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Agricultural intensification in Ghana: Evaluating the optimist's case for a Green Revolution

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ABSTRACT

While there are valid reasons for a renewed interest in adapting the lessons of the Asian Green Revolution to the African setting, research must go further in identifying the main, and potentially unique, drivers of agricultural intensification within and across African countries. In this study we look at the case of Ghana to identify whether fast population growth and the remarkable agricultural performance the country has enjoyed in recent years have resulted in favorable conditions for the adoption of Asian-style Green Revolution technologies. Through descriptive analysis combined with empirical assessment of the economic efficiency of agriculture in different production systems and agroecologies we are able assess the relevance of Green Revolution technologies for agricultural production in Ghana. In particular, we analyze whether fertilizer use in Ghana is associated with high population density and intensive cereal production and whether land-intensive innovations are associated with more efficient production practices. Overall, we do not find evidence of Asian-style Green Revolution agricultural intensification in Ghana; in fact, we find no correlation between population density and input intensity. We also find that labor costs still play a major role in Ghanaian agricultural development in limiting the adoption of labor-intensive technologies even in relatively high population density areas.

Introduction

During the 1960s and 1970s, Asian and Latin American countries experienced yield increases and accelerated agricultural output growth due to the adoption of high yielding varieties of wheat, rice, and maize combined with intensive use of inputs such as fertilizer and irrigation. However, the transformation of agriculture brought to these regions by the Green Revolution did not reach Africa. Following independence in the late 1960s and 1970s, African governments and donors alike attempted to increase agricultural production by developing policies and programs inspired by the Asian Green Revolution (Crawford et al., 2003). These policies and programs led to heavy reliance on input subsidies, government-provided services (marketing, infrastructure, extension, research), and the establishment of input and commodity marketing parastatals. However, in the African setting, these policies produced little effect in terms of increasing use of chemical fertilizer or high yielding varieties.

It is now clear that, in part, the failure to increase yields and the use of modern inputs in the past were due to conditions in Africa that were quite different at that time from those in Asia. For example, the demand for chemical inputs was low because land was relatively abundant and farmers had little incentive to use cultivated land more intensively or to save on land costs (Binswanger and Pingali, 1988). In contrast with Asia, most crop area in Africa is unfertilized and hoe-cultivated; and little animal ploughing is practiced. Traditionally, African farmers have alternated crops with long fallows (shifting cultivation) and practice intercropping as the primary method for reducing weeds and pests as compared with hand-weeding, manual pest control, and the employment of agrochemicals, as is common in Asia (Lipton, 2012). In this context, output growth between 1960 and 2000 has been achieved mainly by expansion of cultivated area and more intensive use of owned land, i.e., reduction in fallow periods to increase the area under cultivation in a given year, with little or no improvement in yields (Evenson and Gollin, 2003).

In addition, differences in labor availability and agroecology resulted in crop mixes in sub-Saharan Africa (SSA) that differed significantly from those in Asia. In addition, African smallholders have long produced higher proportions of non-cereal staples (for example, cassava and plantain) and higher proportions of food

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crops that are consumed in the household or sold in local markets rather than marketed to the city. Because of this, improvements in rice, wheat, and maize that largely addressed the main food security concerns in Asia were not appropriate for African regions with diverse cropping systems where many non-cereal crops were central to food security. Even where major cereals were grown in Africa, suitable varieties for those agroecologies only became available in the 1980s, due to research specially targeted to African conditions (Pingali, 2012).

In this unfavorable context for the type of policies applied in Asia to promote agricultural development, the government-led approach was financially unsustainable and collapsed in macroeconomic crises in many African countries. Consequently, development strategies shifted in the opposite direction—away from government intervention and also away from agriculture-led development. Structural adjustment programs (SAPs) were implemented in the 1980s with a focus on private sector development, putting an end to the Green Revolution-inspired government-led process of agricultural transformation. However, expectations that the private sector would fill in the gaps left by retreating governments were not fulfilled (Dorward et al., 1998; Jayne et al., 2002), and access to and use of inputs, particularly fertilizers, declined (Gordon, 2000; Bumb and Baanante, 1996).

More recently, the policy pendulum has swung back. At present, direct state support for technical innovation and African agricultural productivity are again high on many policy and research agendas. With these priorities comes renewed interest in the lessons of the Asian Green Revolution as well as renewed government support for agriculture, input promotion programs, and subsidies (Diao et al., 2008; Morris et al., 2007; Reardon et al., 1999). As in the past, in most cases, the focus of these policies and programs remains on a land scarce-labor abundant model in which technology supply, intensive input use, and addressing natural resource constraints are ready solutions (Cleaver and Donovan, 1995; Morris et al., 2007). If conditions in the past were admittedly so different from those in Asia, what has changed at present to justify a second look at the Asian Green Revolution as a possible model for agricultural development in Africa?

