Food Policy 67 (2017) 12–25

Contents lists available at ScienceDirect

Food Policy

journal homepage: www.elsevier.com/locate/foodpol

Ten striking facts about agricultural input use in Sub-Saharan Africa

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ARTICLE INFO

Article history:
Available online 18 October 2016

JEL classification:
O13
O33
Q16

Keywords:
Improved seed
Fertilizer
Agro-chemical
Machinery
Irrigation
Sub-Saharan Africa

ABSTRACT

Conventional wisdom holds that Sub-Saharan African farmers use few modern inputs despite the fact that most poverty-reducing agricultural growth in the region is expected to come largely from expanded use of inputs that embody improved technologies, particularly improved seed, fertilizers and other agro-chemicals, machinery, and irrigation. Yet following several years of high food prices, concerted policy efforts to intensify fertilizer and hybrid seed use, and increased public and private investment in agriculture, how low is modern input use in Africa really? This article revisits Africa's agricultural input landscape, exploiting the unique, recently collected, nationally representative, agriculturally intensive, and cross-country comparable Living Standard Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) covering six countries in the region (Ethiopia, Malawi, Niger, Nigeria, Tanzania, and Uganda). Using data from over 22,000 households and 62,000 agricultural plots, we offer ten potentially surprising facts about modern input use in Africa today.

1. Introduction

Much of the sustained agricultural growth necessary for economic transformation comes from expanded input use, especially of modern inputs—like improved seed, fertilizers and other agro-chemicals, machinery, and irrigation—that embody improved technologies. Asia and Latin America enjoyed tremendous increases in agricultural productivity in a relatively short period of time through rapid and widespread uptake of yield-enhancing modern agricultural inputs (Johnson et al., 2003). The gains from diffusion of these inputs were enjoyed broadly, including to consumers (Evenson and Gollin, 2003), helping to stimulate historically unprecedented economic growth and poverty reduction in east and southeast Asia (David and Otsuka, 1994). It is well-acknowledged that Sub-Saharan Africa (SSA) did not participate to the same degree in the Green Revolution of the 1970–80s and has, therefore, not been able to reap the economy-wide rewards associated with input use expansion. Indeed, low use of modern inputs is nearly synonymous with African agriculture and acts as a motivation for the policy priorities set forth in forums such as the Abuja Declaration, Malabo Declaration, and under the Comprehensive Africa Agriculture Development Programme (CAADP).

But has no progress been made in input use over the last several decades in SSA? Should the rhetoric surrounding modern agricultural input use promotion remain unchanged? There are many reasons to expect it may be time to check the current accuracy of existing wisdoms about the African agricultural input use landscape. Most obviously, several governments have recently reinstated or revitalized agricultural input subsidy schemes aimed at promoting access to chemical fertilizers and improved seeds (Minot and Benson, 2009), with variable success (Jayne and Rashid, 2013). Irrigation and mechanization technologies have received far less policy attention, potentially translating into stagnation or even the reversal of prior progress in expanding their use (Mrema et al., 2008; Van Koppen, 2003). Meanwhile, factors external to agricultural policy—such as record high international food prices, urbanization, rapid growth of a middle class, increased access to market and other information through cell phones, and transformation of some food marketing channels—may have changed on-farm incentives and resulted in updates to farm management practices, including modern input use (e.g., Reardon et al., 2009; Tiffen, 2003). Furthermore, increased awareness of climate change and soil erosion may also be influencing farmers' practices related to inputs (Nelson et al., 2010).

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http://dx.doi.org/10.1016/j.foodpol.2016.09.010
0306-9192/

Despite these changes in the policy and operating environment, many prevailing beliefs about input use remain rooted in ideas formed 10–20 years ago, before the onset of what seems to be an African agricultural renaissance. Most knowledge of modern input use is currently derived from macro-level statistics, which cannot capture within-country heterogeneity and are prone to issues of data reliability (Jerven, 2013), or from studies using small or purposively chosen samples, which may not be reliably scalable for informing national- or multinational-level policy priorities. In spite of myriad studies focusing on some specific facet of modern input use in SSA, our understanding of the current input landscape at the country and continent level remains inadequate for guiding the next generation of agricultural policies and investments in the region.

The nationally representative, recently collected, agriculturally intensive, and cross-country comparable data sets provided through the Living Standard Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) Initiative, inclusive of some of the most populous countries in Africa, offer the timely opportunity to provide a more up-to-date platform for informing policy related to a bundle of inputs used by farming households. These data sets allow us not only to compute national-level statistics derived from household responses about their input use, representing cross-checks against the country-level statistics derived from macro-data that often form the basis of conventional wisdom, but also to study within-country and even within-household variation in input use levels that may be important considerations for the policy formation process. Further, because the LSMS-ISA effort includes the collection of global positioning system (GPS) information related to households and plots, the abundance of data therein can also be linked to external and increasingly plentiful and rich geospatial data sets containing a range of relevant covariates.

