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Is rainfed agriculture really a pathway from poverty?

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ABSTRACT

Agriculture's potential to reduce poverty at household level is explored for rainfed crop production in Africa and India. A literature survey of crop improvement and natural resource management interventions demonstrates that new technology can substantially increase net returns per hectare per cropping season. However, the median net income from improved technologies was only $558/ha/season at 2005 Purchasing Power Parity (PPP) and a *de facto* limit of around $1700/ha/season was identified, with values rarely exceeding $1000/ha/season. These values for net returns from the literature were mostly derived from small-plot studies and are likely to be overestimates when technologies are implemented by farmers on larger areas. Crop production could be a pathway from poverty where smallholders are able to increase farm size or where markets stimulate crop diversification, commercialisation and increased farm profitability. For most smallholders, however, small farm size and limited access to markets mean that returns from improved technology are too small for crop production alone to lift them above the poverty line and the direct benefit will be improved household food security.

1. Introduction

> *'Smallholders' chances of rising out of poverty depend directly on their ability to increase the productivity of their crop and livestock husbandry activities'* (CGIAR, 2005).

Poverty reduction became a strategic objective for development in the 1990s. As donors prioritized poverty, however, they also de-prioritized agriculture. Aid spending on agriculture fell by 45% in real terms between 1990 and 2005 (Islam, 2011). Shrinking budgets intensified the pressure on agricultural research to show it could directly reduce poverty. Among international agricultural research centres, where in 2000 budgets were back to the same level as the mid-1980s (Beintema and Stads, 2008), this resulted in agriculture being promoted as a 'pathway from poverty'. True, funding constraints have eased somewhat with the advent of new donors and a renewed consensus on the importance of agriculture for development. Nevertheless, these twin imperatives – the need to compete for scarce research funding and to demonstrate impact on poverty – continue to determine the market for agricultural research. Yet the rhetoric of poverty reduction and the emphasis on impact gloss over inconvenient truths about the structure of smallholder agriculture and variations in potential between different agricultural environments.

Agriculture's potential to reduce poverty is rarely contextualized in terms of the farm household, or the share of agriculture in household income, or the livelihood strategies that rural households have used to graduate from poverty. Conventionally, the benefits from new technology are measured in terms of higher yields or, less commonly, income per hectare, without reference to the size of landholding or to the actual benefits that can be expected for an individual household. Similarly, where the share of agriculture in total income is low, increasing agricultural productivity will have only a modest impact on total household income. A classic example is rainfed rice in Uttar Pradesh, India, where reducing yield loss from drought increased mean income by just 1%, because rice accounted for only 9% of total household income (Singh et al., 2000). Thus, a livelihoods perspective may give a very different view of the benefits from new technology. Finally, the evidence suggests that the main driver of graduation from poverty has not been agriculture but income from non-farm sources. ICRISAT's village studies in semi-arid India show that while between 1975 and 2004 average income *per capita* rose by 114%, only 4% of this increase came from agriculture and only 1% came from crop production (Badiani et al., 2007). The decisive role of non-farm income for poverty reduction is confirmed by results at the all-India level (Krishna and Shariff, 2011). Similarly, a multi-country study concluded that 'self-employment or entrepreneurship is the most frequent path out of poverty'. Income from agriculture came fourth, after income from wages or salaries and help from the extended family (Narayan et al., 2000).

Again, a universal model of agriculture as a pathway from poverty overlooks the diversity of agro-ecological zones and farming

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systems. This is particularly true of areas where crop production is predominantly based on direct rainfall. The drylands epitomize the 'complex, diverse, risk-prone' environments by-passed by the Green Revolution (Chambers, 1983). Sorghum and millets, for instance, are grown in 10 major farming systems where the probability of drought leading to crop failure is one year in three, and six in ten of the rural population lives on less than $1.25 per day (ICRISAT and ICARDA, 2012). In addition, many farmers in these areas have poor access to markets. In southern Africa, for example, 75% of the rural population lives more than four hours by road from a major urban centre (Harvest Choice, 2011).

Doubts about the potential of rainfed agriculture to reduce poverty are part of a wider debate over 'the future of small farms' (Hazell et al., 2010). Since the 1960s, the consensus has been that equitable growth required a development strategy based on smallholder agriculture (Ellis and Biggs, 2001). This orthodoxy is now being challenged on several fronts: by those who believe that large farms are more efficient (Collier and Dercon, 2009), or that neoliberal policies have reduced the ability of small farmers to produce for the market, forcing them into non-farm activities and accelerating a process of 'de-peasantisation' (Bryceson, 2002), or that rural non-farm employment and urban migration offer higher returns than agriculture (Ellis, 2005). At the heart of this debate lies the future of smallholder agriculture in SSA, where 80% of farms are now below 2 ha (Nagayets, 2005; Bélières et al., 2013). Shrinking farm size has serious implications for poverty reduction, suggesting that the majority of African farms may simply be too small for agriculture to be a viable pathway from poverty. Given the present agrarian structure, therefore, current strategies to reduce poverty directly through improving yields or access to markets may benefit only a small minority of smallholders.

