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The Rise of Large Farms in Land Abundant Countries

Do They Have A Future?

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Abstract

Increased levels and volatility of food prices has led to a surge of interest in large-scale agriculture and land acquisition. This creates challenges for policy makers aiming to establish a policy environment conducive to an agrarian structure to contribute to broad-based development in the long term. Based on a historical review of episodes of growth of large farms and their impact, this paper identifies factors underlying the dominance of owner-operated farm structures and ways in which these may change with development. The amount of land that could potentially be available for expansion and the level of productivity in exploiting available land resources are used to establish a country-level typology. The authors highlight that an assessment of the advantages of large operations, together with information on endowments, can provide input into strategy formulation at the country level. A review of recent cases of land acquisition reinforces the importance of the policy framework in determining outcomes. It suggests that transparency and contract enforcement, recognition of local land rights and ways in which they can be exercised, attention to employment effects and technical viability, and mechanisms to re-allocate land from unsuccessful ventures to more productive entrepreneurs are key areas warranting the attention of policy makers.

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The Rise of Large Farms in Land Abundant Countries:

Do they have a future?

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1. INTRODUCTION

After a long period of neglect, policy makers have recently re-discovered the importance of agriculture for food security, poverty reduction, and broader development. A recurring debate in the development literature is the relative emphasis to place on the roles of small-scale farms versus large-scale farms in fostering agricultural growth and economic development. In the 1960s, T.W. Schultz's landmark study, *Transforming Traditional Agriculture* convincingly argued the case for the efficiency of small-scale family operated farms and their responsiveness to new markets and technologies. This, together with the success of the Green Revolution, placed small-scale farm productivity at the center of the development agenda. Other work also showed that broad-based gains in productivity of small-scale farmers favored better development outcomes in terms of overall economic growth, employment generation, and poverty reduction (Mellor 1976). The much greater success of Asian countries in building on the Green Revolution to transform their economies and reduce poverty relative to Latin America with its highly unequal agrarian structure, further re-enforced this development model. Recent reviews (Lipton 2009, World Bank 2007) have re-affirmed the potential of smallholder agriculture in a number of respects. In particular, growth in smallholder agriculture has been shown to have a disproportionately higher impact on poverty reduction than growth in other sectors (Loayza and Raddatz 2010; de Janvry and Sadoulet, 2010). Even in countries such as the United States during the late 19th century, high inequality in land ownership at the county level reduced investments in public goods such as schools, due to effects on local tax schedules (Vollrath 2009).

However, disillusion with the limited success of smallholder-based efforts to improve productivity in Sub-Saharan Africa (Collier and Dercon 2009) and the apparent success of Brazil in establishing a vibrant agricultural sector based on much larger farms have led some countries to view the development of large-scale mechanized farming as the path to modernization of the sector. Such concerns are reinforced by evidence that, in India, farms are too small and under-mechanized and that consolidation of land holdings could result in significant increases in productivity while at the same time contribute to industrialization by releasing potentially large amounts of labor to the non-agricultural sector (Foster and Rosenzweig 2010). The emphasis on large farms was reinforced by the apparent export competitiveness of 'megafarms' in Latin America or Eastern Europe and a move by institutional investors into agriculture, in part in response to the 2007/8 global food crisis and focus on labor- rather than land-saving technologies could make economic sense in relatively land-abundant regions of Latin America and Africa.

At the same time, experience with establishment of large farms in the course of history has been largely negative. Reference to greater efficiency of 'modern' large farms applying 'scientific' methods was often

just a pretext to acquired large amounts of land without putting them into productive use. Instead a monopoly on land was combined with other policy distortions to deprive local populations of opportunities and drive down wages (Binswanger *et al.* 1995), with far-reaching and long-lasting negative effects (Baland and Robinson 2008, Conning and Robinson 2007, Nugent and Robinson 2002). The irregularities and corruption associated with many contemporaneous land transfers have led some observers to view these as a new 'land grab' (Zoomers 2010). Concerns center around the potential of such farms to generate employment, provide market access to small producers, and whether public policy can or should regulate such transfers to contribute to broader development goals. To address these, more in-depth empirical analysis will be needed.

Against this backdrop, this paper has three objectives. First, we review recent evidence on the establishment and evolution of large farms across regions. This illustrates that such units often emerged in response to policies or market failures related to availability of infrastructure, technology, and property rights. The environmental, social, and productivity impact was strongly affected by these factors, highlighting the importance of well-defined property rights and a clear, transparent, and enforceable regulatory framework, provision of public goods, and undistorted factor prices. If, as was often the case, these conditions were absent, large farms strategies were associated with significant social and environmental risks, often leading to negative outcomes that were not conducive to longer-term development.

Second, a discussion of key determinants of the way the agricultural sector is organized highlights that, while large operations have historically had a dominant role in plantation crops, agricultural production, in contrast to marketing or processing, is not characterized by significant economies of scale. Larger units have advantages in accessing credit or lumpy inputs but the ability of family farms to overcome these through collective action, together with owner-operators' superior incentives for exerting effort imply that, in contrast to other industries, farming is still dominated by family-owned businesses. A key reason for operational farm sizes to increase over time is rising wages in the non-agricultural economy and the desire to equalize returns to labor across sectors. Three recent developments may affect these relationships, namely (i) new technology that makes it easier to standardize and/or monitor farm operations; (ii) increased consumer demand for social and environmental standards and certification even for traditional low value commodities; and (iii) a desire to expand cultivation into previously uncultivated areas where, in the absence of in-migration, labor is scarce.

Third, to assess how these factors may affect the potential emergence of large farms, they need to be related to country-level endowments, in particular (i) growth of non-agricultural employment and the

sector's ability to productively absorb labor; (ii) availability of uncultivated land that is potentially suitable for agricultural production in areas with very low population density; and (iii) the extent to which gaps in provision of public goods or market imperfections may limit the scope for the agricultural sector to achieve its potential as indicated by the 'yield gap'. We use these factors to establish a typology and draw on experience with actual land acquisitions and case studies to analyze the potential efficiency and equity outcomes of investments in large farms. Finally we identify areas related to the regulatory and policy framework, property rights, and the ability to transfer resources to more efficient producers that will need to be addressed if large farms are to successfully contribute to overall development.

2. EVIDENCE ON CHANGING FARM SIZE IN LAND ABUNDANT REGIONS

While there is little evidence of significant recent changes in agrarian structure in land scarce countries (Lipton 2009), many land-abundant countries are characterized by rising investment in large-scale farming based on a nonfamily corporate model, a trend that can but need not be accompanied by growing concentration of land ownership (Deininger *et al.* 2011, UNCTAD 2009). Table 1 provides characteristics of a sample of very large farming operations in land abundant countries or regions within countries.[1]

The largest operations, most of them in developing or transition countries, share some characteristics. With operational units that often exceed 10,000 ha, they are bigger than the largest farms in comparable land abundant regions in developed countries. Such large operational units are often horizontally integrated into corporations controlling hundreds of thousands of hectares with the largest now approaching a million ha of good crop land and sales above $1 billion annually. Vertical integration with processing, marketing, and export logistics is common and business models depart substantially from that of family farming characteristic of developed countries, often separating ownership, management and labor. At the same time, there are big inter-regional differences. Historical evidence on establishment and evolution of large farms across regions can help illustrate the diversity of conditions.

(a) Latin America

Following the liberalization of markets and trade in the 1980s, relatively land abundant countries in Latin America, including Argentina, Brazil, Paraguay and Uruguay, capitalized on growing global demand to increase their position in world markets for several major products such as soybean, sugar, and meat in processes involving massive land expansion. Most widely known is forest clearing for extensive livestock ranching and establishing land rights in the Amazon basin where, in less than two decades (1990 - 2006),

[1] Land abundance is defined in terms of area suitable for cultivation that is not currently under cultivation as discussed below. We find little evidence of a shift toward large-scale farming in land scarce countries. However, some countries such as Indonesia are characterized by land scarcity (Java) and land abundance (outer islands).

the cattle population more than doubled and pasture expanded by 24 million ha (Pacheco and Poccard Chapuis 2009). Unclear boundaries of public land, weak enforcement of environmental regulations, and legislation that required land clearing in order to establish property rights contributed to a rapid expansion of cultivated area by both small and large-scale farms. Even if small farmers were the first to expand the frontier, farm sizes concentrated rapidly thereafter. As most of this land, often of very poor quality, was not put to productive use (Morton *et al.* 2006), impacts were often negative.

