Financial tools for agricultural development and transformation pertinent to low-income and low-middle income countries

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Abstract

The process of agricultural transformation is discussed and the role of agriculture in both growth and poverty reduction is reviewed. The finance needs for agricultural development in low- and middle-income countries is discussed and the public and other official flows to agricultural development reviewed. It is seen that the monetary flows into agriculture have been grossly inadequate, compared to needs. The situation of smallholders is reviewed and their financing needs are explored. It is shown that the current finance flows to smallholders are less than 5 percent of perceived needs. A variety of institutional methods and models for increasing agricultural smallholder finance are then reviewed and assessed.

1. Introduction

The purpose of this paper is to first explore the finance needs that arise in the course of agricultural transformation in low and middle income countries and then to review financial tools that have been utilised in a variety of settings in the agricultural sectors of such countries and to identify opportunities for expansion of innovative financial tool ideas. The effort will be to identify situations and settings where some types of financial institutions are more likely to be successful than others and to identify gaps in financing needs.

The agricultural transformation seems to be an inevitable stylised fact of development, characterised largely by major changes in agricultural land and especially labour productivity. It is the transition to a state of higher agricultural productivity and the ensuing higher level of aggregate income, that creates the needs for finance and the appropriate provision in both amounts as well as form of finance can facilitate or delay the necessary transformation.

Rural smallholders are the predominant agents of agricultural production in most low-income countries and are also the agents where the largest incidence of poverty and food insecurity is located. Rural smallholders have needs for similar types of financial services as urban based agents, albeit the types of specific financial products needed are different given the agricultural product cycle. These include savings, loans, insurance, production and consumption risk management tools, payment systems, etc. Many rural residents and agricultural producers are constrained in their economic behavior by the absence of many of these tools and are consequently greatly hampered in improving their livelihoods, thus affecting overall growth and welfare of the countries where they reside.

There exist a multitude of formal organisations that deliver financial services to rural residents, including commercial and publicly owned banks and insurance companies,

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savings and loan cooperatives, microfinance banks, specialty financial institutions, such as leasing companies, housing and consumer finance companies. However, many of these institutions have not expanded much into agricultural finance. This because of the dispersion of agricultural households, that renders the provision of services expensive, the covariate risks, usually linked to weather, that affect large numbers of rural households simultaneously, lack of knowledge of the formal institutions about the particulars of agriculture and low education on the part of the rural service recipients. In their absence a variety of informal financial institutions have tried to fill the gap, these include rotating savings and credit associations, local credit unions, financial NGOs, businesses financing their customers, local private money-lenders, friends and relatives, self-help groups and many others. Nevertheless, a large number of rural smallholders in many low-income countries are underprovided in financial services and face high costs for the financial services available.

The paper will start by describing the patterns of agricultural transformation and its relation to overall growth in different parts of the world. In the next section the role of agriculture in development is reviewed. Section 3 discusses the process of agricultural transformation and growth in order to pinpoint the areas where financing is useful. Section 4 describes the financial flows and financing gaps to agriculture. Subsequently the paper discusses the role of agriculture in poverty alleviation with a special focus on rural smallholders. Section 6 discusses the role of agriculture in poverty alleviation with a special focus on rural smallholders. Section 6 discusses rural finance and the various models that exist as well as the wide perceived gap between needs and possible remedies in rural finance.

Links between stand-alone financial and insurance services with other economic functions will be particularly emphasised in section 6 as these may have the potential to reduce costs and expand service coverage. Recent innovations in rural finance are discussed, such as warehouse receipts, cereal banks, credit linked with weather index insurance, supply chain approaches, microfinance based approaches and others. Finally, the paper indicates in the concluding Section 7 lessons and good practices from the literature as well as gaps in the provision of financial and risk management services.

2. Agricultural transformation and development

According to Timmer (2008), “a powerful historical pathway of structural transformation is experienced by all successful developing countries. This structural transformation involves four main features: a falling share of agriculture in economic output and employment, a rising share of urban economic activity in industry and modern services, migration of rural workers to urban settings and a demographic transition in birth and death rates that always leads to a spurt in population growth before a new equilibrium is reached”. Political pressures generated along the pathway, because of the distributional implications of the transition have led to diverse policy approaches designed to keep the poor from falling off the pathway altogether.

Figures 1-4 illustrate the agricultural transformation from different perspectives. Figure 1 shows that among developing countries in all continents the share of agriculture in GDP has declined considerably over the last 40 years, with the fastest declines having been in East Asia and Pacific and South Asia. By contrast the rates of decline have been much smaller in Middle East and North Africa, as well as Sub-Saharan Africa. Figure 2 indicates the share of agriculture in GDP over time for emerging developing countries and low-income countries (LICs) and contrasts it with the evolution of the same share in advanced economies. It is clear that, except for the Middle East and North Africa (where the share is already low); there has been a continuous decline in the share over time, albeit the rate of decrease has been different in different regions.
Figure 3 exhibits the average shares of agriculture in GDP and share of labour in agriculture, as a function of GDP per capita. The figure presents something akin to a structural relation whereby the two graphs are both declining with the one for labour share above that of the GDP share and both asymptotically converging towards each other and towards zero at the higher income levels. Figure 4 presents the same type of information, with the addition of the difference between the two shares, which can be seen to converge towards zero. In other words it appears that in the long run the share of agriculture in GDP and the share of labour in GDP tend to reach the same level. Theoretically this is possible only when the level of GDP per agricultural worker or the level of average product per agricultural worker is the same as the level of non-agricultural GDP or average product per non-agricultural worker. This equality largely defines the end of the agricultural transformation and implies that agriculture can be regarded in the same fashion from an income and distribution perspective as anyone of the many sectors of the economy. It also reflects better integrated labour, product and financial markets. Several of the advanced economies have largely reached this stage.

While the structural transformation just exhibited seems an inevitable part of growth, the role of agriculture in development and growth is much more controversial. For many of the world’s poorest countries, especially in Africa, a future without or low levels of agriculture has been urged as the efficient path to development (e.g. Rosenzweig, 2004, Wood 2003). Many macro economists, convinced of the power of rapid economic growth to lift populations out of poverty, see resources devoted to slow-growing agriculture as wasted. A “pessimistic school” of agricultural development specialists thinks that for both technical and economic reasons, Africa cannot rely on agriculture as a source of growth or poverty reduction (Maxwell, 2004). In fact the question arises that in a world of ample food supplies in world markets (some of it free as food aid) and increasingly open borders for trade, what is the role of agriculture in pro-poor growth.

Two of the major themes in the development literature as well as thinking, that have received additional emphasis since the 1990s, have been growth and poverty reduction. The new endogenous growth theory has highlighted the importance of several factors conducive to faster economic growth, such as human capital, infrastructure, sound monetary and fiscal policies, democracy and political stability, trade openness, corruption and others, while considerable effort has been given to exploring relationships between growth and inequality as well as poverty. This essentially macroeconomic approach to growth has placed much less emphasis on sectoral aspects of growth and poverty reduction. This, lack of sectoral emphasis, however, gives little practical guidance to policy makers who have to make decisions about the allocation of public resources, as well as sources of funds to finance public expenditure. Similarly the World Bank Development Report for 2000/2001 titled "Attacking Poverty", that emphasised three themes, opportunity, empowerment and security, is notable for the relatively limited discussion of sectoral priorities in reducing poverty and enhancing growth.

It is well known that the majority of the world's poor live in rural areas. Of the about 880 million people in the world that are estimated to live on less than one dollar a day, or the 2.1 billion that live on less than 2 dollars a day, about three quarters work and live in rural areas and depend to a large extent on agriculture. This would seem to be good reason for support of rural poverty reduction strategies and labour intensive agricultural growth. Yet, since the mid-1980s and until the food crisis of 2007-8 aid in support of agriculture fell sharply in both absolute as well as relative terms, inducing
slower growth in staple food yields and lower elasticity of poverty to overall growth. Figures 5-7 taken from Islam (2011) and FAO (2012) make this point very vividly, as while total external aid to all sectors of developing countries has grown from 40 billion constant (2007) US$ in the mid-1970s to more than 100 billion in 2006-8, the share going to agriculture has gone from 13 percent of the total in the mid-1970s to a high of more than 22 percent in the early 1980s and then declined almost continuously to less than 6 percent in 2006-8. Since 2008 figures 7 and 8 indicate that official development assistance to agriculture has increases sharply in 2009-10, but data is not readily available for more recent years. Furthermore, the importance of agriculture in developing and especially African countries’ policies seems to be increasingly recognised by policy makers. At the international level the importance of agriculture was highlighted in several of the G-8 and G-20 high level meetings in the past few years and some initiatives were launched such as the New Alliance for Food Security and Nutrition adopted at the May 2012 Camp David G-8 meeting.

It is not clear why there was a decline in support for agriculture before 2007 and it is not clear the same pattern will not happen after the end of the food crisis. Lipton (2000) suggested that the declining pattern could be justified under the following arguments.

- If public action were more cost-effective in reducing urban poverty;
- If the role of agriculture and the rural sector in supporting and advancing poor people in low income countries has declined;
- If rural people gained more from urban poverty reduction than vice versa;
- If rural anti-poverty spending deterred successful urbanisation;
- If rural anti-poverty spending induced less economic growth than urban poverty reduction; or
- If labour-intensive methods for small farmers and orientation of support for staple food production has disadvantages in the context of more globalised markets

Lipton suggests that none of these arguments holds true. Nevertheless, in the context of public resource allocation, the major questions that policy makers may ask concerning support for agriculture are the following. Under what conditions can additional or disproportional support for agriculture become both growth enhancing as well as poverty reducing? Is there a trade-off between faster growth and poverty reduction in the context of agricultural development? Given that overall support for agriculture as an efficient growth enhancing and poverty reducing strategy can be justified, what are the most appropriate ways to support agriculture so as to maximize the effectiveness of such support in generating growth and reducing poverty? These questions will form the basis of the review and discussion of this section.

What is the role of agriculture in economic development? Can agriculture be a leading sector to induce faster growth and under what conditions? These questions are very important for development strategy and the choices of policy makers. What does the theoretical and empirical literature have to say on these issues?

On the relationship between agricultural and overall growth, Stern (1994) has presented a summary of the empirical evidence concerning correlations between agricultural and non-agricultural or overall growth. The historical pattern supports the view that in the course of development the share of agriculture in both output, as well as labour falls. This is the outcome of an initial disparity between labour productivities between
agriculture and the non-agricultural “modern” sectors that leads resources, especially labour to move out of agriculture. Simultaneously the capital intensity in both sectors rises.

The empirical evidence across countries points out to close positive correlations between agricultural and non-agricultural growth rates for the period before 1980 and little or no correlation between the same growth rates after 1980. Stern hypothesizes that after 1980 there were considerable exogenous shocks for many countries that may have slowed down the growth of their non-agricultural sectors and weakened the correlation between sectoral growth rates. The associations highlighted by Stern suggest some complementarity between agricultural and non-agricultural growth and this can be supported by simple theoretical models based on demand. For instance, rising income in a closed economy would lead to rising food consumption at a positive but slower rate than that of non-agriculture, because of the fact that the income elasticity of demand for food is smaller than one. This thinking would then suggest a positive association between agricultural and non-agricultural growth rates, but with the latter larger than the former. Of course, in open economies production and consumption can differ and it is not clear whether such conclusions and associations can be justified. The association between agricultural and non-agricultural growth does not, of course, say anything about any causal relationship between the two and similarly does not say anything about a strategy for agriculture in the course of development.

