestic seed companies in the region were recently purchased by other multinationals:

South Africa's Panner Seed merged with Dupont (Pioneer Seed) in 2013 and Zambia's Maize Research Institute (MRI) was bought up by Syngenta that same year (ACB, 2015a).

Some of these corporations have freely acquired germplasm developed in public institutions and by farmers over many decades (Thompson, 2012). However, the transnational seed companies have filed sweeping patent documents with the World Trade Organization (WTO) for climate-ready seeds developed in field trials in Africa (Bezner Kerr, 2010). At the same time, such private actors are among entities pushing for the implementation of uniform seed laws in the region, entailing intellectual property rights. New seed laws are expected to equip seed companies with enormous power and control as their seeds start to dominate the region's markets (Tansey, 2011).

The African Green Revolution's commercially-oriented approach to food security certainly raises questions about its capacity to enhance social and economic sustainability for Africa's smallholder farmers given the high cost of inputs in resource-poor environments. Koopman (2012) explains that AGRA's disproportionate support for commercial input packages is likely to carry heavy economic risks for farmers because input costs have an upward trend while farm gate prices can be extremely volatile. Some critical food scholars and actors go further in their calls to reject this agrarian model altogether, claiming that it offers no valid solutions for Africa's food security challenges (AFSA, 2015; Holt-Giménez & Altieri, 2013). AGRA and its philanthropic supporters are ostensibly promoting corporate interests in Africa under a guise of "helping the poor" (AFSA, 2015; Curtis, 2016; Dano, 2007). Critics call for rebuilding food systems based on an alternative model of food sovereignty, free from subordination or co-optation by the African Green Revolution.

At the same time, various scholars coming from different philosophical backgrounds question food sovereignty's capacity to sustainably feed the world and foster viable rural livelihoods. Foremost, critics argue that food sovereignty's vision for self-sufficiency is overstated. While this model rejects industrial agriculture, Jansen (2015) argues that its one-sided approach to agro-ecology, based on little to no external inputs, is problematic. Some marginal areas that rely on local resources often see low yields or a depletion of natural resources. Thus, some use of industrial inputs (e.g. chemical fertilizers and improved varieties) can be critical to raising yields in agro-ecological regions with adverse conditions (Jansen, 2015; Lotter, 2015). It is also unclear whether smallholders' low-input agriculture can adequately feed a growing number of non-producers in developing countries (Bernstein, 2014). In southern Africa, urban populations are projected to rise drastically in the coming decades (Crush & Frayne, 2011; Parnell & Pieterse, 2014).

Bernstein (2014) argues that food sovereignty perpetuates a (misinformed) view that peasants should produce food for household and local self-sufficiency purposes rather than for global markets. However, farmers often face complex realities that do not always align with food sovereignty's visions. For example, food sovereignty supports building local food economies with short and fair distribution chains between producers and consumers (Nyéléni, 2007, 2015). Yet, domestic agricultural markets in southern Africa present vast challenges for producers (Barrett, 2010; Boughton et al., 2007; Jayne, Chapoto, & Govereh, 2010; Mather, Boughton, & Jayne, 2013). Output markets are characterized by price instability and low investment returns, and generally see small volumes of produce traded (Poulton, Kydd, & Dorward, 2006). A compelling body of literature explains that many peasants are leaving agriculture, and those who stay opt to produce commercially viable crops (Agarwal, 2014; Bryceson, Kay, & Mooij, 2000; Hall, 2009; Li, 2009; Masakure & Henson, 2005). Export agriculture supports the livelihoods of millions of smallholders (Burnett & Murphy, 2014).