The implications of small farm size for strategies to reduce poverty have been addressed in two seminal papers by Jayne et al. (2003, 2010). In this article, we extend their argument to explore the implications for agricultural research. Our general objective is to test the hypothesis that the benefits from agricultural research for rainfed agriculture can raise household incomes sufficiently to reduce poverty. Specifically, we ask four questions:

1. What is the current net income from rainfed agriculture?
2. How much can new technology raise income per household?
3. What impact will this gain in income have on poverty?
4. What are the implications for the role of agricultural research in poverty reduction strategies?

We stress limitations of scope. The focus of the article is on crop production and we have excluded irrigated situations, livestock activities, fish-farming and other more investment-rich, intensive land-based enterprises. The geographic focus is on the semi-arid and dry sub-humid tropics of Africa and Asia (referred to for brevity as 'the drylands') where agriculture is predominantly rainfed (FAO, 2000). This is a synthetic essay that offers no new data. Rather, its originality lies in linking two separate literatures, on agricultural technology and on poverty dynamics. Our aim is not to provide definitive answers but to raise questions, challenge assumptions, and to suggest connections between farm size, new technology and livelihoods that deserve deeper investigation.

2. Data and methods

2.1. Data

2.1.1. Household surveys

The stylized facts about smallholder agriculture are captured in recent household surveys. Table 1 presents comparative data from ten surveys – nine covering seven countries in SSA plus one from India. Throughout this paper, we use these facts as a point of reference for our discussion of rainfed agriculture. The data refer only to farm households and exclude households without income from crops.

Five of the SSA surveys are national surveys that collected information on smallholder agriculture. The design of these surveys has been described elsewhere (Jayne et al., 2010). Of the remaining three surveys, two are local surveys in Malawi and Ethiopia (Asfaw et al., 2010; Simtowe et al., 2010). Although designed to collect baseline information for grain legumes, both surveys collected data for all major crops. In Ethiopia, the survey was made in three districts (Minjar-Shenkora, Gimbichu and Lume-Ejere) located in the Shewa region in the central highlands. The sample size was 700 farm households, representing a proportional random sample from 26 *kebeles*. In Malawi, the survey was made in four districts, three in the southern region (Chiradzulu, Thyolo, and Balaka) and one district (Mchinji) in the central region. Chiradzulu and Thyolo districts are centres of production for pigeonpea while Balaka and Mchinji are centres of production for groundnuts. The sample size was 594 farm households, representing a random sample from three randomly selected villages from each of the four sections in each district producing the most pigeonpea or groundnuts. Finally, the third survey is a national household survey of Malawi conducted by the National Statistical Office in 2007–2008. A total of 10,698 households were surveyed, of which 6586 had reliable income data. Of these rural households, 4837 (86%) were defined as crop-producing households. Table 1 presents data for the sample crop-producing households, based on the published survey data (NEC, 2000a,b; GoM, 2000).

Household data for predominantly rainfed agriculture are available from ICRISAT's Village Level Studies (VLS) in India and West Africa. For India, the most recent data presents information for six villages in Andhra Pradesh, averaged over four crop years (2001–2004). The sample size for farm households included in both the first generation VLS in 1975–1978 and the new VLS in 2001–2004 was 269 households (Badiani et al., 2007, Table 9). Table 1 presents average data for the six villages. For West Africa, information is available for six villages in Burkina Faso, representing the three major agro-climatic zones of West Africa's semi-arid tropics. The villages were first surveyed in 1985 and re-surveyed in 2002 (Ndjeunga and Savadogo, 2002). The data refer to 115 households that were surveyed in both 1985 and 2002.

2.1.2. Net returns from rainfed crop production

A survey was made of improved technology available for dryland agriculture. Literature published since 2000 was surveyed for studies that either reported net returns directly or included input and output data to enable the calculation of net returns for a diverse collection of rainfed crop improvement technologies tested for a wide range of crops and countries. Since experiments where no improvements in yield or profitability were found are not reported, these results represent the 'best case' results for improved technology. We based our initial search on the CABI (www.cabdirect.org) database but additional reports from the grey literature were also included. The selection is representative rather than exhaustive. Table 2 lists the cases considered for this analysis. Of the 69 cases, 23 (33%) are from India, and 44 (64%) from SSA. In each case, the 'base' value is the net return, in $/ha/per season (converted to 2005 Purchasing Power Parity, PPP) associated with either the farmers' practice or the 'control' in agronomic trials and surveys. The 'improved' value is the net return of the best-performing treatment or technology reported in that publication. Where original values represented annual returns in situations where there are two cropping seasons per year (e.g., in Kenya and Uganda), or where long-duration crops occupied land for more