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Green Revolution in Sub-Saharan Africa: Implications of Imposed Innovation for the Wellbeing of Rural Smallholders

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Summary. — Green Revolution policies are again being pursued to drive agricultural growth and reduce poverty in Sub-Saharan Africa. However conditions have changed since the well-documented successes of the 1960s and 1970s benefitted smallholders in southern Asia and beyond. We argue that under contemporary constraints the mechanisms for achieving improvements in the lives of smallholder farmers through such policies are unclear and that both policy rationale and means of governing agricultural innovation are crucial for pro-poor impacts. To critically analyze Rwanda's Green Revolution policies and impacts from a local perspective, a mixed methods, multidimensional wellbeing approach is applied in rural areas in mountainous western Rwanda. Here Malthusian policy framing has been used to justify imposed rather than "induced innovation". The policies involve a substantial transformation for rural farmers from a traditional polyculture system supporting subsistence and local trade to the adoption of modern seed varieties, inputs, and credit in order to specialize in marketable crops and achieve increased production and income. Although policies have been deemed successful in raising yields and conventionally measured poverty rates have fallen over the same period, such trends were found to be quite incongruous with local experiences. Disaggregated results reveal that only a relatively wealthy minority were able to adhere to the enforced modernization and policies appear to be exacerbating landlessness and inequality for poorer rural inhabitants. Negative impacts were evident for the majority of households as subsistence practices were disrupted, poverty exacerbated, local systems of knowledge, trade, and labor were impaired, and land tenure security and autonomy were curtailed. In order to mitigate the effects we recommend that inventive pro-poor forms of tenure and cooperation (none of which preclude improvements to input availability, market linkages, and infrastructure) may provide positive outcomes for rural people, and importantly in Rwanda, for those who have become landless in recent years. We conclude that policies promoting a Green Revolution in Sub-Saharan Africa should not all be considered to be pro-poor or even to be of a similar type, but rather should be the subject of rigorous impact assessment. Such assessment should be based not only on consistent, objective indicators but pay attention to localized impacts on land tenure, agricultural practices, and the wellbeing of socially differentiated people.
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Key words — Sub-Saharan Africa, Malthusian trap, agricultural modernization, impact assessment, policy framing, Rwanda

1. INTRODUCTION

"Green Revolutions" transformed the rural economies of many Asian and Latin American countries during 1960–90. The transfer of the same strategies to Sub-Saharan Africa (SSA) had limited success, due in part to locally unsuitable seed varieties (Evenson & Gollin, 2003) and a lack of human and institutional capacity (Denning *et al.*, 2009). Contemporary proponents of an African Green Revolution claim these obstacles have now been overcome through capacity building and the development of locally relevant technologies (Ejeta, 2010). Indeed agricultural growth is widely viewed as the only pathway to long-term and pro-poor economic development in SSA, by driving growth in the wider economy and allowing for absorption of excess labor through growth in the rural non-farm economy (Adelman, 1984; Collier & Dercon, 2014; Diao, Hazell, & Thurlow, 2010; Minten & Barrett, 2008). As a result of this analysis, policies for a Green Revolution in Africa have become heavily supported by donors (Jayne & Rashid, 2013; Sanchez, Denning, & Nziguheba, 2009).

In considering the prospects for an African Green Revolution, it is important to consider changes in the political economies of rural development since the 1960s and 1970s. Earlier Green Revolutions occurred when rural development politics was shaped by narratives of state-led modernization, import substitution, and growth through redistribution, a political context that justified transformative levels of state financing and extension activities (Ellis & Biggs, 2001). For example policies in India, Indonesia and the Philippines in the mid-1960s promoted smallholder-driven agricultural intensification through massive public investments that included price guarantees to raise smallholders' incomes (Birner & Resnick, 2010). By contrast, the context for contemporary African rural development was transformed by the spread of neoliberal political agendas, including the structural adjustment policies of the 1980s and 1990s, with governments now facing greater conditionality structures and smallholders facing lower and more volatile prices and less favorable terms of trade (Dorward, Kydd, Morrison, & Urey, 2004). These political constraints on state support for agriculture are arguably compounded by the challenges faced in SSA today, including relatively high population densities in those areas best suited to agriculture, high dependency ratios, relatively poor infrastructure, and vulnerability to climate change. These are major challenges for realizing directly pro-poor impacts from

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agriculture. As a result, there has been a shift away from viewing Green Revolution technologies as directly pro-poor and scale neutral, toward a view that poverty alleviation will be achieved indirectly and over longer timescales, through trickle-down effects from an agricultural boom, including employment opportunities, reduced food prices, and a developing rural non-farm economy (Dorward *et al.*, 2004). Green Revolution policies still aim to create material benefits through more immediate micro-social processes as well as longer term macro-economic logic; but the balance has shifted toward the latter in SSA (Collier & Dercon, 2014).

Just as the politics of statehood have changed since earlier Green Revolutions, so too have the political narratives of civil society. In particular, we note that ideas of food sovereignty have become significant, both in more organized forms of advocacy and more generally in terms of how the rural poor respond to imposed agricultural policies (Chaifetz & Jagger, 2014). In a context in which agriculture has already been exposed more to variability in market prices and climate, farmers might be characterized as increasingly resistant to changes that are perceived to further reduce their control over food production (Agarwal, 2014).

For these reasons we contend that the mechanisms by which many of SSA's agricultural policies are expected to alleviate poverty and enhance food security are not inherently clear. In particular, we are interested in how policies play out at local level and affect different groups of local stakeholders. Much policy assessment work operates at the macro scale, and either aggregates people (providing average effects only) or evaluates limited types of impact (focusing for example on income or nutritional status). More localized cases that shed light on micro-level experiences are important to complement these macro surveys as they can capture socially differentiated experiences and explore locally relevant factors in poverty and wellbeing. The importance of such understanding is elaborated in the remainder of the introduction. We then introduce our case study, describing policies to drive growth in agricultural production in Rwanda. The specific contribution of this paper is to reconcile opposing perspectives of Green Revolution policies, to elucidate relevant micro-social processes in the case of rural Rwanda in order to complement the macro-economic logic which guides policy implementation and dominates its assessment. The results are utilized to draw out general conclusions about agricultural policy and assessment in SSA and more specifically to make recommendations for adapting and improving Rwandan policies' contribution to the wellbeing of the rural poor in the study region.

We conceptualize agricultural intensification as an innovation comprising multiple and nonlinear processes (Hall, Bockett, Taylor, Sivamohan, & Clark, 2001; Spielman, Ekboir, & Davis, 2009). Green Revolution policies represent a radical change to agricultural practice and related political, social and economic systems. Policy evaluation will benefit from considering this change as an innovation which involves complex interactions between numerous people, groups, institutions and organizations. This contrasts with mainstream evaluations that tend to employ a simplified, linear theory of change whereby policies are implemented, cause changes in farmer behavior and contribute to changes in production, incomes, and poverty rates (Knickel, Brunori, Rand, & Proost, 2009).

Such theories of change have often evolved in association with entrenched problem narratives. Notably in SSA a Malthusian narrative has repeatedly described a crisis arising from growing populations in the context of finite and degrading land resources (Roe, 1999). Proponents of a Green Revolution in SSA point out that much of the agricultural growth achieved to date has been caused by expansion into new land, which, in the face of increasing population, has reached its geographical limits and is often associated with soil fertility decline (Breisinger, Diao, Thurlow, & Hassan, 2011; Denning *et al.*, 2009). Malthusian crisis framings have not only justified the prioritization of agricultural intensification policies but also their imposition with limited consultation (Peters, 2009). Such top-down governance of agriculture neglects the key role which rural people play in the implementation of agricultural innovation in Africa and in determining how it affects different actors (Gabre-Madhin & Haggblade, 2004). Indeed while Malthus did not envisage that innovation could help feed a growing population, Boserup (1965) suggested that farmers themselves would respond to population growth through bottom-up innovation. Ruttan and Hayami (1984) developed the idea further to suggest that shifts in demand and prices should incentivize "induced innovation" among farmers, attributing a significant role to institutions operating at different scales and to the design and implementation of policies which facilitate innovation by affecting input supply, factor prices, land markets and tenure and output markets.