Early development writers such as Rosenstein-Rodan (1943), Lewis (1954), Hirschman (1958), Jorgenson (1961), Fei and Ranis (1961) regarded agriculture only as a reservoir and source of abundant labour and transferable product and financial surplus. The role of agriculture was seen as ancillary to the main strategy of growth, which was accelerating industrialisation. Hirschman (1958) in particular was negative on agriculture as a source of growth on the basis of its weak forward and backward linkages needed for development. By contrast Kuznets (1968) pointed out that in a successful development strategy, technological progress must support both industrialisation and agricultural productivity. The basis of this view is the observation that the stylised shift of employment away from agriculture and toward industry is the consequences of technological changes in both agriculture and industry. The revolution in agricultural productivity, according to Kuznets, is an indispensable base of modern economic growth. A similar view was expounded by Kalecki (1960, 1971), who based his position on the idea that balanced growth in both wage goods and capital goods forms the basis of sustainable long run growth. Since agriculture is the main/n sector producing food, the key wage good in a developing economy, agricultural development is essential for a successful industrialisation strategy for developing countries.

Development thinking and practice in the 1960s and 1970s tended to neglect agriculture as a leading sector with its emphasis on import substitution industrialisation and export promotion. This thinking was aided by the literature concerning the terms of trade of agriculture. The idea was to “force” savings, food and labour out of agriculture through explicit and implicit taxation in order to finance industrial growth.

Such thinking provided the intellectual basis for policies that were applied in many countries in sub-Saharan Africa and other regions in the 1960s and 1970s, that taxed explicitly and implicitly agriculture. The results of such policies were disastrous for growth leading to the adoption of structural adjustment programs that aimed at reversing such policies (Sarris, 1994). In all of the literature supporting this view, the basic assumption is that the major source of domestic savings is non-agricultural
profits. This is basically a functional view of savings and income distribution. Translated to personal income distribution this view assumes that the recipients of agricultural incomes are subsistence farmers with little savings for investment and that recipients of non-agricultural profits are different from the recipients of agricultural and wage incomes. This, however, neglects the possibility that the bulk of income recipients in developing countries have joint income from agriculture and non-agriculture and rural agricultural producers may generate considerable investible savings.

It was only in the late 1970s and early 1980s that the role of agriculture as a leading sector was re-emphasised in the development literature by authors such as Mellor (1976) and Adelman (1984). These authors emphasised the importance of agricultural growth in generating demand for locally produced non-tradable products and thereby stimulating overall production and growth. Such a strategy was termed Agriculture Demand Led Industrialisation (ADLI) by Adelman (1984).

The real issue from a growth perspective is how to accelerate growth. The role of agriculture must be examined in such a context if some guidelines for strategy and policy are to be derived. Unfortunately, there seems to be very little research focusing on such a problem and then only partially. In an early paper Krishna (1982) observed using data from the period 1960-80 that non-agricultural growth not only was correlated with that of agricultural growth, but, furthermore, that the growth rate of agriculture was usually lower than that of non-agriculture. He also noted that the incremental output-capital ratios for agriculture are higher than those of mining and manufacturing. Since such ratios are often used to plan investments, the implication is that to achieve a similar growth rate for agriculture and manufacturing, a larger share of investment should be devoted to agriculture, relative to the share of agriculture in GDP.

On the relationship between agricultural and non-agricultural growth there was very little research in the 1970s and 1980s as already mentioned. A major exception is the paper by Adelman (1984) that advocated an Agriculture-Demand-Led-Industrialisation (ADLI) strategy for middle income developing countries. This strategy that resembles in some ways the “interrelated rural development” strategy of Mellor and Johnston (1984) basically consists of building a domestic mass-consumption market by improving the productivity of agriculture and letting farmers share in the fruits of improved productivity. The demand linkages generated by farmers, especially the small low income ones, are stronger with domestic industries and other non-tradable and domestic low capital intensity non-agricultural sectors. The strategy advocates higher shares of investment going to agriculture, in response to higher rates of return there. Thus, investment allocations are made functions of the relative rates of return and the ADLI strategy is based on the observation that investment returns are higher in agriculture than in non-agriculture at some stages of development. This is, of course, a key observation that has also been made by Lipton (1977, chapter 8).

More recently, in relation to the revival of discussion about growth rates, in the context of the “endogenous growth literature”, there has been a number of papers dealing with agricultural growth, the terms of trade and overall economic growth (Thirlwall (1986), Canning (1988), Matsuyama (1992), Taylor (1991), Skott and Larudee (1998), Sarris (2002), Gollin Perente and Rogerson (2002)), Adamopoulos and Restuccia (2014). Almost all of these models and papers highlight the fact that a healthy agricultural sector should be the driving force behind industrial growth in the early stages of development, superseded by export growth in the later stages. They also point out that the degree of openness, especially in the presence of economies of scale, is a key factor
in understanding the role of agricultural productivity growth in speeding up overall growth. They also point out that since that demand factors are crucial in determining whether agricultural productivity growth is helpful for overall growth, the distribution of income and gains from growth is a key factor in this issue. They finally point out that the composition of demand among tradables and non-tradables seem to be an important element of the agriculture-first theories. The models, however, do not consider the issue of how agricultural productivity growth is to be achieved and how it is to be financed.

The recent World Bank (WB) World Development Report (WDR) on agriculture (World Bank, 2008) classified countries in three groups in terms of agriculture’s role in fostering growth and poverty reduction. First are the agriculture-based economies (most of them in Sub-Saharan Africa), where agriculture contributes significantly to growth and the poor are concentrated in rural areas. The key policy challenge in such economies is to help agriculture play its role as an engine of growth and poverty reduction. The second group consists of transforming economies (mostly in Asia and North Africa and the Middle East), where agriculture contributes less to growth, but poverty remains overwhelmingly rural. In such countries the rising urban-rural income gap accompanied by unfulfilled expectations creates political tensions. Growth in agriculture and the rural non-farm economy is needed to reduce rural poverty and narrow the urban-rural divide.

The final group consists of urbanised economies (mostly in Eastern Europe and Latin America), where agriculture contributes only a little to growth. Poverty is no longer primarily a rural phenomenon, although the US$2.15-a-day poverty incidence is 63 percent higher than in urban areas. Agriculture acts like any other competitive tradable sector and predominates in some locations. In these economies, agriculture can reduce the remaining rural poverty by including the rural poor as direct producers and by creating good jobs for them. The average characteristics of these three groups are indicated in table 1.

The WDR 2008 indicates that there is no unique route for a country to move from an agriculture-based to an urbanised and eventually to a high-income country. However, the routes traveled by China (1981–85 to 1996–01), India (1965– 70 to 1989–94), Indonesia (1970–76 to 1990–96) and Brazil (1970–75 to 1990–96) are illustrative. Both China and India moved from the agriculture-based category to the transforming category over 15 to 25 years but with little change in the rural share in poverty. Indonesia, already in the transforming category in the 1970s, further reduced the share of rural poverty, as did Brazil, a country in the urbanised category.

The World Bank report indicates that pathways out of poverty open to developing countries by agriculture include smallholder farming and animal husbandry, employment in the “new agriculture” of high-value products and entrepreneurship and jobs in the emerging rural, non-farm economy. According to the World Bank, using agriculture as the basis for economic growth in the agriculture-based countries requires a productivity revolution in smallholder farming. Top priorities are to increase the assets of poor households, make smallholders—and agriculture in general—more productive and create opportunities in the rural non-farm economy that the rural poor can seize. As an economic activity, agriculture can be a source of growth for the national economy, a provider of investment opportunities for the private sector and a prime driver of agriculture-related industries and the rural non-farm economy. Two-thirds of the world’s agricultural value added is created in developing countries. In
agriculture-based countries, it generates on average 29 percent of the gross domestic product (GDP) and employs 65 percent of the labour force. The industries and services linked to agriculture in value chains often account for more than 30 percent of GDP in transforming and urbanised countries (World Bank, World Development Report 2008).

Agricultural production is also important for food security because it is a source of income for the majority of the rural poor. It is particularly critical in a dozen countries of Sub-Saharan Africa, with a combined population of about 200 million and with highly variable domestic production, limited tradability of food staples and foreign exchange constraints in meeting their food needs through imports. These countries are exposed to recurrent food emergencies and the uncertainties of food aid and for them, increasing and stabilising domestic production is essential for food security.

Agriculture is also a source of livelihoods for an estimated 86 percent of rural people. It provides jobs for 1.3 billion smallholders and landless workers, “farm-financed social welfare” when there are urban shocks and a foundation for viable rural communities. Of the developing world’s 5.5 billion people, 3 billion live in rural areas, nearly half of humanity. Of these rural inhabitants an estimated 2.5 billion are in households involved in agriculture and 1.5 billion are in smallholder households. (World Bank, World Development Report 2008)

According to the World Bank, poverty is concentrated in rural areas, where 75 percent of the world’s poor live. The decline in the US$ 1-a-day poverty rate in developing countries—from 28 percent in 1993 to 22 percent in 2002—was mainly the result of falling rural poverty (from 37 percent to 29 percent) while the urban poverty rate remained nearly constant (at 13 percent). More than 80 percent of the decline in rural poverty was attributable to better conditions in rural areas rather than to out-migration of the poor. So, contrary to common perceptions, migration to cities has not been the main instrument for rural (and world) poverty reduction.

But the large decline in the number of rural poor (from 1,036 million in 1993 to 883 million in 2003) has been confined to East Asia and the Pacific. In South Asia and Sub-Saharan Africa, the number of rural poor has continued to rise and will likely exceed the number of urban poor until 2040. In these regions, a high priority is to mobilise agriculture for poverty reduction.

Agriculture’s contributions differ in the three rural worlds. The way agriculture works for development varies across countries depending on how they rely on agriculture as a source of growth and an instrument for poverty reduction. The contribution of agriculture to growth and poverty reduction can be seen by categorising countries according to the share of agriculture in aggregate growth over the past 15 years and the current share of total poverty in rural areas, using the US$ 2-a-day poverty line. This perspective produces three types of countries—three distinct rural worlds, according to the World Bank World Development Report 2008.

- **Agriculture-based countries**—Agriculture is a major source of growth, accounting for 32 percent of GDP growth on average—mainly because agriculture is a large share of GDP—and most of the poor are in rural areas (70 percent). This group of countries has 417 million rural inhabitants, mainly in Sub-Saharan countries. Eighty-two percent of the rural Sub-Saharan population lives in agriculture-based countries.

- **Transforming countries**—Agriculture is no longer a major source of economic growth, contributing on average only 7 percent to GDP growth, but poverty remains overwhelmingly rural (82 per-cent of all poor). This group, typified by China, India,
Indonesia, Morocco and Romania, has more than 2.2 billion rural inhabitants. Ninety-eight percent of the rural population in South Asia, 96 percent in East Asia and the Pacific and 92 percent in the Middle East and North Africa are in transforming countries.

- Urbanised countries—Agriculture contributes directly even less to economic growth, 5 percent on average and poverty is mostly urban. Even so, rural areas still have 45 percent of the poor and agribusiness and the food industry and services account for as much as one third of GDP. Included in this group of 255 million rural inhabitants are most countries in Latin America and the Caribbean and many in Europe and Central Asia. Eighty-eight percent of the rural populations in both regions are in urbanised countries.