A second process was the expansion of soybeans and other crops in the *cerrado* (savannah) region of Brazil by using varieties, soil amendments and conservation tillage developed through long-standing public investment in research and development that allowed cultivation of acid soils that were previously considered unsuitable for agriculture. This was a major technological success that dramatically increased production and exports. Impacts on rural poverty, however, were below potential as capital subsidies and labor laws encouraged highly mechanized cultivation rather than more labor intensive production that could have had higher employment and poverty-impacts (Rezende 2005, World Bank 2009a). Currently, the median farm size in the Cerrado is more than 1,000 ha and many companies operate more than 100,000 ha of crop land in this region. Few studies have analyzed the economic efficiency of farms over 10,000 ha but one study finds a U-shaped curve with decreasing efficiency up to about 500 ha and then increasing efficiency up to 10,000-20,000 ha, especially for renters (Helfand and Levine 2004). This is attributed to preferential access to services such as credit and extension. Inequities associated with foreign ownership of farm land, which is reported to be as high as 20% in Mato Grosso, are also leading to increasing policy debate and measures to limit land acquisition by foreigners are under discussion.

Finally, in Southern Brazil, production of sugarcane, often for ethanol, is expanding rapidly, under a more mixed regime. About half of production is from medium farmers with an average of about 50 ha. Much of the rest produced in vertically integrated operations with mills on land they manage and operate. While average operated size per mill is some 13,000 ha, some very large operators farm over 300,000 hectares.

Argentina presents a somewhat different picture. There, farm management companies, *pools de siembra*, have emerged that own neither land nor machinery but rent in land and contract machine operators (Regunaga 2010). This business model emerged during Argentina's financial crisis, when having access to outside capital provided a significant advantage. With clear property rights allowing easy contracting, several companies farm more than 100,000 ha, most of it rented, on operational units in the 10,000-15,000 ha range. The largest companies, many traded publicly, operate across several countries in the region. Access to highly qualified agronomists who undergo continued training and are organized hierarchically allows adoption of near-industrial methods of quality control and production at low cost.

Competitive land lease markets, with contracts renewed annually, imply that at least part of any efficiency savings of Argentine's large operators are passed on to landowners, who often receive lease payments above what they may have been able to earn by self-cultivation. With land ownership remaining constant, agricultural production has become more concentrated -the 30 largest companies control some 2.4 million ha (Manciana *et al*, 2009).

Finally, positive experiences with investment in large-scale farming have been recorded in Peru's Pacific region. There auctions of some 235,500 ha of public land in a very transparent process with strong technical vetting brought in almost $50 million in investment over the past 15 years, underpinning the country's emergence as a major high-value agro-exporter of horticultural produce and generating large numbers of jobs (Hernandez 2010).

(b) Eastern Europe and Central Asia

Eastern Europe has undergone far-reaching transition from the former Soviet system of collective and state farms to new agrarian structures. This has unfolded in many ways, depending on countries' factor endowment, institutional structure, the share of agriculture in the overall labor force, infrastructure, and the way the reforms were implemented. In areas of low population density where collectives were divided into small plots allocated to members, the plots were quickly rented back by companies with access to finance and machinery. These companies were often created from former collective farms whose former managers could easily identify land owners and consolidate land parcels and shares. Services, institutions, and logistics were geared to large-scale production. In countries with large amounts of land, capital-intensive, corporate farming is now dominant. The share of area under corporate farms 10 years after the transition varies widely, ranging from 90 percent in Slovakia, 60 percent in Kazakhstan, 45 percent in Russia, and less than 10 percent in Albania, Latvia, and Slovenia (Swinnen 2009).

Given the slow development of markets, mergers to integrate vertically to help acquire inputs and market outputs led to the emergence of some very large companies and high levels of concentration, especially in Russia, Ukraine, and Kazakhstan, the region's three most land abundant countries. For example, in Russia, the 30 largest holdings farm 6.7 million ha or 5.5% of cultivated area and in Ukraine, the largest 40 control 4.5 million ha or 13.6% of cultivated area (Lissitsa 2010). In these countries, investment in very large farms contrasts with an overall contraction of agricultural land use and de-population of the countryside. In Russia, Ukraine, and Kazakhstan, area sown to grains has declined by 30 million ha since the end of the Soviet era even as exports, at least in years of normal rainfall, increased dramatically. Large farms were also better able to deal with financing, infrastructure, and technology constraints of the transition than smaller operators. They have increased grain production but large scope to improve

technology and yields remains. Most agricultural companies in these countries are home grown, although they may rely on investment and technology transfer from abroad with several now publicly traded in European stock exchanges. Some Western European companies have also invested directly in large-scale farming in the region. For example, Black Earth, a Swedish company, farms more than 300,000 ha in Russia.

Ways of acquiring land vary depending on institutional arrangements. In Russia land is commonly leased but sometimes owned, and in Ukraine, where private land sales are not allowed, all land is leased, usually for 5 years although some operators try to lock in lease contracts at favorable terms for much longer. All over the region, land rents relative to land of comparable quality in other parts of the world are very low. Competitive markets for land rental have yet to emerge as imperfections in financial markets as well as those for inputs and output often make owner-cultivation difficult. Land owners' weak bargaining power reduces rental rates and few of the potential benefits from large-scale cultivation are transmitted to them.

(c) Southeast Asia

The perennial crop sector in Southeast Asia illustrates the plantation model of large-scale farming. Malaysia and Indonesia produce nearly 90 percent of the world's palm oil, production of which has expanded rapidly in response to growing global demand for edible oils and strong government support. In Indonesia, planted area more than doubled from about 2.9 million ha in 1997 to 6.3 million ha in 2007. In contrast to annual crops, oil palm is highly labor intensive and the industry is estimated to have created an estimated 1.7 to 3 million jobs. Smallholders participate usually in association with plantations.

Given the processing requirements, large-scale production close to the processing unit, often complemented by outgrower schemes, is the norm, with the sourcing area for a typical palm oil mill averaging around 10,000 ha. In many cases, companies have integrated operational units horizontally to form some very large firms. Eight of the world's 25 largest agricultural production–based companies identified in the 2009 *World Investment Report* have major interests in oil palm (UNCTAD 2009). There has also been a strong trend toward consolidation in the industry through mergers and by vertical integration with refining oil and manufacturing of palm oil and palm kernel oil products. Several large oil palm companies now control plantations of 200,000-600,000 ha of oil palm.

The fact that more than half of the expansion of oil palm was at the expense of natural forests has been a source of major concern (Koh and Wilcove 2008). Policies aiming to foster development of the industry by providing land and timber at well below opportunity cost have been linked to deforestation of large areas. Concerns abound about oil palm expansion as a contributor to loss of biodiversity, greenhouse gas

emissions, and social conflict due to a failure to recognize local land rights, opaque and poorly understood contractual agreements and limited benefit-sharing with local communities (World Bank 2009b).

Rubber provides an interesting contrast. Large rubber plantations often opened areas by establishing processing facilities, markets, and roads via settlement programs where locals or migrants provide labor to establish the plantation and acquire land as outgrowers. In some cases, as in the FELDA program in Malaysia and the Indonesian transmigration program, these were state sponsored. After processing and infrastructure was established, production almost entirely shifted from large plantations to 2-3 ha farms with smallholders now making up 80 percent of world rubber production (Hayami 2010). Rubber's high labor intensity, emergence of production systems adapted to smallholders' capital constraints, and more flexible processing requirements than those for oil palm all facilitated this transition.

(d) Sub-Saharan Africa

In Africa after independence, many countries attempted to 'modernize' their agricultural sectors through large-scale farming, providing subsidized credit, machinery, and land. These efforts almost universally failed (Eicher and Baker 1992). One of the largest and most well-documented cases was mechanized large scale sorghum and sesame production in Sudan that originated in attempts by financiers from the Gulf following the 1970s oil price spike, to transform the country into a regional breadbasket. Schemes with very favorable access to land and subsidized credit for machinery attracted civil servants and businessmen who mostly hired managers for farms of over 1,000 ha, with some over 100,000 ha. While some 5.5 million ha were converted to arable land according to official statistics, estimates put the area informally encroached upon at up to 11 million ha (Government of Sudan 2009). Encroachment on traditional users' land rights led to serious conflict. Partly due to the ensuing tenure insecurity, investment was low and most mechanized farms rely on low-level technology. Yields are only 0.5 t/ha and have been stagnant or declining (Figure 1) relative to 4 t/ha in comparable agro-ecological environment in Australia.