The contrasting perspectives on the pathways through which Green Revolution policies' effects are realized raises questions about the way in which their impacts are assessed. There is limited empirical, household-level research on the pathways by which increased agricultural production reduces poverty, particularly in different circumstances and contexts (Abro, Alemu, & Hanjra, 2014). Policy impacts are commonly assessed using large-scale household survey data, analyzing changes over five or 10-year periods in household assets, incomes, and consumption. Such policies may be deemed to have contributed to poverty alleviation and food security based on favorable movements, in the medium to long-term, of objective indicators representing agricultural outputs, rates of fertilizer application, income levels, or poverty rates. Analyses sometimes also aggregate indicators over large scales.

Assessing such far-reaching and ambitious policies in this way may be inadequate for several reasons: Firstly, at least in the short-term, there may be considerable material costs for rural inhabitants which are not captured by the selected indicators or by aggregate patterns. Agricultural sector growth has been shown in a number of recent examples from SSA to correlate with reduced levels of poverty at aggregate national or regional levels (Breisinger *et al.*, 2011; Denning *et al.*, 2009; Diao *et al.*, 2010). However studies in the same countries which focus on disaggregated local perspectives of those same policies have highlighted material costs and vulnerabilities among poor smallholders or at best an inability to benefit from policies, in Malawi (Bezner Kerr, 2013; Harrigan, 2003), Ethiopia (Abro *et al.*, 2014), Uganda (Kijima, Otsuka, & Sserunkuuma, 2011) and in Kenya's Millennium Villages (Wanjala & Muradian, 2013). More generally a number of studies have suggested that agricultural growth is less likely to result in reduced poverty in instances where high inequality exists and may in fact lead to exacerbated poverty or marginalization among disadvantaged groups (Negin, Remans, Karuti, & Fanzo, 2009). This is particularly relevant in SSA where levels of inequality are relatively high (Thorbecke, 2013) and where current rural development politics may preclude significant investments to support farmer incomes (Dorward *et al.*, 2004).

Secondly, reliance on normatively selected objective indicators may overlook locally meaningful values and definitions of wellbeing and poverty. Incorporating plural perspectives can

be important because, for example, people may prioritize their household's food security over income maximization, and this might require e.g., staggered production rather than single harvests. Policies focused on yield maximization may ignore or phase out crops that are vital to preferred strategies of the poor, while introducing crops more vulnerable to environmental and economic variability thus undermining food sovereignty (Kijima *et al.*, 2011). While many judge that food security may be enhanced through increased agricultural production, others suggest that this overemphasizes national food availability over local food access and food utilization (Altieri, Funes-Monzote, & Petersen, 2012; Lee, 2013). The disconnect between normative definitions of food security and interpretive studies of food security or sovereignty highlights a need to reconcile these different perspectives (Agarwal, 2014). Factors known to contribute to pro-poor agricultural growth include the incorporation of farmer knowledge, active involvement of farmers in decision-making, customization to local context, and provision of support to traditional practices (Bates, 2005; Pretty, Toulmin, & Williams, 2011; Tendler, 1997; Van Donge, Henley, & Lewis, 2012).

Thirdly, attention to micro-level mechanisms can improve understanding of the interactions between people, groups and institutions which determine how policies are actually implemented and experienced. The pathways to innovation, including levels of participation, may determine how the Green Revolution is experienced by rural people, and ultimately determine its effectiveness in alleviating poverty. Furthermore the chronically poor often require targeted policies such as social protection to address the power relations which reproduce their poverty (Cleaver, 2005; Hulme & Shepherd, 2003). Top-down policies justified through narratives of crisis have been associated with negative implications for the poor in terms of impacted agency and marginalization, both in SSA (Bates, 2005; Berry, 1997; Peters, 2004) and elsewhere (Li, 1999; Tendler, 1997).

Lastly, agricultural policies are only one driver of change in the lives of rural inhabitants. Globalization, climate change, population change, new technologies, and social change are all exerting increasing influence. Household census data may be inadequate to assess policy impacts and require supporting information in order to establish causal relationships, i.e., the extent to which observed changes in indicators such as poverty rates or consumption are attributable to the policy in question as opposed to other drivers of change (Shaffer, 2013; White, 2009).

This study utilizes a multidimensional wellbeing approach (Gough & McGregor, 2007) to assess impacts of agricultural modernization policies. Here we focus on the two most significant policies effecting agricultural transformation: the Rwandan Land Policy (ROR., 2004) and the Crop Intensification Program (MINAGRI, 2008). Rwanda provides a fascinating example for such analysis as its rural population suffers great difficulties, faces rapid change and has been exposed to internationally-supported policies to promote land reform and agricultural transformation (Van Damme, Ansoms, & Baret, 2014). Rwanda exhibits the highest population density on mainland Africa and 89% of the labor force is involved in agriculture (McMillan & Headey, 2014). The population is growing rapidly, expected to increase from close to 10 million in 2009 to between 13.5 and 15 million in 2022 (NISR, 2007). Nationally, average land size per household is only 0.76 hectares (NISR, 2010) and as many as a quarter of rural households are virtually landless (Jayne *et al.*, 2003). Some argue that Rwanda therefore provides a startling example of the Malthusian trap (Van Hoyweghen, 1999). Land scarcity has even been proposed as a factor in the 1990–94 war and genocide which killed 10% of the population (André & Platteau, 1998; Percival & Homer-Dixon, 1996).

Although agriculture is the primary occupation nationwide, this study centers on rural inhabitants in the mountainous west of Rwanda, where population density is highest, land holdings smallest, infrastructure least developed and efforts to enhance land productivity arguably the most challenging. Soils across much of the country exhibit characteristics which can limit crop production, being acidic, with limited nutrients and organic content (Roose & Ndayizigiye, 1997; Verdoodt & Van Ranst, 2006), though this is particularly acute in parts of the mountainous west where heavy rains remove them from exposed soils (Drechsel, Gyiele, Kunze, & Cofie, 2001; Mupenzi, Varenyam, Habiyaremye, Theoneste, & Emmanuel, 2011). Poverty is also more acute in the more remote west, where the majority of children between six months and five years old suffer from chronic malnutrition (WFP, 2012).

Despite these obstacles, Rwanda's agricultural policies have been pronounced as successful in alleviating poverty and enhancing food security (IMF, 2011). Rwanda has enjoyed a period of consistent economic growth, increases in crop production, and a fall in income-based poverty from 57% in 2006 to 45% in 2011 (NISR, 2012). Though Rwanda is considered internationally to be a shining example of successful economic and social development (Crisafulli & Redmond, 2012), the governance of change is the subject of debate (Zorbas, 2011). Rwanda has been described as an authoritarian developmental state (Booth & Golooba-Mutebi, 2012). Some highlight the achievements of the state in overseeing successful rebuilding and reconciliation in a post-genocide era, despite limited democracy and top-down decision making (Clark & Kaufman, 2008). But whether focusing on development outcomes or governance concerns, few studies have paid attention to the perspectives of rural inhabitants themselves (de Lame, 2005; Ingelaere, 2010).

By focusing on local experiences and wellbeing priorities, this study challenges the sufficiency of national-level statistics that support generalized claims of rural development success. It advocates for greater scrutiny of similar far-reaching policies and recommends forms of compromise through which innovation is induced and embedded alongside locally-valued modes of production rather than imposed.

