Growth Research Programme

Agriculture and growth in low-income countries

Overview of debates and links to current projects in the DFID-ESRC Growth Research Programme

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www.degrp.sqsp.com

The DFID-ESRC Growth Research Programme (DEGRP) will produce a range of knowledge products aimed at linking the research of DEGRP to a number of research and policy debates in the areas of agriculture, financial markets, innovation and growth.

This paper outlines academic and policy debates central to the theme of agriculture and growth and shows how the current portfolio of projects commissioned under the programme addresses these issues.

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1. INTRODUCTION

The DFID-ESRC Growth Research Programme (DEGRP) funds research on economic growth in low-income countries, with high potential for impact on policy and practice. It aims to ensure evidence is used and has an impact on growth policy. It also contributes to developing capacity to undertake and use research in developing countries.

The programme includes research on three themes: agriculture, finance and innovation. Within each, the programme is expected to provide evidence on how growth and structural transformation takes place; identify conditions and drivers that lead to productivity change; and highlight significant research gaps.

Research projects funded by the programme are expected to provide evidence on measures to enhance the working of markets by, for example, provision of information and institutional innovations that reduce transaction costs and allow greater participation in markets by those deterred by such costs. It is also concerned with measures to facilitate, steer and regulate the market.

This paper looks at the theme of agriculture and growth. This sector was chosen as, in many low-income countries, the majority of the labour force works on the land, and agriculture is often a major contributor to gross domestic product and export earnings. Concerns over agricultural development in broad terms are discussed in Section 2. The three principal areas of work of the programme are set out in Section 3, together with a brief description of programme projects that address the differing issues.

2. AGRICULTURE AND GROWTH

How can agricultural growth contribute to the overall economic development of low-income countries? How should growth in agriculture be promoted to have strong impacts on growth and poverty? These questions have long been addressed in development thought.

Some history of agricultural development in the developing world

In the 1950s, development efforts focused on industrialisation and urbanisation that were seen as driving growth through manufacturing that would, at least initially, be more productive in use of labour and capital than agriculture. It was expected that agriculture, where the marginal product of labour was thought to be very low, would release labour — and perhaps also capital — for investment in manufacturing and services. Demand for agricultural products would grow in response to rising incomes in urban areas, while technology to raise productivity, it was thought at the time, could readily be transferred from industrialised countries (Staatz and Eicher, 1986).

The expectation that agriculture would grow with higher productivity, with little additional stimulus other than demand, proved optimistic in some countries: agricultural growth was often slower than expected and hindered overall growth.[1] Technologies from industrialised countries were often unsuited either to tropical conditions or to the relative costs of capital and labour of the developing world. By the

[1] This is not to deny that in other countries agriculture did grow quickly, with some notable cases in colonial Africa when smallholders were given the opportunity and support to grow export crops. Coffee in Kenya would be an example.

1960s, this led to a reassessment of the role of agriculture. Rather than merely following the lead of manufacturing, the sector was seen as playing key roles in the early stages of development. It would provide food and raw materials to the rest of the economy, constitute a domestic market for the infant manufacturing industry, earn foreign exchange to allow the import of capital goods for industrialisation, and transfer factors of production to manufacturing and services. If agriculture were to play these roles, then productivity of factors of production had to rise (Johnston and Mellor, 1961).[2]

That meant there was a need for better technology appropriate for conditions in developing countries. Owing to investment in agricultural research from the 1940s onwards, some funded by North American foundations (Lele and Goldsmith, 1989), the 1960s saw the dissemination of improved varieties of maize, rice and wheat capable of much higher yields per hectare, provided they were fertilised, protected from pests and diseases, and adequately watered. These seeds formed the basis of the green revolution over the next few decades, which took place provided that crops could be irrigated or rains were reliable, that inputs could be provided to farmers and that crops could be transported to market. This applied to significant parts of Asia and Latin America, but less so in Africa. Where, above all in Asia, the green revolution took place, agriculture reinforced industrialisation by supplying staple foods at lower cost, and allowing labour to shift out of farming into manufacturing and services. Not only did food production increase faster than populations grew, but agricultural growth often led to lower incidence of rural poverty — with links from farming to other rural activities often being strong (Hazell, 2009, Hazell and Ramasamy, 1991).[3]

