Rural Infrastructure for Smallholders

A UK Parliamentary Report into rural water, energy, transport and storage infrastructure for smallholder farmers, on behalf of the All-Party Parliamentary Group on Agriculture and Food for Development.
The All-Party Parliamentary Group (APPG) on Agriculture and Food for Development brings together Parliamentarians concerned with agriculture, nutrition and food security in developing countries. The APPG was established in 2008 in response to the growing concerns over heightened food prices and the chronic underfunding of agricultural development by bilateral and multilateral organisations and national governments. Chaired by Jeremy Lefroy MP and Lord Cameron of Dillington, the APPG is a cross-party initiative drawing members from both Houses of Parliament.

The APPG recognises that a vibrant, resilient and environmentally sustainable agricultural sector is key to development and that agriculture is one of the most effective tools to ensure economic, social and political well-being in developing countries. Smallholder farmers are central agents to addressing global hunger, eradicating poverty and increasing national productivity. In recognising this, the APPG uses its cross-party membership to facilitate informed and progressive debate to deepen understanding of the needs, opportunities and challenges of the 500 million smallholder farmers who feed 2 billion people worldwide.

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Action Against Hunger-UK, Agriculture for Impact, Bangor University, CABI, Christian Aid, Concern Worldwide, Farm Africa, Hand in Hand International, London International Development Centre, Natural Resources Institute at the University of Greenwich, Oxfam GB, Results UK, SAB Miller, Save the Children, Small Foundation, Tropical Agriculture Association, University of Leeds.
Why infrastructure?

A lack of access to basic services such as water, energy and transport is an important characteristic of poverty. More than 620 million people in sub-Saharan Africa (two-thirds of the population) live without electricity\(^1\) and two thirds of rural Africans live more than two kilometres from an all-season road.\(^2\)

Global poverty is concentrated in these rural, poorly served areas, where infrastructure is either weak or non-existent. The people affected are mostly small-scale farmers, and in sub-Saharan Africa they produce an estimated 70% of the local food supply\(^3\). With the population of sub-Saharan Africa expected to double to 2.5 billion by 2050, achieving the Sustainable Development Goals (including the ending of poverty and hunger) will depend on rural populations being able to improve their productivity and earn income from markets. Without greater investment in infrastructure, that is unlikely to happen.

Rural smallholders need better access to energy, irrigation, storage and transport infrastructure if they are to increase yields and participate in markets. For example, with a reliable, affordable source of energy, they can improve the efficiency of land preparation, planting and harvesting, and engage in on-farm processing to add value to crops. Irrigation can reduce reliance on increasingly erratic rainfall patterns and enable multiple harvests each year. Storage facilities on the farm and in community hubs can prevent crop losses and the forced selling of surpluses at low prices, while better roads reduce transport costs and enable
more food to reach urban and peri-urban markets more quickly and in better condition. For many countries in sub-Saharan Africa the remoteness of many smallholder farms is a critical factor. It is difficult to buy inputs or sell harvested crops when your farm is 20km from the nearest hard-surface road.

Studies of investment in rural infrastructure have shown a specific association with poverty reduction: in China, every yuan invested in low-quality rural roads was found to generate 1.57 yuan of agricultural GDP. In India, every additional million rupees ($23k) spent on rural roads in the 1990s was found to lift 881 people out of poverty. Research into the impact of irrigation has found that the incidence of poverty is 20-30% lower in irrigated settings compared to rain-fed settings.

In 2003, NEPAD’s Comprehensive African Agricultural Development Programme (CAADP) called for “improving rural infrastructure and trade-related capacities for market access”. But in practice, large-scale projects are often prioritised and these tend to be less beneficial to smallholders. For example, large-scale electricity infrastructure will improve overall connection to the grid, but is unlikely ever to extend to the rural farmers whose productivity could benefit so greatly from access to energy. The Programme for Infrastructure Development in Africa (PIDA), launched in 2012, also does not articulate a policy on rural infrastructure.