3. How does agriculture grow?

What is the process through which agriculture grows? Concerning agricultural growth and its components, early research (Binswanger et al. 1987) showed that the major determinants of agricultural supply are physical capital, infrastructure, human capital, research, extension and rural population density. Prices were found to be weak determinants of agricultural supply. Similarly Antle (1983) showed that the major determinants of total factor productivity (TFP) in agriculture in cross-country regressions are education, research and infrastructure. Later research, (Mundlak, Larson and Butzer, 1997), confirmed these results and specified that technological change in agriculture is incorporated into increased agricultural production through the increases in physical capital stock. In cross country regressions that incorporate both country specific and time effects, the result is that constant returns to scale cannot be rejected and that the shares of capital, land, labour and fertilizer are respectively 0.37, 0.47, 0.08 and 0.08. These are different when time effects are included, which is the way most cross-country production functions have been estimated. In such regressions the elasticity of capital is lower (around 0.34), that of land is practically nil, the elasticity of labour is 0.26 and that of fertilizer is 0.43. In other analyses without time effects (Craig et. al, 1997) the production elasticity of land was found to be around 0.35, labour was 0.25 and fertilizer 0.04. Capital elasticity was quite low in this study but the contributions of infrastructure, human capital and research variables were quite significant. The various estimates are considerably hampered by the inaccuracy of aggregate data for inputs such as labour and capital, or measurement inaccuracies in other key variable such as those of human capital (variables such as adult literacy and life expectancy are often used as proxies) or infrastructure (variables such as road density often act as a proxy).

The changes in the total factor inputs appear to account for only about half of the total growth of agricultural output. The rest is accounted for by the “residual”, namely what is normally termed total factor productivity (TFP), which is basically technical change. Mundlak (1999) suggests that the empirical evidence points to the fact that the major way technology is incorporated into agricultural production is through physical capital. The different rates of growth of physical capital among sectors in turn can lead to differential sectoral growth rates along standard Rybczynski theorem logic. Changes in technology, however, especially those involving new discoveries in production techniques, come irregularly and hence cannot be planned.

There are not many studies that explore the contribution of different factors to agricultural TFP growth. A monograph by Evenson, Pray and Rosengrant (1999) estimated the contributions of various factors to India's TFP growth in agriculture. They
find that public research and extension are the two most important factors accounting for TFP growth, with irrigation coming next. The internal rates of return to public agricultural research in particular are estimated to be higher than 50 percent, which is fairly impressive. Fan, Hazell and Thorat (1999) similarly show, using an econometric model estimate with Indian data, that public expenditure for research and extension have had the largest impact on agricultural productivity growth, with rural roads, education and irrigation following with a distance. Finally, Fan, Zhang and Zhang (2000) found that in China the largest contribution to agricultural productivity has come from research and development public expenditure, followed by education, rural telephones, rural roads and electricity. It is interesting that irrigation investments in that setting had the lowest impact on agricultural productivity.

The latest work on agricultural growth and productivity is that of Fuglie et al. (2012). Table 2 summarizes the main findings of that book. The major finding is that despite earlier worries to the contrary, based on analyses of TFP growth in agriculture during 1970-1990, there does not appear to be a slowdown in sector-wide global agricultural productivity growth. If anything, the growth rate in global agricultural TFP accelerated since 2001, in no small part because of rapid productivity gains achieved by developing countries, led by Brazil and China and more recently because of a recovery of agricultural growth in the countries of the former Soviet Union. However, the results do show clear evidence of a slowdown in the growth in agricultural investment: the global agricultural resource base is still expanding but at a much slower rate than in the past. These two trends — accelerating TFP growth and decelerating input growth — have largely offset each other to keep

Agricultural producers have substituted productivity for natural and material resources as the primary means of raising agricultural supply. This finding has important implications for the appropriate supply-side policy response to the recent rise in real agricultural prices and the future potential to raise agricultural supply.

One implication is that we should be sanguine about the prospects for global agriculture to respond to the recent commodity price rises by increasing supply in the short run. If TFP were slowing down, it would likely take several years for policy responses to influence this trend. The principal policy lever to increase TFP growth is to increase spending on agricultural research, but there are long time lags between research investments and productivity growth.

But the main trend identified in the book is a slowdown in the rate of growth in agricultural inputs. This is at least in part a consequence of a long period of declining real prices facing producers, who then found better opportunities for their capital outside of agriculture. It was also in part a consequence of the institutional changes in the countries of the former Soviet bloc that precipitated a rapid exit of resources from agriculture in that region. The incentives afforded by the current high commodity prices and a resumption of agricultural growth in the former Soviet republics should positively affect the rate of agricultural capital formation at the global level. So long as TFP growth continues at its recent historical pace, this should lead to an increased rate of real output growth in global agriculture in a relatively short period of time.

Table 3 exhibits the output and productivity growth rates for different global regions. The regional results reveal that the global trend is hardly uniform, with three general patterns evident:

- In developed regions, total agricultural inputs have been declining since
the 1980s (output growth is less than TFP growth) and at an increasing rate; TFP growth offset the declining resource base to keep output from falling and has remained robust (above 1.5% per year in all regions except Oceania (Australia & New Zealand).

- In developing regions between 1960-70 and 2001-9, productivity growth has more than tripled from less than 0.7% to 2.2% per year. Input growth has been slowing each decade but still expanding enough to keep output growing at over 3% annually for each of the last three decades. Two large developing countries in particular, China and Brazil, have sustained exceptionally high TFP growth. Several other developing regions, including Southeast Asia, North Africa, Central America and the Andean region, also registered accelerated TFP growth in the 1990s or 2000s. The major exception is Sub-Saharan Africa where long-run TFP growth remained below 1% per year.

- In transition countries, the dissolution of the Soviet Union in 1991 caused a major shock to agriculture as these countries made a transition from centrally-planned to market-oriented economies. In the 1990s, agricultural resources sharply contracted and output fell. Productivity growth, which was minimal during the USSR era, took off in 2001-09. As a result, output growth again turned positive.

Also the evidence suggests that there has been a convergence in agricultural productivity growth across major world regions, with TFP growth in developed, developing and transition country regions all growing at or slightly about 2 percent per year at least since the turn of the Century. This is in marked contrast with previous decades, in which productivity growth in developed countries was markedly higher than elsewhere. Nonetheless, it remains true that many countries have not been able to achieve or sustain productivity growth in agriculture and as a consequence suffer from high levels of poverty and food insecurity. This has not contributed to a slowdown in global agricultural TFP growth because their growth rates were never high to begin with. But this certainly has led to agriculture performing below its potential and has kept these countries poor. The largest group of countries in this low-growth category is in Sub-Saharan Africa, but also included are several countries in Latin America (notably Bolivia, Panama, Paraguay and several Caribbean states) and in the Asia-Pacific region.

It appears from these empirical exercises that publicly financed research and extension and rural infrastructure in the form of rural roads, electricity, irrigation, etc., are the major contributors to agricultural TFP growth, with investments in human capital also a significant factor (Alston, et al. 2000). This is all in line with the conclusions of the endogenous growth theory. All these papers, however, deal only with agricultural TFP growth. Hence they do not answer the question of whether the same funds if invested by the public in non-agriculture could have achieved larger TFP growth there. As Evenson and Westphal (1995) point out there are significant differences between agriculture-related research and industrial research, with the former much more circumstantially sensitive, namely sensitive to local conditions. Thus, to make agricultural research have a high payoff, the large fixed cost of establishing and running technological facilities must be geared to producing results that can possibly be adopted by a large number of producers. This explains, for instance, why returns to agricultural
R&D have been so high in densely populated agrarian countries such as those in Asia, while they are lower in sparsely populated agrarian economies, such as those of Africa. Evenson and Westphal (1995) in their survey of many returns to agricultural R&D studies find that in Africa of 10 reviewed studies 4 (40 percent) reported rates of return higher than 50 percent, while among 77 reviewed studies in Asia, the number was 48 (63 percent). Nevertheless, if returns to agricultural research are as high as they appear to be, the question arises as to why they do not attract further funds devoted to such research. Perhaps, the reason may have to do with constraints on public investment budgets or the long term nature of such investments. Another reason maybe political as direct subsidies to agriculture are far more popular than expenditure on research.

The most surprising result of research in total factor productivity in agriculture and manufacturing, is that across a variety of studies it appears that the rate of growth of total factor productivity (TFP) in agriculture has been greater than the rate of growth of TFP in industry (Martin and Mitra, 2001). Martin and Mitra, in particular found that the average annual growth rate of TFP in manufacturing in developing countries varied between 0.62 and 0.92 percent over the period 1967 to 1992 depending on the methodology of estimation used, while in developed countries the range was between 1.91 and 3.29 percent. On the other hand in agriculture the average rate of growth of TFP in developing countries ranged between 1.76 and 2.62 percent, while for developed countries the range was between 3.35 and 3.46 percent. For low-income developing countries, the average rate of TFP growth in agriculture was between 1.44 and 1.99 percent, while in manufacturing it was between 0.22 and 0.93 percent. Clearly the rate of growth of TFP in agriculture seems to be higher than that of manufacturing. While this source is somewhat dated, more recent research making this comparison is not available.

The study found that there seems to be convergence in the growth rates of TFP in agriculture between all countries both developed and developing ones. The same was found for the growth rates of TFP in manufacturing. The authors interpret their results as suggesting that they weaken the case for policies that discriminate against agriculture in favour of the supposedly more dynamic manufacturing sector. The results suggest that the high rates of TFP growth in agriculture reflect effective systems of developing and disseminating innovations in agriculture internationally and this seems to be related to the establishment in the early 1960s of a large-scale system for international agricultural research. One hypothesis is that the “globalisation” of agricultural research has contributed to faster TFP growth in agriculture, compared to that of manufacturing, for which a large portion of applied research is privately funded and appropriated.

While these results are very interesting, it is not clear whether they are due to disproportionally high public investments in agriculture or other policies discriminating against other sectors. For instance, if the contribution of infrastructure or education to TFP growth is similar across sectors, it would be no surprise if higher TFP growth in one sector is due to higher shares of public expenditure on these factors within each sector. In fact, Byerlee (1996) presented data that shows that developing countries have invested proportionally more in agricultural research than developed countries and this would be consistent with the above results.

The above studies do not consider the contribution of the overall policy environment for agricultural TFP growth. Early research showed that policies affected the pace of agricultural growth (Lele, 1989) and the review of agricultural price policies in 18 developing countries by Schiff and Valdes (1991) tended to support the view that anti-
agriculture price policies are associated with slower agricultural growth. However, it was not clear from these studies whether it was the decline in overall resources to agriculture that slowed down agricultural growth (and this is consistent with the sources of agricultural TFP growth literature) or it was the decline in the elasticity of TFP growth to specific inputs resulting from bad policies was the cause.

More recent research by Anderson and collaborators in the World Bank “Distortions” study (Anderson, 2009) showed that the anti-agricultural and antitrade biases of policies of many developing countries have been reduced; export subsidies of high-income countries have been cut; and some re-instrumentation toward less inefficient and less trade-distorting forms of support, particularly in Western Europe, has begun. However, protection from agricultural import competition has continued an upward trend in both rich and poor countries, notwithstanding the Uruguay Round Agreement on Agriculture (URAA), which aimed to bind and reduce farm tariffs. For developing countries as a group, net farm income (value added in agriculture) is estimated to be 4.9 percent higher than it would have been without the reforms of the past quarter century which is more than ten times the proportional gain for non-agriculture. If policies from 2004 were removed, net farm incomes in developing countries would rise a further 5.6 percent compared with just 1.9 percent for non-agricultural value added. In addition, returns to unskilled workers in developing countries—the majority of whom work on farms—would rise more than returns to other productive factors from that liberalisation. Together, these findings suggest both inequality and poverty could be alleviated by such reform given that three-quarters of the world’s poor are in farm households in developing countries. Nevertheless, they ignore the potentially large distributional effects within the farming sectors themselves.

The above studies suggest that while the standard inputs (capital and labour) enhance agricultural growth, it is public expenditure for agricultural research and extension, rural infrastructure and rural education that are important for agricultural TFP growth. They do not make the case for disproportional public expenditure on such items relative to other sectors as a growth enhancing strategy, albeit the exceptionally high returns to publicly funded agricultural research seem to suggest that considerable public investment should be devoted there. The studies also do not consider how institutional and structural factors affect the effectiveness of these types of policies. In other words, while by now we know the factors that affect agricultural growth and TFP growth and in some cases we even know the elasticities of TFP with respect to these factors, we do not know how the elasticities of agricultural TFP growth with respect to the various variables identified above are affected by structural and institutional features of an economy. While country specific effects in cross-country regressions have taken account of country heterogeneity and isolated the net contributions of the indicated variables to growth, their inclusion has not answered the more interesting question about what influences the elasticities of TFP with respect to the standard variables. This is a topic ripe for further research.