Yet in other areas lacking irrigation or reliable rainfall, and often where farmers found it difficult to access inputs, finance or market produce, agricultural growth was slower and intermittent. This was typically the case in much of sub-Saharan Africa.[4] Rural poverty remained high and widespread. Debates over factors limiting agricultural growth in Africa have variously focused on adverse geography (poor soils, low and variable rainfall) and environmental decline, unfavourable conditions in international markets, macroeconomic policies that have undermined agriculture, inefficiencies in state support for agriculture, the need to generate technology appropriate to African conditions, failings in rural markets and apparent poverty traps, and limited domestic demand and the extent to which this translates into incentives at the farm gate (Wiggins and Leturque, 2010).

Contemporary concerns

The new century has seen renewed interest in agricultural development in many low-income countries and especially in Africa. In part, this has been a reaction to failure to see more progress. But it has also responded to significant changes in prospects for agricultural growth and the context in which it takes place. Four changes can be singled out:

[2] Matsuyama (1992) has subsequently queried this, by modelling an open economy, where higher productivity in agriculture would attract labour and capital to farming, thereby stymying the development of manufacturing. His argument, however, relies on strong and questionable assumptions about technical change in agriculture being exogenous with no learning-by-doing on farms. Given evidence of growth of total factor productivity in agriculture often being faster than that of manufacturing — see Martin and Mitra 2001 — the assumption may not often hold.

[3] Green revolution technology of seeds, fertiliser, water and chemicals was neutral to farm size, but larger farmers tended to adopt earlier, smaller farmers later. To the extent that increased production led to lower prices, then later adopters thus gained less than early adopters; given that the smaller farmers were poorer, this limited the poverty impact.

[4] It did not help that agricultural research in much of Africa was not well funded enough to produce more innovations appropriate to local conditions and crops.

1. Demand for agricultural produce, especially higher value produce, is rising strongly domestically in low-income countries in Africa, as the continent urbanises[5] and as economic growth accelerates in some countries. Internationally, use of grains for biofuel and increasing consumption of vegetable oils and animal feed across Asia have contributed to higher prices for cereal and oilseeds, thereby creating incentives for agricultural exporters — as well as for net-importing countries with agricultural potential to replace imports by domestic production (Binswanger and McCalla, 2010);
2. High population growth, rising rural population density, improved transport and better access to markets means that much of Africa has moved beyond extensive cultivation with fallowing and shifting fields. While pressure on natural resources may be unwelcome, transport costs to markets may fall, and intensification may see complementarities between factors of production that increase the rate of return to investment on farms;[6]
3. Innovations in agricultural supply chains, as dominant retail chains and exporters demand higher and consistent quality that confer advantages to farmers who can meet such requirements — and threaten to marginalise those who cannot. This may favour larger over smaller scale farms (Reardon et al., 2009); although given that sometimes links are made to smallholders, this is neither inevitable nor universal; and
4. Environmental concerns are becoming ever more important for agriculture. When the green revolution began in the 1960s, agriculture was able to grow while drawing down groundwater aquifers, polluting soils and water through copious use of fertiliser and crop protection chemicals, and converting forests and wetlands rich in biodiversity to new fields.[7] Today, mounting scarcity of water and the rising value of ecosystem services limit these options. Loss of soil nutrients is a frequent concern, especially in Africa. Climate change, furthermore, threatens to alter weather patterns and increase their variability (World Bank, 2009).

Against this background, the agricultural theme of the programme currently addresses three questions about agriculture and growth in low-income countries:

1. Under what conditions can agricultural growth contribute to overall economic growth and support structural transformation towards a modern, high value-added economy?
2. How can agricultural productivity be raised at the level of households, farms and farming communities?
3. How can the potential of irrigation be exploited in those countries, primarily in sub-Saharan Africa, where current use of irrigation represents a small fraction of the potentially irrigable area?

