THE KENYA NATIONAL DOMESTIC BIOGAS PROGRAMME

Can carbon financing promote sustainable agriculture?

INA PORRAS, BILL VORLEY AND ALEXANDRA AMREIN – 2015

SHAPING SUSTAINABLE MARKETS

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About the Hivos-IIED PES Learning Trajectory Programme
IIED and development organisation Hivos launched a two-year strategic partnership to provide research-based policy advice to improve sustainable food systems and access to energy in developing and emerging countries. Through this research IIED and Hivos explore the feasibility of payments for ecosystem services (PES) as incentives to promote a shift to sustainable smallholder agriculture. We focus on practical learning from existing smallholder and community PES projects linked to energy and agroforestry activities. Working with local partners and project practitioners, we analyse the opportunities, challenges, strategies and potential 'no-go' areas in a pre-selected group of smallholder projects and analyse them within the global context of wider learning on what works and what does not in PES. Based directly on lessons drawn from case studies, we adapt the value chain map and business model LINK methodology developed by the International Center for Tropical Agriculture (CIAT) to understand if and how PES and carbon approaches can help smallholders successfully enter and benefit from existing markets. Results from this research are published in the **Payments for Ecosystem Services in Smallholder Agriculture series** under Shaping Sustainable Markets and can be downloaded online.

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GLOSSARY

Additionality	In the context of carbon offsets, a project activity is 'additional' if anthropogenic GHG emissions are lower than those that would have occurred in the absence of the project activity. In the context of other ecosystem services, additionality refers to incremental services being delivered by the project.
Carbon dioxide equivalent (CO_2e)	The universal unit of measurement used to indicate the global warming potential of each of the six GHGs regulated under the Kyoto Protocol. Carbon dioxide – a naturally occurring gas that is a by-product of burning fossil fuels and biomass, land-use changes, and other industrial processes – is the reference gas against which the other GHGs are measured, using their global warming potential (Kossoy *et al.*, 2014).
Certification	Certification is a market-based mechanism, guaranteed by a third party, designed to encourage environmentally sustainable and/or socially responsible practices. Certification can also offer 'chain of custody' information.
Clean Development Mechanism (CDM)	This is a mechanism provided by Article 12 of the Kyoto Protocol, designed to assist developing countries in achieving sustainable development by allowing entities from Annex 1 Parties to participate in low-carbon projects and obtain Certified Emission Reductions (CERs)in return (Kossoy *et al.*, 2014).
Co-benefits	In carbon projects this refers to well-managed and sustainable projects associated with a variety of benefits beyond reduction of GHG emissions, such as increased local employment and income generation, protection of biodiversity and conservation of watersheds.
Certified Emission Reduction (CER)	A unit of GHG-emission reductions issued pursuant to the Clean Development Mechanism of the Kyoto Protocol and measured in metric tons of carbon dioxide equivalent. One CER represents a reduction in GHG emissions of one metric ton of carbon dioxide equivalent (Kossoy *et al.*, 2014).
Ecosystem services/ environmental services	Ecosystem services are the benefits that people obtain from ecosystems, and include provisioning services (like food, timber, etc), regulating services (eg climate regulation, flood management, water purification and disease control); cultural services (eg recreation, spiritual) and supporting services that contribute to soil productivity through nutrient cycling, soil formation and primary production (MEA, 2005).
Ex-ante offsets	Ex-ante offsets are determined by the future carbon fixation of an activity (often forest based). Accredited projects are then able to sell credits on the agreement of future activities within a set timeframe.
Greenhouse gas (GHG)	Both natural and anthropogenic, GHGs trap heat in the Earth's atmosphere, causing the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) are the primary GHGs. The emission of GHGs through human activities (such as fossil fuel combustion or deforestation) and their accumulation in the atmosphere contributes to climate change (Kossoy *et al.*, 2014).
ICROA	The International Carbon Reduction and Offset Alliance is an industry body overseeing businesses that deliver carbon reductions and offset services. It promotes best practice to support voluntary climate mitigation efforts. www.icroa.org