These problems were not unique to Sudan. Efforts to introduce mechanized rainfed wheat in Tanzania on some 40,000 ha, of land that had previously been prime grazing grounds for pastoralists illustrate the challenges. After a $45 million investment, wheat production was deemed unprofitable, and production is declining (Lane and Pretty 1991, Rogers 2004). Nigeria's large-scale mechanized irrigated wheat schemes of the 1970s and 1980s have largely been abandoned (Andrae and Beckman 1985). The fact that some recent investments seem to repeat the mistakes made in the 1970s and 80s suggests that attention to these issues is required to prevent the current wave of land acquisitions from yielding similarly negative results.

Beyond state-supported schemes, policy distortions against agriculture, especially for export, and scant public investment in rural areas reduced private investors' incentives so that most area expansion was by smallholders. Policy reforms of the 1990s allowed agricultural growth to accelerate and paved the way for renewed investor interest in the continent. Still, structural issues arising from long-standing neglect of technology, infrastructure, and institutions continued to contribute to disappointing performance of commercial cultivation of bulk commodities, where, in light of its land endowment, Africa should have a comparative advantage (World Bank 2009a). Past success with commercial agriculture was limited to traditional export crops such as cotton, cocoa, and coffee produced by smallholders, and more recently horticultural exports, by both small and large farms. Plantation crops such as sugarcane in Southern Africa -aided by preferential access to developed markets- and oil palm in West Africa also had some success. Although smallholder-based growth remains critical to achieve poverty-reduction in Africa (Diao *et al.* 2010), there is increasing recognition of the need to overcome market imperfections if smallholders are to play this role (Hazell *et al.* 2010). In the wake of market liberalization, multiple institutional challenges associated with effective service provision to smallholders remain and have, in many instances, not yet been addressed effectively (Dorward *et al.* 2009).

Recent land acquisitions in Africa attracted not only large amounts of media attention but were also quantitatively large; in fact compared annual rate of area expansion of some 1.8 million ha in the 1961-2007 period, demand in 2009 alone amounted to some 39.7 million hectares –greater than the total agricultural land in Belgium, Denmark, France, Germany, the Netherlands, and Switzerland combined (Deininger *et al.* 2011). Data from six countries where reliable information could be gathered -often aggregated up from regional figures- highlight that the size of lands transferred recently is significantly above what was observed in the past. Total transfers in 2004-09, in millions of ha (table 2) amounted to 4.0 ha in Sudan, 2.7 in Mozambique, 1.2 in Ethiopia and 1.6 -mainly renegotiation of existing agreements- in Liberia.[2]

The volume and nature of land transfers depends on policies; for example in Tanzania, where land rights are vested with villages, less than 50,000 ha were transferred to investors in the same time period. Virtually everywhere, local, rather than foreign investors, dominated. In most cases, expected job creation and net investment were either not recorded or very low. Often land was not fully used, as in Mozambique where a 2009 land audit found large shares of transferred land being either unused (34% of the total) or used in ways that did not comply with agreed investment plans (15%). Even if, as is the case

[2] Comparison with figures on possibly available land in table 5 suggest that the land transferred accounts for 8.6%, 16.6%, and 25.4% of the total suitable non-forested non-protected area with a density of less than 25 inhabitants per km^2 for Sudan, Mozambique, and Ethiopia, respectively.

in Mozambique, legal provisions allow the state to cancel underutilized concessions, doing so incurs significant transaction cost, poses high demands on skilled manpower and judicial capacity which is often lacking, and is likely to be opposed by vested interests benefiting from the status quo.

Case studies of projects in 7 countries suggest that widespread concern about large-scale farming being associated with potentially large risks is justified. Key risks include (i) weak land governance and an associated failure to recognize, protect, or -if voluntary transfer can be agreed upon- properly compensate local communities' land rights (Alden-Wily 2010); (ii) lack of capacity to process and manage large scale investments, including inclusive and participatory consultations that result in clear and enforceable agreements; (iii) investor proposals that were non-viable technically, or inconsistent with local visions and national plans for development, in some cases leading investors to encroach on local lands to make ends meet economically; and (iv) resource conflict with negative distributional and gender effects (Tamrat 2010, World Bank 2010). Often, progress with implementation was well behind schedule. As a result, local people have often suffered asset losses but received few or none of the promised benefits, implying that -even if expected positive effects might materialize at some point in the future, poor locals may have ended up subsidizing rich local or foreign investors.

At the same time, by comparing over time, case studies document that well-executed investments can provide benefits. These accrue through four main channels, namely (i) social infrastructure, often supported by community development funds using land compensation; (ii) employment and jobs; (iii) access to markets and technology for local producers; and (iv) local or national tax revenue. In all cases, economic viability of investment is a necessary condition for positive social outcomes to materialize, including food security. Even if overall effects are positive, distributional issues may arise and will need to be addressed upfront to inform negotiation and contract design. For example, entrepreneurial and skilled people could gain from jobs creation through an investment while vulnerable groups or women lost access to livelihoods without being compensated.

Both unilateral and bilateral regressions suggest that, in contrast to general foreign direct investment, a country's probability to be targeted by large scale farmland investment is positively associated with weak land governance and failure to protection traditional land rights. This suggests that, if the recent trend of growing interest in large scale corporate agriculture in Africa is to be sustained and bring about positive development outcomes, improvements in land governance and transparency are essential. Efforts by some African countries to better protect customary land rights, increase transparency and incentives for land-related investment, and improve access to information to better negotiate contracts and enforce them go in

the right direction. In most cases, however, significant additional effort and investment will be needed for these to translate into reality on the ground.

In the case studies, lack of institutional capacity and non-transparent processes that did not involve local consultation led to overlapping land claims, conflict, and negative outcomes for local communities. Weak land governance creates challenges to reigning in opportunistic behavior by elites, e.g. by ensuring proper consultation with local and indigenous populations and makes it difficult to appreciate the true value of a piece of land. In many cases this appears to have resulted in land being transferred at implicit values that were well below its opportunity cost. Many initial investment projects were thus poorly conceived in terms of technical and financial viability, leading to sub-standard performance and in some cases abandonment. Where large scale investment was heavily promoted, even conditional land transfers are often difficult to reverse, with the result that assets that could be highly productive cannot be accessed because of the high administrative demands associated with the liquidation of existing but failed ventures.

3. WHY AGRICULTURAL PRODUCTION IS DOMINATED BY OWNER-OPERATED FARMS

In most countries, both rich and poor, average farm size is relatively small, implying that the industry is dominated by owner-operated family units that combine ownership of the main means of production with management (table 3). Indeed, at a global scale, agriculture is one of few industries based overwhelming based on a family firm model; that is, farms are owner operated and rely largely on family labor (Lipton 2009).

A key reason is that agricultural production has few technical (dis) economies of scale, implying that a range of production forms can coexist. A look at the 300 or so publicly listed companies in table 4 illustrates this point. Even though farming accounts for 22 percent of the global agricultural value chain, it makes up a mere 0.2 percent of equity market capitalization. As of October 2009, there were only seven publicly listed farming companies worldwide, three in Brazil and Argentina and four in Ukraine and Russia. By contrast, agricultural processing, input industries, and sometimes output markets are characterized by significant economies of scale largely related to fixed costs (e.g., R&D, large processing units) which has often given rise to concentration in these industries (World Bank, 2007).

There are three reasons for the endurance of the family farm model even in rich countries (Allen and Lueck 1998, Binswanger and Deininger 1997, Deininger 2003). First, as residual claimants to profit, family workers will be more likely to work hard than wage workers who require costly supervision. This is especially important in agriculture where production is spatially dispersed. Owner operators also have an intimate knowledge of local soil and climate, often accumulated over generations, that gives them an

advantage in tailoring management to local conditions and the flexibility to quickly adjust management decisions to site, seasonal and market conditions. Finally, family farms have considerable flexibility to adjust labor supply to the seasonality and annual variability of production since family labor can more easily be reallocated to other tasks on and off the farm.

A well-known and important exception to the superior performance of owner-operated units of production over those relying on wage labor is in plantation crops, where economies of scale in processing and the need for close coordination of production and processing can make plantations more efficient. The need for quick processing of some harvest products to avoid deterioration, often within 24-48 hours, requires tight adherence to delivery and harvesting schedules and transmits economies of scale in processing to the production stage (Binswanger and Rosenzweig 1986). For this reason, sugar factories and palm oil mills usually run their own plantations to ensure a base load for processing. The scale of these has increased significantly; new mills in Brazil for example, may capture produce from up to 70,000 ha versus 20,000 ha a decade ago. Concentrating production also lowers transport costs from the field to the processing point. This is important for bulky and relatively low-value raw products (e.g. sugarcane). Spatial concentration of production in large estates owned by mills in Brazil may reduce total costs by some 20%, compared to dispersed smallholder models (as practiced in Kenya) by lowering transport costs to the mill.