In Sheahan and Barrett (2014) we utilized one cross section of LSMS-ISA data collected between 2010 and 2012 in each of six countries (Niger, Nigeria, Ethiopia, Malawi, Tanzania, Uganda), including over 22,000 cultivating households and 62,000 agricultural plots, to produce a large number of descriptive statistics related to a set of inputs often cited as "under-used" in SSA: fertilizer, improved seed varieties, agro-chemicals (pesticides, herbicides, and fungicides), irrigation, and animal power and mechanized farm equipment. In this synthesis article, we focus on ten key facts we found most striking and important to pushing forward today's research and policy frontier related to agricultural input use. The ten "new" (or, in some cases, "newly verified") facts that follow are founded purely on descriptive analysis; our aim is not to uncover the pathways and casual determinants of the conditions we describe. Instead, we focus on the more fundamental goal of getting the basic truths right, an essential and to-date-overlooked step in the intensifying debates about how to stimulate African agricultural development. While a multitude of other interesting and policy relevant correlates exist that expose the great degree of heterogeneity across the region, we focus on just ten salient facts to help propel along the broader literature and policy debate.

2. Sample selection and variable creation

In order to create reliable and cross-country comparable descriptive statistics to underpin new understandings about agricultural input use in SSA, a major effort was undertaken to identify the appropriate underlying sample selection and variable creation process. The sample used in our analysis includes all households that cultivated at least one agricultural plot in a recent wave of LSMS-ISA data in Ethiopia (2011/12), Malawi (2010/11), Niger (2011/12), Nigeria (2010/11), Tanzania (2010/11), and Uganda (2010/11). For those countries where two seasons of agricultural data are available (Malawi, Niger, Tanzania, Uganda) our analysis focuses on the main agricultural season. Because the surveys are nationally representative (apart from Ethiopia, which is representative of the rural and small town population only) and not necessarily representative of the farming population, the portion of the total sample that we use differs across countries.[1] Then, since most input use is observed at the agricultural plot, not household, level and much can be said about the within-farm variation in input use, some of the statistics that follow will also be calculated at the plot level.[2] Table 1 describes the sample size for each country used in this analysis. Across the six countries, our sample includes 22,565 cultivating households and 62,387 agricultural plots, which represents nearly three-quarters of all households in the full surveys and is overwhelmingly but not exclusively rural.

Great attention was paid to ensure that computed input variables and covariates are as comparable as possible across countries despite sometimes large differences in how questions were asked or what type of information was extracted from survey respondents. This involved standardizing data cleaning rules and, in some cases, making assumptions about how best to aggregate specific input types within broader categories (e.g., mechanized inputs).[3] We "clean" the transformed input use per hectare (generally kg/ha) values using a "winsorizing" technique, replacing extreme outliers beyond the 99th percentile with the value observed at that percentile under the assumption that all extreme values are due to measurement error. In some countries, we observe unreasonably extreme values in inorganic fertilizer application rates below the 99th percentile, and therefore apply additional winsorizing by replacing total application rates over 700 kg/ha, nitrogen application rates above 200 kg/ha, and phosphorous application rates above 100 kg/ha with those values. In those cases where a continuous variable (e.g., application amount) follows a binary input use variable, we allow the continuous amount to confirm the binary entry, meaning missing or zero continuous values are always assumed to denote "non-users."

Since some of the inputs in which we have interest are best compared per unit of cultivated land, particularly application rates and area under irrigation, we put considerable effort into standardizing land size measures both within and between countries. In all of these surveys, farmer-reported plot sizes are complemented with GPS-based measures of some plots for comparison. Given evidence that self-reported measures of land size may contain bias and cause the misrepresentation of key relationships (Carletto et al., 2013), we use multiple imputation to arrive at a full set of GPS-based plot sizes where self-reported values are used as an instrument following the methodology described by Palacios-Lopez and Djima (2014). This major advance allows us to overcome some of the deficiencies of statistics derived from other household surveys where respondent error is acknowledged as likely but unable to be detected or eliminated.

Geo-referenced data also allow us to link any number of geospatial data sets to our constructed input variables. In this analysis in particular, we utilize geovariables matched by staff at the World Bank to the following external datasets: World Clim (rainfall), NASA's Shuttle Radar Topography Mission (elevation), FAO's Harmonized World Soil Database (soil nutrient availability), NASA

[1] The surveys are also population-representative at various sub-national levels, differing by country. We refer interested readers to the individual survey documentation (all available on the LSMS-ISA website) for more details.

[2] While we use the term "plot" throughout this analysis for simplicity, the actual unit of land described in each of these surveys may differ: Ethiopia-field within parcel by holder; Malawi-plot; Niger-parcel within field; Nigeria-plot; Tanzania-plot; Uganda-parcel (aggregating input use across plots on a parcel).

[3] For much more detail on our data cleaning protocols, see Appendix 2 in Sheahan and Barrett (2014).