Inclusive business models	A profitable core business activity that also tangibly expands opportunities for the poor and disadvantaged in developing countries. They engage the poor as employees, suppliers, distributors or consumers and expand their economic opportunities in a wide variety of ways (BIF, 2011).
Inclusive trading relationships	Inclusive trading relationships are the result of inclusive business models that do not leave behind smallholder farmers and in which the voices and needs of those actors in rural areas in developing countries are recognised.
Insetting	A variation of carbon offsetting, insetting is a partnership or investment in an emission-reduction activity by a company and their partners, where the company reduces its socio-environmental footprint (eg CO_2, biodiversity and water protection) while tackling procurement costs and risk and strengthening links with suppliers (Henderson, 2014). The 'in' within insetting highlights the fact that the carbon transaction takes place within a supply chain or a production area.
Intermediary	An intermediary is a mediator or negotiator who acts as a link between different parties in a supply chain, usually providing some added value to a transaction that may not be achieved through direct trading.
Offset	An offset designates the emission reductions from project-based activities that can be used to meet compliance or corporate citizenship objectives vis-à-vis GHG mitigation (Kossoy *et al*., 2014).
Outgrower schemes	Partnership between growers or landholders and a company for the production of commercial (usually forest or agricultural) products. The extent to which inputs, costs, risks and benefits are shared between growers/landholders and companies varies, as does the length of the partnership. Growers may act individually or as a group in partnership with a company, and use private or communal land.
Payments for ecosystems services (PES)	An economic instrument that addresses an environmental externality through variable payments made in cash or kind, with a land user, provider or seller of environmental services who voluntarily responds to an offer of compensation by a private company, NGO or local or central government agency. PES is anchored in the use of payments to correct an economic externality (Pigou, 1920; Coase, 1960). Coase argues that socially sub-optimal situations, in this case poor provision of ecological services, can be corrected through voluntary market-like transactions provided transaction costs are low and property rights are clearly defined and enforced (Ferraro, 2009; Pattanayak *et al*., 2010; Porras *et al*., 2008).
Poverty	While there can be many definitions of poverty, we understand it as the lack of, or inability to achieve, a socially acceptable standard of living, or the possession of insufficient resources to meet basic needs. Multidimensions of poverty imply going beyond the economic components to wider contributory elements of well-being. Poverty dynamics are the factors that affect whether people move out of poverty, stay poor, or become poor (Suich, 2012).
REDD+	A UNFCCC framework where developing countries are rewarded financially for activities that reduce emissions from deforestation and forest degradation and contribute to conservation, sustainable management of forests, and enhancement of forest carbon stocks.
Small producers/small farms	Although no common definition exists we follow Nagayets' (2005) approach, defining small farms on the basis of the size of landholding. This has limitations as it does not reflect efficiency. Size is also relative. Individual agricultural plots of <2 hectares are common in Africa and Asia but are generally larger in Latin America. Community forest land can include considerably larger patches.

Transaction costs	Pagiola and Bosquet (2009) define transaction costs in reducing emissions from deforestation and forest degradation (REDD)/PES as those necessary for the parties to reach an agreement that results in the reduction of emissions. The costs are associated with identification of the programme, creating enabling conditions for reducing emissions, and monitoring, verifying and certifying emissions reductions. Costs fall on different actors, including buyers and sellers (or donors and recipients), market regulators or institutions responsible for administration of the payment systems, project implementers, verifiers, certifiers, lawyers and other parties. The costs can be monetary and non-monetary, ex-ante (initial costs of achieving an agreement) and ex-post (implementing an agreement).
Validation and verification	Validation is the process of independent evaluation of a project activity by a designated operational entity against the requirements of the Clean Development Mechanism (CDM). Verification is the review and ex-post determination by an independent third party of the monitored reductions in emissions generated by a registered project approved under CDM or another standard during the verification period (Kossoy *et al*., 2014).
Value chains	The value chain describes the full range of activities that firms and workers do to bring a product from its conception to its end use and beyond. This includes activities such as design, production, marketing, distribution and support to the final consumer. The activities that comprise a value chain can be contained within a single firm or divided among different firms. Value chain activities can produce goods or services, and can be contained within a single geographical location or spread over wider areas (Global Value Chains Initiative, 2014).
Verified Emission Reduction (VER)	A unit of GHG-emission reductions that has been verified by an independent auditor. Most often, this designates emission reductions units that are traded on the voluntary market (Kossoy *et al*., 2014).
Voluntary carbon market	The voluntary carbon market caters to the needs of those entities that voluntarily decide to reduce their carbon footprint using offsets. The regulatory vacuum in some countries and the anticipation of imminent legislation on GHG emissions also motivates some pre-compliance activity (Kossoy *et al*., 2014).