2. AGRICULTURAL MODERNIZATION POLICY IN RWANDA

The Government of Rwanda's agricultural policies aim to transform farming practice nationwide. This involves a rapid shift away from traditional modes of production toward specialization in a small number of government-approved, marketable staple or cash crops. The two major components of this strategy are the Rwandan Land Policy (ROR, 2004) and the Crop Intensification Program (MINAGRI, 2008). The Rwandan Land Policy, introduced in 2004, states that current trends lead toward "*a completely degraded land as a result of such archaic agricultural practices, unable to meet the food demand of an ever increasing population,*" (ROR, 2004). The polyculture system of farming practices is described as a:

> "*simple self-subsistence agriculture based on working the land without caring for its conservation or the improvement of its production capacity*," which "*hinders all forms of technical innovations… What prevails therefore is a mediocre agriculture that has no future, characterized by*

tiny plots on which the prevailing crops are sweet potatoes, sorghum and beans for domestic consumption... Obviously, the share of such agricultural produce that goes onto the market is insignificant, if non-existent."

The two policies combine to govern rural practices in a top-down administrative manner: through formalization and control over land tenure; regulation of farming practices, and; by cascading down powers of enforcement and policy targets to local government officials. Regarding tenure, the 2004 Land Policy highlighted that all land was effectively government property and belongs to citizens on a conditional, leasehold basis, restricting further fragmentation of plots through hereditary transfer: To ensure achievement of production goals for production of specific edible or cash crops "*it should be possible for the government to repossess the land if the owner or holder of the land rights has failed to use it in accordance with the law,*" (ROR, 2004). Subsequently a Crop Intensification Program (CIP) has been introduced to control production through designation of regions for crop types, to ensure widespread use of new technologies through making approved seed types and subsidized chemical fertilizers available and to set strict and simple time-scaled targets to make sure that the desired production of those crops is achieved (MINAGRI, 2008). The Rwandan government, supported by international donors, has attempted to monetize the agrarian economy and align rural production with national economic goals, proposing that "*agriculture in Rwanda should be oriented towards specialization...to manage the land and use it in an efficient, uniform manner,*" (ROR, 2004). The government now specifies what each Rwandan can grow in which season (there are two main growing seasons through the year) by determining regional specializations for individual crops. The crop types allocated to each administrative area are based upon a higher level spatial planning exercise utilizing data on soils, climate, and government judgement on the needs of the national economy, including export demand (Huggins, 2014). As a result large areas of land were designated suitable for one of six approved edible crops such as maize (now deemed suitable to be grown in most of the west of Rwanda) or cash crops such as tea which may serve to boost national exports as well as local food security. The CIP policy has been implemented nationally through "*imihigo*" targets, for which local officials are held accountable (MINAGRI, 2008) and for which fines are imposed on or land reallocated from farmers who fail to comply (Ingelaere, 2011; Van Damme *et al.*, 2014).

Rwandan smallholders have traditionally dealt with the environmental constraints placed upon them through a system of polyculture. Farmers cultivate a wide variety of crops, dependent upon fine-scale environmental gradients, with varied sowing dates and overlapping crop cycles, such that some crops are frequently planted in among one another and mixes can differ even within a small plot (de Lame, 2005; Verdoodt & Van Ranst, 2006). In the west of the country, the 2008 national agricultural survey revealed that farmers grew sixty different types of edible crops, with 95% of farmers using traditional polyculture at that time (NISR, 2010). Prior to introduction of the new policies, subsistence farming was the main source of harvests for sweet potato (61%), banana (63%), and beans (68%), and these crops dominated national food production (WFP, 2009). While 13% of farmers grew cash crops such as tea or coffee in 2008, these were most often grown alongside a mix of edible crops (NISR, 2010).

As a result of the two policies described, use of provided seeds is claimed to have risen nationally from 3% to 40% of households during 2007–11, fertilizer use increased from 8 to 23 kg per hectare and production increased accordingly (MINAGRI, 2011). Gains in production of the six prioritized crops of maize, wheat, potato, cassava, rice, and beans all exceeded their national targets in 2008 on the way to a 30% proposed increase during 2006–12, as did production of tea (IMF, 2011). The area under production of these crops was planned to increase from less than half a million hectares in 2007 to approximately 1.8 million hectares in 2013 (MINAGRI, 2011). Crop production per capita has risen steadily since 2001 but since 2008 has risen more rapidly to levels comparable to those experienced pre-1994 (data from http://data.worldbank.org/country/rwanda). The Ministry of Agriculture (MINAGRI, 2011) reported that "*the program has provided the much needed foundation for a positive change in Rwanda's agriculture development. CIP has also revealed the massive potential that exists in the country in increasing the smallholder agricultural productivity*."

3. METHODS AND STUDY SITES

Using mixed methods social research this study applies a multidimensional wellbeing framework (Figure 1, Gough & McGregor, 2007). These methods generate differentiated forms of data, including objective indicators of assets such as land size and housing standards which are then averaged across different social groups, but also links these to interpretive approaches associated with detailed testimonies of individual interview respondents. Attempts are made to: (1) explore how rural people define wellbeing; (2) analyze differences in wellbeing between socio-economic groups, socio-ethnic groups and sites; (3) examine changes in wellbeing over the previous ten years; and (4) examine how the policies employed to promote agricultural modernization affect wellbeing outcomes for socially differentiated kinds of rural people.

The wellbeing framework utilized for the analysis looks at the diversity of factors involved in "what a person has, what they can do and how they think and feel about what they both have and can do," and puts the focus very much on people and their own perceptions, rather than policies, instruments or institutions. Resources represent "What a person has," building on the sustainable livelihoods framework's five types of capital: natural, human, material, cultural, and social (Bebbington, 1999). It is this mix of resources which enables a person to achieve wellbeing outcomes or "what they can do," including meeting basic needs or satisfying wants or goals in regard to different aspects of life such as health or social relationships. We consider basic needs as in Doyal and Gough (1991), i.e., the level below which harm of an objective kind will result for any individual.

The definition of wellbeing comprises meaning as a subjective dimension in addition to material wellbeing (Gough, McGregor, & Camfield, 2007) to focus on individuals' own ideas of what is important and represents a good quality of life. The subjective dimension represents "how they [interviewees] think and feel about what they both have and can do," (McGregor, Camfield, & Woodcock, 2009). This subjectivity allows for variation in ways of thinking and acting between individuals and groups of people, in terms of their individual agency and socially constructed or "'inter subjective" social relations, cultural values, beliefs, and practices (Coulthard, 2008).

This study was conducted in eight villages across three sites in mountainous western Rwanda (Figure 2) between October 2011 and June 2012. The three sites were selected because of their geographical and administrative separation in different districts but also because they differ on a gradient of remoteness and in terms of infrastructure and opportunities for both

