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Scarcity amidst abundance? Reassessing the potential for cropland expansion in Africa

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ABSTRACT

Sub-Saharan Africa is typically regarded as land abundant, and previous efforts to estimate the true extent of potentially available cropland (PAC) have largely affirmed this perception. Such efforts, however, have largely focused on production potential and have underemphasized economic profitability and other constraints to expansion. This paper re-estimates PAC for Africa in a more explicit economic framework that emphasizes the returns to agricultural production under a variety of assumptions, using recent geospatial data. Existing PAC estimates for Africa are shown to be highly sensitive to assumptions about land productivity and market access, and are moderately influenced by the use of alternative data sources. The region's underutilized land resources are concentrated in relatively few countries, many of which are fragile states. Between one-half and two-thirds of the region's surplus land is currently under forest cover; conversion of forests to cropland would entail major environmental costs. Most of the continent's unexploited land resources are located far from input and output markets, limiting their economic attractiveness. In the long run, improvements in infrastructure and agricultural productivity and the growth of hinterland towns will enhance the economic returns to cropland expansion. In the short to medium term, however, the potential for profitable smallholder-based cropland expansion in most African countries is likely to be much more limited than it is typically perceived to be.

Introduction

Sub-Saharan Africa has about 900 million inhabitants at present – a number expected to grow to 1.4 billion by 2030 (UN, 2013). Substantial increases in agricultural output will be required to meet the rising demand for food within the region. Such output growth will have to come from higher yields on existing cropland and/or expansion of land under cultivation. Over the past four decades, crop production growth has occurred predominantly through area expansion (Brink and Eva, 2009; Evenson and Gollin, 2003). While there would be distinct advantages if additional food supplies could be generated mainly through intensification of existing farmland, this may not be realistic. It is almost certain that African governments will face intensified political and economic pressures to allocate much of the region's underutilized land for exploitation, including at the expense of the region's forest land (Gibbs et al., 2010), to meet the growing food and energy needs of African cities and global markets.

The recent "land grab" phenomenon – driven largely by rising international food and energy prices – has sparked renewed interest in determining the true extent of under-utilized land in Africa. It is well understood that rural Africa is highly heterogeneous and that much of its land is either unutilized or underutilized even while a considerable fraction of its rural population resides in densely settled smallholder farming areas facing land shortages (Table 1; e.g., Tittonell and Giller, 2013; Jayne et al., this issue). Less well understood is how land transfer decisions made today will affect the viability of future agricultural development patterns in the coming decades, particularly the potential for cropland expansion under a smallholder-led development strategy. Unlike other developing regions, Africa's rural population will continue to grow by almost 50% between 2015 and 2050 (UN, 2013).

The demand for unutilized land by indigenous African communities will depend largely on the rate of non-farm employment growth, land productivity growth rates, and on the potential for rural–rural migration to relieve land pressures in densely populated areas. Robust growth in non-farm employment opportunities

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Table 1
Production costs per hectare (Zambian maize).

Costs (USD/ha)	Small farm		Large farm
	Low-level management	Medium-level management	High-level management
Labor	215	108	180
Traction	38	75	85
Other costs[a]	9	19	274
Fertilizer	0	213	285
Herbicides and pesticides	0	10	16
Seed	0	47	70
Total costs excluding land	263	473	910

Notes:
Source: ZNFU Enterprise Budgets (ZNFU, 2011). Management levels (low-, medium- and high-levels of inputs) are defined to correspond to the management levels used by the GAEZ, where the low-input "traditional management" assumption is defined as production based on the use of traditional cultivars, labor-intensive techniques, and minimal application of purchased inputs and minimal conservation measures; medium-level corresponds to the intermediate-input "improved management" assumption, wherein partly market oriented production is based on improved varieties, mostly manual labor with some mechanization, some application of fertilizer, herbicides and pesticides, adequate fallows and some conservation measures. See Fischer et al. (2009: p. 38) for more details.
[a] Other costs include fuel, oil, crop insurance, packaging, repairs and maintenance.

and in cropland productivity will relieve pressures on the demand for new cropland, but these sources of growth are not assured. It is indeed likely that cropland expansion will be necessary for the success of a smallholder-led development trajectory in much of the region. For this reason, well-designed agricultural development strategies will depend on accurate estimates of the quantity and spatial distribution of underutilized land that is suitable for cropland expansion, or more accurately the relationship between food and input prices and the quantity of land available for profitable cropland expansion (Hertel, 2011).