[5] Although not necessarily very rapidly, see Potts, 2012.
[6] That said, at very high population density, the advantages of higher settlement density may reverse: Jayne et al., 2012 find rural incomes declining in rural areas with more than 55 persons per square kilometre.
[7] On the other hand, the green revolution raised yields per hectare and thus probably limited the extent to which agriculture grew by expanding the area cultivated and in the process converting forests and other valued habitats to fields.

3. DEGRP RESEARCH ON AGRICULTURE AND GROWTH IN LOW-INCOME COUNTRIES

Agriculture, economic growth and structural change

How does the growth of agriculture affect the growth of the overall economy, and how does growth in other sectors affect that of agriculture? For most low-income countries, agricultural growth may be an initial source of growth, or a necessary adjunct to the growth of other sectors, or both. Indeed, agriculture has been shown to be highly effective in reducing poverty in low-income countries (Christiaensen, Demery and Kuhl, 2010), while it seems that both overall economic growth and the effectiveness of that growth in reducing poverty are hindered by high initial levels of poverty (Ravallion, 2012). That indicates that agricultural growth, by reducing poverty and thereby stimulating overall growth, may be particularly effective in contributing to economic growth as well as poverty reduction in low-income countries.

Yet as economic growth takes place, it is very likely that the importance of agriculture will decline. In the most general terms, countries that are now industrialised or upper-middle income have seen four transitions as they have changed from being agrarian to industrial economies and societies (Timmer, 2009): agriculture's share of gross domestic product and employment declines relative to other sectors; manufacturing and services correspondingly become increasingly large in the economy and employment; rural-to-urban migration leads to urbanisation; and a demographic transition takes place as rates of both deaths, and subsequently births, fall from high to low levels. The faster that agriculture can both increase output and raise its productivity, and thereby release labour, some capital and land, then potentially the faster the structural change to an urban and industrial economy. Given that the demographic transition leads to a higher ratio of workers to dependants, which is likely to persist over several decades until an aging population lowers the ratio, labour is unlikely to limit such processes. It also means that the development of all sectors of the economy can be labour intensive.

However, history specifically shows diverse experiences of the role of agriculture in economic growth and development. In some cases, such as China since the late 1970s, growth of agriculture and manufacturing have proceeded apace with complementary roles, as agricultural growth has provided food for the cities and factories while releasing labour for manufacturing, and as urban growth has provided a market for increased farm output. In other cases, notably in Africa, urbanisation has taken place with weak growth of manufacturing, agricultural productivity in returns to land, and labour has remained low, trapping populations on the land, limiting the expected structural shift (Badiane, 2012 in Timmer et al., 2012).

For agriculture, a key to transition is the productivity of labour. Agriculture in most developing countries has much lower average labour productivity than other sectors. Average labour productivity, even when adjusted to reflect time spent working and quality of human capital, is roughly half that of the rest of the economy (Gollin et al., 2012). This gap can be seen in specific cases, such as of that of the Kagera Region, Tanzania (Beegle et al., 2010) where earnings generally rise considerably for those leaving farming for jobs in other activities. The gaps in average labour productivity can sometimes

widen in the early stages of development, as other sectors with higher average labour productivity usually grow faster (Barrett et al., 2010).[8]

The persistence of these gaps raises questions: why does labour not leave agriculture for other sectors, until marginal value products of labour equate across activities?[9] If labour were able to move from low productivity agriculture to higher value activities, growth would accelerate considerably (McMillan and Rodrik, 2012). In southern Africa, it was long ago noted that households were reluctant to move to urban areas, as residence in rural areas conferred rights to valuable land and to draw on collective resources such as forests, grazing and water (Low, 1986). Cultural ties may also be important as well as imperfect knowledge concerning opportunities. In addition, when food prices are unstable, people may be reluctant to give up their own food production, no matter how low its productivity, to rely solely on the market.

Another reason for these rigidities lies with the growth of other sectors and their ability to absorb labour from agriculture: the chronically weak growth of manufacturing in sub-Saharan Africa is worrying (Badiane, 2013, Timmer, 2013). Incentives for farmers to innovate and raise productivity are limited if demand for output grows slowly and if there are few better-paid jobs on offer in urban areas.