Ending poverty and achieving food security depends on smallholder farmers having the opportunity and incentive to participate in markets. Without appropriate infrastructure, that cannot happen. The evidence gathered for this report has suggested that filling the infrastructure gap is particularly urgent for sub-Saharan Africa: it is here that governments and donors need to allocate adequate resources to rural irrigation, energy, roads and transport, and in particular to create an enabling environment for local infrastructural enterprises and farmer-driven investment.

1. Water

The very low levels of irrigation in sub-Saharan Africa (about 4% of arable land) means that the vast majority of farmers depend on rainfall to water their crops. With climate change making weather patterns in Africa more erratic, this puts them in an increasingly vulnerable position. If rains arrive too early or late – or not at all – entire growing seasons can be lost. The irregular nature of rain-fed agriculture puts farming communities in a precarious position from a household food security perspective and also makes it difficult for them to participate in any organised value chains.

**Impacts of effective water management**

Conversely, the ability to manage water effectively can increase yields and cropping intensity (the ability to harvest crops predictably several times a year) and enable farmers to diversify into higher value crops such as beans and tomatoes which need a reliable water supply. Given access to markets, these crops can raise incomes while also contributing to improved household dietary diversity. At present, smallholder farming is dominated by rain-fed cereals and starchy roots which have more limited value both in terms of nutrition and cash.
A reliable water supply also gives farmers the confidence to invest in better quality inputs, such as improved seeds and fertilisers. Such investments, and improved yields, help to stimulate rural employment both on and off the farm, further improving incomes, livelihoods, and the quality of life in rural settings. Irrigation was a key component of the Green Revolution package of inputs during the 1960s and 1970s in Asia. Poverty still exists in Asia, but the increased production and significant reduction in poverty could not have been achieved without substantial investments in irrigation.

Studies of irrigation development in sub-Saharan Africa have confirmed its potential to reduce poverty. For example, in a study by FAO of the Murara district of Zimbabwe, irrigated maize yields were found to be 6 tonnes/ha, compared to 1–2 tonnes/ha under non-irrigated conditions. Farmers were also growing baby corn, cucumbers, carrots and peppers as high-value crops for both local and export markets. Some individual farmers practicing irrigation were earning Z$5,833 each per month from plots of 1 ha, while non-irrigated farmer incomes were as low as Z$1,000 per month from an average 6 ha plot size. In Malawi, an evaluation of a government-led Irrigation, Rural Livelihoods and Agricultural Development project – which supported the rehabilitation and development of small-scale irrigation systems, reservoirs and rainwater harvesting on smallholder farms between 2006-2012 – found an average increase in real net income of 43%.

After decades of underinvestment, governments and donors are paying more attention to irrigation, particularly in Africa and often on a large scale. Given the paucity of irrigation infrastructure as a whole, such schemes are justified but are also costly and often do not lead to increases in productivity for rural smallholders, whose plots lie far out of reach. Yet researchers have found that the internal rate of return on investment in small-scale irrigation is significantly higher than for large-scale (dam-based) irrigation schemes. The International Water Management Institute (IWMI) has similarly found that having many small-scale irrigation systems, as opposed to centralised infrastructure, is generally more effective in sub-Saharan Africa in terms of unit cost and performance.

What does small-scale irrigation look like?

Smallholder farmers practicing irrigation access water from a variety of sources, including rainwater, shallow (and deeper) groundwater, rivers, lakes and wastewater. Water management can be seen as taking place on a spectrum, ranging from improving water retention in the soil and using buckets and watering cans, to more elaborate forms of water capture from both surface and underground sources, and motorised pump systems.
For the very poorest farmers, there is scope to substantially increase productivity and incomes by expanding the use of appropriate rainwater harvesting techniques. Small dams, ponds, reservoirs and tanks can be used for capture, while buckets, watering cans, hoses and pumps move it around. This can be relatively inexpensive for the simplest forms of capture and movement.

Harvesting groundwater is also an option, and is currently under-used as a source: only 1% of cultivated land is currently irrigated in this way in sub-Saharan Africa (compared to 14% in Asia). IWMI estimates it could be safely expanded by a factor of 20\(^3\). The APPG was told that small-scale groundwater irrigation is already the fastest growing form of irrigation in Africa, which may be because farmers see it as an individually controlled, convenient and reliable resource.