4. Insights from sustainability assessment

The respective ideational backgrounds and critiques of the African Green Revolution and food sovereignty models offer valuable insights into the complex challenge of achieving food security. However, there is a growing level of polarization surrounding the debates, raising concerns about the two models' capacity to foster sustainability in Africa's food and agricultural systems in ways that serve the livelihood needs of smallholder farmers. Questions surrounding the most-appropriate seed

technology; how best to secure rural populations' access to productive resources, particularly land, and what types of market relations will be of most benefit to smallholder farmers, are key sustainability concerns. Thus, there is a need for more-nuanced approaches to evaluating what progress is needed for smallholders' food security and agricultural sustainability (IAASTD, 2009), and what each model has to offer to achieve these two goals. Context-specific sustainability assessment frameworks of key food security concerns can provide new knowledge about an area where research is at a crossroads.

Many approaches to sustainability assessments are derived from experience with Environmental Impact Assessments (EIAs), which originally mandated that project developers avoid or mitigate potential adverse environmental consequences resulting from their operations (Dalal-Clayton & Sadler, 2005; Morrison-Saunders & Therivel, 2006; Pope, Annandale, & Morrison-Saunders, 2004). Over time, more progressive EIAs evolved. Projects saw significant changes in the assessment process, i.e. they became more thoroughly proactive in seeking overall lasting positive net gains for three pillars of sustainability: social, economic and ecological (Gibson, Hassan, Holtz, Tansey, & Whitelaw, 2005; Pope et al., 2004).

Several sustainability assessment frameworks for agricultural systems exist (Hansen, 1996; Food and Agriculture Organization [FAO], 2013; Partidário, 2009; Smith & McDonald, 1998; Van Cauwenbergh et al., 2007; von Wirén-Lehr, 2001). A few such frameworks pertaining to peasant agriculture (or smallholder farming) in developing country contexts are also in place (Astier, Speelman, Lopez-Ridaura, Maser, & Gonzalez-Esquivel, 2011; Izac & Swift, 1994; López-Ridaura, Maser, & Astier, 2002). Although these frameworks provide useful insights for implementing (or evaluating) activities based on strong sustainability principles, most limit their applications almost exclusively to systemic properties at the farm scale or local level.

For example, the Framework for Assessing the Sustainability of Natural Resource Management Systems (MESMIS) uses multiple socio-economic and environmental indicators for implementing sustainability practices in peasant farming systems, primarily in the context of Central and Latin America (López-Ridaura et al., 2002). The MESMIS' assessment criteria include yield efficiency and quality, soil nutrient balances, agro-diversity, market diversification, cost of external inputs vs. returns (income) and self-empowerment (pp. 142–143). However, this framework primarily focuses its unit of analysis on factors at the farm, household and local economy level. Political issues, which often go beyond the local and even regional spheres, as well as concerns over power relations that are pervasive in food systems, are largely unaddressed. In addition, the aforementioned frameworks, rather than assess sustainability from farmer perspectives, tend to take a deductive approach to evaluating indicators based on established normative criteria. An evaluative process based on farmer perspectives allows this group to verify sustainability assessment criteria based on their lived experience with the conditions or trends that indicators represent. This latter approach enables the research to focus more directly on areas that are of key concern or priority to farmers.

In many ways, moreover, the tensions between the African Green Revolution and the food sovereignty models are connected to how policies are applied, and what they do or do not address, etc. For instance, critics of the African Green Revolution view its emphasis on upscaling technocratic innovations to resolve a “low-productivity trap” as problematic because the diagnosis is reduced to a technical challenge (with a technical fix) (Jarosz, 2012; Javdani, 2012; Moseley, Schnurr, & Bezner Kerr, 2015; Scoones & Thompson, 2011). In various places across Sub-Saharan Africa, agricultural technological interventions are often overshadowed by significant social, economic and political inequalities, e.g. large-scale land acquisitions (Jarosz, 2012, p. 193). When unaddressed, such inequalities will likely deepen smallholders' marginalization, hunger and poverty.

There is a need for sustainability assessments to substantively engage with policy, including its effects on the social, economic and environmental dimensions of sustainability. Governance mechanisms strongly shape what and how food is grown, distributed and ends up—or does not end up—in

the mouths of consumers (Lang & Heasman, 2015; Lawrence et al., 2010). Policy processes, therefore, are partly to blame for the unsustainable practices in Africa’s food and agricultural systems, as well as why millions of people are food insecure in that region and around the world (cf. FAO, 2012).