Finally, plantations that specialize in perennial crops have developed highly structured 'industrial type' production processes that facilitate labor supervision and management efficiency. A focus on a single crop with relatively low seasonality of operations provides year round employment and allows managers and workers to develop specialized skills. The modern tropical plantation is akin to highly specialized stall-fed livestock operations in industrial countries which, for the same reasons, have moved away from family farm to nonfamily corporate farming.[3]

In most industrialized countries, a key factor contributing to growing farm sizes has been rising wages in the nonagricultural sector that led farm operators to seek ways to attain incomes comparable to what they can obtain in other sectors of the economy (Eastwood *et al.* 2010). Normally this implies substitution of capital for labor and an increase of farm size over time in line with wage rates. As figure 2 illustrates, both variables moved together closely in the United States for most of the 20th century, suggesting that the

[3] In developing countries, a modern day equivalent to the plantation crop is fresh horticulture for export. Not only is the produce highly perishable, but the harvest must be closely coordinated with shipping schedules (usually air). In addition, export markets have very stringent quality requirements and demand backward traceability of output to the farm level. However, due to market limitations, these enterprises may be large-scale in terms of capital and labor but *not usually in land*. The huge horticultural enterprises in Chile and more recently in Peru that supply a large part of the winter fruits and vegetables to the North American market are an exception in terms of land size.

desire to obtain a comparable nonagricultural income was the main factor driving changes in the average size of operational holdings (Gardner 2002).

Changes in operational farm size structure often occur via generational change (Aubert and Perrier-Cornet 2009) and will be affected by policy and institutional factors (Huettel and Margarian 2009) and the scope for partnerships (Larsen 2010). Of course, even large farms in the US are mostly owner-operated rather than company-owned.

Further, the capital requirements of farm operations typically increase with economic development, with higher levels of technology, and investment in land and other improvements, as well as investment in labor-saving machines. Although small agricultural operations have advantages in acquiring labor and local knowledge, they in many cases have difficulty acquiring capital. The high transaction costs of providing formal credit in rural markets mean that the unit costs of borrowing and lending decline with loan size and bias lending against small farmers. Raising interest rates on small loans does not overcome this problem, as it will lead to adverse selection (Stiglitz and Weiss 1981). Unless ways are found to provide small farmers with access to finance (through, for example, credit cooperatives), their inability to obtain financing may outweigh any supervision cost advantages they have and improve efficiency of larger farms (Chavas 2001).

4. FACTORS FAVORING THE RECENT ESTABLISHMENT OF LARGE FARMS

In addition to secular shifts of labor out of the agricultural sector, three main factors that have recently contributed to increased farm size are (i) new technology that makes it easier to supervise labor or occupy it continuously; (ii) the limited availability of labor in frontier areas, possibly exacerbated by high capital requirements of land clearance and infrastructure construction; and (iii) greater emphasis on integrated supply chains and certification of produce. Although new information technologies may also help to better organize smallholders, the effect of these factors on total firm size may be reinforced by advantages from horizontal or vertical integration further up in the supply chain.

Recent innovations in crop breeding, tillage, and information technology may make labor supervision easier and reduce diseconomies of scale of large operations. Pest-resistant and herbicide-tolerant varieties facilitated broad adoption of zero tillage and, by reducing the number of steps in the production process and the labor intensity of cultivation, allowed management of larger areas. The ability to have machinery operations guided by GPS technology rather than driver's skills makes close supervision of labor less relevant while information technology can generate data to help better supervise labor. The scope for substituting crop and pest models and remotely sensed information on field conditions for personal observation also reduces the advantage of local knowledge and experience in tactical farm decisions while

climate change and the associated greater variability of climatic conditions reduces the value of traditional knowledge. Private operators in Argentina and Ukraine assert that, with modern technology, good managers can effectively supervise units of 10,000 to 15,000 ha for grain and oilseeds.

With changes in technology and markets, the ability to acquire and process information also gives advantages to managers with high levels of formal schooling and technical education -the 'value of the ability to deal with disequilibria' (Schultz 1975). This is particularly important for new crops and frontier areas where managers skilled in modern methods may enjoy advantages. Unit costs of acquiring and processing information also decline with farm size (Collier and Dercon 2009, Feder and Slade 1986). Large farms that employ highly trained managers may enjoy an efficiency advantage under conditions of rapidly changing markets and technologies, and in opening new areas to agriculture.

Expansion of certification, introduced as buyers in high income countries demand certification of social and environmental sustainability, into 'bulk commodities' can also provide advantages to large operations. Industry-led organizations, such as the Roundtable on Sustainable Palm Oil or Responsible Soy, the Better Sugar Initiative, and EU biofuels standards, have all been put in place in the past decade to develop certification standards and procedures. The high fixed costs of gaining certification and the need to preserve product identity through the supply chain provide advantages to large operating units and to integrated supply chains. While the added cost of certifying smallholders can often be justified in high value products, it poses challenges for bulk commodities such as palm oil. Standards may favor large operations in other ways as well; for example, environmental standards that prohibit burning of sugarcane prior to harvesting to reduce carbon emissions essentially rule out manual harvesting, disadvantaging smallholders and reducing labor requirements by half.

Beyond these factors, large companies' ability to integrate operational units horizontally or vertically in marketing and processing can provide additional advantages in a number of respects.

If markets are not working well, large firms, possibly comprised of many operational units, can improve coordination with processors or shippers, and reduce transactions costs and risks through vertical integration. For example, integration of with livestock production with grain and oilseed production in Russia and Ukraine reflects efforts by large livestock operations to assure feed supplies and some of the largest companies in Argentina are integrated with processors or input suppliers. Vertical integration also allows companies to fill gaps in public services. In Brazil or Ukraine, a number of large companies constructed their own port terminals for export, shielding them from the limitations imposed by public facilities. This is consistent with studies in Russia that fail to find any inherent economies of size in farm production but clear advantages of large farms in terms of lower transactions costs and higher product

prices (Svetlov and Hoekmann 2009), suggesting that the ability to overcome market imperfections is a key driver toward large farms in Russia (Koester 2007).

In addition to advantages arising from the ability to spread the fixed cost of providing credit over a larger amount to be borrowed, the ability of vertically or horizontally integrated firms to access foreign capital markets, possibly by issuing equity, can provide large agricultural firms with additional advantages. These will be particularly relevant if domestic financial markets are distorted, as in the case of Argentina, so that global capital markets, which can be accessed only by large corporations, may provide access to capital at a cost that is significantly below domestic rates. In some cases, Argentinean companies that obtain loans abroad pay only half of the rate that local banks demanded from farmers, if they could get credit at all. Such advantages, which are particularly relevant where significant start up costs, such as soil amendments, irrigation, and establishment of perennial crops, are required to make land arable but do not return a positive cash flow for several years, can well affect industry structure in the long term.

Horizontally integrated large operators will also be better able to compensate for shortcomings in the provision of public goods such as infrastructure or technology. For example, in industries dominated by large companies such as sugarcane (Brazil), oil palm (Malaysia), or plantation forestry, large part of R&D is now carried out by private firms. Much of this research is proprietary and not available to others, including smallholders. Horizontal integration allows companies to reap the large economies of size inherent in modern crop research (Traxler and Byerlee 2001). In other cases (e.g., for soy in Brazil), this role is performed by the public sector so that technologies are equally available regardless of farm size. However, public R&D has weakened in many countries to the detriment of smallholders in particular.

Large firms, even if they are not vertically integrated, can also leverage their superior bargaining power' as markets for agricultural inputs and outputs are often highly concentrated. In Argentina, large companies with more bargaining power are reported to be able to reduce input prices and increase output prices by 10–20 percent (Manciana et al., 2009). Likewise, spatial covariance of risk implies that, even in developed countries, markets for agricultural insurance are often incomplete. Diversification of operations across large geographical areas can allow large companies to self-insure against weather risks, thereby overcoming these difficulties. Some companies explicitly identify spatial dispersion of production to manage production risks as part of their growth strategy, in addition to diversification across commodities to smooth market risks. This could allow large companies to expand strategically by acquiring assets at relatively low prices in periods of climatic or other distress.