In the short and medium term, it is possible that new and higher earning opportunities can be created elsewhere, in the non-farm economy of the rural areas themselves. While non-farm activities are becoming steadily more important in rural Africa, the details of the conditions under which a *productive* non-farm economy may emerge[10] are less well understood (Haggblade et al., 2007).

Last but not least of the overall issues for agricultural development is policy choice: Why is it that governments follow policies likely to hinder agricultural growth? In the past, the danger to agricultural growth lay with urban bias (Lipton, 1977) where cities received disproportionate shares of public services and investments, and heavy net taxation on agriculture (Krueger et al., 1991), in part the unintended consequences of overvalued exchange rates and industrial protection.[11] While the worst of net taxation on agriculture may have been eliminated in many developing countries, the danger of overvalued exchange rates persists — especially in countries with exports of oil and minerals (McMillan and Rodrik, 2012), as does the over-allocation of public spending in urban areas.

On the other hand, there are dangers of populist support to agriculture. Highly visible transfers, as seen in subsidies to inputs such as fertiliser, irrigation water and rural electricity (Wiggins and Brooks, 2012), or support for prices well above market clearing levels, may be popular with rural voters, but can be costly. In low-income countries, such policies will almost certainly compete strongly with investments in public goods. These policies become more tempting if initial economic growth results in widening productivity and income differences between urban and rural areas (Timmer, 2009).

The programme addresses many of these issues, including:

- The nature of structural change and the conditions that affect it;
- Is structural transformation in developing countries still valid and under what conditions is rural-urban labour migration optimal?

[8] This is not inevitable, nor should it be taken that the productivity of agriculture in returns to land or labour are stagnant. On the contrary, agricultural productivity can grow quickly and faster than that of manufacturing, see Martin and Mitra, 2001.
[9] It is possible however that, while average productivity of labour diverges, the marginal products for agriculture and non-agriculture are the same, as long as the marginal returns to labour are falling in both sectors.
[10] Some non-farm jobs have even lower productivity than farming, being employment of last recourse.
[11] It has been argued that in low-income countries, decisions to favour urban and industrial interests over rural and agricultural interests stem from the greater power of the urban population compared to the rural population.

- Is a step change in agricultural performance necessary for structural transformation, helpful or neutral in its impact on other sectors? Under what conditions?
- To what extent has agricultural productivity changed in response to migration of labour?
- Do efforts to boost agricultural productivity and growth work when there are severe constraints in the non-farm sector? Does the removal of these constraints in the non-farm sector significantly boost the performance of agriculture?
- The conditions under which enterprises and jobs can be created in the rural non-farm economy with higher productivity than agriculture; and
- The political forces and institutional factors that lead either to heavy net taxation of agriculture, or to support that offers farmers cheap inputs or high output prices at considerable opportunity cost to limited public funds for investment in public goods. What lessons can be learned from middle-income countries on how they escaped these traps in their development?

Currently, three projects examine parts of this agenda. Two look at agricultural supply chains, one at the specific case of dairying in Malawi (Box A) and the other at a sample of chains from across Africa (Box B). These should reveal the links, bottlenecks to growth, and productivity applying in different parts of the chains.

Box A: Assessing the contribution of the dairy sector to economic growth and food security in Malawi

How can milk production, supply and consumption be stimulated in Malawi? What obstacles are found in the current value chain? What welfare gains might result from improvements to the chain? Key actors in the dairy supply chain — farmers, milk groups, processors and consumers — will be surveyed on their activities, costs, prices and perceived obstacles. International donors that fund dairy development will also be interviewed. This information will allow a model of dairying to be compiled that will allow assessment of the current contribution of the dairy sector to economic growth and the welfare of different participants, as well as simulation of potential consequences of interventions to improve the functioning of the dairy chain.

Principal Investigator (PI): Dr Cesar Revoredo G., Scotland's Rural College (SRUC), Edinburgh
June 2012 to May 2015
Source: http://bit.ly/1cYPIbK

Box B: Agricultural supply chains, growth and poverty in sub-Saharan Africa: market structure, farm constraints and grass-roots institutions

How can supply chains be improved in Africa for the benefit of farmers and consumers? What is the interaction between agriculture supply chains, farm constraints and poverty?
For selected crops and countries in Africa, supply chains will be mapped to characterise market structures. At farm level, the constraints faced by smallholders to increase productivity will be

examined. Case studies will look at how local institutions might help overcome constraints. Impacts on poverty will be assessed.