Figure 9 indicates that among the various contributions to agricultural growth over the past 50 years, it is TFP and inputs that have provided the biggest share in developed and developing countries, while in Sub-Saharan Africa it has been largely land expansion. Table 6 illustrates the substantial gaps in agricultural productivity among different groups of countries and in particular between high and low-income countries.
Among the constraints that inhibit the convergence of agricultural productivity among developed and developing countries, the following have been highlighted by much of the past research on the topic.

- Small size of farms limits productivity growth of labour.
- Reduction of land size parcels due to inheritance tends to increase tenancy.
- Weak local or regional markets.
- Expensive inputs unless subsidised by government.
- Considerable non-diversified and non-insured risks in production and incomes.
- Lack of finance for production and consumption.

In section 4 below, we concentrate on the last of these factors - namely the lack of finance.

4. Finance and resource flows into agricultural development

There are two major types of finance for agricultural production and growth. First is medium and long-term finance for investment in both private capital as well as public capital. Second there is short-term finance for production or marketing. In this section we concentrate on finance for capital accumulation.

Figure 10 indicates that capital stock is directly related to agricultural GDP. Low agricultural output countries are characterised by low agricultural capital stock per worker. Table 4 indicates the enormous difference in agricultural capital stock per worker among developed and low and middle-income countries. The disparity is more than 13:1. More worryingly the growth rate of agricultural capital stock per worker in developing countries has declined over the past 30 years, compared to a significant increase for developed countries (figure 1). The decline is large and significant in Sub-Saharan Africa and insignificant in South Asia, while in all other world regions the agricultural capital stock per worker has increased. Figure 12 highlights the fact that the structure of capital stock is vastly different in high and low- and middle-income countries. In the former more than 40 percent of the capital stock is machinery, while in low-income countries it is less than 3 percent. A very large share in developing countries is livestock, more than 60 percent, compared to less than 20 percent in high income countries. Another important fact is that most of the agricultural capital in low and middle income countries (but also in high income countries) is private as farmers are by far the largest investors in agriculture as Figure 13 indicates.

Figure 14 suggests that the level of per worker agricultural capital stock is directly related to the level of agricultural public expenditure per worker. This makes for a direct link between agricultural public expenditure and agricultural capital stock. However, not all public expenditure in agriculture is investment. The share of investment in agricultural public expenditure varies from 9 to 84 percent (FAO, 2012).

Concerning public expenditure for agriculture, while the total has increased worldwide in absolute terms predominantly in the East Asian, Pacific and Latin American regions as figure 15 indicates, the share of public expenditure going to agriculture has declined over time (see Figure 16). The food crisis of 2006-8 may have changed these trends but no aggregate figures such as those of figure 15 are available. Figures for some specific countries exist and some examples from Sub-Saharan Africa from IFPRI’s SPEED
(Statistics of Public Expenditure for Economic Development 2013 edition) database are exhibited in Figures 17a-d. These show that the pattern has generally been mixed, with some countries exhibiting positive trends since 2007 (Kenya and Tanzania), while other negative trends (Senegal) or erratic (Nigeria).

Clearly the situation as far as absolute expenditure is concerned is worse for the regions that have exhibited declining total expenditure for agriculture such as in Sub-Saharan Africa. Moreover, within that declining share, the share going to research and development, a major determinant of agricultural productivity growth, has stayed the same in low- and middle-income countries at 0.54 percent, while the share in high income countries has increased from 1.53 percent in 1980 to 2.37 percent in 2000 (Figure 18).

The financing needs of agriculture to achieve a world free of hunger by 2025 have been estimated by Schmidhuber and Bruinsma (2011) who provide estimates of incremental public expenditure on agriculture and safety nets needed. Over this period, incremental annual public expenditure is US$50.2 billion. Of these the bulk (US$ 18.5 billion or almost 40 percent) is for expansion of rural infrastructure and market access, US$ 9.4 billion is for conservation of natural resources, US$ 6.3 billion is for research and development and extension, US$ 5.6 billion for rural institutions and US$ 10.4 billion for safety nets. Figure 19 by contrast indicates the average total (public and private) annual investment needs of agriculture in low- and middle-income countries for the period up to 2050 to reach the FAO long term projections for food and agriculture to achieve global food adequacy. The needs are evenly split between crop and livestock production after taking out support for services. It is clear that the investment needs are considerable amounting to more than US$ 200 billion (constant 2009) annually for low and middle income countries.

Concerning resource flows into agriculture, Lowder and Carisma (2011) have made a review of all the available information sources on this and have arrived at some general findings. Comparison amongst datasets shows the average spending on and investment in agriculture for low and middle income countries for the three most recent years for which data is available reveals:

- Domestic annual government spending on agriculture in low and middle income countries appear to be much larger in size than foreign direct investment and official development assistance combined (about ten times more).
- FDI inflows to the above countries averaged US$ 3 billion (2006 – 2008) to agriculture, forestry, fisheries and hunting.
- All flows exhibited an increase in total levels as well as levels per agricultural worker since the early 2000s.
- Agricultural shares of some resource flows increased whereas others decreased.
- Levels of foreign direct investment were larger for the high income country total than for the low and middle income country total.

Figure 7 shows that among these flows ODA to agriculture decreased from the 1980s to 2004 and from then on has increased considerably. Table 5 indicates the composition of aid to agriculture from 2000 to 2008. The bulk of aid to agriculture (more than a quarter) has gone into agricultural policy and administration management. Other major
components include agricultural development, land resources and water resources, while food production and extension which was small in the early 2000s have seen a revival in the later years.

The monetary resource flows into agriculture are part of the overall assistance to agriculture which includes indirect transfers from consumers via, for instance, trade policy. Figure 20 reveals that, while the rate of assistance to agriculture in high-income countries has declined, from a high of more than 50 percent in 1985-89 to less than 20 percent in 2005-2010, in developing countries. It has increased from very high negative levels (namely taxation) in the 1950-1960 to almost zero and even positive levels for Sub-Saharan Africa in 2005-2010.

Of particular interest are Foreign Direct Investment (FDI) flows into agriculture. Lowder and Carisma (2011) have reviewed the available follow and have shown the following:

- According to UNCTAD data, levels of FDI to all sectors including food and agriculture have increased, but the increase is due largely to an increase in the number of countries reporting FDI.
- Much of the apparent upward trend in total FDI is in reality due to an increase in the number of countries receiving FDI that are included in the dataset (from about 30 to 70). The increase in FDI over time is further exaggerated because the data are reported in current dollar values, rather than constant dollar values adjusted for inflation.
- FDI inflows to food and beverages are much larger than inflows of FDI to agriculture; levels to both sectors have increased, but the increase is due largely to an increase in the number of countries reporting FDI.
- Figure 21 shows that levels of FDI reported to the food and beverage sector are substantially more voluminous than levels going to agriculture. In 1991, FDI inflows to food and beverages totaled US$ 5 billion dollars (current); by the year 2008 it had increased nearly twentyfold and amounted to US$ 85 billion. However, it can be seen from the figure that the number of countries measuring this data increased from about 20 percent in the early 90s to about 40 percent in more recent years.
- Reports of FDI to agriculture, hunting, forestry and fishing (hereafter referred to as FDI to agriculture) are much less voluminous than FDI to food and beverages. In 1991 they were US$ 0.2 billion and by 2008 they had increased to US$ 5 billion. The increases in FDI to agriculture over time have been exaggerated due to the increase in the number of countries over the same time period and because data is reported in current dollars.
- For those countries attracting the largest amounts of FDI (Figure 22), we see there was a large increase in FDI to agriculture in China, Russian Federation, Brazil, Uruguay and Costa Rica. Assuming that from 2000 to 2008, there was no decrease in levels of FDI to the major host countries for which information is missing (e.g. Indonesia, Romania, or Argentina) and assuming there were no large flows that were unreported, we may conclude that inflows of FDI to agriculture have increased in low and middle income countries as a whole from 2000 to 2008.

5. Agricultural transformation and poverty reduction

Rural poverty is extensive and comprises the largest share of overall poverty. Figure 23 indicates that the number of rural extreme poor has increased considerably over the past
two decades in Sub-Saharan Africa, has stayed roughly constant in South Asia, has decreased somewhat in Latin America and the Middle East and has declined precipitously in East and South-east Asia. Currently the bulk of the world’s rural poor (more than 800 billion people) live in South Asia and Sub-Saharan Africa. The share of income of rural households arising from agriculture is about 50 percent in most countries (figure 24). Figure 25 provides estimates of the number of smallholder farmers in the world. The total is estimated at near 450 million, of which the bulk (410 million) is found in developing Asia and Sub-Saharan Africa.

There are basically three ways through which the poor (or anyone else for that matter) can improve their real incomes. Firstly by increasing the productive assets they own. This can be done either through their own investments, out of their own savings or borrowing, or through increases in publicly provided but privately appropriated assets, such as health and education. The second mechanism is by improved employment and returns on the assets the poor already own. Such improved returns could be obtained, for instance, through increased utilisation of unused land, profits from increases in prices for the products the poor produce and sell, or increases in employment and wages. The final channel is through increased productivity of the assets the poor own. This could involve, for instance, increased land or labour productivity e.g., increased output per unit of land or labour at unchanged prices. How does agricultural development contribute to these three channels?

The answers to the above question depend on the structure of assets of the poor, on the structure of their income sources, on the structure of various institutions that mediate between the poor and the rest of the economy (such as markets, family networks, etc.) and on the dynamic economic and social processes that create and maintain poverty. In other words they depend on the static and dynamic profile of poverty. Concerning the sources of income of the different classes of the poor in a country, it is useful to classify them as income from agriculture (normally divided by income from crops and livestock, or as income from food and non-food, or income from tradable and non-tradable products depending on the data and context), income from farm and non-farm labour employment, profit income from own enterprise activity, income from land rentals and income from various other sources such as transfers, remittances, dividends etc.

The profiles of the poor differ considerably in different countries and regions and change over time. For instance many of the poor in South-East Asia are rural smallholders, with substantial portions of their income coming from agriculture, but also many others are rural landless, relying primarily on farm and non-farm labour income. In much of Sub-Saharan Africa, the poor are mainly rural with the bulk of their incomes from agriculture. In Latin America a large part of the poor are urban based, relying for income on informal enterprise activity and non-farm labour.

Another differentiating aspect across countries and also within countries, is the existence of different farming systems in different agro ecological zones and parts of the world. The FAO farming systems study, done for the World Bank (FAO, 2000) demonstrates not only the heterogeneity in farming systems across the world but also highlights the fact that even within the same agro ecological zone there may be several farming systems that coexist.

Along with the static description of poverty and of significant importance are the dynamic poverty processes, namely structural features that create and, more importantly, maintain poverty. An early description of a variety of such mechanisms,
as they apply to the rural sector, is given by Jazairy et al (1992), based on the experiences of IFAD in dealing with rural poverty related projects. They include dualism, population pressures, resource management and environmental degradation in fragile settings, natural production cycles inducing production risk, social marginalisation of women, cultural and ethnic factors and exploitative intermediation mechanisms. In that volume an attempt was made to indicate the importance of these various mechanisms in different countries. Overall they managed to characterize the rural poor as falling largely into the following functional classes:

- Smallholder farmers
- Landless rural residents
- Nomadic pastoralists
- Ethnic indigenous groups
- Artisanal fishermen
- Displaced or refugee populations
- Households headed by women

It should be clear from this characterisation that agricultural growth has different poverty reducing and growth implications under different settings and for different groups.