5. LAND SUPPLY AND FARM SIZE EVOLUTION

To assess how the above factors may affect the potential for emergence of large farms, they need to be related to endowments at the country level, in particular (i) growth of non-agricultural employment and the sector's ability to productively absorb labor; (ii) availability of land that is potentially suitable for agricultural production in areas with very low population density that is currently not cultivated; and (iii) the extent to which gaps in provision of public goods or market imperfections may limit the ability of the agricultural sector to achieve its potential.

If little 'new' land is available for expansion, the only way in which large farms can be established is by obtaining land from existing operators, suggesting that, if markets work well, market transactions will determine farm size. On the other hand, if large areas of currently uncultivated land (i.e. not used for sedentary agriculture) could be brought under more intensive agricultural cultivation, large farms may help better utilize existing resources and, if agreements are fair and a regulatory framework is in place to prevent negative externalities, provide benefits to land owners and local communities. We use the typology as well as experience with actual land acquisitions to illustrate typical cases.

(a) Assessing land availability and the yield gap

With stronger global markets for agricultural commodities, concerns about food security, and improved transportation, pressure on previously uncultivated lands that could be suited for crop cultivation is increasing. Typically, these are areas of low population density with important traditional uses for hunting and gathering, pastoralism, or low intensity agriculture (e.g., swidden farming systems in forest areas). In many of these, the scope for intensification of existing operations is limited. Labor supply through migration from other regions is likely to be inelastic in the short to medium term so that intensification of land use would require some mechanization and larger farm sizes. Trends towards larger operational units may be reinforced by high capital outlays to clear land or establish necessary infrastructure and the production of unfamiliar new crops which can place a premium on skills and entrepreneurship that may not be available locally.[4]

To gauge how relevant this may be in practice, data on potential supply of land for rainfed cultivation is needed. We use the global agro-ecological zoning (GAEZ) methodology developed by the International

[4] Historically these areas have been cultivated through settlements from more densely populated areas of the country or from abroad (e.g., North America and Australia). Settlement may be state supported or spontaneous in response to land pressures in the origin area. Large state-supported schemes were generally costly and less productive than expected as inexperienced farmers have to adjust to new crops and environments or non-farmers attempt to learn farming (Kinsey and Binswanger 1993). Conflicts, with local land users have been common. Ethiopia's resettlement program from high density highlands to the 'virgin' lowlands in the 1980s under the communist regime has been revamped in 2004-06 to resettle 600,000 people under strict guidelines. But, lack of respect for local rights was still a major source of conflict (Pankurst and Piguet 2009).

Institute for Applied Systems Analysis (Fischer *et al.* 2002) to assess potential rainfed yields that can be achieved on a given plot in light of prevailing agro-ecological conditions. This predicts potential yield for rainfed cultivation of five key crops (maize, wheat, soybean, sugarcane, oil palm) based on simulated plant growth at each stage of the vegetative cycle based on factors including soil, temperature, precipitation, elevation, and slope, allowing for different climate change scenarios as well.[5] Applying a price vector then allows the determination of the crop that produces the highest revenue. As market access will affect transport cost and profitability, we classify potential crop areas based on whether they are within 6 hours of an urban center with a population of at least 50,000. Full details of the model and data sources are provided in Deininger *et al.* (2011).

Depending on current land use, this technique provides two parameters of interest. For cultivated areas, the difference between possible output and what is currently attained taking crop choice as given provides an estimate of the 'yield gap' which can indicate the extent to which gaps in technology, institutions, or other public goods (e.g. infrastructure) prevent existing cultivators from realizing there potential. Uncultivated areas with high potential could be possible candidates for area expansion if they are not designated as a protected area, not forested, located reasonably close to markets and have low population density so that whatever existing interests are displaced can be compensated.

Two key results stand out. First, yield gaps vary widely across regions and can be large (table 5).

Oceania is close to realizing its potential, followed by North America (0.89), Europe (0.81), and South America (0.65). Sub-Saharan Africa realizes only 20 percent of potential production, offering large potential for increasing yields. If it were to attain 80 percent of potential yield, a level usually considered economic, it could quadruple maize output, equivalent to expanding area by of 90 million ha – more than the area suitable for maize expansion close to infrastructure globally – at current yields.

Second, the non-forested non-cultivated area suitable for rainfed cultivation of at least one of the crops considered here amounts to 446, 306, or 198 million ha for population density cut-offs of 25, 10, and 5 persons per km^2 (table 6).

In all scenarios, non-cultivated area suitable for rainfed cultivation is highest in Africa (202, 128, and 68 million ha corresponding to 45, 42, and 34 percent of the total, respectively), followed by Latin America. Within Africa and Latin America, available land is concentrated in a few countries and not always close

[5] To keep things tractable, we use a 5' x 5' resolution that divides the world into 2.2 million grid cells. Computation of output in each cell is based on more disaggregated data. Yields are for 2008. Suitable area is not currently used for crop production, could attain at least 60 percent of the potential yield for this crop, is located in an area with population density less than 10 persons/km^2, and at 2005 prices will not yield higher gross revenues with any other of the five crops considered here (maize, soybean, sugarcane, oil palm, wheat). Close to infrastructure means a travel distance of less than six hours to the next market based on available transportation.

to infrastructure. Using the 25 persons/km^2 cutoff, the seven countries with the largest amount of suitable but uncultivated land (Sudan, Brazil, Australia, Russia, Argentina, Mozambique, and Democratic Republic of the Congo, in that order) account for 224 million ha, or more than half of global availability. Thirty two countries each with more than 3 million ha of land available account for more than 90 percent of available land. Of these, 16 are in Africa, 8 in Latin America, 3 in Eastern Europe and Central Asia, and 5 in the rest of the world. More strikingly, many of the counties with ample amounts of suitable but uncultivated land have limited amounts of land under cultivation, either because clearing it is unaffordable or uneconomical, technology for exploiting it or institutions to protect investment are not available, or it is too far from infrastructure.

(b) Assessing the potential for large farms at the country level

To put these elements together and identify implications for countries' broader development, we classify countries by relative availability of land for rainfed cultivation and the 'yield gap'. Figure 3 illustrates results by plotting relative land availability compared to currently cultivated area (in logs) against the potential for increasing yields and defining four types of countries depending on whether they are above or below the sample mean/median for these two variables (indicated as a dashed line).

One group (type 1) includes Asian countries with high population density, such as India, China, Vietnam, Malaysia, Republic of Korea, and some countries in the Middle East where agricultural growth has been, and will continue to be, led by productive smallholders. Sustained gains from technological and institutional change in the past, including the Green Revolution, imply that yield gaps are low. To meet expanding demand for horticultural and livestock products, private investors increasingly provide capital, technology, and access to markets by contracting smallholders. As these countries reach the stage of declining agricultural population, land consolidation, largely by entrepreneurial farmers leasing from neighbors, will lead to gradually increases in farm size. Well-functioning land markets to facilitate such processes are important to a successful transition.

A second group (type 3) includes the majority of developing countries as well as densely populated areas in Ethiopia, Kenya, Malawi, the Philippines, Cambodia, parts of Eastern Europe, and Central American countries (such as El Salvador) with limited land availability and often large numbers of smallholders in poverty. Productivity on land currently cultivated remains far below the yield potential. Strategic options depend on the reasons underlying this yield gap as well as the size and likely evolution of the nonagricultural sector. If yield gaps are large and non-agricultural development is limited, increased smallholder productivity will be the only viable mechanism for rapid poverty reduction. This will require public investment in technology, infrastructure, and institutions and market development to raise

smallholder productivity, following the example of the green revolution in Asia. If, on the other hand, incomes and employment in the nonagricultural sector grow rapidly, land markets work reasonably well, and population growth is low, as in parts of Eastern Europe, land consolidation and the associated move to larger operational units may offer positive benefits. The distribution of benefits will depend on the bargaining power of the parties involved which depends on their endowments (and reservation utility), information access, and ability to enforce contracts.

A third group, especially relevant from the perspective of large farms, comprises countries in the right bottom quadrant (type 2) where land with reasonably well-defined property rights is available, infrastructure access is fairly good, and technology advanced -often the result of past investment in technology, infrastructure, institutions, and human capital. Figure 3 illustrates that many of these are located in Latin America, including Argentina, Uruguay, and central Brazil. It is here where investors have exploited opportunities for cropland expansion mainly through large-scale farming. If property rights are secure, markets function well, and areas with high social or environmental value are protected effectively the public sector's role is mainly to regulate environmental externalities. Good institutions and land governance will thus be critical to ensure that the technical potential is realized sustainably.