This paper delineates a sustainability assessment framework to help us better understand farmers’ needs and what different agrarian models in southern Africa can offer. The framework entails a twofold process. The first is to establish guiding evaluation criteria for progress on core sustainability pillars. The second is to identify food system indicators that characterize key concerns with regards to achieving food and livelihood security for smallholder farmers in a given context. Data collection and analysis for such a sustainability assessment framework drew insights from the author’s field research in Mozambique conducted in 2014 and 2015 (Table 1) (Shilomboleni, 2017).

The guiding sustainability criteria here are concerned with efforts that seek not only to mitigate negative impacts on the indicators, but also to foster overall positive net gains on them in an integrative manner. These evaluation criteria are informed by sustainability assessment frameworks (FAO, 2013; Gibson et al., 2005; Noble, 2014; Partidário, 2009; Pope et al., 2004). The selection process for potential sustainable food system indicators should entail a combination of several techniques, taking into consideration temporal and spatial constraints.

A comprehensive literature review of the characteristics and concerns surrounding each context is necessary to delineate which indicators to appraise.⁴ Researchers may need to conduct fieldwork to help refine and narrow in on those indicators that warrant detailed consideration.⁵ Where possible, researchers may also take quantitative measures at the farm level (e.g. soil properties, species diversity, crop yields, total biomass, income levels, etc.) (see López-Ridaura et al., 2002). While numeric measures may be assigned to the performance of each model, these have to be accompanied by a comprehensive qualitative discussion to shed light on the complex realities and qualities of life, e.g. issues of justice, that are not easily quantifiable.

This framework is meant to guide research that comparatively assesses the activities of the African Green Revolution and food sovereignty models in particular contexts. The selected indicators and criteria do not necessarily identify all the main areas where important contributions could be made in food and agriculture system redesign for Southern Africa. Regional studies seeking to propose sustainability requirements for broader purposes should consider additional indicator and criteria areas for assessment. Such areas may include making food and agricultural systems flexible and adaptive enough to deal with uncertainties and surprises; minimizing post-harvest loss and other inefficiencies; promoting equity in opportunities beyond land rights (e.g. gender equity, better

Table 1. Guiding sustainability criteria for evaluating the African green revolution and food sovereignty models in southern Africa

Sustainability pillar	Criteria	Indicator
Environmental	Maintain (or increase) levels of production over the long term to ensure food availability	Access to quality seeds
	Facilitate ecological integrity and the health of bio-physical systems	Activities to improve soil health
Economic	Provide lasting livelihood opportunities that allow households to pay for other basic necessities such as health care, education, clean water, etc.	Income opportunities
Social	Promote intra-generational and intergenerational equity to ensure fair access to productive resources	Land rights
Governance	Foster public dialogue to ensure that policy undertakings over time prevent and minimize unsustainable practices, and to prioritize investments in key areas that promote positive net-gains	Policy engagement

Framework informed by: Gibson et al. (2005), Pope et al. (2004), Noble (2014), Partidário (2009), Food and Agriculture Organization (2013), López-Ridaura et al. (2002), Astier et al. (2011).

opportunities for the least advantaged); integrating agricultural and non-agricultural ecological systems beyond soil health; and paying direct attention to interactive effects and explicit consideration of trade-offs and how to avoid or minimize them.

Moreover, the selected indicators in this study may be contested in the broader academic literature. Some scholars coming from the food sovereignty perspective might not value technical indicators of quality seeds and income. Similarly, those coming from the African Green Revolution perspective might not entirely appreciate justice indicators such as land rights. There might also be tensions surrounding various interpretations of “quality seeds”, including the use of improved seeds to describe conventionally bred open pollinated varieties (OPVs) or hybrids. The concept of “good governance” and what constitutes appropriate policy engagement may also be subject to different opinions. However, the terminology used to describe these indicators is less important—what matters are the opportunities and challenges they present for farmers. Therefore, these indicators should be respected as such.