PI: Dr Nicolas Depetris C., Africa Centre for Economic Transformation (ACET), Accra
April 2012 to April 2015
Source: http://bit.ly/1cxHLHG

The links from agriculture to the rest of the rural economy are the focus of a study in southern Africa that will map flows of resources between the two sectors, see Box C.

Box C: Space, markets and employment in agricultural development: case studies from southern Africa

How much does the nature of farming by scale and by activity affect the vigour of the local non-farm economy? What impacts do differing links have on different social groups? Resource flows between economic actors will be mapped in two districts of Malawi, South Africa and Zimbabwe, following the money by identifying the upstream and downstream connections that link households and enterprises to one another, and iteratively building a map of social and economic networks. These networks will be analysed using software developed for mapping social networks. A household livelihood survey will then measure the impact on employment, incomes and food security of women and men to build a detailed understanding of how local economic networks and value chains shape the prospects for non-farm employment.

PI: Professor Andries du Toit, Western Cape
March 2012 to August 2014
Source: http://bit.ly/14S7Pee

Raising agricultural productivity in low-income countries

Many low-income countries, and especially those in sub-Saharan Africa, have seen disappointingly slow growth of agriculture in the last forty years. Moreover, much of the limited increase in production has come from expanding the cultivated area and from increased use of labour. Agriculture has tended to be extensive: both yields of crops per hectare and productivity of labour on farms remain low. Technologies to intensify production, such as improved seeds, fertilisers, crop-protection chemicals or irrigation, have only been applied to a limited degree (Udry, 2010).

There are several reasons for this. Low intensity of production may be explained by lack of technically appropriate innovations, by low profitability of existing options on farms, by underdeveloped and imperfect markets for inputs and services, and by insecure and ill-defined property rights — to mention some of the most frequently cited causes.

There may be some crops and ecosystems for which there are few innovations currently available which are technically appropriate and profitable (Lipton, 2012). In shifting cultivation, for example, extensive production with fallowing may reduce returns to external inputs to the point where they are simply not

worthwhile (Pingali et al., 1987).[12] For many others, however, field evidence shows the improved yields per hectare that can be obtained by using straightforward technology such as improved varieties and fertiliser and better control of water (see for example, Larson et al., 2010 on potential increases in rice yields in Africa). Moreover, large variations in yield often seen at the community level also suggest that the problem is not only or primarily physical.[13]

A second possibility is that more intensive agriculture may not pay off. Distortions in prices arising from economic policies may depress returns to farmers; although as a result of liberalisation, cases of heavy implicit taxation of farming are less common in low-income countries than in the past. High unit transport costs raise the cost of external inputs and reduce output prices at the farm gate, thereby reducing the returns to external inputs and making production for market less profitable. Across much of Africa, unit transport costs are notably high, often several times higher than in Asia (Livingston et al., 2011), with equally high potential to limit productivity (Gollin and Rogerson, 2012). Improved, all-weather roads in rural Ethiopia, for example, would reduce poverty by almost 7 percentage points and raise consumption by more than 16 percentage points, according to estimates by Dercon et al. (2009).

Another set of reasons lies in underdeveloped and imperfect markets for inputs, insurance and credit. In many low-income countries, farming depends on a single season of rainfall with uncomfortably high possibilities of low or poorly distributed rainfall leading to serious harvest loss. When farmers are averse to risk and also have limited informal insurance — Kazianga and Udry (1996) were surprised how little was available in villages in Burkina Faso — this can lead to profitable options being foregone. Drought-resistant crops may be sown in place of crops with higher mean returns but higher variance; while farmers will be reluctant to spend on inputs such as improved seed and fertiliser that would be lost in the event of a drought. For example, Dercon and Christiaensen (2011) found that farmers across Ethiopia restricted their use of fertiliser because of the risk of low consumption, due to poor harvests in the event of poor weather. Such high and uninsured risks could thus trap poorer farmers in poverty. Similarly, lack of access to formal credit may also trap some households in poverty: above all, those who cannot afford to forego some consumption and accumulate sufficient funds to invest (Carter and Barrett, 2007).