The fourth type, in the right top quadrant, consists of countries with available land and a high yield gap. It includes sparsely populated countries in Sub-Saharan Africa such as the Democratic Republic of the Congo, Mozambique, Sudan, Tanzania, and Zambia with large tracts of land in areas with sufficient precipitation and limited run-off suitable for rainfed cultivation as well as a number of countries from Eastern Europe and Central Asia region like Russia and Ukraine. Many of the African countries have an agricultural sector dominated by smallholders who achieve only a fraction of potential productivity. Labor supply often constrains area expansion, implying that much potentially suitable land is not used for crop production. If migration from other regions is inelastic in the medium term, growth will require larger farm sizes, and labor-saving mechanization may be the most attractive short-term option although assembling the required land may be a challenge (Aryeetey and Udry 2010). If there is need for new crops and farming systems, large investments in land improvement or processing, or transport and marketing links to export markets, outside investors can have an important role. It could result in institutional arrangements, technology, and infrastructure for mutually beneficial and agreed on land transfers.

Most of the recent upsurge in investor interest has been focused on this type of situation which provides scope for the private sector to contribute technology, capital, and skills to increase productivity and output in the short to medium term. How to accomplish this most effectively will depend on local conditions. Capital-intensive activities with low labor absorption, such as annual crops using fully mechanized

production, will be appropriate only if population density is low, the likelihood of in-migration is limited, and a vibrant nonagricultural sector can absorb growth of the labor force. If property rights are well defined, technology is available, markets work well, and nonfarm sectors lead economic growth and employment generation, investment in large-scale farming can lead to positive social outcomes. If land and labor markets function competitively and information is broadly accessible, land prices will reflect productive potential and market transactions will benefit land owners and investors. Entrepreneurs can earn rents by bringing capital and technology to improve productivity on land that is currently used less intensively (and thus available at fairly low prices) whereas holders of land rights can negotiate for their share of these rents.

Yet the examples discussed earlier also illustrate that, in many historical contexts, provision of land either free of charge or well below its opportunity cost has seriously distorted investors' choices, encouraging land expansion rather than intensification, and often left local communities with few if any benefits. Gaps in the policy framework or the provision of public goods have often exacerbated negative social and environmental effects. Ill-advised provision of subsidized credit led to highly capital intensive farms that generated little employment. Land market imperfections are especially pronounced in Sub-Saharan Africa and investors often acquire land through government intermediaries, ostensibly acting on behalf of local communities. Limited market access or lack of technology will affect potential returns from landowners' self-cultivation, thus weakening the returns small producers can obtain from their land and thus their bargaining position. The potential impact of such imperfections is illustrated in Ukraine, where lack of competition in land markets reduce land rents to only a fraction of what is obtained in Argentina, even though the productive capacity of the land is very similar. Clarifying and securing the rights of existing land users is thus an essential precondition for fully realizing and equitably sharing the potential benefits from operation of large farms.

In areas of higher population density where land rights are already better defined, existing smallholders can benefit from investors providing access to technology, finance, or markets. A variety of institutional arrangements, including contract farming, nucleus-outgrower schemes, or joint venture companies can help combine investors' assets (capital, technology, markets) with land, labor, and local knowledge by communities and smallholders. Contract farming, where investors provide capital and technology, would be expected for crops such as oilseeds or sugarcane because processing makes it easier to enforce contracts, as side-selling can be limited. If upfront investments are large, as for horticulture and perennials, land ownership will be important and benefits for local people can accrue through wage payments or land rental fees instead of self-cultivation. An environment for parties to be well informed

and able to voluntarily enter into mutually advantageous and enforceable contractual relationships is an important public sector role. This role can be complemented by collective action through farmer organizations or cooperatives. As transaction costs and implementation capacity are critical, the most appropriate arrangement will depends on local context –population density, the type of production system, and the nature of local institutions and markets.

6. CONCLUSIONS AND POLICY IMPLICATIONS

Expected increases in the demand for agricultural products, whether as food, feed or inputs into other industries such as biofuels has led to an increase in the number and size of large farms and new business models involving a mix of large and smaller operations are evolving. This trend is notable in Latin America and Eastern Europe, for perennials in Southeast Asia, and recently Sub-Saharan Africa. In addition to factors that have long underpinned the expansion of large operations such as the economies of scale in plantation crops, policy distortions, and large farms' superior ability to deal with imperfections in markets for finance and insurance, four factors are likely to affect future evolution of agrarian structures, namely (i) technical change that makes it easier to standardize supervision of the production process for bulk commodities; (ii) the ability of large operations to benefit from horizontal and vertical integration and exercise market power, especially in situations where there provision of public goods such as infrastructure and technology is deficient; (iii) standards and associated requirements for certification and traceability that favor large operations; and (iv) inelastic labor supply, together with high capital requirements for expanding cultivation into suitable but hitherto uncultivated areas. While many of these may favor large farms, at least in the short run, some, such as the use of information technology, may also work in the opposite direction and make it easier to integrate smallholders into the value chain.

A strong historical bias against export agriculture combined with high agricultural potential in many areas with low population density imply that the challenge is particularly large for Africa where governments hope to enlist the private sector to overcome long-standing bottlenecks in availability of infrastructure and technology and to link rural areas to global markets for output and finance. While there has been a huge volume of announced investments, they have largely failed to live up to expectations. In the past, gaps in the policy and regulatory framework have often implied that area expansion led to land concentration and a 'resource curse' rather than sustainable broad-based growth. This suggests that, if such investment is to provide economic and social benefits, a proper public sector role to set policy, provide complementary public goods, and assist local people in screening investments and investors. Three priority areas for attention are (i) property rights to and proper valuation of land; (ii) labor market impacts and technical as well as economic viability; and (iii) the ability to flexibly reallocate land in case an investment fails.

Property rights to land: In many cases, traditional notions of land being 'owned' by the state or by traditional authorities led to it being transferred for free or well below its opportunity cost. This results in a range of speculative or economically non-viable deals going forward, often with negative environmental or social consequences as investors struggle to make a profit on land that once made important contributions to local livelihoods. Recognition of existing property rights, proper land valuation and taxation, and ensuring that decisions on land transfers are taken with the consent of local people can help improve economic and social outcomes. In areas with high potential and good market access where pressure is likely to be high, systematic registration of property rights, possibly at community level, together with establishment of transparent and accountable mechanisms for decision-making are needed. Some countries, e.g. Mexico which registered more than 100 million hectares in less than a decade, had considerable success with this and their experience could be drawn upon. Many African countries have put in place legislation allowing similarly rapid registration of group rights.

Employment, social, and environmental effects: Except for perennials, large farms' ability to productively employ labor is often very limited, much below that of smallholder agriculture. Combining the advantage of large farms, in terms of access to markets, infrastructure, and technology, with the local knowledge, flexibility, and superior incentives of smallholders through appropriately structured partnerships could have considerable employment and social benefits, including on local food security. Moreover, while large farms have often had negative environmental impact, either by encroaching on valuable natural habitats or by pushing local cultivators off the land and into fragile environments, some of the technologies applied by them, such as conservation tillage, can provide significant environmental benefits. Realizing these and ensuring that they are compatible with local visions for development requires transparency and access to information to strengthen local communities' bargaining power and their ability to ensure that contractual arrangements, once entered, are actually complied with. Establishing minimum standards, improving transparency, and allowing independent third-party verification will thus be important to avoid negative consequences. While much can be done by the private sector, creation of the necessary preconditions is an important activity by the public sector.

Flexible arrangements for land transfer: Even in well-established industries, the share of newly formed firms surviving for more than 5 years is often low. In the environment discussed here, lack of proven technology, weak institutions, and high levels of market and price risk may lead to even higher numbers of firms exiting the industry or in need for restructuring. The experience of the large 'bonanza farms' established with the settlement of the northern Great Plains in the US in the late 1800s, virtually all of which were disbanded and land markets broke them up into smaller operations (Drache, 1964), can

provide lessons. In many African countries, land that had been given to investors cannot be transferred easily. A policy framework that implies high opportunity cost of holding land (e.g. because rental fees or land taxes are collected effectively), clearly identifies boundaries, and provides mechanisms for allow more efficient operators to gain access to land through decentralized processes will reduce the danger of large amounts of potentially very productive land being locked up in speculative holdings amassed by 'investors' with limited skills that provide few benefits while creating significant potential for conflict.