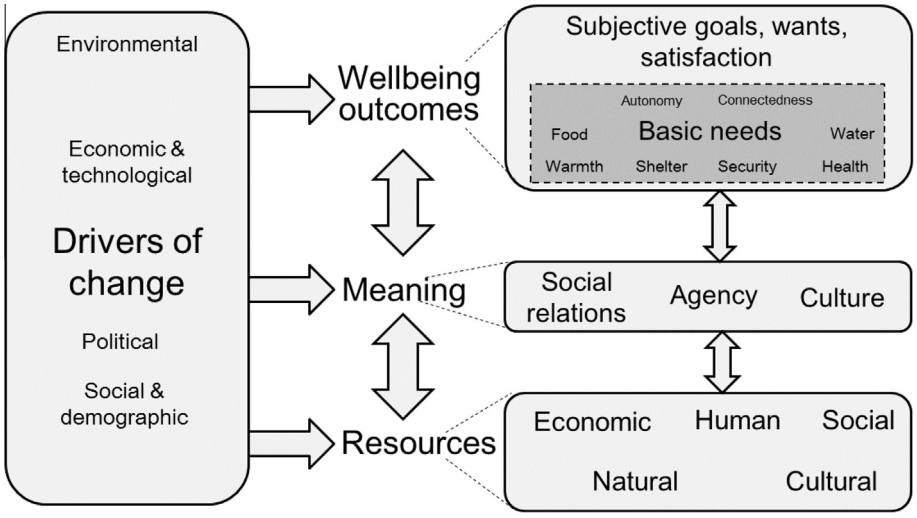

Figure 1. *Conceptual framework of human wellbeing and drivers of change.*

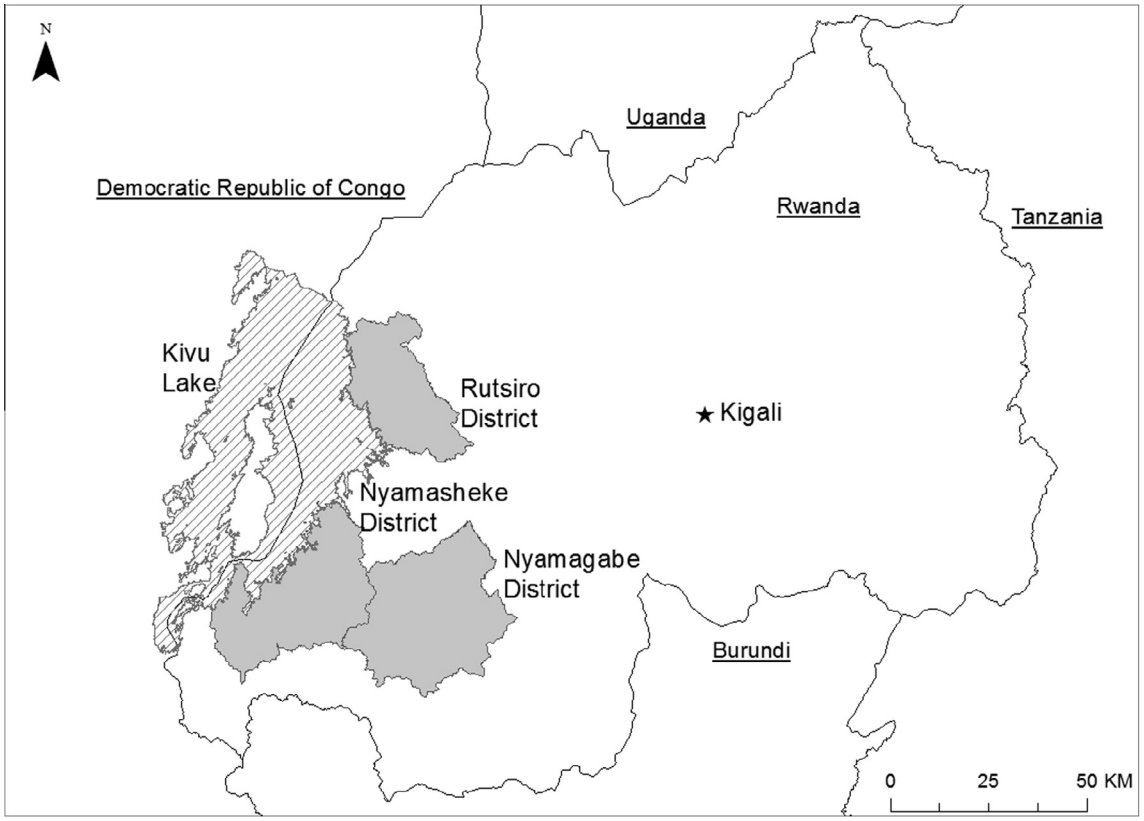

Figure 2. *The three Rwandan districts in which study sites were located (Rutsiro, Nyamasheke, and Nyamagabe). Source: The authors.*

agricultural and non-agricultural incomes. Eight villages were selected across the three sites to give a representation of the variety of social and ethnic groups present. There are 30 districts in Rwanda, divided into over 400 sectors, each containing on average more than 30 villages. Villages usually comprise less than 200 households. A village may consist entirely of a single ethnic group or people with a similar shared history, whether long-term residents (predominantly Hutu), returnees from neighboring countries such as DRC (primarily Tutsi), who were provided with housing and land when they resettled after the 1994 genocide, or Twa pygmies who have gradually been removed from their traditional lives in the region's tropical forests and provided more conventional homes.

To explore local conceptions of wellbeing, a focus group was conducted in each village with between five and seven participants. Participants were selected randomly by researchers from lists of households held by local administrators, with

male and female members of households asked alternately to take part. This provided a broad range of participants based on gender, age, and ethnic group. Participants were asked what they felt is required to live a good life in that particular village and discussion was encouraged until no further answers were provided, to enable locally grounded definitions of wellbeing to be developed.

Semi-structured interviews were then conducted with randomly selected respondents from more than 10% of households in each village (165 in total representing between 12% and 17% of the overall number of households in each village: 15 minimum, 30 maximum per village). Again participants were selected randomly by researchers from lists of households held by local administrators. Interviews were conducted with either adult male (mostly considered household head) or adult female in that household. Overall 42% of respondents were male, 58% were female and 19% of households had only a female head of household.

One hundred and sixty five households may be considered a small sample size in comparison to studies based on government census data, and this was a relatively "'small *n*" rather than "large *n*" study. However interviews collected a large array of both qualitative and quantitative data from each household to support an analysis of wellbeing in complementary objective and subjective terms. Data allowed for disaggregation of households on several levels, development of context-specific indicators of wellbeing, exploration of social processes affecting individual and household outcomes, and also attention to causal relationships effecting changes. This approach, while attempting to include interpretations of rural perspectives, did not privilege the peasant way of life as superior to more developed alternatives, but could instead be considered exploratory and neutral, with attempts being made to avoid ideological bias. Interviews contained a number of open questions, providing space to explore topics considered important to the participant and the subjective meaning they applied to different domains of life in line with the framework in Figure 1. More objective data included the demographic and socio-economic characteristics of people within each household, their resources, education, occupation, and land practices, their ability to meet specific basic needs, and the ways in which each had changed over the past ten years.

We consider wellbeing an ongoing process, influenced by economic, social, environmental, and political change (Figure 1) and adopt a timeframe of ten years to study agrarian change (Berry, 1993). To attempt to differentiate between groups of households based on socio-economic status, a hierarchical cluster analysis was conducted to create meaningful groups of households based on the main material and human resources put forward by participants in focus groups as being most important for their wellbeing. Clustering was agglomerative using between-group linkages and squared Euclidean distances with standardized values to account for the different scales of the four variables described below.

4. EMPIRICAL FINDINGS—VARIATION IN AND TRENDS RELATING TO WELLBEING IN RURAL WESTERN RWANDA

The results section firstly explores local conceptions of wellbeing. Secondly households are differentiated to show the variation which exists socio-economically, socio-ethnically and between the three sites. Subsequently changes in the wellbeing of rural households are discussed and the role of agricultural policy alongside other interrelated drivers is explored.

(a) *Local conceptions of wellbeing*

Results from focus groups yielded eight types of resources, both tangible and intangible, which were put forward by respondents as priorities for wellbeing in at least six of the eight villages (Table 1).

(b) *Differences in wellbeing between households*

Hierarchical cluster analysis was performed based on the four quantifiable material and human resources put forward in focus groups as making the greatest contribution to wellbeing: land, livestock, occupation, and shelter (recorded during household interviews). The analysis illustrates some realities regarding levels of poverty, and provides a means to differentiate the impacts of policies on socio-economic groups (alongside gender, ethnicity, and geographic location). Each variable was split into categories, comprising between three and six bands for the household-level analysis:

Land size: Less than 0.1 hectare (17%); 0.1–0.25 ha (23%); 0.26–0.5 ha (22%); 0.51–1 ha (19%); 1.1–2.5 ha (14%) and >2.5 ha (4%).

Livestock: No livestock (33%); small livestock (sheep, pig or goat) or borrowed cow (17% and 14%, respectively); own one cow (22%) and; own two cows or more (14%).