Using groundwater does require investment in equipment to access it. Foot operated treadle pumps to access shallow groundwater started spreading in south Asia around 30 years ago, introduced by iDE. These pumps use suction to lift water from up to 6 meters below ground and deliver it directly to crops, or into a storage container. Around 200 million have been sold around the world, priced between $20 and $100.

Operating costs will be low for this where family labour is used, but treadle pumps are also labour intensive and can therefore be less suitable where labour is in short supply (e.g. in areas affected by HIV/AIDS). According to iDE, four hours of pumping will irrigate 0.2 ha; a substantial effort\(^4\). Farmers who can afford it will prefer a motorised pump, which can cover far more ground with less physical labour.

The cheapest motorised pumps are available for less than $250 and rental markets are also growing. These can be used to access deeper groundwater and pump it to pipes, drip systems and sprinklers over a larger area. Solar-powered irrigation systems are also emerging as a
more sustainable alternative to diesel pumps in off-grid settings (see Futurepump box, p 19).

**Supporting farmer-driven irrigation investment**
Smallholders will irrigate as much as they can, where it makes sense to do so. It’s not unusual for farmers to manage both rain-fed and irrigated plots to varying degrees, with irrigated land used to grow higher value crops for markets. Small-scale manual irrigation may also be used by women around homesteads for household dietary diversity.

For most small farmers in sub-Saharan Africa, the problem is not an absence of water, but the absence of capital to put it to much better use. According to research by both IWMI and FAO, there is significant scope to expand the area of irrigated land by supporting private, small-scale investment on the part of individual smallholders or communities. This is an established trend in South Asia, and while irrigation is still low overall in sub-Saharan Africa, where it is expanding it is being driven in the same way. In Ghana, private irrigation by smallholders already covers 25 times more land than public schemes.

The challenge is to help more smallholders overcome the constraints of upfront capital costs and access to information and training on irrigation practice and equipment. Farmers are aware of the value of irrigation,

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**Ask the ‘waterists’ what they want**

People with well-developed career specialisms usually fall back on their training and office. ‘Price water’ says the economist; ‘line irrigation canals’ intones the engineer; and ‘partner with drip irrigation companies’ suggests the policymaker interested in public-private partnerships.

But what would you do if you were a ‘waterist’? A waterist is someone whose discipline and position does not come to the fore when asked for a solution. He or she sees the solution by looking at the resource via the eyes of a certain kind of resource user. A waterist seeks out certain kinds of irrigators in an irrigation system who: a) rarely have any disciplinary training, and b) are farming on boundaries and margins of resource availability. An example might be a farmer at the tail end of an irrigation system or cropping a particularly shallow and infertile soil. A waterist realises these types of farmers are least likely to represent themselves loudly at a resource workshop where the momentum is building towards expert or bold solutions, but if engaged with might contribute their experience on managing a resource prudently and carefully. (Words: Bruce Lankford)
so the persistently low level of practice in sub-Saharan Africa is evidence of how substantial the entry constraints are to the poorest farmers. Only the richest 20% of farmers in Ghana own pumps, for example, and in sub-Saharan Africa as a whole fewer than 5% of pump owners are women.

Another problem is poorly developed supply chains, which prevents farmers from readily accessing inputs and being incentivised to invest in irrigation. The sustainable management of water sources is also important, and will become more urgent as irrigation develops. More research is needed on the quantity, quality and recharge rates of aquifers throughout sub-Saharan Africa to avoid the kind of depletion seen elsewhere, such as in Punjab. Strong local and national governance will be needed.

**Recommendations**

The presence of irrigation infrastructure will not in itself end rural poverty. But where smallholder farmers have the prospect of market access, they are also more likely to be incentivised to invest in irrigation themselves. Priorities for support include:

**Access to water**

For many of the poorest smallholders not already irrigating, the first step in developing the productive use of water is to improve rainwater harvesting and storage. On-farm ponds can be useful for capturing rainwater where rivers and lakes are scarce and groundwater not accessible. Where available, groundwater can be accessed through shallow wells or using pumps.
Development of value chains
Markets are essential to make investment in irrigation worthwhile. High-value vegetables are particularly attractive to farmers. Smallholders need reliable buyers, market information and storage/transport infrastructure to also be in place (see next section). Organisation into farmer groups will help, and the development of regional cross-border markets as well as local/global ones.