Consider increases in private productive assets. One mechanism through which such assets can be augmented, especially benefiting the rural poor, is land distribution, land reform, or general enhancement of property rights to land. There are considerable issues concerning land relations in agricultural development and they have taken new dimensions in the context of the transition of many countries in Central and Eastern Europe (Binswanger et. al, 1995, de Janvry et al., 2001). For this report it will be assumed that the landed poor own or have access to given amounts of land through some form of arrangement that give them at least rights of cultivation. The landless poor, of course, do not have access to any agricultural land.

However, a major issue, which is related to agricultural development and its role in reducing poverty, is security of land ownership or tenure rights. These rights are far from secure in many developing countries and are a major impediment to land augmenting technical change, which will enhance the value of land. This could be, for instance, a major problem in most African countries where the land tenure systems are such that they provide very weak private ownership rights. Access to land has many advantages for poverty reduction and for achieving efficiency gains. For instance access to farm land can give value to many factors that are under-utilised by the poor (e.g. family labour); can lower the cost of using household factors of production (e.g. family labour through the lower transactions and supervision costs); can provide food security and insurance when food prices rise, etc. (see deJanvry et al., 2001).

Thus the poverty and growth implications of any land augmenting technical change in agriculture will depend considerably on the existing land tenure system because it is the appropriation of the benefits of technical change that is at issue. As Adams and He (1995) showed, agricultural development concentrated on technological change in crop production tended to worsen income distribution in rural Pakistan as most of the poor were landless and as increased crop income tended to favour the owners of land. Hayami (2000) illustrates vividly the different growth paths of agricultural
development since the nineteenth century in the Philippines, Indonesia and Thailand and attributes the different agricultural growth trajectories to the evolution of agrarian structures in these countries. In the Philippines, bimodal and dual agrarian structures, while initially efficient due to the early substantial expansion of the land frontier, eventually turned into a disadvantage because of the inefficiencies of large-scale agriculture with its monitoring needs for hired labour. On the contrary, in Thailand and Indonesia despite similar early vent-for-surplus agrarian development, the agrarian structure that was maintained was largely unimodal and smallholder based which facilitated later agricultural growth and development. More research on this issue is needed.

Consider increases in private productive assets through investment. It is well known that most poor people face credit constraints meaning most of their investments are made using own funds out of personal savings. To have savings, of course, implies that households can meet their basic food and other needs first out of whatever income they have. The evidence from household surveys suggests that the poor do have savings often of the order of 20-30 percent of their gross incomes. If there are variations in the incomes of the poor and of a magnitude that can reduce basic needs satisfaction below some minimum acceptable levels then there is vulnerability. The considerable vulnerability among the poor around the world is well documented in the recent World Development Report (WDR) 2014 (World Bank, 2013), as well as the earlier WDR 2000 (World Bank, 2000).

Under vulnerability the poor may devote a considerable portion of whatever savings they have into liquid forms of non-productive assets such as insurance. Such assets can take the form of grain stocks or animals in rural areas, gold and jewelry in non-farm households, etc. This has been documented in several analyses of microeconomic behavior (WDR 2000, p143). The poor, in response to external risks, may devote a disproportional portion of their savings to such unproductive self-insurance and reduce their investments in more productive activities. Thus, the need for precautionary savings may reduce the growth opportunities of the poor and may create poverty traps. For instance Rosenzweig and Wolpin (1993) found that in rural semi-arid India, poor farmers are less likely to invest in irrigation equipment than in bullocks despite the fact that the return to the former is higher than the return on the latter because bullocks can be sold in times of need while pumps cannot. Similarly, Fafchamps and Pender (1997) showed using similar panel data from ICRISAT that the indivisibility of profitable investments, such as wells, coupled with the need to have cash on hand for insurance purposes, made it very difficult for poor households to undertake such investments. In the same vein, in many parts of the world, the need to maintain some income when adverse shocks occur, induces parents to pull children away from school (an acknowledged profitable investment) and send them to work. This clearly prevents human capital accumulation and leads to persistent poverty across generations. Dercon and Christiaensen (2011) recently showed that ex-ante consumption risk could affect fertilizer use and thus reduce current farm incomes. It is clear that under such conditions, what is needed is some mechanism to provide in a reliable and credible way income insurance to the poor in order to let them utilize in a more productive way their own savings.

The second major way in which poor can expand their own assets is through acquisition of human capital such as education and better health. The role of the government in provision of such assets is crucial and has been reviewed extensively in WDR 2000 (chapter 5). However, it must be mentioned that human capital assets by households
such as education can make for more efficient use of other productive services. Thus it appears that there are complementarities between human capital variables and the productivity of physical capital. This implies that agricultural productivity enhancing measures, such as provision of infrastructure and new technology, will produce higher returns when implemented by more educated producers or when accompanied by action to strengthen the education of those affected. Another aspect of public sector provision of human capital services is that it appears that the poor do better with some of all rather than with a lot of one type of service and little or none of the others (Lipton, 2000).

As indicated in the WDR 2008, agricultural growth in agriculture-based countries involves productivity increases and this can occur through either new techniques of production or through productivity enhancing infrastructure and human capital investments. These are the main mechanisms identified earlier that create agricultural growth and it is the possibility of these mechanisms that must be considered to alleviate rural and urban poverty. Agricultural development also entails improvements in all markets which entails better infrastructure, institutions and services that provide market information, establish grades and standards, manage risks and enforce contracts.

There are direct as well as indirect ways in which agricultural development can contribute to poverty alleviation. The direct way involves direct improvement in the incomes of the rural poor through adoption of improved techniques or increases in the productivity of their agricultural assets such as land. Such increases in productivity can come about through agriculture-related research and extension, as well as agriculture related infrastructure investments, such as irrigation and rural electrification. The extent to which such agricultural productivity improvements lead directly to income increases of the poor depends on the extent to which the poor produce the products for which improved techniques become available as well as the degree of adoption of the new techniques by the rural poor.

Consider new techniques of agricultural production. These normally involve the possibility of higher crop or animal yields. For crops this can involve improved yields for food or non-food crops. While both can lead to improved incomes, increased yield of staple foods has the advantage that a portion can be consumed directly by poor producing households since the income elasticity of demand for staples is normally larger than zero. This implies that the increase in marketed surplus out of increased food production by poor rural producers will be smaller than the increase in production and this avoids large price declines of staples when the products are not perfectly traded, the markets are imperfect, or the price elasticity of demand in the rest of the economy is small. That such imperfections are prevalent in the rural areas of developing countries is by now well accepted and a substantial part of development economics research over the past twenty years has been devoted to the examination of the implications of such imperfections (Bardhan and Udry, 1999, Besley, 1995).

Concerning adoption, it is not at all assured that the poor agricultural smallholders will adopt the improved techniques to benefit directly. The major reasons involve uncertainty and risk about the new technology (Feder, Just and Zilberman, 1985), plus issues involving the availability of the minimum initial capital that may be needed to implement the new techniques. Under conditions where adoption is perceived as risky and in addition requires capital outlays, it is quite likely that the early adopters are the better off farmers. This may create initially adverse consequences for the poorer farmers if the increased production of the progressive farmers depresses domestic prices. This may either marginalise the poorer farmers or may accelerate their tendency
for adoption. In any case historically the Green Revolution seems to have had negative initial effects on the smaller farmers but the later impacts were positive (Murgai 1999).

The major way, however, through which the poor may benefit from agricultural technological change is indirect. Mellor (1999) makes the point that "...it is agricultural growth and essentially only agricultural growth that brings about poverty decline in low income countries with a substantial agricultural sector". He explained that the main channels through which agricultural productivity increases impact on poverty reduction are non-agricultural employment generation, increases in staple food output through yield increases so as not to increase domestic prices for the foods that are the major wage goods unduly and shifts towards more high value labour intensive agricultural commodities that stimulate demand for agricultural labour.

The recent WDR 2008 on agriculture makes similar points noting that pathways out of poverty for the rural poor include smallholder farming and animal husbandry, employment in the "new agriculture" of high-value products, entrepreneurship and jobs in the emerging rural non-farm economy. Using agriculture as the basis for economic growth in the agriculture-based countries requires a productivity revolution in smallholder farming. It also indicates that addressing income disparities in transforming countries requires a comprehensive approach that pursues multiple pathways out of poverty- shifting to high- value agriculture, decentralising non-farm economic activity to rural areas and providing assistance to help move people out of agriculture.

Concerning employment generation of agricultural productivity increases, Mellor (1999) makes the point that agricultural employment is not likely to be very much stimulated by improvements in land or labour saving technology for staple foods production because the elasticities are rather low normally much smaller than one. He suggests that a much more likely contributor to agricultural employment generation is the stimulation of production of high value labour intensive commodities such as fruits and vegetables. However, such a stimulus must come from increases in demand for these products which are in turn stimulated by higher incomes. Thus, one needs higher incomes to generate such rural employment growth. He goes on to suggest that the major stimulus to rural employment is not from agriculture but from rural based non-agricultural activities. He suggests that employment elasticities from rural non-farm activities are close to one.

The major way that agricultural growth contributes to overall growth and simultaneous poverty reduction is the stimulation of demand for non-tradable labour intensive non-agricultural activities through the demand linkage effect. Supply of such activities is normally assumed to be very elastic under the hypothesis of under-utilised labour resources in rural areas of developing countries. Hence, the increase in demand is assumed to lead to an almost one-for-one increase in supply. This accounts for the large multipliers. The estimated multipliers from increased agricultural output to overall output are in the vicinity of 1.4-1.8 in most studies (e.g. Haggblade, Hazell and Brown, 1989, Delgado, et al., 1998,) and can reach values as high as 3. However, in cases where the price elasticity of supply of labour is not infinite then these multipliers are smaller (Haggblade, Hammerand Hazell, 1991).

Mellor (1999) also makes the point that development of urban-based formal sector manufacturing in the absence of agricultural growth is not likely to reduce poverty. The reason is that formal sector manufacturing growth through borrowed techniques from abroad, is most likely to be capital intensive. This implies that while the wages of some lucky formal sector employees may be high, the reservation wage of those who supply
the pool of potential employees, namely the average product of labour in agriculture will not rise. The consequence is that more rural people may migrate to the cities in search of high paying formal sector employment with the result of larger urban unemployment, lower urban wages and higher urban poverty. This is a pattern that seems to have been followed in many Sub-Saharan Africa countries.

Of course, the demand stimulus for higher valued agricultural products and for rural based non-agricultural activities does not have to come strictly from the agricultural sector. Broad-based increases in urban incomes can also lead to a stimulus for rural incomes especially if the marketing margin from rural to urban areas is small. This indicates the two conditions that must be fulfilled so that urban based growth can stimulate poverty reducing rural income growth, namely the broad based nature of urban growth and the reduction of the cost of rural-urban marketing.

All of the above raise the question of the conditions that are conducive for agricultural growth to have beneficial impact on overall growth and poverty reduction. Delgado, et al (1998) has outlined these conditions. The first condition is that agriculture must account for a large share of aggregate employment. The second is that agricultural growth must be equitable and evenly distributed. In other words, it must allow a large number of rural people to increase their incomes and hence demand. This condition will be fulfilled when agricultural growth is targeted to products that are produced with labour intensive technology and by a broad range of rural producers. Initial asset distribution, especially land, matters. The third condition is that the consumption patterns of the direct beneficiaries of agricultural growth must be such that large shares of the increments to income are spent on labour-intensive local non-tradable goods and services. In other words the growth multipliers are likely to be larger the less open the rural economy is, in the sense that the bulk of the local economy consists of production and consumption of non-tradables. The final condition is that there must be a supply of under-utilised local resources to make the supply of local non-tradables elastic, so as not to choke the increased demand for local non-tradables by undue increases in prices.