ACRONYMS

ABPP	African Biogas Partnership Programme
CDM	Clean Development Mechanism of the UNFCCC
CIAT	International Center for Tropical Agriculture
GHG	Greenhouse gas
KCC	Kenya Cooperatives Creameries
KENDBIP	Kenya National Domestic Biogas Programme
KENAFF	Kenya National Farmers' Federation
MFIs	Microfinance instituituions
PES	Payments for ecosystem services
POs	Producer organisations
SACCOs	Savings and credit cooperative organisations
UNFCCC	United Nations Framework Convention on Climate Change
VCM	Value chain map

SUMMARY

IIED and development organisation Hivos launched a two-year strategic partnership to provide research-based policy advice to improve sustainable food systems and access to energy in developing and emerging countries. Through this research IIED and Hivos explore the feasibility of payments for ecosystem services (PES) as incentives to promote a shift to sustainable smallholder agriculture. We focus on practical learning from existing smallholder and community PES projects linked to energy and agroforestry activities. Working with local partners and project practitioners, we analyse the opportunities, challenges, strategies and potential 'no-go' areas in a pre-selected group of smallholder projects and analyse them within the global context of wider learning on what works and what does not in PES. Based directly on lessons drawn from case studies, we adapt the value chain map and business model LINK methodology developed by the International Center for Tropical Agriculture (CIAT) to understand if and how PES and carbon approaches can help smallholders successfully enter and benefit from existing markets. Results from this research are published in the **Payments for Ecosystem Services in Smallholder Agriculture series** under Shaping Sustainable Markets.

This report looks at the Kenya National Domestic Biogas Programme (KENDBIP) to understand how payments for ecosystem services (PES) might benefit smallholder agriculture. The research was carried out as part of the Hivos-IIED PES Learning Trajectory Programme.

The dairy cow biodigester system promoted by the Kenya National Domestic Biogas Programme is a highly effective 'green' technology – both in terms of its primary product (biogas) and by-product (bioslurry). Biodigesters have three climate-friendly impacts: they avoid deforestation, since less fuelwood or charcoal is needed in switching to biogas; they avoid the use of chemical fertilisers, since bioslurry is an effective fertiliser; and bioslurry improves crop productivity. Biogas also has a positive impact on health, especially for women, as a smokeless cooking fuel.

Each biodigester qualifies for small amounts of carbon offsets as payments for ecosystem services, since the use of biogas avoids deforestation, protecting the ecosystem services provided by forests (such as reducing atmospheric carbon). These carbon offsets translate into small revenue streams from international sales in carbon markets. However, the farmers who have transferred their carbon rights to the project that handles these sales are not seeing any direct benefits: the process seems very removed from the farm, and high transaction costs mean that revenues per individual biodigester are negligible.

Also, despite its multiple social and environmental benefits, the technology for domestic biogas remains expensive for smallholder farmers; only better-off farm households have adopted the technology. A donor subsidy to help farmers install biodigesters was withdrawn at the end of 2013. This risks moving biogas further away from an

inclusive model, unless the price of the technology is reduced.

FINDINGS AND RECOMMENDATIONS

The authors used the LINK Methodology tools developed by the International Center for Tropical Agriculture (CIAT) to investigate value chains and business models both for farm enterprises and for the biogas programme as a whole. This clarified how PES or carbon offsets can contribute to farming and to what extent. The following findings and recommendations emerged:

- **Carbon fund:** rather than making small individual payments to farmers from carbon sales, KENDBIP and Hivos have proposed creating a 'carbon fund.' This would pool revenues from carbon offsets and match them with funding with other sources (such as government or donors), to finance a 'client service centre' for the long-term technical support of farmers using biogas technology.
- **Upscaling the biogas programme:** the withdrawal of the farmers' subsidy has taken biogas technology further from poorer farmers. Carbon finance alone would be insufficient to provide a new subsidy. However, pooled in a carbon fund as described above, revenues could potentially generate additional funding to promote local biodigester production and lower their prices; or even reinstate some level of subsidy directly to farmers.
- **Carbon revenues reaching the farmer:** Currently, Hivos is responsible for aggregating carbon offsets and engaging with the carbon market. But the challenge in the long term is to establish a direct link with the farmers who have actually produced the carbon savings. Again, a carbon fund is the best way to provide direct clear benefits to farmers, such as a client service centre. More transparency is needed so that farmers are aware, from the moment they enter the project, what happens to their carbon credits and how are they going to benefit from them.
- **Client service centre:** Provided with long-term funding by the proposed carbon fund, a client service centre could offer light-touch institutional support once biogas installation is entirely market-driven. It could provide training for users, installation quality assurance, promotion, cost reduction and access to bank credit.
- **Carbon 'insets':** There are opportunities for 'insetting' within the value chains of a high value cash crop, such as coffee: the buyer (trader and/or processor) can offset the emissions of their processing facilities or transport, for instance, by channelling carbon payments back to their own grower-suppliers, or to the growers' cooperative. However this only applies to a small proportion of Kenya's farms, since most farms are subsistence or engaged in informal trade.
- **PES for bioslurry:** Bioslurry, a by-product of biodigesters and a good quality natural fertiliser, provides an effective substitute for chemical fertilisers – it could therefore be considered for PES. More work would be required for farmers to benefit from any payments, however, such as clarifying what benefits would emerge from the use of organic fertilisers outside the farm (eg improved biodiversity or better water quality).

ONE
INTRODUCTION – PES AND BIOGAS IN SMALLHOLDER AGRICULTURE

There is general agreement that better agricultural practices can help protect, enhance, or reverse patterns of degradation in the services that ecosystems provide; services such as reducing atmospheric carbon, conserving biodiversity and protecting water quantity and quality. There is also growing interest – and some controversy – in developing financing mechanisms that try to **bring these ecosystem services into markets**, creating new incentives to promote behavioural changes towards more sustainable practices. One of these financing mechanisms is payments for ecosystem services (PES). PES offers a potential source of extra funding, either by offering farmers financial incentives to switch to more sustainable practices, or as co-funding for projects that work to upscale good practices.

1.1 PES AND THE GREEN ENTREPRENEURSHIP PROGRAMME

Hivos has been looking into possibilities for providing market-based incentives to smallholders that will allow them to build more environmentally sustainable production systems. In conjunction with IIED, Hivos is examining the potential of payments for ecosystem services (PES) to boost provision of ecosystem services within smallholder agriculture in developing countries. In this project we look at the role, benefits and costs for key stakeholders involved in existing or proposed PES-type projects, though our main focus remains on the smallholder farmer.

This study will help local partners map their business strategy in relation to the ecosystem services, and gain a different viewpoint of the incentives for sustainable practices. The learning from this study forms part of a larger portfolio of ongoing PES initiatives, which will feed into the Hivos Green Entrepreneurship Programme.

1.2 THE KENYA NATIONAL DOMESTIC BIOGAS PROGRAMME

A common driver for deforestation and carbon dioxide emissions in developing countries is **the need for household energy**. Domestic biogas technology is designed to tackle that need. The **Kenya National Domestic Biogas Programme** (KENDBIP) promotes the use of small-scale biodigesters (see Figure 1) in order to phase out households' dependence on fuelwood and charcoal. Apart from the environmental benefits of reducing carbon emissions, substituting conventional cookstoves for stoves fuelled by biogas can improve household health and sanitation: biogas is a clean, smokeless fuel, and provides on-demand energy for cooking and boiling water. Biodigesters provide additional on-farm benefits via their by-product, bioslurry, which boosts agricultural productivity by fertilising crops without the need for chemical fertilisers.

A farmer in Kenya operating the biodigester system. Cow dung is mixed with water to achieve the required consistency and then added to the biodigester © Ina Porras