Given the potential importance of risk in deterring investment, interest has been shown in insurance, indexed either to rainfall or area yields, that overcome some of the administrative costs and moral hazards that apply to conventional insurance, which indemnifies a farmer against their specific losses. However, few of the several pilots of index insurance have so far been taken to scale. Uptake of index insurance has often been low. While it seems financial literacy of farmers and their trust in the insurance provider increase uptake, it is still not clear whether low adoption stems from low underlying demand or shortcomings in the way that insurance schemes have been designed and marketed (Cole et al., 2012).

From the relatively few experiences that have been evaluated, however, it seems that insured farmers do use more fertiliser and improved seed (Cole et al., 2012). A recent study from northern Ghana (Karlan et al., 2012) confirms this: an experiment showed that farmers who accepted the offer of insurance invested significantly more in fertiliser and planted greater areas than their neighbours who received either a cash grant or nothing. Working capital did not appear to be an obstacle to increased investment: cash grants alone had much less effect.

[12] It may be more difficult to generate innovations for agriculture in sub-Saharan Africa owing to the large variety of ecosystems. This may make agricultural research more difficult or costly, but does not excuse lack of technical progress: Asia also faced similar diversity at the start of the green revolution (Lipton, 2012).

[13] That said, the technical challenges in areas of poor soil should not be underestimated; fertiliser response in such areas may be low and not worth the cost of the fertiliser (Tittonell and Giller, 2012).

A further potential cause of under-investment may be insecure property rights; either because insecurity deters investment as farmers cannot be sure of a return on their spending, or because the absence of a formal title prevents land being pledged as collateral against bank loans. Despite the large literature on security of tenure in different parts of rural Africa, there are contrasting reports of the degree of security and its impact on innovation and investment. Some see little relation: for example, Besley (1995) on Ghana; Brasselle, Gaspart and Platteau (2002) on Burkina Faso; and Place and Otsuka (2002) on Uganda. In contrast, Goldstein and Udry (2008) see the under-use of fallowing in southern Ghana due to fears of loss of rights to land not being actively farmed, while farmers in Uganda have invested more on the plots they own compared to those for which they have only the right to occupy (Deininger and Ali, 2008). Given the subtle gradations in land rights and the implied degree of security under collective and longstanding arrangements, it is perhaps not surprising that differing outcomes should be observed in different locations and times.

In the past, costly schemes to survey, map and register land rights have been promoted. More recently, schemes to register land collectively and individually at lower cost have been pioneered, as seen in Ethiopia (Deininger et al., 2007, Deininger and Byerlee, 2011). These may well strengthen rights at relatively low cost, but their impacts are yet to be fully understood.

Finally, explanations may lie with learning and appreciation of innovations. While in some cases it seems that farmers learn about techniques from their more successful neighbours, as seen for pineapples in southern Ghana (Conley and Udry, 2010), in other cases, such as maize in western Kenya, no such learning from neighbours was observed (Duflo et al., 2008). Public extension services have long sought ways to provide suitable messages for farmers, conveyed by a motivated, competent and responsive extension service: farmer field schools represent one of the more recent models to be promoted (Davis, 2008). In the meantime, however, mobile phones have become widely available in rural areas, even in low-income countries, offering the means to supply farmers with up-to-date information on markets and technical advice.

These potential explanations are not exclusive: limitations may well apply in combinations, as well as applying differently by circumstances, and between farms. For example in Kenya, Suri (2006) reports that returns to hybrid maize seed vary significantly across farms, so that some farmers who could profitably adopt do not, apparently because they cannot readily get physical access to inputs; while other groups gain little from the improved seed, yet still adopt, as this provides some protection against varying yields.