Sustainable use
A watershed perspective is important to avoid unintended negative impacts on water supply and quality. Good hydrogeological data at the local level needs to be more widely available to support local knowledge and policy for accessing water supplies.

Addressing financial barriers
This underpins the recommendations above as a whole. Farmers are widely aware of and interested in agricultural water management but few formal financial products are available to finance it. They might be supported by the development of a wider range of innovative financial products and business models. These can include pump rental industries, lease-to-buy arrangements, and irrigation service providers. Specific groups such as women in higher potential areas might be explicitly targeted with subsidised equipment as part of value-chain development efforts. Equipment providers themselves can also provide their products on credit/PAYG models.

Information
Financial support should also be coupled with information on which technologies to buy, and how to operate and maintain equipment. The market for pumps in sub-Saharan Africa, for example, is poorly developed with little quality control. Farmers will be more likely to invest when they know that the equipment they are buying is suited to their land and crops, and will not break down after one season.
2. Transport, Roads and Storage

With most of Africa’s food being produced by smallholders in rural settings, transport and storage infrastructure are crucial to the ability to move goods and earn money. Such infrastructure is often poor or non-existent. Great personal effort is made to transport crops, usually by women and often on foot and using head-loading. Crops suffer in quality and farm-gate prices stay low. Poor storage exacerbates the problem, causing spoilage, forced sales at low prices, and making participation in high-value markets more difficult.

Problem of the ‘first mile’

In one of the evidence sessions for this report, the APPG heard that the initial movement of crops from the field to the nearest road or collection point – the ‘first mile’ – is typically the most problematic and expensive per kilometre of the entire value chain. Crops are usually head-loaded across difficult terrain, and such loads are necessarily small, so it is difficult to achieve economies of scale. Studies by the Africa Community Access Partnership (AfCAP) in Kenya and Tanzania have shown that head/backloading can cost 23 times as much per kilometre as truck transport. A study of onion growers in Nyeri County, Kenya found that the costs of transporting the crop over the first two
kilometres accounted for 10% to 20% of net income for farmers.

Intermediate forms of transport (IMTs) – bicycles, motorcycles and pack animals – are used as an alternative to head/backloading when the transport and a passable road are available. However, the costs are still much higher than for motorised vehicles. Crops are also easily damaged during this stage of transport. This, and the fact that farmers are dependent on unpredictable roadside collection by intermediaries with trucks, means that farmers are in a weak position when it comes to prices.

For example, AfCAP’s study of a tomato value chain in Tanzania found that 88% of initial movement was done by headloading (4% by motorcycle, and 8% by bicycle). The farm-gate price was 10,000 Tanzanian shillings per 60kg bag, 14,000 TSh at the roadside collection point, and 35,000 TSh in Dar es Salaam market. The effort and cost of moving relatively small volumes at a time for the first mile keeps farmer incomes low and more importantly can reduce the incentive to produce more.

Impact of improvements to roads
Rural road investment can include making improvements to an existing track, constructing small bridges and culverts, building or upgrading an earth road, or building a new gravel or bitumen sealed road.

For smallholders, improving an existing rural track to make it suitable for vehicle access can make the biggest difference. For example, it was estimated that, in Ghana, a 5km improvement of an existing accessible vehicle track might only increase farm-gate prices by 0.01 per cent for maize. However, the effect might be a hundredfold greater if a change in transport is involved.
Evidence from a large-scale project in Uganda adds further weight to this. The Community Agricultural Infrastructure Investment Programme (CAIIP), launched in 2007 and co-funded by IFAD, the African Development Bank and the Government of Uganda, rehabilitated 538km of feeder roads and 3289km of all-weather rural roads. It also constructed 74 rural markets. As a result, travel times to major towns in the targeted districts were reduced by at least 50%, and transport costs went down by a similar amount. The farm gate prices of cassava rose from USh 8,000 to 20,000 per kilo, and milk from USh 150 to USh 600 per litre. Post-harvest losses went down by around 20%, particularly for perishables such as tomatoes, pineapples and watermelons.