House size and type: Very small houses of one room or very basic constructions of earth and sticks (25%); small houses of three rooms or less, constructed with large adobe or concrete blocks (42%); and larger houses built with concrete or manufactured bricks (33%).

Occupation: Rural livelihoods are extremely diverse and 25 different income streams were identified across households. Households very rarely engage in only one of these and

Table 1. *Factors considered by participants to be important to their wellbeing and rationale provided*

Component of wellbeing	Rationale provided
Land	To produce food for the household, to earn income from trading crops, and to utilize knowledge of farming practices
Livestock	For production of manure to enable effective crop growth and provide
Suitable shelter	To guard from the extremes of cold and rain
Infrastructure, particularly paved roads, transport networks and electricity	Linked to opportunities for both trade and work
Access to work opportunities	Enables people to exploit different income streams among the diverse rural economy
Good health	Enabling people to work and contribute to household needs
Social relations and sharing between households	To maintain good relations and as a crucial safety net for the poor
The freedom for people to be able to make their own decisions about how to act to achieve wellbeing	Centrally designed rules can impose too many constraints on villagers

occupation type was divided into four categories: subsistence agriculture or agricultural labor only (17%); other laboring work such as tea labor, building, charcoal making, or brewing (25%); own trade such as crop trade and those who own a shop (36%); and finally professionals such as builders, teachers, administrators, mechanics or drivers (22%).

The hierarchical cluster analysis revealed four main socio-economic groups within study sites and exposed a clear ranking in terms of material and human resources (Table 2). It also displayed the extent of poverty within study sites. 34% of households could be classed as laborers with no land or only very small plots and a further 38% as resource-poor workers, leaving only 28% who could be classed as belonging to two relatively wealthy groups. One household was shown as an outlier and could not be grouped with others, being landless professionals (a relatively wealthy couple who lost all of their land to a government reforestation project without compensation). Analyses of variance revealed that groups one to four were significantly different from one another at a 5% significance level, except for the relatively wealthy households without livestock, whose livestock holdings were unsurprisingly similar to landless laborers.

The difference in resources available to groups has clear implications for their wellbeing outcomes, including their ability to meet basic needs (Table 3). Households with little land were unable to produce sufficient food or income, particularly in the absence of livestock to provide manure. For many, additional work was not able to provide sufficient income to make up the shortfall in food production and 39% of the overall sample population failed to eat at all on at least one day per month. This included 75% of landless laborers, for whom scarcity was likely to occur more frequently. More than half of landless laborers failed to afford health insurance, despite nearly a third of households in that category being paid for by the government or donors. For 89% of households in the landless laborer category the only access to fuel for warmth and cooking was through illegal collection of wood from surrounding habitats, which commonly carries risks of being fined or beaten. In contrast, of the 40 households of relatively wealthy, diversified farmers 68% traded crops (as opposed to 4% of laborers), more than half also traded wood from their private forests and only 13% suffered food scarcity one day per month or more.

The socio-economic groups produced through the cluster analysis correlated strongly with socio-ethnic groups. 88% of Twa were classed as landless laborers and not one Twa household fell in the two highest socio-economic groups (Table 3). This contrasted dramatically to returnees from DRC, of whom only 7% of households were classed as landless laborers and for whom 43% were classed in the higher two categories, compared to 29% of long-term residents. As such, returnees from DRC had considerably higher land holdings, on average, than the other two groups with 1.73 hectares compared to 0.68 hectares for long-term residents and 0.22 hectares for Twa. Returnees had often spent years in refugee camps before being resettled and provided homes and usually one to two hectares of land to farm. Greater proportions of female-headed households were categorized in the lower two socio-economic groups, though gender difference was not as striking as the divide between socio-ethnic groups (Table 3).

Occupations and land holdings differed between the three sites (Table 3). The site in Nyamasheke lay on a paved highway, was serviced by regular public transport, had a large tea plantation and factory, some hotels and guesthouses for tourists who visited the nearby national park and consequently had a larger market. At this site households held less

Table 2. *Characteristics of groups identified through hierarchical cluster analysis relating to land, livestock, occupation, and housing*

	Landless laborers ($n = 56$)	Resource poor workers ($n = 63$)	Relatively wealthy, diversified farmers ($n = 40$)	Relatively wealthy professionals without livestock ($n = 5$)
Land	Very little or no land, average 0.13 ha	Small, average 0.56 ha	Relatively large, majority have more than 1 ha, average is 2 ha	Relatively large, average 2.25 ha. All grow trees commercially
Livestock	Majority have no livestock. 7% own a cow	29% own a cow	Nearly all own cows	No livestock
Occupation	All reliant on laboring and subsistence earning USD0.6 to USD1.5 per day	Regular low-paid work or several income streams. 43% trade crops	Own business or professionals. 68% trade crops	All are professionals and trade crops
Housing	Small and basic houses	Mostly medium. The few with small, basic houses all have land and higher occupations	Relatively large houses	All have large houses

Table 3. *Key characteristics by socio-economic group, socio-ethnic group and by study site*

	Socio-economic groups				Geographic Locations			Average (range by village) (n = 165)
	Landless laborers (n = 56)	Resource poor workers (n = 63)	Relatively wealthy, diversified farmers (n = 40)	Relatively wealthy without livestock (n = 5)	Nyamasheke (connected site n = 50)	Rutsiro (Remote site n = 75)	Nyamagabe (very remote site n = 40)	
Basic needs indicators								
Food scarcity	75%	27%	13%	20%	32%	37%	53%	39% (10–87%)
Without medical insurance	55%	35%	28%	0%	34%	48%	28%	39% (20–75%)
Medical insurance paid by government	32%	11%	3%	0%	8%	23%	13%	16% (0–67%)
Collect firewood illegally	89%	54%	43%	0%	50%	57%	83%	61% (30–93%)
Socio-economic variables								
Average land size ha	0.13	0.56	2.00	2.25	0.61	0.74	1.20	0.81 (0.3–1.8)
Trade of crops	4%	43%	68%	100%	56%	19%	50%	38% (5–67%)
Trees for trade	0%	27%	58%	100%	22%	37%	15%	27% (7–65%)
Female headed households	27%	22%	10%	0%	22%	23%	13%	20% (10–35%)
Socio-ethnic groups								
Long-term residents	30%	41%	25%	4%	98%	52%	60%	73% (13–97%)
Returnees from DRC	7%	46%	43%	4%	2%	25%	21%	17% (0–85%)
Twa	88%	12%	0%	0%	0%	19%	8%	10% (0–87%)

land on average, likely due to their more diversified incomes and the greater private interests in land use. Land holdings were highest in the most remote site, Nyamagabe, with no paved road or public transport, but where 50% of households were able to trade at least some crops. However 53% suffered food scarcity compared to 32% in Nyamasheke, where important unskilled options for earning income included cutting trees and picking tea. The proportion of landless laborers was similar at all three sites, between 32% and 38% of the sample population.

(c) *Changes in wellbeing over time*

The vast majority of respondents perceived wellbeing as a whole to be decreasing. In support of this claim strong downward trends in key material resources were recorded in the three study sites (Table 4). This perceived trend came despite wellbeing gains highlighted in certain areas of respondents' lives, specifically regarding physical security and the provision of health and education services.

Of the 28% of sample households whose land holdings decreased (Table 4), 4% decreased directly as a result of parents passing holdings to their children and the other 24% were due to the sale of plots. Many households had sold land over the previous decade when faced with a need to feed their family or to meet other costs associated with basic needs. 36% of landless laborers lost land during that period, which equates to 12% of the sample having fallen into the landless laborer category within approximately a decade.

Across the three sites, wealthier households were able to take advantage of the sale of resources, particularly land, by poorer households (Table 4). Changes in land holdings were not consistently observed across households, but rather differed across socio-economic groups, and 16% of all sample households, primarily those in the two highest socio-economic groups, were able to acquire more land than they had ten years previously through purchase (Table 4).