4.1. Environmental: Quality seeds and soil health

At the farm level, progress towards sustainability requires maintaining or increasing yields through the efficient use of natural, synthetic and economic resources (López-Ridaura et al., 2002; Morse, 2010). In Mozambique and the broader region, farmers see low and stagnating crop productivity—a majority of households are unable to produce enough food to last a year (Cunguara & Hanlon, 2010; FAO, 2011a). Thus, quality seeds that produce a decent yield and healthy soil practices are critical to facilitating physical availability and access to food. Achieving long-term sustainability, however, also requires improved biodiversity in food and agricultural systems. This need often entails optimizing the use of agro-ecological farming practices, such as nutrient cycling and crop diversity (Altieri & Nicholls, 2005; Gliessman, 1998; Pretty, 1998). Agro-ecological practices are especially important in smallholder food systems where farmers have limited income or access to credit. Thus, while moderate use of external inputs, e.g. chemical fertilizers, can increase crop yields, practitioners must consider other factors such as the cost of inputs and whether poor farmers can reliably gain access to them (Astier et al., 2011; Hecht, 1995).

To foster positive improvements on the indicator of access to quality seeds, this study recommends that crop-breeding activities target crops that help farmers meet their nutritional needs, suit southern Africa’s diverse agronomic environment, and encourage participatory engagement from farmers (Lynam, 2011; van Etten, 2011). High quality seeds should be accessible to a majority of farmers in given contexts over the long term. Mozambican farmers interviewed by the author similarly agree with this idea. Access to seeds can entail delivery either through commercial channels, e.g. agro-dealers, or social means, such as community seed banks.

Some actors coming from the food sovereignty perspective may take issue with the various interpretations of “quality seeds”, including using the term to describe conventionally-bred open pollinated varieties (OPVs) and hybrids. Indeed, some African Green Revolution initiatives, such as the Water Efficient Maize for Africa (WEMA) project⁶, make use of three breeding approaches to improve seed quality: conventional, marker-assisted and genetic modification⁷ (WEMA, 2016b). But with Monsanto as one of its implementing partners, WEMA might symbolize a case for concern, given the emergent interests of agro-companies looking to patent germplasm developed in field-trials in the region (see ACB, 2015b). New intellectual property rights developments are likely to carry significant sustainability effects in the region, and as such demand further attention not only from those supporting the two agrarian models, but from policy-makers as well.

With respect to soil health, continual improvements are needed because agricultural systems often export nutrients from soils. If these nutrients are not replaced, the result is soil degradation and decline in crop yields (FAO, 2011b). Improving soil health entails adopting Integrated Soil Fertility Management (ISFM) practices, which can comprise organic and inorganic nutrient stocks. Healthy

soils should have a capacity to recycle vital crop nutrients and to maintain a diversity of organisms that minimize disease-and-pest outbreaks (FAO, 2011b). Although high-input agriculture (which makes use of chemical fertilizers) is frequently linked to unsustainability, Hansen (1996) argues that no-input agriculture can equally be unsustainable. Studies in Benin, Mali, Tanzania and Zambia demonstrate evidence of resource degradation in the absence of nutrient renewal (Budelman & Van Der Pol, 1992 in Hansen, 1996; see also Lotter, 2015). In each case, extensive overuse of soils resulted in erosion, leaching and de-nitrification. Consequently, farmers often experienced harvest loss (Hansen, 1996; Smith & McDonald, 1998). The authors conclude that some application of fertilizer could make these farming systems more sustainable. But, as mentioned, practitioners have to consider how poor farmers can reliably access (often) high-priced external inputs or find suitable local sources or revised agricultural system solutions.