The effect of improved transport extends into the rural off-farm economy as a whole: passing traffic incentivises the provision of other products and services such as vehicle repair, mobile phones and so on. It also means improved access to inputs. Better roads make it more likely that extension services will access rural farmers, and that those farmers will be able to buy good...
quality seeds and fertiliser. In Ethiopia, it was found that fertiliser use increased by 2.5 times between villages with poor and good accessibility. Uganda’s CAIIP programme reported higher rates of school enrolment (because children no longer had to walk across difficult terrain) and an increase in expectant mothers visiting health centres for antenatal visits.

**Incentivising investment in storage**

Smallholder farmers suffer substantial crop losses as a result of having poor storage facilities – or none at all – on the farm and at collection points. Losses are both quantitative (physical losses caused by rodents, insects or infestations) and qualitative (loss of quality and value). The extent of these losses is substantial. Estimates range from 5% to 30% or more, and in sub-Saharan Africa alone the value of post-harvest losses overall is thought to be around $4bn a year.

The need for better on- and off-farm storage has long been recognised and a range of effective storage options are available. At the lower end of the scale these can be as simple as plastic sealable bags or metal silos. Off the farm, village-level aggregation centres and moisture-controlled warehouses are also
an option. The challenge is not to drive innovation in storage technology itself, but to increase the uptake in sub-Saharan Africa. This requires better farmer organisation, financing and market access, because without these there is still little reason or opportunity for farmers to individually invest in the storage of any significant surpluses. In some cases, warehouses and other community storage facilities have been built but are under-used because of the absence of market opportunities to make it worthwhile storing surpluses.

In written evidence shared with the APPG, Farm Africa reported on a project launched in 2016 which demonstrates the importance of linking storage interventions to market access. Tanzania and Uganda produce an overall surplus of staple crops such as maize, while in most years neighbouring Kenya imports maize from outside Africa due to high tariffs within East Africa. Regional trade barriers were recently eased, creating a potential market opportunity for Tanzanian and Ugandan smallholders to sell to Kenya.

But smallholder producers in Tanzania and Uganda still needed help if they were to access that market. Farm Africa, working with local partners, trained farmers organised into cooperatives in methods of drying, sorting and grading maize, rice and beans, and provided equipment such as tarpaulins, moisture readers and silos to set up village aggregation centres. These village-level centres are linked to warehouses approved by the East African Grain Council (EAGC), which means the smallholders have a pathway to better prices on the regional market.

The assurance of better prices through this market link to Kenya, and the ability to properly dry and store their crops, means that smallholder farmers in Tanzania and Uganda now have an incentive to produce more and the ability to sell that increased yield. The presence of buyers and storage infrastructure creates a virtuous circle.

Recommendations
Poor road and transport infrastructure prevents smallholder farmers from easily accessing markets, and keeps their costs high and incomes low. This, in turn, is a disincentive to produce more and makes locally driven investment into storage facilities less worthwhile. Breaking this cycle will depend on a mix of approaches, some driven by donors and
governments, so that farmer-driven investment is also more likely to emerge. These approaches include:

**Focusing on the ‘first mile’ of crop movement**
Improving rural feeder tracks to enable vehicle access can allow smallholders to move from head-loading to vehicle use for the initial stage of crop movement. This can make the greatest difference to smallholder incomes.

**Improving local-level road planning**
The WFP project in DRC included community-led road maintenance committees. Concern Worldwide recommends decentralising road budgets so that local communities have a greater say in prioritisation. Construction and maintenance can form part of social protection programmes and local employment projects.

**Improving finance mechanisms for storage**
Accessing finance remains a problem for smallholders, though many effective on-farm solutions are inexpensive and training in their use is often as much of a barrier. Facilitating a private storage rental market to prove the economic benefits to farmers can lead to donors supporting loans to farmer groups through financial institutions to expand storage capacity.