Reductions in livestock holdings were dramatic in the study areas: 45% of households reduced livestock holdings (Table 4). This reduction similarly affected all four socio-economic groups.

Eighty-four percent of households interviewed stated that they had changed the type of food the household ate or reduced the frequency of meals due to price changes as the cost of common foods such as beans, cassava and potatoes intermittently increased. This figure included 100% of landless laborers and very high proportions for the two most remote sites (Table 4).

The rapidity of change in western Rwanda is underlined by the decrease in the proportion of households trading their own edible crops over the preceding decade. Thirty-seven percent of the sample ceased trading edible crops over the period, a key income-generating activity for most. The proportion of households ceasing trade of crops was much lower in Nyamasheke, the site where livelihoods were more diversified, at only 8%. Loss of resources were also least pronounced at this site: lower proportions sold land, reduced livestock or changed the type of food they bought due to price increases (Table 4).

(d) *Drivers of change: the impacts of agricultural policy*

Land and livestock sales, changes in food consumption and occupations were caused not only by agricultural policies but by a number of cumulative drivers. The impacts of the National Land Policy and CIP were interrelated with a number of other political, economic, social, and environmental

Table 4. *Selected changes affecting household wellbeing from 2003 to 2012*

	Socio-economic groups				Geographic Locations			Average (range by village) (n = 165)
	Landless laborers (n = 56) (%)	Resource poor workers (n = 63) (%)	Relatively wealthy, diversified farmers (n = 40) (%)	Relatively wealthy without livestock (n = 5) (%)	Nyamasheke (connected site n = 50) (%)	Rutsiro (Remote site n = 75) (%)	Nyamagabe (very remote site n = 40) (%)	
Land holdings decreased	36	21	33	0	10	40	30	28% (5–55%)
Land holdings increased	2	14	38	40	10	16	25	16% (7–25%)
Reduced livestock holdings	21	51	68	60	34	51	50	45% (5–65%)
Change in food type or regularity	100	78	75	60	62	97	88	84% (50–100%)
Began using chemical fertilizer	16	30	53	80	40	21	43	32% (0–47%)
Credit taken from bank	4	14	28	80	44	20	40	32% (0–73%)
Joined cooperative	20	35	45	40	32	9	10	16% (0–55%)
Began cultivating tea	0	10	30	40	10	4	30	12% (0–40%)

changes occurring in the region. However, of these different drivers, agricultural policies were perceived to have imposed a major, negative change. Agricultural policies were heavily enforced through centrally established targets set for local authorities and negatively impacted participants through restrictions placed upon agricultural practices (which particularly constrained subsistence production), and reduced tenure security over agricultural land.

Agricultural modernization was experienced differentially by households of different socio-economic status. The CIP began to influence rural areas in this study from 2010, with intensive growing of single edible crops such as maize and beans (alternated between the two growing seasons) introduced gradually to the sites in Nyamasheke and Rutsiro Districts and tea production also prioritized in Nyamagabe. In response some households were able to participate in schemes to improve land management or diversify livelihoods. More than half of households in the two relatively wealthy socio-economic categories began using chemical fertilizers on their land, and much higher percentages began growing cash crops, took loans or joined cooperatives than did landless laborers or resource-poor workers (Table 4). However, the majority of households were unable to apply this model. Only 38% of sample households grew crops for trade in 2011/12, which means that the remaining 62% who do not yield income from crop sales were unlikely to take fertilizers on credit for fear that they would be unable to repay the loan. However, land owners were obliged to cultivate specified crop varieties even when inputs were unaffordable, risking crop failure. Thus many households were compelled to substantially change their practices and crops. Many participants in this study were obliged to grow maize despite their perception that alternative crops (such as sweet potato, banana, or taro) would be more productive and leave them less vulnerable to food shortages. In total the six crop types now approved nationally through the CIP (wheat, rice, potatoes, beans, maize and cassava) and for which seed types and the associated fertilizers are now distributed by the authorities, made up only 30% of total national production in 2008 (NISR, 2010).

Interview respondent (resource-poor worker): *"The monocropping system is not good because in the past we would grow beans and cassava together. You could take the bean harvest and eat them and also plant corn while the cassava was ripening. Then you would always have some food to eat, it was a good system. There were many different harvests we would get from that. But now if you harvest beans, as soon as you have finished eating them you begin to suffer from hunger."*

Reduced tenure security due to agricultural policies was a contributory factor to the loss of land, illustrated by the following example. In areas which had been deemed suitable by the government for growing tea as a cash crop, dramatic effects on households were evident. In these regions, large areas of land were gradually being designated only for tea cultivation and land use firmly controlled. At Nyamagabe, the most remote site, 30% of households had so far been compelled to convert large areas of cropland to tea plantation (Table 4). Seedlings were provided to households, which take three to four years to reach maturity. In the meantime credit is given to households by a tea cooperative (for which subscription fees must also be paid) to pay laborers for weeding. Moreover, if a household proves unable to manage that land effectively, the government reallocates it, often without compensation. In public meetings inhabitants have been informed that the remaining land used for crops will also be converted to tea in the future. Only a minority of wealthier households see this as an opportunity to accumulate. With the majority

pre-empting that their land may be reallocated without compensation and that they may also be relocated from their homes, many voiced an incentive to sell land for money before that could take place. 18 of the 165 households in this study had experienced expropriation from land within the last ten years by the state for afforestation, road building or agricultural projects meaning reallocation is considered highly likely to be enforced.

Interview respondent (landless laborer): *"I just wish we could do some farming here, that we could get some land to grow crops on. We are living in fear here because the house is becoming old and crumbling. We need to build another one, but we don't expect to stay here if I'm honest. The tea is coming. We can be evicted at any time."*

The changes brought about by CIP also influence a broader set of subjective, nonmaterial functionings, and values. Crop specialization restricted the use and continuation of the complex local knowledge systems, harvest times and associated social patterns, labor availability and ultimately the networks of trade, communications and relations between villages and their inhabitants, who grew different crop varieties or would buy and transport them to nearby areas to exchange or trade with others. The usual streams of villagers carrying, for example, sugar cane from wetter conditions at lower altitudes upward to trade, not only for money but often simply to exchange with those who grow potatoes (which can resist frost and drier soils) have been disrupted. The villages which previously traded with one another based on their competitive advantages now frequently grow the same crops. Trade patterns therefore noticeably shifted to be dictated by local administrative borders as those are the lines by which crop selection targets are established and enforced, rather than the ecological and topographic gradients which have become engrained in those complex, culturally linked systems. This affects the very meaning of the farming practices and production because social and cultural elements which have been long-established are quickly and severely disrupted. This social and cultural impact affects long-term residents whose livelihoods have been embedded in those local systems for the longest time.

In addition to changing the types of food they grow, the majority of households had changed the types of foods they buy and eat. Many types of food were reported to have become unaffordable and as a result meals increasingly consisted of only sweet potatoes and beans for many poorer households. A number of drivers contributed to this change including reduced land holdings and crop production alongside increasing costs of living. Prices of common staples such as potatoes more than doubled over six months during 2012 and wages remained static (New Times of Rwanda, October 8, 2012). Price rises of sorghum caused half of the 10% of households trading beer to stop indefinitely representing a lost income stream. Additionally the restrictions placed upon households by the CIP against growing commonly eaten crops (sweet potatoes, potatoes, bananas, and taro among others) increased the need for many households to purchase this shortfall from market, reducing their ability to subsist.

The rapid reduction in livestock holdings was partly driven by the need for short-term disposable income to meet increased costs of living. Several dramatic increases in household expenditure had resulted from development policies, most notably the enforced requirements to use modern building materials to improve housing conditions and to purchase health insurance, the cost of which tripled in 2011 from approximately USD1.50 to USD4.50 per person per year. This increased financial burden contributed to both the low proportion of poor households able to afford insurance (Table 3) and the frequency of land and livestock sales (Table 4). The reduction in livestock, in turn, negatively affected cultivation. Smallholders saw manure as a requirement to enable crop growth through the maintenance of soil fertility on permanently cultivated plots.