To summarise, the conditions that can make agricultural productivity increase to be both overall growth enhancing as well as pro-poor are the following.

- Agriculture must account for a large share of aggregate employment.
- Initial distribution of land must be equitable and property rights must be well specified.
- The technological improvements must not be risk increasing, nor should they require substantive private capital to be implemented.
- The marginal budget shares of the direct beneficiaries of agricultural growth for labour intensive local non-tradables must be large.
- There must be an excess supply of under-utilised local labour resources.
- There must be complementary improvements in the provision of human capital assets at the local level (e.g. education and health), as well as improvements in marketing infrastructure (e.g. roads).

The consequences of agricultural development for the poor can be direct, through improved agricultural incomes, or indirect, through the impacts on employment, wages, product pricing and productivity of non-farm assets. A major contribution of the research on agricultural growth and poverty over the past decades has been to point out
that the indirect impacts can be as large or even larger than the direct ones but may take some time to be realised.

DeJanvry et al. (2000) have shown that the shares of direct and indirect effects on poverty reduction from agricultural TFP growth are vastly different in different institutional and economic settings. They note that in an Asian context the indirect effects are likely to be much larger than direct effects and this implies that most of the benefits from agricultural TFP growth on the poor arise from increased employment and unskilled wage increases, as verified by the various studies of agriculture and poverty reduction in India. In Africa, the direct effects are much more important and this suggests that targeting poor farmers for technological change is essential to reduce poverty. In Latin America, by contrast the indirect effects are much larger than the direct effects e.g., the benefits to the poor from technological improvements are likely to come through the declines in food prices.

6. Rural finance and agricultural development

Agricultural transformation in the current era involves a world of rapidly changing agri-food systems. In particular the changing nature of retail systems, with the rise of supermarkets and the global food chains that supply them has created many opportunities as well as potential problems for the world’s smallholders as well as many finance related issues (Reardon et al. 2003, Swinnen and Maertens, 2007, Reardon and Timmer, 2007 and McCullough et al. 2008).

The literature that deals with agricultural finance and development (see Conning and Udry, 2007, Karlan and Morduch, 2010) has highlighted several issues pertinent to finance and agricultural development.

- Financial market imperfections that limit access to finance is a binding constraint to agricultural and overall development.
- Access to finance is not easy to measure. Financial access by agricultural households is limited in Low Income Countries (LICs), Emerging Market Economies and barriers to access are common.
- Different financial services are required by different groups of farmers. Risk management and mitigation are of paramount importance to poorest.
- Insurance cannot be separated from credit.
- Access to finance both pro-growth and pro-poor. Spillover effects of financial development are likely to be significant.
- Provision of financial services to the poor will require subsidies.
- For the rural smallholders (about 450 million worldwide) credit is not the only service needed but also savings and payment systems.
- Multinational buyers increasingly rely on smallholders for procurement of supplies. The chief obstacle is large and largely unmet need for formal value chain finance.

The size of the unmet demand for rural smallholder finance is huge. Figure 26 suggests that the demand for smallholder finance in the foreseeable future is of the order of US$ 450 billion per annum, of which only about 2 percent is currently met by “social lenders” defined as impact investors, who seek a combination of market returns and social impact. Impact investors generally accept lower-than-market rates of return in exchange for achieving social or environmental goals not easily quantified by the market. Microfinance institutions are, for instance, a form of social lending,
The above estimate made by Dalberg (2012) is based on the rather dubious assumption that of the 450 million smallholders 225 million are subsistence farmers who do not currently need finance while the other more “commercial” smallholders need on average US$ 1000 short term finance per annum and US$ 1000 longer term finance amortised over several years. However, even small holders have financing needs and clearly if these are added the number is considerably larger.

Social lenders have established a successful model for providing short-term export trade financing to producer organisations and agricultural businesses that reach smallholder farmers. This is where the bulk of financing for agricultural smallholders goes. However, given that only 10 percent of smallholders belong to producer organisations, social lenders could currently address only US $22 billion of the short-term total financing demand or only 5 percent of total demand. Of that, 90 percent is for export trade finance and this overlooks the huge demand for finance of staples that comprises more than 90 percent of total demand for finance.

The Dalberg report proposes five distinct strategies, or “growth pathways,” for deploying investment that meets smallholder finance demand: (i) replicating and scaling existing social lending financing models, (ii) innovating into new financial products beyond short-term export trade finance, (iii) financing through out-grower schemes, (iv) financing through alternate points of aggregation and (v) financing directly to farmers. These pathways map to particular value chain typologies, geographic focus and cost structures. In particular, the efficiency of capital varies for each market pathway, because each involves a particular mix of the following costs:

- R & D costs for developing and piloting models
- Marketing costs for acquiring and educating customers
- Operating costs for handling and servicing customers
- Risk management costs accounting for volatility and the cost of capital

Each of the five growth pathways are discussed briefly below:

*Growth pathway 1. Replicate and scale social lending*

Social lenders can continue to expand their existing model of creating and supporting producer organisations and providing short-term trade finance to them. Social lending is targeted toward exportable cash-crop value chains characterised by high levels of smallholder aggregation into producer organisations. By choosing markets to replicate and scale, social lenders can expand to new crops in geographic areas they already serve. Inversely, they can expand to new geographic areas that produce crops with which they have experience. This growth pathway is driven by the marketing cost of increasing financial literacy and creating and acquiring producer organisations as clients. Risk management and operating costs are also relevant but because this model is well established, the cost of R&D is negligible.

*Growth pathway 2: Innovate into new financial products beyond short-term export trade finance*

Building on the social lending model, this pathway involves social lenders, smallholders in producer organisations and exportable cash-crop value chains. Currently, social lenders primarily provide short-term trade financing for producer organisations. Through product innovation, social lenders could expand to meet other financing needs such as working capital, longer-term financing of equipment, tree renovation and on-lending schemes for financing individual organisation members.
Some social lenders have already begun to experiment with these products.

This growth pathway is driven by high risk-management costs that stem from long-term lending exposure to market fluctuations. It also involves high R&D costs for developing and testing new products. Because new financial products would be marketed to existing clients, the cost of acquiring customers is small but there is some cost associated with introducing a new product to customers.

**Growth pathway 3. Finance out grower schemes of multinational buyers in captive value chains**

Many multinational buyers have captive value chains organised around out-grower schemes that involve production contracts with farmers. These captive value chains can be contrasted with social lender value chains in which producer groups are not necessarily contractually bound to a particular buyer beyond each individual transaction. Commercial lenders (and social lenders to a lesser extent) could provide finance to smallholders through these out-grower schemes by focusing on markets where buyers already provide finance or technical assistance to smallholders.

This growth pathway is driven by the R&D cost of developing and testing new out-grower schemes. By using existing buyer relationships with farmers, marketing and operating costs can be kept relatively low. Lenders can reduce risk-management costs by sharing risk with buyers and, possibly, farmers.

**Growth pathway 4: Finance alternative points of aggregation**

Aggregating farmers allows easier penetration of finance supply but less than 10 percent of smallholder farmers are aggregated in producer or other organisations, especially in domestic value chains for local staples. Financing for these smallholders could be channeled through alternate points of aggregation in the value chain, such as warehouses, procurement networks and input providers.

This growth pathway is one of the most expensive on a per-farmer basis, because it involves the high R&D cost of new finance models and the high risk management cost of financing small businesses. It also involves moderate marketing and operating costs related to working with small business clients. Therefore, this is an ideal pathway for donors to support if the social or environmental impacts warrant it.

**Growth pathway 5: Finance direct to farmer**

The value chains of some local staples are not organised with dispersed producers and few points of aggregation. Reaching smallholders in these value chains is the last mile of addressing smallholder finance demand. The most promising solution is a variation on microfinance models for agriculture markets, perhaps, through mobile banking.

This growth pathway is also expensive on a per-farmer basis because non-aggregated farmers tend to be isolated and dispersed across rural areas. In rural settings, the R&D costs of developing distribution models are high as are the costs of marketing and operating. However, this growth pathway has the potential to minimise risk through diversification across a wide client base. Microfinance institutions could play a key role in addressing this demand.

Figure 27 displays the main actors in each of the five pathways. It can be seen that there is ample room for all types of financial lenders to enter different parts of the rural finance market.
The finance models described above must be combined with existing finance mechanisms, many of which also serve the “subsistence sector”. These models include:

- Family and friends network “informal” finance.
- Interlinked credit (credit with labour or credit with land sharecropping, etc.) practiced between a larger intermediary (normally landowner or trader).
- Microfinance through group lending.
- Input supplier finance (interlinked trade and short term credit).
- Trader finance (interlinked trade and short term credit).
- Cooperative finance.
- Government finance via monopolistic purchasing and input supply parastatals.

Clearly there is partial overlap between these and the earlier pathway models but all are needed if the huge unmet needs for rural finance are to be met.

In this context it is also useful to discuss recent innovations in rural finance:

**Finance through forward sales and contract farming** seem to be simple and compatible with many of the institutional structures of the developing agrarian countries. They normally involve an agreement between a seller and a buyer. They are widespread in many parts of the world especially between larger scale intermediaries such as processors who need raw materials and groups of farmers. Many times the processors provide credit in the form of either cash, or advance provision of inputs for production. The intermediaries may also provide other services such as technical advice. Such contracts are a way to reduce price risks to farmers, but they seem to be more prevalent in products that do not constitute staple foods but need processing or are perishable. There are many different types of contracts involving delivery and quality specifications as well as price commitments (Bijman, 2008). As such they are clearly price risk reducing as they specify price for delivered products in advance.

Contract farming and forward sales are well suited to the social network based institutional setting of African as well as Asian farmers and they are also an appropriate mechanism of price risk management that can function via groups of farmers as well as cooperatives. They are based on trust and hence enforcement may sometimes be difficult. As indicated above, however, they are much less appropriate for sales of staples, as the quantities to be delivered are not easy to guarantee, given the changing seasonal food security objectives of farmers. It appears that as a risk management strategy for farmers contracting may be appropriate for marketing part or all of the crops grown for cash. Given the large transactions cost for entering contractual relationships with small farmers, it appears that fruitful future work may address ways in which these transaction costs may be reduced and therefore making contracting more cost effective on the part of contractors (Wang et al. 2014 and Prowse, 2012).

As liquidity and credit constraints are present in many developing countries, a system that offers considerable promise is the **Warehouse Receipt System** (WRS). The idea of such a system is that a producer of a storable commodity can deposit in a particular location an amount of the commodity of stated quality against a receipt. The commodity could be cleaned, dried, graded and stored, all for a fee. The depositor could sell the commodity any time in the future and with smaller transaction cost, as the sale could be done with paper or electronically. The main advantage of such a system in credit constrained rural settings is that the warehouse receipt could serve as collateral for loans obtained by a bank. This could alleviate one of the major constraints of small farmers,
namely the need for cash at harvest time, and allow them to market the product at a later time when prices are presumably higher.

A limitation of this system is that a warehouse may require a minimum lot size to issue a receipt and this may in effect be an entry barrier for smallholders. However, while a WRS may not cater to smallholders, it may well cater to larger operators who may act on behalf of smallholders. These could be cooperatives, larger traders and others. These actors could then use the benefits from finance and risk management to provide better prices (initial or total) to farmers or to provide them with forward prices if warehouse receipts are combined with operations in futures and options markets. Another benefit of a WRS is that it may provide a reliable storage medium and help diversify sales during the year. Another benefit is that it can facilitate trade as it may make trade more efficient by acting as a clearing house and enforcing sale contracts.