4.2. Economic: Income opportunities

Agriculture serves multiple functions. It directly provides food and income through produce sale. Agriculture also offers ecological services, maintains rural landscapes and represents cultural heritage (International Assessment of Agricultural Knowledge, Science and Technology for Development [IAASTD], 2009). In rural Mozambique and the broader region of southern Africa, farming is, in most cases, the only feasible means of food provision and income. Income from agricultural produce is critical to meeting other household needs, such as paying for health care, education, clean water, etc. Sustainability assessment literature similarly explains that improved economic opportunities in agricultural sectors are vital to sustaining rural livelihoods (IAASTD, 2009; López-Ridaura et al., 2002; Van Cauwenbergh et al., 2007).

Trends in agricultural markets in southern Africa, however, are characterized by low and volatile farm gate prices, to an extent that the agriculture sector does not offer reasonable returns to support smallholders' livelihoods (Boughton et al., 2007; Cunguara, 2012; Jayne et al., 2010; Mather et al., 2013; Walker et al., 2004). Masakure and Henson (2005) show that Zimbabwean small-scale farmers choose to produce high-value "out-of-season" fresh produce under contract for UK supermarkets. The authors outline several major reasons why Zimbabwe's smallholders chose to grow under contract. One is the opportunity to earn an income given that there are few alternative livelihood options. Another reason is having a guaranteed market and access to transportation in an environment where both components are underdeveloped (Masakure & Henson, 2005). There are evident needs to foster domestic market relations that allow farmers to earn stable prices under fair trade conditions.

Those coming from the food sovereignty perspective may not value income as a key indicator for food security and sustainability. For them, self-provisioning and working towards self-sufficiency might be a more important goal considering that the problems of underperforming domestic agricultural markets and depressed output prices are directly linked to distorted international trade agreements and practices (Nyéléni, 2007, 2015). Indeed, Pretty, Camilla, and Stella (2011) explain that numerous initially successful efforts to increase farmers' yields in Sub-Saharan Africa have ended in failure due to weak (income) incentives in agricultural market (p. 8). These are legitimate concerns that warrant serious engagement from the two agrarian models and policy-makers.

Nonetheless, much of the smallholder population, particularly in Mozambique, sale of produce is currently the primary means to earn a living. Self-provisioning might not be a feasible option in the short-to-medium term given that there are few to no other livelihood opportunities, e.g. industry jobs. Mozambican farmers who participated in this study agree that there is a need to foster better incentives that establish equitable trade practices in domestic agricultural market.

4.3. Social: Land rights

A significant majority of southern Africa's rural populations use land to produce their food as well for various subsistence purposes, such as grazing, collecting wild produce and firewood (cf. Hanlon, 2004). Over the last decade, however, rural communities have seen increased pressure on land-use

as state authorities encourage private investors to enter the agricultural sector. The rate at which land transfers are occurring in some Sub-Saharan countries is unsustainable and the side effects are often negative. From 2004 to 2009, total land transfers of land were estimated at 1.2 million ha in Ethiopia, 2.7 million ha in Mozambique and 4 million ha in Sudan (Aabø & Kring, 2012). Large-scale land transfers have contributed directly to the displacement of rural populations and to the enclosure of former public lands and other resources, e.g. water (Borras, Fig, & Suárez, 2011; Cotula, 2013; De Schutter, 2011; UNAC and GRAIN, 2015). In response to an international outcry over the detrimental effects of “land grabs”, global governance institutions have introduced various initiatives⁸ to promote responsible investments in land transfers (see Collins, 2014).

The World Bank makes a case for African countries to formalize community-based tenure systems as a way to manage land-related conflicts, and to improve the “the fluidity of land markets” (Byamugisha, 2013, p. 9). Where formalized tenure systems exist, Byamugisha states that countries can see increased productivity as “land moves from less efficient to more efficient producers through rental and sales markets” (Byamugisha, 2013, p. 36). Indeed, those coming from the African Green Revolution perspective tend to favor market innovations that will transfer land to the most efficient farmers in the long run (cf. Pingali, 2012). For them, large-scale land transfers may not necessarily be undesirable as long as they can create income opportunities, e.g. jobs, for rural populations so they can purchase food and other basic necessities.