The reduction in the proportion of households trading crops was related to all of the above changes. Sales of land and livestock and reduced soil fertility meant a reduced capacity to produce crops. Increased costs of living made inputs more difficult to afford and also increased the likelihood that households focus on subsistence production. And as described above the strict regulation of farm crops counterintuitively led to reduced harvests for trade among many households, particularly those unable to apply chemical fertilizers to the modern seed varieties.

Impacts of the policy differed between socio-ethnic groups. Further qualitative study of cultural values and related land use preferences revealed considerable variation between long-term residents, returnees from DRC, and Twa households. Long-term residents primarily practised polyculture and the vast majority expressed wishes to continue doing so. Returnees switched more readily from crop cultivation to alternative land uses, for example planting trees on their land for trade. Returnees also held more livestock on average and many used land for grazing rather than cultivation. Twa, who had negligible land holdings, relied heavily on paid labor and access to natural resources compared to other groups, and many maintained a strong cultural connection to native forests (Dawson, 2013).

5. DISCUSSION—AGRICULTURAL MODERNIZATION AND RURAL WELLBEING IN WESTERN RWANDA

Policies seeking to drive a Green Revolution in Sub-Saharan Africa are finding renewed support as a pathway to reduce persistent poverty and hunger. The Rwandan Land Policy and Crop Intensification Program have implemented goals to maximize production of approved crops through subsidized inputs and, with a limited off-farm economy, the wellbeing of many rural Rwandans rests upon the innovation promoted by these ambitious policies (Pottier, 2006). Yet as with many other contemporary Green Revolution policies in SSA, poverty alleviation is primarily sought not directly through support to rural smallholders, as was more possible and prevalent in the Green Revolutions of the 1960s to 1980s, but rather indirectly through a longer term, market-based macro-economic logic.

The agricultural transformation initiated through the Rwandan government's policies has widely been hailed as a successful one by focusing on increased yields of specific crop types, considered to represent improved food security, and through correlated reductions in indicators used to represent poverty rates (Crisafulli & Redmond, 2012; IMF, 2011). However through conceptualizing and studying this innovation as a complex set of processes and interactions, quite different conclusions can be reached. In this study, mixed methods research collecting quantitative and qualitative was employed at the household level to provide an exploratory assessment of impacts. Through disaggregating rural households, employing a locally grounded definition of wellbeing and exploring the numerous social and political processes through which people's lives are impacted, we develop an understanding of impacts which goes beyond that facilitated by the government

census data commonly used in agricultural policy evaluation. Results of this in-depth study reveal that the Rwandan Land Policy and Crop Intensification Program fail to align solutions with the needs or values of a largely poor rural population. Supported by a crisis narrative, Rwanda's agricultural policies are authoritarian and the change they enforce is therefore an imposed innovation rather than an induced one. The lack of attention to the complex pathways through which impacts are realized leads to neglect of potentially severe short-term costs for some of the poorest in Rwandan society.

Disaggregation of the population into different socio-economic and socio-ethnic groups reveals that agricultural policies promoting agricultural intensification cause considerable negative impacts for many rural inhabitants in western Rwanda. The change to grow a monoculture with approved seeds represents a significant adjustment, most especially for subsistence farmers and long-term residents who had practised polyculture for many generations. Among the poorest socio-economic groups, policies contributed to increasing poverty and food insecurity. This often manifested through decreasing land tenure and subsequent frequency of land sales in the face of inability to grow approved crops successfully, and the potential threat of government reallocation of land. When uncertainty levels are high, the poor are more likely to try to maintain what they have than to try to accumulate by engaging in new and risky behaviors (Mosley & Verschoor, 2005; Wood, 2003). Insights into social differences from this study resonate with existing analyses of rural inequality in Rwanda. The poorest socio-economic group identified bears a strong resemblance (minimal land, livestock, poor housing, and reliance on farm laboring) to those categorized as living in "chronic" or persistent poverty in Rwanda (Howe & McKay, 2007).

This study indicates that Rwanda's agricultural policies appear to be contributing to increasing inequality. The tenure arrangements imposed through the National Land Policy and farming practice required through the Crop Intensification Program have increased government control over all agricultural land. While the majority of rural inhabitants face reduced tenure security, threats to their ability to subsist and potential fines or repossession of land, a minority of less poor households benefit from subsidized inputs and plots of land sold by or reallocated from those who were financially unable to comply with the demands of the policy (Pritchard, 2013). For example, the allocation of areas in western Rwanda to cash crops such as tea under contract farming arrangements with the government has caused particularly dramatic changes in control over land, documented not only in this study. At a national level, 17,000 smallholder families became involved in tea farming by 2009 with "*satisfactory development outcomes*" for income and assets, human and social capital, yet even those implementing the policy highlight that tea growing has proven quite unsuitable for those with small landholdings who need to allocate land to crops and cannot afford to pay membership fees for required coops and for laborers (IFAD, 2011), meaning a likely land reallocation to more wealthy households. This effect has been referred to as "control grabbing" for its impacts upon smallholder tenure, effective reallocation of power into the hands of private and state actors and changes in land use to the detriment of local inhabitants (Huggins, 2014). Trends of increasing inequality have been noted to result from similar policies implemented throughout SSA (Stein, 2011; Thorbecke, 2013). The relationship between agricultural growth and poverty alleviation may be weaker where inequality is high (Negin *et al.*, 2009), and with a Gini coefficient consistently above 0.5 since 2,000, Rwanda is placed among the least equal countries in the world (http://data.worldbank.org/indicator/SI.POV.GINI, accessed 09.07.2013).

Land scarcity is an issue for rural Rwandans as population rises, land is more frequently cultivated and soil fertility declines (Rutunga, Janssen, Mantel, & Janssens, 2007). Yet patterns in land holdings across households in this study suggest that increasing inequality appears to characterize patterns in land holdings better than widespread scarcity leading to a Malthusian trap. Although reduced land holdings were recorded for many households in this study over the last ten years, almost as many households were able to increase their land holdings. Agricultural extensification has been possible in Rwanda, even in recent years, as large areas of wetland were recently converted through government initiatives (Nabahungu & Visser, 2011; REMA, 2009). Furthermore the drivers of reduced land holdings were commonly economic and political, including policies promoting modernization of rural communities, suggesting that rising landlessness in Rwanda is not simply an inevitable process of environmental change but is exacerbated by policies which seek to address that very problem.

Attention to local social, cultural, and environmental context in this study revealed that local definitions of wellbeing were not well or comprehensively captured by government census data or conventional poverty indicators. Local definitions of wellbeing were multidimensional, included material and non-material elements and differed in important ways to conventional development indicators. This locally grounded conceptualization differed to include, perhaps unsurprisingly for the rural poor, land, and livestock as priorities for wellbeing, and traditional uses of them, which were strongly linked to household-level food security. As other authors considering links between agriculture and development have noted, land use, access, and tenure security are key elements in the wellbeing of rural inhabitants, not to be detached from pathways into or out of poverty (Norton, 2004). The critical importance of land and livestock to rural Rwandans has also been emphasized through a national exercise of participatory poverty assessments (Howe & McKay, 2007). Although topographic and climatic conditions are also extreme in western Rwanda, similarly complex farming systems have developed in response to environmental constraints and variability throughout the world, embodying multiple values among inhabitants (Berry, 1997; Li, 1999).