In a widely cited report, Deininger and Byerlee (2011) estimate the potential for cropland expansion in Africa using geospatial data on population distributions and agroecological potential. This important contribution bases its conclusions on a relatively simple methodology combining various thresholds of agronomic suitability, existing rural population densities, and proximity to cities. A striking conclusion of that analysis was that Africa has more underutilized arable land than any other continent: 198–446 million hectares, depending on the assumptions used, and that there is likely to be ample room for well-planned large-scale land acquisitions to contribute to the region's economic growth without compromising land accessibility for indigenous communities.

This study revisits the question of how much land is really available for crop expansion in Africa, employing explicit economic criteria. Because the incentives for crop area expansion clearly depend on agricultural input and output price levels and ecological and social costs associated with land expansion, we agree with Hertel (2011) and Lambin et al. (2013) in posing the question as a function of such variables. We therefore report alternative estimates of potential area for cropland expansion (PAC) for various scenarios based on alternative assumptions to be explained below.[1] We also address the related question of what kinds of factors might substantially constrain cropland expansion and/or rural-to-rural migration.

The motivations for this research are twofold. First, more accurate estimates of PAC can guide policy decisions about future land allocation. For example, if it were concluded that there is great potential for PAC, this would relieve the opportunity costs of allocating substantial amounts of land to foreign interests that might otherwise entail foreclosing indigenous communities' access to additional land. By contrast, findings of limited potential for PAC would create a greater sense of urgency in resolving how remaining scarce underutilized land should be allocated among competing interest groups.

Second, the relative endowments of land and labor will be crucial for a country's agricultural development path (Boserup, 1965; Ruthenberg, 1980; Ruttan and Hayami, 1984). Land constrained rural populations clearly need to focus their efforts on agricultural intensification, as well as nonfarm diversification and reducing population growth (Headey and Jayne, this issue). But populations with ample land resources of sufficiently good quality will typically resist intensive technologies since land expansion and fallowing are far less costly than intensive agricultural practices (Binswanger and Pingali, 1988). For African countries endowed with ample underutilized land it is not obvious that the technological priority for their farming systems should be increasing yields on existing land resources. Rather, it may well be road expansion, or agricultural technologies, that increase the returns to underutilized land resources.[2] Assessing the economic potential for land expansion could enable national and international agricultural research systems to anticipate desired technical crop production trajectories based on relative factor scarcities, and help policy makers prioritize public expenditures that take account of these emerging factor scarcities.

The remainder of this paper is structured as follows. Section 'Prior studies estimating surplus land' reviews prior studies concerned with estimating PAC in Africa. Section 'Analytical framework' describes the methodological underpinnings of our model. Section 'Data and assumptions' describes the data and key assumptions. Section 'The magnitude and location of potential available cropland in Sub-Saharan Africa' presents our basic estimates of the magnitude and location of potentially available cropland, including an assessment of the economic returns to expansion into currently underutilized areas. We evaluate the sensitivity of our estimates in Section 'Alternative future scenarios for prices and productivity', and entertain plausible future price and technology scenarios in Section 'Other constraints to expansion'. Section 'Conclusions and policy implications' examines important non-economic constraints to utilizing currently uncultivated land. We conclude by outlining the implications of our findings for policy and offer suggestions for further empirical assessments.

[1] This study defines PAC in the same way as Lambin et al. (2013), i.e., the reserve of moderately to highly productive land that could be utilized for rainfed farming, that is not currently under intensive use or legally protected. Our only departure from Lambin et al. is that several of our scenarios explicitly include land under mature forest cover in order to measure the sensitivity of PAC estimates to the inclusion of forest land.

[2] The Brazilian *cerrado*, for example, was opened up by a combination of road expansion and agricultural R&D aimed at increasing the productivity of tropical soils (The Economist, 2010).

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