The major issue with a WRS is to instill trust in the system so that banks and other operators can rely on the warehouse receipts as legal instruments of title and as reliable substitute for the physical commodity. This implies that a certain amount of maturity of the regulatory framework is needed, such as independent certification agencies to certify the appropriate warehouses, reliable inspection companies, appropriate standards and an independent oversight agency (Hollinger, et al. 2009).

Another closely related institutional arrangement is an inventory based credit system. The idea of such a system is that groups of farmers place their product in a warehouse and a lending institution, such as a Microfinance Institution (MFI) or a bank, uses the inventory as collateral to extend individual loans to farmers. The management of the inventory is the collective responsibility of the group and this places demands on the system in terms of trust. The difference from the WRS discussed earlier is the less formal nature of the system and the focus on groups. This system has been tried in Ghana and Zambia among others (Coulter and Onumah, 2002).

Another related mechanism would be to indemnify loans for price risk in the sense that the price risk could be made part of a loan package. In some African settings price risk maybe a major reason for possible non-repayment of a crop or other agricultural product loan, thus deterring bank lending. In such cases a minimum price, put option like contract could be made part of the loan, so that if the price fell below a certain level, the farmer would not have to pay back the loan. The implicit cost of the option could be included in the overall loan, so that the farmer may not have to put up any money up front but would have to pay back a larger amount later at the time of repayment. While some evidence indicates that there may be demand for such types of product (Sarris, et al. 2007), other recent empirical evidence suggests that demand for this type of loan may be small (Karlan, et al. 2010). Also the supply side of this system is difficult, as someone must take up the risk of the put-option like contract offered by the financial institution. If the financial institution keeps the risk, it opens itself to market risk in addition to the normal credit risk. It may be able to manage this risk, via some kind of specialised price insurance or reinsurance or via hedging in an organised or over the counter exchange.

Another approach to rural finance is cereal banks. The idea here is much like the warehouse receipt system and the inventory based credit system discussed earlier, except that it applies mostly to staple crops such as cereals. Given that cash and export crops are easier to finance than cereals, the cereal bank idea is promising for the largest component of unmet demand for smallholder finance.
7. Conclusions

The main conclusions that we can draw from the analysis above are the following:

i) Agricultural transformation entails considerable financial needs. This is because of the demands for productivity improvements necessary in the course of the transformation require considerable capital upgrading and also short term financing for production inputs.

ii) Lack of finance can choke off agricultural development and poverty reduction for the reasons indicated in (i) above.

(iii) Government expenditure and financial flows into agriculture are inadequate in most developing countries

(iv) The investment financing needs for agricultural transformation are very large and current lending accounts for a very small share of total needs.

(v) The bulk of financing flows into agriculture is private with public flows very small compared to the total.

(vi) Donor ODA flows into agriculture are small compared to needs and have fluctuated considerably over the past two decades.

(vii) Most agricultural transformation and poverty reduction must be based on a smallholder model of development.

(viii) Large gaps exist in smallholder financing needs compared to existing flows.

(ix) Traditional rural financial institutions are inadequate to meet needs.

(x) There are several promising rural financial innovations that are emerging and which could help to address the serious finance gap for agricultural development.
References


Food and Agriculture Organisation (FAO), (2012). The State of Food and Agriculture. Investing in Agriculture. Rome


Table 1. Demographic and economic characteristics of the three country groups important for agricultural development

<table>
<thead>
<tr>
<th></th>
<th>Agriculture-based countries</th>
<th>Transforming countries</th>
<th>Urbanized countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural population (millions), 2005</td>
<td>417</td>
<td>2,220</td>
<td>255</td>
</tr>
<tr>
<td>Share of population rural (%), 2005</td>
<td>68</td>
<td>63</td>
<td>26</td>
</tr>
<tr>
<td>GDP per capita (2000 US$), 2005</td>
<td>379</td>
<td>1,068</td>
<td>3,480</td>
</tr>
<tr>
<td>Share of agriculture in GDP (%), 2005</td>
<td>29</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Annual agricultural GDP growth, 1993–2005 (%)</td>
<td>4.0</td>
<td>2.9</td>
<td>2.2</td>
</tr>
<tr>
<td>Annual nonagricultural GDP growth, 1993–2005 (%)</td>
<td>3.5</td>
<td>7.0</td>
<td>2.7</td>
</tr>
<tr>
<td>Number of rural poor (millions), 2002</td>
<td>170</td>
<td>583</td>
<td>32</td>
</tr>
<tr>
<td>Rural poverty rate, 2002 (%)</td>
<td>51</td>
<td>28</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 2. Productivity indicators for world agriculture

<table>
<thead>
<tr>
<th>Period</th>
<th>Gross output</th>
<th>Total input</th>
<th>Total factor productivity</th>
<th>Output per Worker</th>
<th>Output per Hectare</th>
<th>Cereal Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-1970</td>
<td>2.74</td>
<td>2.55</td>
<td>0.18</td>
<td>1.13</td>
<td>2.45</td>
<td>2.88</td>
</tr>
<tr>
<td>1971-1980</td>
<td>2.30</td>
<td>1.70</td>
<td>0.60</td>
<td>1.58</td>
<td>2.09</td>
<td>2.08</td>
</tr>
<tr>
<td>1981-1990</td>
<td>2.12</td>
<td>1.50</td>
<td>0.62</td>
<td>1.58</td>
<td>2.09</td>
<td>1.88</td>
</tr>
<tr>
<td>1991-2000</td>
<td>2.21</td>
<td>0.55</td>
<td>1.65</td>
<td>2.00</td>
<td>2.16</td>
<td>1.57</td>
</tr>
<tr>
<td>2001-2009</td>
<td>2.49</td>
<td>0.65</td>
<td>1.84</td>
<td>2.80</td>
<td>2.64</td>
<td>1.80</td>
</tr>
<tr>
<td>1971-1990</td>
<td>2.25</td>
<td>1.53</td>
<td>0.72</td>
<td>1.11</td>
<td>1.97</td>
<td>2.25</td>
</tr>
<tr>
<td>1991-2009</td>
<td>2.29</td>
<td>0.70</td>
<td>1.59</td>
<td>1.97</td>
<td>2.27</td>
<td>1.42</td>
</tr>
<tr>
<td>1961-2009</td>
<td>2.23</td>
<td>1.28</td>
<td>0.95</td>
<td>1.19</td>
<td>2.00</td>
<td>1.99</td>
</tr>
</tbody>
</table>

Average annual growth rate in percent

Gross output: FAO gross production value in constant 2004-2006 international dollars. Total input: Author's aggregation of agricultural land, labor, capital and material inputs (see text). TFP: The difference between output growth and total input growth, based on author's estimation. Output per worker: FAO gross production value divided by number of persons working in agriculture. Output per hectare: FAO gross production value divided by total arable land and permanent pasture. Cereal yield: Global production of maize, rice and wheat divided by area harvested of these crops. The average annual growth rate in series Y is found by regressing the natural log of Y against time, i.e., the parameter B in ln(Y) = A + Bt.

Source: Fuglie (2012)
Table 3. Agricultural Output and Productivity Growth for Global Regions by Decade

<table>
<thead>
<tr>
<th>Region</th>
<th>Agricultural Output Growth (annual %)</th>
<th>Agricultural TFP Growth (annual %)</th>
<th>2001-09</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Developing Countries</td>
<td>3.15</td>
<td>2.27</td>
<td>3.43</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>3.95</td>
<td>1.19</td>
<td>2.32</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>3.63</td>
<td>3.31</td>
<td>2.26</td>
</tr>
<tr>
<td>Caribbean</td>
<td>1.78</td>
<td>1.97</td>
<td>0.68</td>
</tr>
<tr>
<td>Central America</td>
<td>4.63</td>
<td>3.72</td>
<td>1.36</td>
</tr>
<tr>
<td>Andean countries</td>
<td>2.97</td>
<td>2.73</td>
<td>2.77</td>
</tr>
<tr>
<td>Northeast (Brazil, mainly)</td>
<td>3.56</td>
<td>3.86</td>
<td>3.41</td>
</tr>
<tr>
<td>Southern Cone</td>
<td>1.88</td>
<td>2.87</td>
<td>3.13</td>
</tr>
<tr>
<td>Asia (except West Asia)</td>
<td>3.26</td>
<td>3.18</td>
<td>2.67</td>
</tr>
<tr>
<td>Northeast (China, mainly)</td>
<td>4.79</td>
<td>3.32</td>
<td>4.49</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>2.63</td>
<td>3.92</td>
<td>3.41</td>
</tr>
<tr>
<td>South Asia</td>
<td>2.62</td>
<td>2.66</td>
<td>3.31</td>
</tr>
<tr>
<td>West Asia &amp; North Africa</td>
<td>2.87</td>
<td>3.03</td>
<td>3.64</td>
</tr>
<tr>
<td>North Africa</td>
<td>2.62</td>
<td>1.58</td>
<td>4.83</td>
</tr>
<tr>
<td>West Asia</td>
<td>2.58</td>
<td>3.65</td>
<td>3.29</td>
</tr>
<tr>
<td>Oceania</td>
<td>2.53</td>
<td>2.14</td>
<td>1.58</td>
</tr>
<tr>
<td>All Developing Countries</td>
<td>2.63</td>
<td>3.93</td>
<td>0.72</td>
</tr>
<tr>
<td>United States &amp; Canada</td>
<td>2.46</td>
<td>2.29</td>
<td>0.98</td>
</tr>
<tr>
<td>Europe (except FSU)</td>
<td>1.96</td>
<td>1.40</td>
<td>0.42</td>
</tr>
<tr>
<td>Europe, Northeast</td>
<td>1.56</td>
<td>1.36</td>
<td>0.51</td>
</tr>
<tr>
<td>Europe, Southern</td>
<td>2.11</td>
<td>1.98</td>
<td>0.69</td>
</tr>
<tr>
<td>Australia &amp; New Zealand</td>
<td>2.90</td>
<td>1.48</td>
<td>1.48</td>
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<tr>
<td>NE Asia, developed</td>
<td>3.21</td>
<td>2.23</td>
<td>1.23</td>
</tr>
<tr>
<td>Transition Countries</td>
<td>4.37</td>
<td>5.32</td>
<td>0.85</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>2.67</td>
<td>1.73</td>
<td>-0.64</td>
</tr>
<tr>
<td>Former Soviet Union (FSU)</td>
<td>2.39</td>
<td>1.10</td>
<td>1.30</td>
</tr>
<tr>
<td>Baltic **</td>
<td>3.56</td>
<td>0.93</td>
<td>1.09</td>
</tr>
<tr>
<td>Central Asia &amp; Caucasus *</td>
<td>3.41</td>
<td>4.71</td>
<td>0.56</td>
</tr>
<tr>
<td>Eastern Europe FSU *</td>
<td>3.16</td>
<td>0.76</td>
<td>1.39</td>
</tr>
<tr>
<td>World</td>
<td>2.74</td>
<td>2.30</td>
<td>2.12</td>
</tr>
</tbody>
</table>

* Data for former Soviet republics covers 1965-2009 only. The average annual growth rate in series Y is found by regressing the natural log of Y against time, i.e., the parameter B in ln(Y) = A + Bt.

Source: Fuglie (2012)
Table 4. Level and change in agricultural capital stock per worker by region.