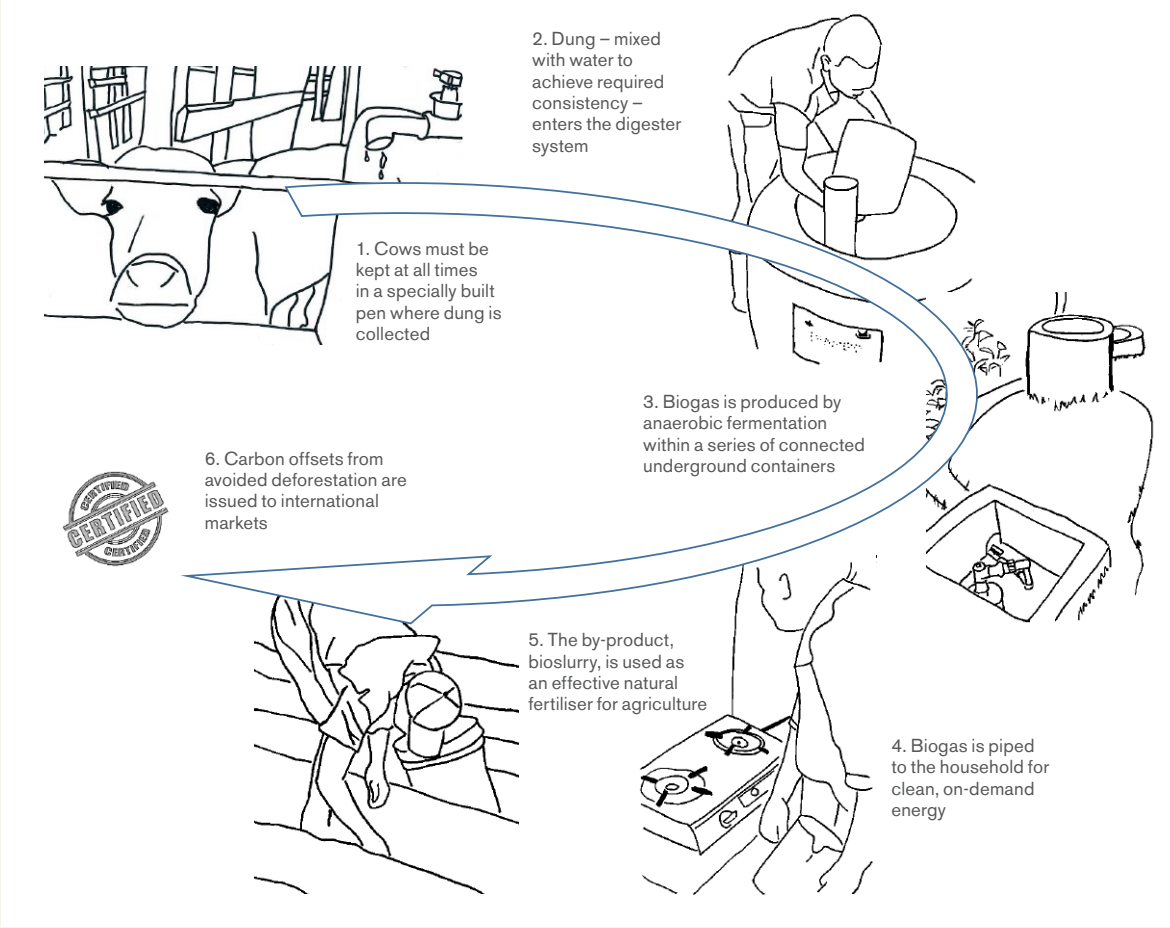
Biogas has wide-ranging benefits. Kenya's biogas programme is expected to cut carbon emissions by 73,623 tonnes, mainly by reducing the use of firewood and charcoal valued at approximately €1.9m and €2.4m respectively (KENAFF, undated). Cleaner energy technology is expected to benefit over 15,000 women and men, and 38,800 children; overall, the time saved by no longer fetching firewood is estimated to be 15–18 million hours per year (ibid) which can be used to invest in the rest of the household or for children to study. The wider economic benefits include creating jobs in the new market of biogas-related services, such as installing and maintaining biodigesters. This new supply chain is expected to provide jobs for nearly 400 people as 'masons' (accredited digester installers, working with biogas construction companies), field supervisors, and so on.

The biogas programme was introduced in Kenya in 2009. In its first phase, from 2009 to June 2013, households could receive a subsidy (with funding from the Directorate General for International Cooperation (DGIS) of the Netherlands' Ministry of Foreign Affairs) to cover 30 per cent of installation costs for a biodigester (25,000 Kenyan shillings or KSH; roughly €223). The subsidy was reduced in the second phase, from June to December 2013, to cover 20 per cent of installation costs (KSH18,500 or roughly €160). The subsidy was withdrawn at the end of 2013.