The programme is thus interested in the following questions:

- How much do high transport costs and high post-harvest costs depress agricultural investment and output?
- What is the potential demand for insurance of crops and livestock? How can insurance schemes be designed to have low overhead costs while meeting farmers' needs? Under what circumstances might insurance increase investment in agriculture?
- What are the impacts of recent innovations in low-cost land registration for farm investment and innovation?
- What does evidence show to be effective practices in agricultural extension services?
- What has been the experience of attempts to use mobile phones to provide technical and market information to farmers? Do farmers with access to phones make use of them for farm decisions, and with what results?

- How have large-scale investments in agriculture, seen since the mid-2000s, most notably in the acquisition of land, impacted on investment and innovation by existing farmers?

The programme has five projects studying these topics. Three look at technical innovation and how information circulates and affects adoption of new practices. The ways in which information disseminates through both formal and informal channels and its influence on agricultural innovation is the subject of studies in Kenya, Sudan and Uganda (Box D).

Box D: Innovation systems, agricultural growth and rural livelihoods in East Africa

Which institutions affect farmer innovation? How do farmers innovate? What factors stimulate or obstruct innovations? How does innovation affect agricultural productivity, household incomes and growth in the local economy?
Qualitative studies in selected villages in Kenya, Sudan and Uganda will provide initial answers. These will then be cast as hypotheses which link institutional arrangements, innovation activity and changes in farm output, livelihoods and incomes. They will be tested by analysis of data from participatory farm management and household surveys.

PI: Professor Chris Garforth, University of Reading
June 2012 to June 2014
Source: http://bit.ly/1etXgkK

More specifically, in the State of Karnataka, southern India, a randomised trial is assessing the impact of access to information on farming provided through networked computers (Box E).

Box E: Information, market creation and agricultural growth

Can provision of better agricultural information, specifically through networked computers, enhance farmer production and welfare? Will its use exacerbate social inequalities among farmers?
In a randomised experiment, surveys before and after the experiment will investigate the impact of access to information about agriculture in the Indian state of Karnataka. The study will look at impacts on agricultural practices, household incomes, social networks, risk coping mechanisms and caste disparities.

PI: Dr Arjunan Subramanian, University of Glasgow
Nov 2012 to Oct 2015
Source: http://bit.ly/16dti4g

In the east of the DR Congo, studies in the Kivu region look at how differing levels of access to markets affect information and adoption of technology.

Box F: Which farmer(s) should we target? How do extension approaches influence social learning and the spread of agricultural innovations?

Will giving farmers better access to inputs and output markets enhance the spread and adoption of technology? How do social networks affect the spread of information?
A randomised trial looks at how differing access to markets for inputs and outputs affects production and incomes. Two treatments will be applied and compared to control cases: assisting local village development committees to supply seed and inoculant to farmers; and provision of seed, plus holding fairs where traders interested in buying produce can meet farmers who might supply them. The studies will take place in Kivu, eastern DR Congo.

PI: Professor Erwin Bulte, Wageningen Agricultural University, NL
July 2012 to July 2015
Source: http://bit.ly/1bPOQmi

Policy-makers have started to give more priority to the management of risk in agriculture, stimulated by the possibility of applying innovative insurance schemes. In eastern Uganda, Mbale District, experiments are being run with farmers to determine how they see risks, and how those risks are affected by their peers, see Box G.

Box G: A behavioural economic analysis of agricultural investment decisions in Uganda

How do farmers perceive risk, and how does this affect their investment on farms? Are perceptions and actions affected by the views of peers?
Experiments will be carried out with farmers in Mbale District, Uganda. They will be asked to allocate funds between competing investments with varying risks. The experiments will be designed to elucidate how farmers see risks with lesser and greater probability of significant loss, as well as to see how much their decisions are influenced by making such choices with their peers.

PI: Dr Arjan Verschoor, University of East Anglia
Feb 2012 to Feb 2015
Source: http://bit.ly/17vXqTB

Finally in a different context, that of rural China, the impact of institutional changes on investment in farming — specifically land leasing and farmer contracts to processors — is being examined (Box H).

Box H: Rural property rights, returns to scale and contracts

How has land leasing in rural China, only recently permitted, affected the use and trading of land? What impact has this had on investment and labour use? What impact does contracting between farmers and large companies have on investment and agricultural productivity?
Existing data from household surveys will be augmented by that from additional surveys, then analysed to examine the patterns that emerge on land leasing and contracting, their determinants, and their implications.