While our review suggests that operational farm sizes may be more flexible than believed in the past, so that a wide range of farm sizes could be competitive in a global setting, available empirical evidence is limited and suffers from a number of methodological shortcomings. There is thus need for more in-depth study of the productivity, welfare, social, and environmental impacts of large farms relative to smaller ones and the impact of policies on the evolution of the farm size structure. To broaden the knowledge base, further study would be particularly desirable in two contexts. First, settings such as Brazil that are characterized by co-existence of a wide range of farm sizes and extensive recent technical change can provide insight into the relative competitiveness of large vs. small farms and the impact of different policy interventions. Second, large-scale land acquisition cases in the developing world provide a rich repository of evidence that illustrates not only the potential pitfalls of such ventures, but also can help to design a policy and regulatory framework –together with contractual and monitoring arrangements- to maximize local benefits and integrate smallholder farmers into value chains. To the extent that many new players now view land acquisition as a promising strategy, such research -in parallel with institutional reform and identification of potential available land at the country level- will be important not only to improve understanding of this phenomenon, but also to guide the formulation of appropriate policies that can help countries support development of an efficient and competitive agricultural sector in line with their endowments.

Table 1: Examples of very large corporate farms in developing and transition countries

Company	Main country (s) of operation	Commodities	Crop area	Comment
Sime Darby	Malaysia, Indonesia	Oil palm	600,000 ha	Planned investment of $1+ billion in 220,000 ha plantation in Liberia
Cosan	Brazil	Sugarcane-ethanol	300,000 ha own & 300,000 contract growers	Shell Oil joint venture to double production with $12 bn investment
El Tejar	Argentina, Brazil and Paraguay	Grains, oilseeds	660,000 ha +	Expanding to Colombia
Ivolga	Russia and Kazakhstan	Grains, oilseeds	1,000,000 ha +	
Fibria	Brazil	Fast growth Eucalyptus	500,000 ha	Merger of Aracruz and JVC

Source: Review of company websites

Table 2: Extent of large land acquisitions in selected African countries, 2004–09

Country	No. of Investment Projects	Total Area (1,000 ha)	Median size (ha)	Share of domestic investors in total area
Ethiopia	406	1,190	700	49
Liberia	17	1,602	59,374	7
Mozambique	405	2,670	2,225	53
Sudan	132	3,965	7,980	78

Source: Deininger *et al.* 2011

Table 3: Mean farm sizes and operational holding sizes worldwide

Region	Mean size (ha)	% < 2 ha	Gini coefficient
Central America	10.7	63	0.75
South America	111.7	36	0.90
East Asia	1.0	79	0.50
South Asia	1.4	78	0.54
Southeast Asia	1.8	57	0.60
West Asia/North Africa	4.9	65	0.70
Sub-Saharan Africa	2.4	69	0.49
Europe	32.3	30	0.60
USA	178.4	4	0.78

Source: Based on Eastwood et al., 2009

Table 4: Publicly listed companies in agribusiness value chains

Item	Global agric. value chain (%)	Number of companies	Market Cap (%)
Suppliers	22.7	103	39.6
Farming	22.2	7	0.2
Processing	14.8	60	9.7
Logistics	14.7	26	9.7
Packing and distribution	25.6	88	36.8
Integrated	n.a.	16	4.0
Total	**100**	**300**	**100**

Note: Global market capitalization is in US$ millions as of October 2009.
Source: Own computation based on Brookfield 2010

Table 5: Current yield relative to estimated potential yield

Country/ region	Maize	Oil palm	Soybean	Sugarcane
Asia (excluding West Asia)	0.62	0.74	0.47	0.68
North Africa and West Asia	0.62	n.a.	0.91	0.95
South America	0.65	0.87	0.67	0.93
Sub-Saharan Africa	0.20	0.32	0.32	0.54
Europe	0.81	n.a.	0.84	n.a.
North America	0.89	n.a.	0.77	0.72
Oceania	1.02	0.6	1.05	0.91

*Source:*Deininger et al., 2011

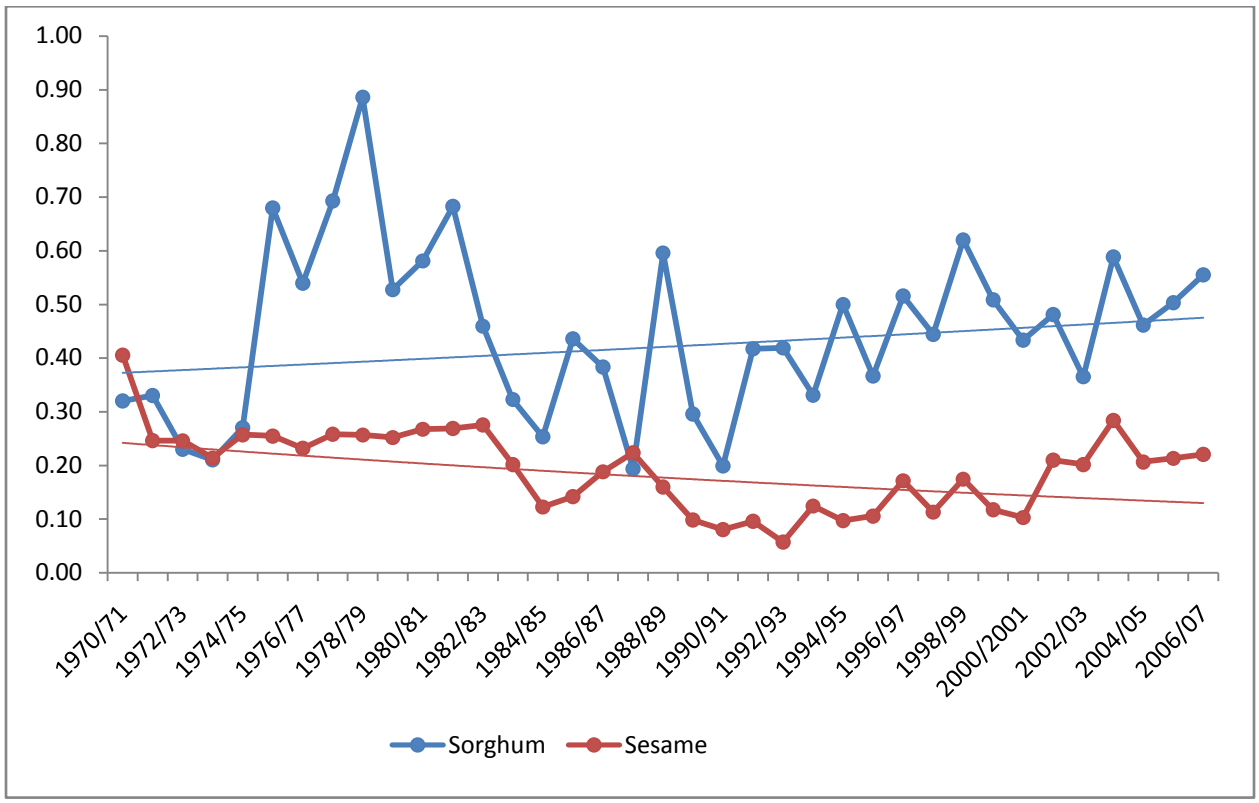
Table 6: Total, forested, cultivated, and non-forested, non-protected agriculturally suitable area by region and countries