**Linking post-harvest and storage investment to value chain development**
Smallholder farmers operating in informal markets or through middlemen are least likely to properly dry and store crops. Facilitating linkages to formal markets incentivises production and better post-harvest handling.

**Facilitating cross-border trade**
Easier access to cross-border markets can be a driver for more organised regional value chains, incentivising smallholder production and making farmer-driven investment in storage/transport more viable.

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3. Energy

More than 620 million people in sub-Saharan Africa (two-thirds of the population) live without electricity\(^24\). Those who are excluded from electricity provision are predominantly rural agricultural populations. In sub-Saharan Africa 65% of farm power relies on human effort, 25% on animals, and only 10% on engines\(^25\).

**Energy equals productivity**

SDG 7 proposes universal access to electricity by 2030, and achieving that goal will mean extending energy access to millions of rural smallholders, most of whom are located well beyond the electricity grid. This is a significant challenge, but also an important precondition for achieving some of the other global goals such as ending hunger and poverty.

In this context, the ability to make productive use of energy for income generation is crucial, and this requires more electricity than would be required to simply power a lightbulb and radio in the home. Household energy is important, but a 50-watt household solar system cannot provide the kind of energy that translates into improved productivity for households primarily dependent on agriculture for their livelihood.
With reliable, affordable access to greater levels of energy, smallholders can prepare and maintain larger areas of land with less effort, thereby increasing their production potential. They can more efficiently irrigate their land and use machinery for de-husking, grinding and milling larger quantities of grain. They can dry vegetables, fruit and meat to preserve them, process cassava into chips or flour, and extract high-value oils from nuts and grains. Power can also be used for refrigeration and open up access to cold-chain markets such as for dairy and fish.

**What kind of energy infrastructure?**

Extending the electrical grid to all rural areas is unlikely to be economically, technically or physically viable for most of sub-Saharan Africa. But the traditional assumption that people have to wait for electricity to come to them is being challenged by new technological possibilities. Decentralised and stand-alone systems are helping to create a new bottom-up approach to energy access that can complement the often slow and expensive pace of national grid extensions.

Grid extension still needs to be part of the mix, but the International Energy Agency (IEA) has estimated that achieving universal access to electricity will depend on 70% of the rural areas that currently lack access being connected through mini-grid or small, standalone off-grid solutions. These can be used by individual households or generate power for a whole village of several hundred houses, or a group of farms and rural businesses.
A mini-grid is simply a local generation source, and in itself is nothing new: diesel- or gasoline-fuelled mini-grids have been long used in many parts of the world. But increasingly, renewable energy such as solar is being used to power these mini-grids. Hybrid systems using both diesel and solar are also popular. The benefit of renewable energy in rural settings is that it doesn’t rely on a supply chain or the fluctuating costs of diesel. Rapid advances in the performance of solar-photovoltaic systems, and decreasing costs, are making these mini-grids increasingly viable and attractive. Solar photovoltaic (PV) modules cost three-quarters less today than in 2009, making renewable mini-grids an increasingly logical option for expanding energy provision in remote areas.

**Futurepump: integrated solar irrigation**

Manual irrigation is back-breaking work. Diesel irrigation pumps are effective but can easily cost a smallholder $30-40 a month in fuel. Is there another way?

Futurepump Ltd thinks so. Its Sunflower SF1 solar-powered irrigation pump (see photo p20) capable of pumping 12,000 litres a day from shallow wells and surface water sources, and connects to drip or sprinkler systems through a direct coupling.

The pump retails at $650, which is a significant capital outlay but according to Futurepump’s CEO Toby Hammond, the fuel savings and increased productivity means payback is two to three crop cycles, or 10-15 months. When farmers can grow multiple crop cycles, they can also sell in the off-season when prices are higher, significantly increasing their income. The firm recently manufactured its 1000th pump at its production plant in India.

Upfront investment remains the big obstacle to wider uptake, so Futurepump has also linked up with mobile money and telecoms service providers to experiment with a pay-as-you-go model of financing.