<table>
<thead>
<tr>
<th>INCOME GROUP/REGION</th>
<th>AVERAGE AGRICULTURAL CAPITAL STOCK PER WORKER, 2005–07</th>
<th>AVERAGE ANNUAL CHANGE (1980–2007) IN:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Constant 2005 US$)</td>
<td>Agricultural capital stock</td>
</tr>
<tr>
<td>High-income countries</td>
<td>89 800</td>
<td>0.2</td>
</tr>
<tr>
<td>Low- and middle-income countries</td>
<td>2 600</td>
<td>0.9</td>
</tr>
<tr>
<td>East Asia and the Pacific</td>
<td>1 300</td>
<td>1.8</td>
</tr>
<tr>
<td>East Asia and the Pacific, excluding China</td>
<td>2 000</td>
<td>2.1</td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>19 000</td>
<td>-1.0</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>16 500</td>
<td>0.7</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>10 000</td>
<td>1.8</td>
</tr>
<tr>
<td>South Asia</td>
<td>1 700</td>
<td>1.4</td>
</tr>
<tr>
<td>South Asia, excluding India</td>
<td>3 000</td>
<td>1.4</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>2 200</td>
<td>1.5</td>
</tr>
<tr>
<td>WORLD</td>
<td>4 000</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Source: FAO (2012)
Table 5. Composition of aid to agriculture (2000-2003 to 2005-2008)

<table>
<thead>
<tr>
<th></th>
<th>Total Bilateral</th>
<th></th>
<th>Total Multilateral</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural policy and administrative management</td>
<td>26.3%</td>
<td>17.7%</td>
<td>29.3%</td>
<td>28.8%</td>
</tr>
<tr>
<td>Agricultural development</td>
<td>15.6%</td>
<td>16.1%</td>
<td>13.5%</td>
<td>6.9%</td>
</tr>
<tr>
<td>Agricultural land resources</td>
<td>8.7%</td>
<td>2.8%</td>
<td>2.0%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Agricultural water resources</td>
<td>14.5%</td>
<td>17.4%</td>
<td>21.3%</td>
<td>18.0%</td>
</tr>
<tr>
<td>Agricultural inputs</td>
<td>6.2%</td>
<td>2.3%</td>
<td>0.2%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Food crop production</td>
<td>3.9%</td>
<td>4.8%</td>
<td>9.8%</td>
<td>10.1%</td>
</tr>
<tr>
<td>Industrial crops/export crops</td>
<td>1.8%</td>
<td>1.2%</td>
<td>1.0%</td>
<td>6.3%</td>
</tr>
<tr>
<td>Livestock</td>
<td>1.8%</td>
<td>1.1%</td>
<td>4.0%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Agrarian reform</td>
<td>1.0%</td>
<td>1.5%</td>
<td>0.0%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Agricultural alternative development</td>
<td>1.7%</td>
<td>9.6%</td>
<td>0.0%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Agricultural extension</td>
<td>1.4%</td>
<td>2.4%</td>
<td>5.5%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Agricultural education/training</td>
<td>2.6%</td>
<td>2.8%</td>
<td>0.1%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Agricultural research</td>
<td>7.6%</td>
<td>14.7%</td>
<td>3.0%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Agricultural services</td>
<td>1.3%</td>
<td>2.0%</td>
<td>4.5%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Plant/post-harvest protection and pest control</td>
<td>0.8%</td>
<td>0.6%</td>
<td>1.2%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Agricultural financial services</td>
<td>2.8%</td>
<td>1.0%</td>
<td>3.1%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Agricultural cooperatives</td>
<td>1.2%</td>
<td>1.1%</td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Livestock/veterinary services</td>
<td>0.7%</td>
<td>0.9%</td>
<td>0.9%</td>
<td>1.4%</td>
</tr>
</tbody>
</table>

Source: Coppard (2009)
Table 6. Agricultural productivity gaps worldwide

<table>
<thead>
<tr>
<th>Region</th>
<th>GDP 2000</th>
<th>GDP 2000-08</th>
<th>Ag Productivity 1990-92</th>
<th>Ag Productivity 2003-05</th>
<th>Ag Productivity 1990-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>60,587</td>
<td>3.2</td>
<td>731</td>
<td>908</td>
<td>24.2</td>
</tr>
<tr>
<td>Low Income</td>
<td>569</td>
<td>5.8</td>
<td>222</td>
<td>268</td>
<td>20.7</td>
</tr>
<tr>
<td>Middle-Income</td>
<td>16,827</td>
<td>6.4</td>
<td>470</td>
<td>650</td>
<td>38.3</td>
</tr>
<tr>
<td>Low MI</td>
<td>8,377</td>
<td>8.3</td>
<td>359</td>
<td>499</td>
<td>39.0</td>
</tr>
<tr>
<td>Upper MI</td>
<td>8,445</td>
<td>4.6</td>
<td>1998</td>
<td>2721</td>
<td>36.2</td>
</tr>
<tr>
<td>Low &amp; Middle Income</td>
<td>17,408</td>
<td>6.4</td>
<td>432</td>
<td>577</td>
<td>33.6</td>
</tr>
<tr>
<td>East Asia and Pacific</td>
<td>5,658</td>
<td>9.1</td>
<td>295</td>
<td>438</td>
<td>48.5</td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>3,861</td>
<td>6.3</td>
<td>1749</td>
<td>2076</td>
<td>18.7</td>
</tr>
<tr>
<td>LA &amp; Caribbean</td>
<td>4,247</td>
<td>3.9</td>
<td>2125</td>
<td>3044</td>
<td>43.2</td>
</tr>
<tr>
<td>ME &amp; NA</td>
<td>1,117</td>
<td>4.7</td>
<td>1583</td>
<td>2204</td>
<td>39.2</td>
</tr>
<tr>
<td>South Asia</td>
<td>1,532</td>
<td>7.4</td>
<td>335</td>
<td>406</td>
<td>21.2</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>987</td>
<td>5.2</td>
<td>263</td>
<td>279</td>
<td>6.1</td>
</tr>
<tr>
<td>High Income</td>
<td>43,190</td>
<td>2.3</td>
<td>15906</td>
<td>25500</td>
<td>60.3</td>
</tr>
</tbody>
</table>

* 2000 dollars

Source: World Bank Development Indicators, 2010 report
Figure 1. Evolution of agriculture's share in GDP in developing countries of different regions

Figure 2. Share of agriculture in GDP in Emerging Markets and Low Income Countries (weighted average by real GDP pc)

Source: Dabla-Norris et al. (2013)
Figure 3. Shares of labour in agriculture and shares of agriculture in GDP versus GDP per capita

Figure 4. The agricultural transformation in 86 countries, 1965 to 2000

Source: Timmer 2008
Figure 5. Total external aid to all sectors, 3-year average (US$ million constant 2007 prices)

Source: Islam (2011)
Figure 6. Sectoral distribution of total external aid to productive sectors 1995-2008 (percent of total)

Source: Islam (2011)
Figure 7. Level and share of official development assistance committed to agriculture by region

Source: FAO (2012)
Figure 8. ODA to African Agriculture (commitments in constant 2010 USD million)

Source Kanu et al. 2014
Figure 9. Growth in global agricultural output, by source of growth and time period
Figure 10. Agricultural capital stock and agricultural GDP per capita

Source. FAO (2012)
Figure 11. Average annual change in agricultural capital stock per worker in low- and middle-income countries, 1980-2007

Source. FAO (2012)
Figure 12. Composition of agricultural capital stock by country income group

Source: FAO (2012)
Figure 13. Investment in agriculture in selected low- and middle-income countries, by source

Source: FAO (2012)
Figure 14. Government expenditure on agriculture and percentage change in agricultural capital stock per worker in selected low- and middle-income countries

Source: FAO (2012)

Note: Change in agricultural capital stock and government expenditures are annual averages from 1990 to 2007 for all countries except those located in Europe and Central Asia, for which averages are from 1995 to 2007.
Figure 15. Government expenditure on agriculture, by region

Source: FAO (2012)
Figure 16 Agricultural share of public expenditure, by region, three-year moving averages

Note: Calculations include 51 low- and middle-income countries. The number of countries included in each group is shown in parentheses. For countries in Europe and Central Asia estimates are from 1995 to 2007. Ethiopia has been excluded from the calculation of the regional average for sub-Saharan Africa for this and other graphics and tables on government expenditure. According to the SPEED database, the share of agriculture in public expenditures in Ethiopia increased from 4–7 percent in 2001–04 to 14–17 percent in 2005–07.

Source: FAO (2012)
Figure 17a. Public expenditure in agriculture in Kenya 1990-2010

Figure 17b. Public expenditure in agriculture in Tanzania 1990-2010

Figure 17c. Public expenditure in agriculture in Senegal 1990-2010
Figure 17d. Public expenditure in agriculture in Nigeria 1990-2010

Source: IFPRI SPEED (Statistics of Public Expenditure for Economic Development) 2013 edition
Figure 18. Public expenditure on agricultural research and development as a share of agricultural GDP, by region

<table>
<thead>
<tr>
<th>COUNTRY CATEGORY</th>
<th>1981</th>
<th>1991</th>
<th>2000</th>
<th>LATEST YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low- and middle-income countries (108)</td>
<td>0.55</td>
<td>0.54</td>
<td>0.54</td>
<td>..</td>
</tr>
<tr>
<td>Sub-Saharan Africa (45)</td>
<td>0.75</td>
<td>0.61</td>
<td>0.55</td>
<td>0.61 (2008)</td>
</tr>
<tr>
<td>East Asia and the Pacific, excluding China (19)</td>
<td>0.41</td>
<td>0.51</td>
<td>0.51</td>
<td>0.57 (2002)</td>
</tr>
<tr>
<td>China (1)</td>
<td>0.38</td>
<td>0.34</td>
<td>0.38</td>
<td>0.50 (2008)</td>
</tr>
<tr>
<td>South Asia, excluding India (5)</td>
<td>0.37</td>
<td>0.39</td>
<td>0.31</td>
<td>0.25 (2009)</td>
</tr>
<tr>
<td>India (1)</td>
<td>0.22</td>
<td>0.29</td>
<td>0.39</td>
<td>0.40 (2009)</td>
</tr>
<tr>
<td>Latin America and the Caribbean (25)</td>
<td>0.90</td>
<td>1.08</td>
<td>1.21</td>
<td>1.18 (2006)</td>
</tr>
<tr>
<td>West Asia and North Africa (12)</td>
<td>0.60</td>
<td>0.59</td>
<td>0.74</td>
<td>..</td>
</tr>
<tr>
<td>High-income countries (32)</td>
<td>1.53</td>
<td>2.11</td>
<td>2.37</td>
<td>..</td>
</tr>
<tr>
<td>Total (140)</td>
<td>0.91</td>
<td>0.98</td>
<td>0.97</td>
<td>..</td>
</tr>
</tbody>
</table>

Notes: Table excludes 31 countries in Eastern Europe and the former Union of Soviet Socialist Republics, because of data unavailability.  
- = data not available.

Source: FAO (2012)
Figure 19. Average annual total investment needs in low- and middle-income countries, by region

Source: Schmidhuber, Bruinsma and Boedeker (2011)
Figure 20. Relative rate of assistance to agriculture, by region, 1955–2010

Source: Anderson and Nelgen (2012)
Figure 21: FDI inflows to the Food, beverage and tobacco sector as well as to Agriculture, forestry, fishing and hunting and number of countries for which observations are available, 1980 to 2008

Source: Lowder and Carisma (2011)
Figure 22: Levels of FDI to Agriculture in countries attracting the largest amounts and attracting less than 100 million USD, 2000 and 2008

Figure 22a: Levels of FDI to Agriculture in countries attracting the largest amounts of FDI to agriculture, 2000 and 2008

Source. Lowder and Carisma (2011)
Figure 23. Rural people living in extreme poverty (Millions of rural people living on less than US$1.25/day)

Source: IFAD (2011)
Figure 24. The share of non-farm income over time in total rural household incomes (Percentage of income)

Source: IFAD (2011)
Figure 25. Global distribution of smallholder farmers

Source: Dalberg, (2012)
Figure 26. Estimate of global smallholder lending financing gap

Source: Dalberg (2012)
Figure 27. Primary actors in the five growth pathways

Source: Dalberg (2012)