One possible answer to this question is given by Pingali (2012), who asserts that a confluence of factors has come together in recent years to generate renewed interest in agriculture and spur the early stages of the Green Revolution in Africa. According to Pingali (2012), the combination of continued food deficits, increasing reliance on food aid and food imports, soaring populations, growing land scarcity, rapidly growing urban demand, and an improved macro-economic environment in many African countries has reintroduced agriculture as an engine of growth in the policy agenda. Adding to this favorable environment for agriculture, new studies provide tangible evidence of the increasing availability of improved varieties of major food crops to farmers in Africa, increased food production in regions where adoption has occurred, and positive returns to research investment. The widespread adoption of improved maize, wheat, and rice varieties in Africa since the early 1990s is especially noteworthy (Maredia et al., 2000).

This renewed optimism about the possibility of an Asian-style Green Revolution taking root in Africa seems to be based on the assumption that rapid population growth on the continent will result in declining labor costs and growing land constraints, generating economic conditions similar to those in Asia. Under such reasoning, these conditions will lead to the adoption of labor-intensive technologies and greater fertilizer use, particularly in densely populated areas with relatively low labor costs and high returns to a more intensive use of land. Is this renewed optimism overlooking the structural and agroecological characteristics of African agriculture that have resulted in the failure of policies pushing land-saving technologies in the past?

We claim that assuming Africa is an appropriate setting for another Asian-style Green Revolution is misleading and could result in, yet again, a frustrated attempt to attain sustainable agricultural growth. As discussed by Woodhouse (2009) and despite rapid population growth, the performance of African agriculture is still largely limited by the high cost and low productivity of labor. Vast areas of agricultural land in many African countries are still under low population pressure. According to Binswanger and Pingali (1988), one-third of all SSA countries will still have extensive rural areas with low population densities in 2025 despite rapid population growth, and shifting cultivation will still be the most common system of farming in these countries.[1] Of the remaining two-thirds of SSA countries, most are naturally resource rich countries where labor costs could remain high even in areas of high population density as a result of structural characteristics that produce rapid urbanization even at low levels of agricultural intensification (Gollin et al., 2013). In other words, land and labor endowments across Africa are diverse (c.f. Headey and Jayne, 2014 and Chamberlin et al., 2014, this issue) and resource rich economies are structurally different from labor abundant economies; population growth will not necessarily transform resource rich African economies into labor-abundant, low labor cost economies.

Adding to structural economic differences, agroecological differences between Africa and Asia are important in explaining fertilizer use and intensification in cereal production, particularly in regions where production of non-cereal staples is significant. For instance, cassava production has expanded in Africa as a food security crop, replacing fallow. Generally, cassava can give reasonable yields in soils of low fertility and is thought to require less labor per unit of output than most other major staples; in fact, expansion of cassava production in Africa appears to be leading to greater labor productivity in the region (Hillocks, 2002). Increasing cassava production could be a profitable alternative to intensive cereal production when labor still imposes significant constraints to production expansion.

To begin addressing the questions and concerns raised above, we take Ghana as a case study. We first provide descriptive statistical analysis of the variation of outputs and inputs per hectare across various population densities and production systems. Unlike other studies in the existing literature that look at population density and agricultural intensification, we also introduce efficiency analysis to determine whether intensive "Green Revolution" technologies are relevant. By comparing the production practices of efficient and inefficient producers we gain a better understanding of the technological conditions of the most efficient producers and we are able to determine whether the use of fertilizer and chemical inputs is correlated with more efficient production practices. Evidence of strong correlation between population density and input intensification or between fertilizer use and economic efficiency in high population density areas would support the optimist's case for an Asian-style Green Revolution in Africa. Clearly, an absence of such evidence would not be sufficient for dismissal of this optimism; however, it should suggest the need for more in-depth analyses of the paths for technical change in agriculture and its linkages with the structural transformation of African economies.

Ghana is an interesting case because its rural population density today is much lower than that in labor-abundant African countries such as Rwanda, Malawi, Uganda, and Nigeria but much higher than that in land-abundant African countries such as Angola, Sudan, South Africa, and Mali. In addition, population density in Ghana today is low compared to that of Asian countries

[1] Jayne et al. (2014, this issue) show that, as of 2010, 70% of the rural population in SSA is clustered on 20% of the rural arable land, indicating that 80% of the rural arable land remains sparsely populated by the remaining 30% of the rural population.