Compelling empirical evidence from southern Africa, however, demonstrates that market-based tenure systems scarcely address the interests of the rural poor, including issues of gender inequality in tenure allocations (AFSA and GRAIN, 2015; Collins, 2014; Milgroom, 2015; Paul & Steinbrecher, 2013). Privatized tenure systems also fail to recognize the multiple forms of land use by communities, such as grazing, sourcing forest foods and engaging in cultural practices and rituals.

Moreover, several African countries, including Mozambique, Tanzania, Ethiopia and Zambia, already have in place fairly strong legal provisions that recognize customary land rights (LandMark, 2016), but the law is often used poorly. For example, Mozambique’s land law (GoM, 1997) requires investors entering the agricultural sector to undertake community consultations in order to identify lands that are not legally occupied and/or negotiate for their use with local communities (Hanlon, 2004). But rather than engage in substantial discussion with communities about the scale and value of investment, many investor-consultations tend to “sell the project” to a few local representatives, offering vague promises for jobs, food security and rural development (Aabø & Kring, 2012; Hanlon, 2004). In Mozambique and the broader region, land deals are characterized by corruption and by improper to no community consultations; hence, rural populations continue to face the risk of land dispossession (Borras et al., 2011; Cotula, 2013; UNAC and GRAIN, 2015).

Fostering sustainability by strengthening land rights could mitigate negative social impacts, such as community land dispossession, and improve communities’ equitable access to productive resources, particularly for vulnerable populations. Thus, it is important for activities of the two agrarian models to engage in advocacy efforts that seek to minimize large-scale transfers, as well as to invest in proactive measures that build greater transparency and equity in land-use rights.

4.4. Governance: Policy engagement

Most of the aforementioned indicators (especially seeds, incomes and land rights) have strong links to policy—progress towards sustainability would inevitably require engagement with governance mechanisms. As illustrated by a high rate of land transfers in Mozambique and the broader region that are facilitated by national policies, policy measures can act as a barrier to facilitating livelihood and food security. Various other policy mechanisms that hinder progress towards food security may be less salient, but are equally harmful. For example, a persistent global trend in food systems is that farm input costs are on the rise, while output prices (earned by producers) are low and/or extremely volatile (IAASTD, 2009; Koopman, 2012). Such distorted incentives in agricultural markets, combined with unfair international trade rules, may inadvertently discourage farmers from increasing their

food production. These challenges suggest a need for more-effective engagement with policy processes to help food systems progress towards sustainability.

State investments in agricultural sector infrastructure also have an important role in facilitating food security. For countries in the early stages of agricultural transformation like those in southern Africa, states have a crucial role to play in the areas of market development, extension support, information about production flows and prices and public infrastructure, etc. (Dorward, Kydd, Morrison, & Urey, 2004). The state should be a prime guarantor of food security as it can enforce the legal nature of various entitlements—ensuring that prices of exchange are fair and stable, and protecting and promoting the social and economic conditions necessary to secure individuals' access to food (Dreze & Sen, 1989; FAO, 1996). Fostering sustainability in southern Africa's food systems would also entail engaging policy-makers to prioritize government investments to key areas of the agricultural sector.

Evaluating organizations' performance on these indicators would entail an inductive approach that seeks to verify and apply sustainability assessment criteria based on farmers' lived experiences. Performance ratings should be addressed in a qualitative manner, e.g. assigning a low, moderate or high rating to an organization's efforts depending on whether there is progress towards (or regress from) a target criterion. A low rating identifies little to no action to improve the conditions or trends on each in the direction of the sustainability criteria. A moderate rating recognizes partial action to meet the target criterion. For example, efforts that increase the levels of good quality seeds, but do not ensure that farmers can gain access them, qualify as having a moderate impact. A high rating is attained when an organization's activities have some evident success and actively seek to foster improvements on the conditions and trends of an indicator as per outlined criteria.