PI: Dr Elaine Liu, Houston University
April 2012 to April 2014
Source: http://bit.ly/17RZvZJ

IRRIGATION IN SUB-SAHARAN AFRICA

Irrigation represents a special case of under-investment, as in many cases irrigation requires investment in dams and river intakes of sufficient capacity that the resulting scheme serves multiple farmers. The costs of works are thus collective, undertaken either by the state or by a group of farmers. A further public challenge arises from costly externalities that can apply from irrigation schemes in potential draw-down of aquifers, waterlogging of irrigated lands, and in saline water draining from irrigated lands threatening downstream users (Schoengold and Zimmerman, 2007).

Within low-income countries, sub-Saharan African countries stand out for their remarkably low levels of irrigation. Compared to Asia, where 37% of land is under irrigation, in sub-Saharan Africa the figure may be as small as 4% (Svendsen et al., 2009, reporting FAO data). Even then, much of the developed irrigation in this region is located in just three countries: Madagascar, South Africa and the Sudan. Omitting those countries, the share of agricultural land under irrigation in the rest of the region would be just 1.3% (FAO Aquastat, 2010). Moreover, as much as one fifth of the area currently equipped for irrigation may not be functioning (Kadigi et al., 2012).

Yet the potential irrigated area in sub-Saharan Africa may be more than five times larger than the current area: FAO (2005) estimates 39 million hectares with potential,[14] compared to 7 million hectares currently irrigated. Not only does irrigation promise to raise land productivity — the 4% of land under irrigation produces an estimated 24.5% of output by value (Svendsen et al., 2009); but variations in harvests owing to the vagaries of rainfall can be much reduced with irrigation. Moreover, in the coming decades, as climate change threatens to exacerbate the variability of climate and hence yields from rain-fed farms, irrigated areas can provide some relief in those catchments where climate change has not reduced run-off.

The limited development of irrigation does not primarily result from technical issues, but more from economic and social problems (Lankford, 2009). Sub-Saharan Africa has a history of large-scale public irrigation schemes that have foundered on high capital costs and poor operation, leading to less area

[14] For all of Africa, the potential was calculated at 42.5M ha. This figure takes out the North African river basins, but leaves in the considerable potential of the Nile.

developed and lower yields than planned (Kadigi et al., 2012). Since the 1980s, efforts have been made to improve management of public schemes, usually by involving farmers more. However, results have been mixed, due in part to management structures being imposed without considering local social circumstances (ibid.).

While public schemes have struggled, over the last two decades it seems that much of the expansion of the irrigated area in Africa has been by farmers individually and in groups investing in relatively small-scale schemes (see for example, Woodhouse et al., 1997, Woodhouse, 2003 and Namara et al., 2011).

A prime research need is to understand more about the institutions and policies that can support private and collective investment in irrigation, as well as those that lead to effective management of multi-user schemes. As of October 2013, the programme has one project that looks at the institutions governing small-scale irrigation, see Box I.

Box I: Innovations to promote growth among small-scale irrigators in Africa: an ethnographic and knowledge-exchange approach

How do small-scale irrigators organise to irrigate their land? Are there common principles that lie behind this? If information is shared across irrigation sites, will this affect irrigation? Ethnography will be used in villages in Bangladesh, Malawi and Tanzania to examine the institutions and individual behaviour that determine the operation of irrigation. Videos will be used to record key information on irrigation management at each site, and then shown to irrigators at other sites, and the impact of this observed.

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Source: http://bit.ly/19hJsHF

4. CONCLUSION

The DFID-ESRC Growth Research Programme addresses critical issues in agricultural development in low-income countries. The current portfolio of nine projects is the result of the first round of proposals: it will be augmented by proposals accepted in the second call — where proposals are currently being selected — and the third call, expected in 2014. These promise to provide significant insights to the questions raised; insights that will be crafted into policy messages and communicated to decision-makers.

From late 2013 onwards, reports from these projects and companion briefs will begin to appear.

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