	Total Area	Forest Area	Cultivated Area	Non-cropped, non-protected suitable			
				Forest	Non-forest with pop. density of		
				<25/km^2	<25/km^2	<10/km^2	<5/km^2
Sub-Saharan Africa	**2,408,224**	**509,386**	**210,149**	**163,377**	**201,540**	**127,927**	**68,118**
Angola	124,294	57,941	2,930	11,502	9,684	6,625	4,561
Burkina Faso	27,342	2,072	4,817	452	3,713	1,040	256
Cameroon	46,468	23,581	6,832	8,973	4,655	3,205	1,166
Cent. Afr. Rep.	62,021	23,496	1,879	4,358	7,940	6,890	5,573
Chad	127,057	2,280	7,707	680	14,816	10,531	7,061
Congo	34,068	23,132	512	12,351	3,476	3,185	2,661
D.R. Congo	232,810	147,864	14,739	75,760	22,498	14,757	8,412
Ethiopia	112,829	8,039	13,906	534	4,726	1,385	376
Gabon	26,269	21,563	438	6,469	954	927	839
Kenya	58,511	3,284	4,658	655	4,615	2,041	935
Madagascar	58,749	12,657	3,511	2,380	16,244	11,265	6,572
Mali	125,254	3,312	8,338	582	3,908	776	28
Mozambique	78,373	24,447	5,714	8,247	16,256	9,160	4,428
South Africa	121,204	8,840	15,178	918	3,555	1,754	649
Sudan	249,872	9,909	16,311	3,881	46,025	36,400	18,547
Tanzania	93,786	29,388	9,244	4,010	8,659	4,600	1,234
Zambia	75,143	30,708	4,598	13,311	13,020	8,367	3,083
Latin America & Caribbean	**2,032,437**	**933,990**	**162,289**	**290,631**	**123,342**	**91,576**	**64,320**
Argentina	277,400	33,626	28,154	16,228	29,500	23,835	16,856
Bolivia	108,532	54,325	2,850	21,051	8,317	7,761	6,985
Brazil	847,097	485,406	62,293	130,848	45,472	27,654	15,247
Colombia	113,112	64,543	7,339	31,313	4,971	3,776	2,838
Ecuador	25,152	11,631	3,384	3,663	638	415	313
French Guiana	8,034	7,809	6	3,554	27	27	27
Guyana	20,845	17,737	464	8,501	210	189	156
Mexico	194,218	64,447	25,845	7,206	4,360	2,857	1,719
Paraguay	39,904	19,112	5,419	10,269	7,269	6,035	5,133
Peru	128,972	68,312	3,799	39,951	496	476	438
Suriname	14,460	13,847	86	5,318	6	5	5
Uruguay	17,772	1,323	2,030	731	9,269	8,681	7,340
Venezuela	90,531	48,345	3,912	6,167	8,966	7,725	5,891
Eastern Europe and Central Asia	**2,469,520**	**885,527**	**251,811**	**140,026**	**52,387**	**29,965**	**18,210**
Belarus	20,784	7,784	6,019	4,853	3,691	868	204
Russian Fed.	1,684,767	807,895	119,985	128,966	38,434	24,923	15,358
Ukraine	59,608	9,265	32,988	2,594	3,442	394	74
East and South Asia	**1,932,941**	**493,762**	**445,048**	**46,250**	**14,341**	**9,496**	**5,933**
China	935,611	167,202	136,945	10,514	2,176	1,383	843
Indonesia	183,897	95,700	32,920	24,778	10,486	7,291	4,666
Malaysia	32,243	21,171	7,184	4,597	186	119	50
Middle East and North Africa	**1,166,118**	**18,339**	**74,189**	**209**	**3,043**	**843**	**236**
Rest of World	**3,318,962**	**863,221**	**358,876**	**134,700**	**50,971**	**45,687**	**41,102**
Australia	765,074	88,086	45,688	17,045	26,167	25,894	25,593
Canada	969,331	308,065	50,272	30,100	8,684	8,289	7,598
Papua N.G.	44,926	29,387	636	9,746	3,771	3,193	1,917
United States	930,303	298,723	174,515	74,350	8,756	6,818	5,058
World Total	**13,333,053**	**3,706,457**	**1,503,354**	**775,211**	**445,858**	**305,711**	**198,064**

Note: 'Suitable' means that at least 60 percent of possible yield can be attained for rainfed cultivation of wheat, oil palm, sugarcane, soybean or maize. A country is are included if it has at least 3 Mn ha of forested or non-forested suitable area with a population density less than 25/km^2.

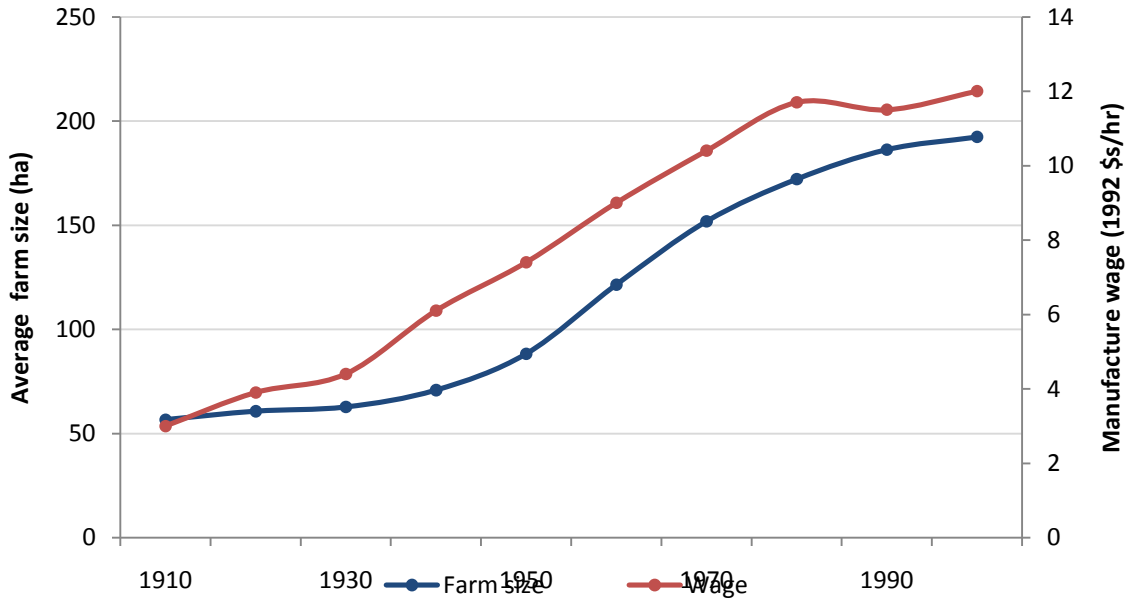
Source: Deininger *et al.* 2011

Figure 1: Yields on semi-mechanized farms, Sudan, 1970–2007 (t/ha)



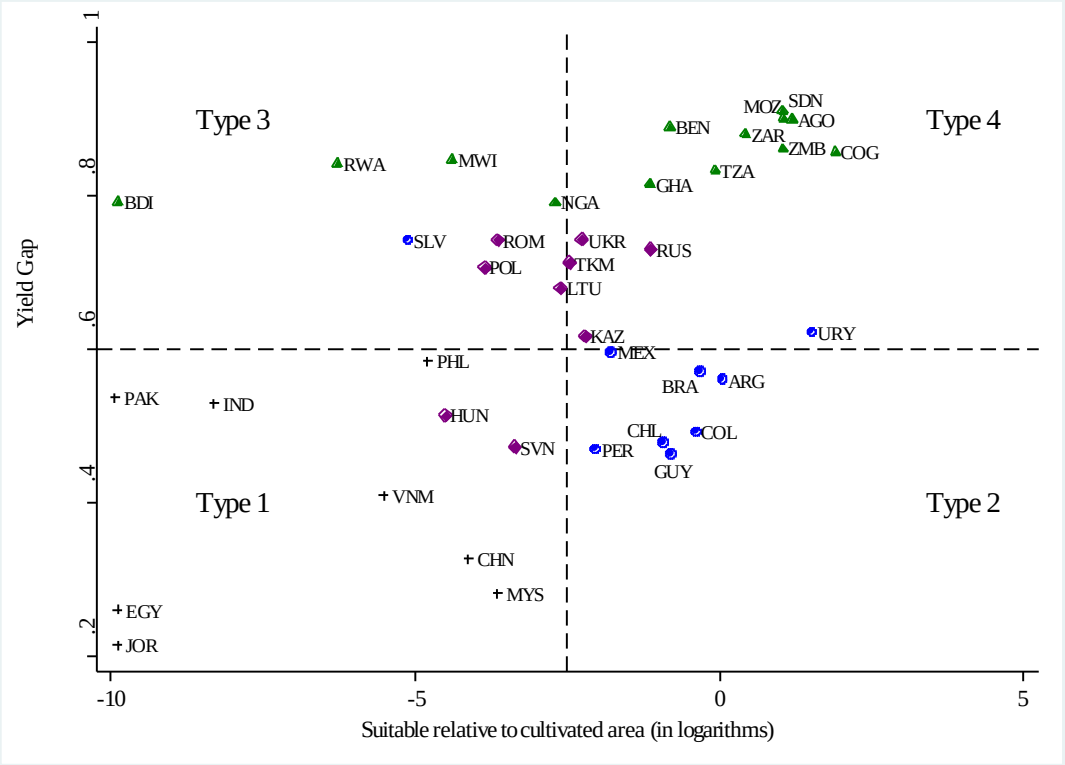
Note: Yields are for rainfed production.
Source: Government of Sudan 2009.

Figure 2: Evolution of United States farm size and nonfarm manufacturing wage



Source: Based on Gardner 2002.

Figure 3: Potential land availability vs. potential for increasing yields, developing countries



Note: Dashed lines indicate average yield gap and 50th percentile for relative suitability.
Source: Deininger *et al.* 2011

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