5. Conclusion

The African Green Revolution and food sovereignty models' respective approaches to food security and sustainability in southern Africa are influenced by their ontological backgrounds. The former model leans towards modern rational ideas about structural transformation and development. As such, African Green Revolution efforts predominately support increasing the availability of improved agricultural technologies, e.g. hybrid seeds, and fostering output markets as a way to increase crop productivity and rural incomes. The latter model is grounded in historical structural principles that wrestle with issues of power and (in) justice in global political and economic structures. Food sovereignty activities in southern Africa largely seek to mobilize political resistance against policy practices that undermine peasants' access to productive resources, particularly land, and to support agro-ecology as a way to foster social reproduction and revitalize crop productivity.

The African Green Revolution and food sovereignty models make important contributions in their efforts to improve the food security and sustainability performance of southern Africa's food and agricultural sectors. In the case of Mozambique, farmers are utilizing some of the tools that both agrarian models offer in complementary ways to meet their needs. However, polarized politics in academic and public forums highlight the contradictions between and within the African Green Revolution and food sovereignty models. This situation hinders fruitful engagement that helps to effectively address concerns in southern Africa's food and agricultural systems.

This paper has shown that insights from sustainability assessments can help to shift discussions towards more-open dialogue about food system concerns in specific contexts from farmer perspectives. In Mozambique and the broader region of southern Africa, the selected indicators and evaluation criteria illuminate important characteristics of smallholder agricultural needs and challenges that must be met by the competing agrarian models. Taken together, the five indicators can help to address both technical aspects of meeting food security (seeds and soils) and income and engage with political economy issues that shape how food is grown and distributed (land rights, policy engagement). From farmers' points of view, both the technical and political dimensions are important to achieving broad-based food security and sustainability.

The value of sustainability assessments, moreover, is their capacity to foster an integrated understanding of essential issues, while creating space for options needed to help communities progress towards sustainability through context-based criteria (Gibson, 2016). These insights offer lessons for how African Green Revolution and food sovereignty scholars can engage in a more productive debate, as the transition to sustainability hinges on being open to influence and critique (Pope & Grace, 2006). Finding common ground in food security and sustainability discussions is crucial because hunger continues to affect a large segment of the rural population in southern Africa. The increasingly fragile nature of farming in the region due to the threat of climate change also suggests a need for novel solutions. History has also shown that efforts that change the world are those that mobilize and collaborate across differences, shifting and creating new forces and agents in their paths (Tsing, 2004).

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Notes

1. Based on the author's field research in Mozambique for a period of seven months in 2014 and 2015 entailing a comparative assessment case study of the Alliance for a Green Revolution in Africa (AGRA) and the National Union of Mozambican Peasants (UNAC) (a food sovereignty movement), and their contributions to these two goals from farmer perspectives.
2. For a full list of AFSA members, visit <http://afsafrica.org/what-is-afsa/>.
3. The Declaration of Nyéléni was adopted at the meeting of food sovereignty movements in the village of Nyéléni in Sélingué, Mali, 2007 (see <http://nyeleni.org/IMG/pdf/DeclNyeleni-en.pdf>).
4. Indicators will vary depending on what contextual factors are likely to carry significant impacts, and are of key concern to the public in that particular setting and /or research participants (Noble, 2014).
5. This may include semi-structured interviews, surveys and focus group meetings with farmers and organizations implementing agrarian activities of different agrarian models.
6. The project is funded by the Bill and Melinda Gates and the Howard G. Buffett Foundations and the US Agency for International Development (USAID). WEMA's implementing partners include the African Agricultural Technology Foundation (AATF), the International Maize and Wheat Improvement Center (CIMMYT), Monsanto and national agricultural research centers in five participating countries: Mozambique, Tanzania, Kenya, South Africa and Uganda (WEMA, 2016a).

7. Genetically modified WEMA varieties in these countries are currently being planted in confined field trials, but have not yet been commercially released (see ACB, 2015b).

8. These initiatives include the Principles for Responsible Agricultural Investment developed by the UN Conference on Trade and Development (UNCTAD), the FAO of the United Nations, the International Fund for Agricultural Development (IFAD) and the World Bank, Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests developed by the Committee on World Food Security.

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