“This is helping to lower the barrier to access,” says Hammond. “But finance is the number one challenge. There is huge unmet demand for a product like ours. Some farmers have been able to double their cultivated area. But we have less than a thousand in the field at the moment. We’re not a bank but if there’s a way to solve that, the potential for impact is huge.”
Small-scale home systems are a standalone model typically used for domestic needs within a single home, to power a light, phone charger or radio. These small solar-powered systems have spread in rural African locations with the help of pay-as-you-go models, using mobile payment systems such as M-PESA.

Some larger home systems are also becoming available: companies such as SolarNow offer 250W systems which can power a radio and phone, household lighting, a TV and a fridge. These individual systems are also starting to become bundled with productive equipment such as irrigation pumps (see box on Futurepump), which takes them beyond the level of domestic use. Stand-alone solar mills and presses are also beginning to appear in the market. In dispersed, low density rural communities these can be more economical than mini-grids given the costs of and power losses involved in long distribution wires.
Policy support has grown rapidly for energy provision: USAID is leading a Power Africa campaign, while in October 2015 DfID launched its own Energy Africa campaign. Its aim is to galvanise private investment in countries where DfID has formed a partnership with the government. Nigeria, Sierra Leone and Somalia were the first to complete an agreement, followed by Ghana, Malawi and Rwanda. Unlike Power Africa, which is focusing on a range of renewable energy projects to connect to the national grid, Energy Africa specifically aims to accelerate off-grid solar power for households using private investment.

**Recommendations for improving energy provision**

The affordability of energy access is a critical barrier. Rural farming populations are amongst the world’s poorest, and although access to productive energy theoretically would improve incomes and create a virtuous cycle of energy affordability, starting this process is difficult. Capital investments beyond domestic-level energy provision can be prohibitive, and there is a lack of financing options for both end users and any SMEs that might supply energy or equipment. Possible solutions to overcome this, and other barriers, include:

**Developing Pay As You Go (PAYG)**

This system is already popular for household systems and can be expanded to larger productive use systems such as solar-powered irrigation. Futurepump’s $650 capital investment is made easier by allowing payment through mobile channels in instalments, which also enables farmers to build up credit histories.
Models of shared-use energy infrastructure
Renting space in a solar-powered cold storage facility, or the use of solar-powered irrigation, means smallholders avoid upfront investment costs but can benefit from energy provision. Over time, increased income from this access can enable individual capital investment.

Grant funding and capital subsidies
These can be used to reduce the purchase price of equipment and kickstart growth. Nepal’s 2016 energy subsidy policy, for example, provides subsidies for both domestic and productive off-grid renewable energy technology installations, graded by geographical remoteness. Subsidies specifically targeted at agricultural production include mini or micro hydropower for milling and wind systems to lift water for irrigation.

Better use of climate funds to fill funding gaps
The energy sector already benefits from climate funds, with about 40% of the $14.1 billion approved climate finance ($5.6 billion) being allocated to energy projects and programmes. But only about $475 million has been allocated to decentralised energy, with the rest largely directed toward large-scale energy and to high and middle income countries. One of the main problems is that these funds simply are not structured in a way that enables them to prioritise decentralised energy, so it’s the “architecture” of climate funds that needs reshaping. If such funding is to reach rural smallholders, it needs to be packaged in smaller ways, less bureaucratically, and to encompass more instruments than just loans.

Integrating energy provision strategies with value chains
In Sierra Leone, Christian Aid has supported solar-powered refrigeration units run by local organisations on a commercial basis. Fishers were charged to store fish but were also linked to institutional buyers of fish, such as hotels, so that the security of a market would make the energy systems sustainable.

Trade policy and consumer information
Introducing measures to facilitate the import of solar equipment, for example by removing fiscal and import barriers, can improve uptake. The adoption of international quality standards and promotion of consumer awareness about the benefits of solar products is also important.
The All-Party Parliamentary Group on Agriculture and Food for Development wishes to thank all those who presented to the group on their ‘Rural infrastructure for smallholders’ seminar series in October 2016.

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