Trajectories in the wellbeing of rural, western Rwandans in this study were inconsistent with trends in national-level poverty indicators. Results show that the effects of Rwanda's agricultural policies polarize the rural population between the relatively wealthy or less poor minority, while accelerating the decline of the majority toward landlessness, loss of productive assets, and a vulnerable dependency on sporadic laboring opportunities, and in doing so, creating a burgeoning underclass, who find it increasingly difficult to find ways out of that poverty trap. Although this finding appears at odds with claims of reduced consumption poverty, this impact does not necessarily contradict claims that consumption has risen for relatively poor households. Increased reliance on sporadic laboring opportunities and purchasing food with variable prices rather than producing it may be deemed a favorable development if it results in increased incomes or consumption. From the household's perspective, however, their poverty has intensified, and they have become much more vulnerable to food insecurity. Food security, measured through crop production at regional scales may have little correlation with the ability of people to feed a family at a local level (Lee, 2013). In this study fewer households were able to produce

their own food, many had changed their diet to include only the cheapest goods available at market and a high proportion suffered regular, chronic food shortages. Such inconsistencies highlight very concisely the need for the integration of interpretive approaches alongside conventional policy evaluation tools to provide contextualized impact assessment and more rigor in assessing causal relationships (Green & Hulme, 2005; Shaffer, 2013). In this case the use of mixed methods enabled some reconciliation between local and national perspectives on food security.

The type of governance through which Green Revolutions are sought may be important to the outcomes and the extent to which they are pro-poor. Policies promoting agricultural growth in Rwanda impose a rapid shift toward technocratic alternatives which are justified through a Malthusian narrative. Local definitions of wellbeing reflected some important subjective and relational components including the importance of social relations and autonomy over land, property, and livelihoods. Restricted freedom of choice was an important mechanism through which a decline in wellbeing is perceived for many households in this study. Social systems and autonomy were shown to be under considerable stress in rural western Rwanda through social and economic change, exacerbated considerably by the imposition and strict enforcement of development policies. Autonomy has also been revealed to be an important element of life satisfaction in other Rwandan studies (Abbott & Wallace, 2012; Ingelaere, 2014). Rather than being provided with choices and opportunities to diversify and link to wider markets, the traditional modes of agriculture in western Rwanda are being dismantled. In its place market integration and modernization have been adopted in law as centrally designed Government policies, which are implemented through regional "*imihigo*" targets, and ultimately enforced through fines and expropriation (Van Damme *et al.*, 2014). The assumption that growth, orchestrated in a top-down, high modernist manner, will provide equitable benefits for Rwandans has received criticism (Ansoms, 2011; Des Forges, 2005; Huggins, 2009). The policies described in this paper, implemented in Rwanda, bear striking similarity to the themes described by Scott (1998), who details examples of failed experiments of social engineering which have occurred under conditions with authoritarian states, very limited civil society, adopting a high-modernist ideology which places faith in technical solutions. This similarity has not evaded the notice of scholars of Rwandan history and politics (Hasselskog, 2015; Newbury, 2011).

6. CONCLUSIONS—THE LIMITS OF IMPOSED INNOVATION FOR PRO-POOR AGRICULTURAL POLICY

This paper has presented a counternarrative to the framing of rural problems, and to the policies seeking to promote innovation in Rwandan agriculture, as evident in other parts of Sub-Saharan Africa: The people are diverse and so therefore are the effects of policy on those people. People respond to policies not only on the basis of their effects on material resources but also the subjective components of their wellbeing such as the desire for autonomy and food sovereignty. Rural people in SSA are not simply degraders of the environment spiraling toward Malthusian crisis, but are complex and adaptive social beings, whose livelihood activities and intertwined cultural practices have developed over centuries. For the participants of this study, population increase and reduced soil fertility were seen as pertinent issues, but not crises which justify radical action to restrict their freedom or traditional practices. The Malthusian framing of rural problems in Rwanda serves to decontextualize the wellbeing of rural populations, overlooks the trends and shocks impacting their lives and removes their interests from policy debates. The policies critically analyzed in this paper appear to be contributing to increased landlessness, poverty, food insecurity, and inequality. Such impacts resulting from coercive development policies are not new to SSA (Abro *et al.*, 2014; Scott, 1998; van Leeuwen, 2001; Woodhouse, 2012).

Agricultural growth can potentially lead to pro-poor outcomes in SSA (Breisinger *et al.*, 2011). However the theory of change which guides such linkage focuses not primarily on direct impacts to the rural poor but macro-economic links which work indirectly over longer time scales (Birner & Resnick, 2010). The impacts of policies seeking innovation depend upon the actual processes by which growth is pursued: the practical implementation of those policies and the multitude of pathways and interactions through which the lives of the poor are impacted (Hall *et al.*, 2001). This paper finds that Rwanda's recent agricultural policies support institutional and technological changes which are inconsistent with the knowledge, practices and preferences of the rural population. Instead of promoting "induced innovation", the policies represent an imposed innovation which seeks to rapidly modernize rural areas in order to meet national economic and political goals. The identified solutions of crop specialization and application of chemical fertilizers are a polar opposite to the traditional polyculture system prevalent in this region and disrupts local social practice, trade and labor patterns in addition to farming methods.

The pro-poor credentials of contemporary Green Revolution policies in Rwanda and elsewhere in SSA may be enhanced through providing a range of solutions to meet the varying needs, values and aspirations of different types of smallholders. In examples from around the world, key factors in the success of policies pursuing agricultural growth to reduce poverty were attention to smallholders' needs, local participation, and adaptation to local context (Birner & Resnick, 2010; Pretty *et al.*, 2011; Van Donge *et al.*, 2012). Yet the context in which contemporary Green Revolution policies are designed and implemented is different from those during and prior to the 1980s, with direct support to the incomes of the poorest smallholders through national policies much less likely (Dorward *et al.*, 2004). Our findings clearly reveal the negative impacts which may occur through centrally designed Green Revolution policies, but which may be neglected if assessment is based on limited indicators. In order to combat negative impacts which commonly occur through imposed intensification, policies permitting a range of solutions could enable more gradual modernization or adaptation at the same time as supporting the social, cultural, and material needs of poor landholders and laborers. The integration of different induced innovations and the choice to pursue them alongside nationally focused intensification may serve to better reconcile local and national conceptions of food security and poverty. For example, particularly in areas of high elevation, mixed farming systems utilizing biomass and agroforestry techniques may be an effective method of local food production and provide a greater range of valued ecosystem services than intensive agriculture (Roose & Ndayizigiye, 1997). Furthermore landlessness is relatively high in Rwanda meaning that inventive pro-poor forms of tenure and cooperation (none of which preclude improvements to input availability, market linkages and infrastructure) may provide positive outcomes for rural people, and importantly in Rwanda, for those who have become landless in recent years.

Policies falling under the general heading of "Green Revolution in SSA" should not all be considered to be pro-poor or even to be of a similar type, but rather should be the subject of rigorous impact assessment (Clemens & Demombynes, 2013). Impact evaluation and potential adaptation are critical areas to limit potential costs of interventions, particularly when highly centralized, national-scale policies are introduced. The ongoing debate regarding the impacts of the Millennium Villages Project highlights the contrasting conclusions which may be drawn from different assessment approaches (Sanchez *et al.*, 2007; Wanjala & Muradian, 2013). The use of mixed methods studies to look not only at potential impacts on material wellbeing but more holistically at subjective, non-material elements and causal relationships by which they are affected is gradually becoming the state of the art in impact evaluation (Shaffer, 2013). The wellbeing approach adopted in this study provides an example of the value in viewing resources as more than capitals, in assessing social and cultural values and in paying attention to inequalities in power and the processes which shape social structures (McGregor & Sumner, 2010). In Rwanda there are very limited attempts to assess impacts on basic needs, livelihoods, cultural identities, or on the vulnerability of rural households (Booth & Golooba-Mutebi, 2012) and the lack of scrutiny applied to these policies internationally has resulted in limited capacity to mitigate negative effects on rural populations (Holvoet & Rombouts, 2008). Policies regulating agricultural production in Rwanda were in early stages during fieldwork for this study. Their impacts can be expected to increase in the coming years and their effectiveness should not be judged by figures for national production of maize or wheat but with more detailed impact assessment.

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