Domestic biogas is not new to Kenya, but has had limited success in the past. A feasibility study in 2007 highlighted problems – poor maintenance, poor dissemination, poor construction or design and acceptance problems by farmers – which limit scaling up (Biogas for Better Life, 2007). KENDBIP's new agenda seeks to overcome these obstacles and to expand beyond a pilot project towards the creation of a commercially viable, market-oriented biogas sector, and had a target of installing 8,000 domestic biogas plants in rural areas in Kenya in 2009–2013. The new approach brings in carbon offsets as a new source of income generation through formal accreditation via the Gold Standard to access international compliance and voluntary carbon markets.

This newly created agenda attempts to integrate the costs and benefits to the farm system from bioslurry and increased fertility – recognising that biogas projects do not take place in a vacuum; their chances of success depend on how well they are designed to fit within existing farm activities. The lessons from this programme feed directly into the development of national biogas standards by Kenya's Bureau of Standards, in order to regulate development of the biogas sector for long-term growth and sustainability.

FIGURE 1. THE BIOGAS PROCESS AND PRODUCTS



TWO
THE DOMESTIC BIOGAS VALUE CHAIN

This section uses one of the LINK Methodology tools, a 'value chain map', to investigate the flow of products, services, value and connections throughout the domestic biogas programme. We introduce the key stakeholders of the overall biogas programme, from the regional organisation to the individual households. We then concentrate on the value chain of the individual farm enterprise – from 'upstream' at the farm household where biodigesters are used, to 'downstream' where farm products, and carbon offsets, are sold. This provides a useful map of where PES fits alongside more traditional agricultural value flows.

2.1 METHODOLOGY

To explore the financial viability of the domestic biogas programme, we used the LINK methodology. This is a participatory tool developed by the International Center for Tropical Agriculture (CIAT) to promote smallholders' engagement with modern markets (Lundy, 2012). One of its key tools is the 'value chain map', a type of value chain analysis (see Box 1). This requires an understanding of the actors along the value chains, including biodigester providers, the farm households where digesters are installed, those managing the biogas programme, and those engaging with the newly created carbon market.

The potential for carbon revenues to encourage the participation of small-scale farmers in the chain (our target group) will depend on the business models of different stakeholders (such as farmers, intermediaries and input providers) and their capacity for and resistance to change. This includes, for example, insights into what costs can or cannot be handled by the value chain.

2.2 KEY STAKEHOLDERS

KENDBIP is part of the African Biogas Partnership Programme (ABPP),[1] the umbrella partnership between Hivos and SNV Netherlands Development Organisation[2] which supports national programmes for domestic biogas in five African countries: Burkina Faso, Ethiopia, Kenya, Tanzania and Uganda (see Figure 2). The speed at which each programme is implemented, and the mechanisms used, varies between the different countries. The ABPP's general managing offices in Kenya are located within the Kenyan National Farmers Federation (KENAFF).

Since its introduction, Kenya's biogas programme has set up a steering committee and significantly expanded its partnership network (see Figure 2). This involves 'leverage partners' at multiple levels (regional, national and local) including the

1. See: http://africabiogas.org/africa-biogas-partnership-programme

2. See: www.snvworld.org/en/sectors/renewable-energy/about-us/snv-energy/domestic-biogas/snv-and-domestic-biogas

BOX 1. WHAT IS A VALUE CHAIN MAP (VCM)?

Value chain maps look at each step in a business that adds value to a product. In the context of PES in smallholder agriculture, VCMs help us understand the dynamics of existing agricultural flows (products and value), the key actors within the chain and their respective roles. A VCM is useful to:

- Define relationships and interconnections,
- Understand the flow of products, services, information and payments (i.e. value),
- Enhance communication between different actors, and
- Identify entry points or key leverage points to improve the value chain.

Value chain maps can also help identify the partner network, whose objective it is to support, intervene or assist the different links of the chain and facilitate the development of the business. Although not included in the value chain's core stages, these partners often play a critical role in the functioning of the business and enable the chain to operate efficiently. In particular they are a vital component in ensuring the delivery of ecosystem services.

Through value chain maps we also identify the larger socioeconomic systems and institutions in a country, either formal (i.e. legislation or laws) or informal (i.e. cultural practices) operating at diverse scales. These institutions affect not only the value chains of different products (e.g. coffee, dairy) but also the potential of PES as an economic instrument that affects producers' decisions.

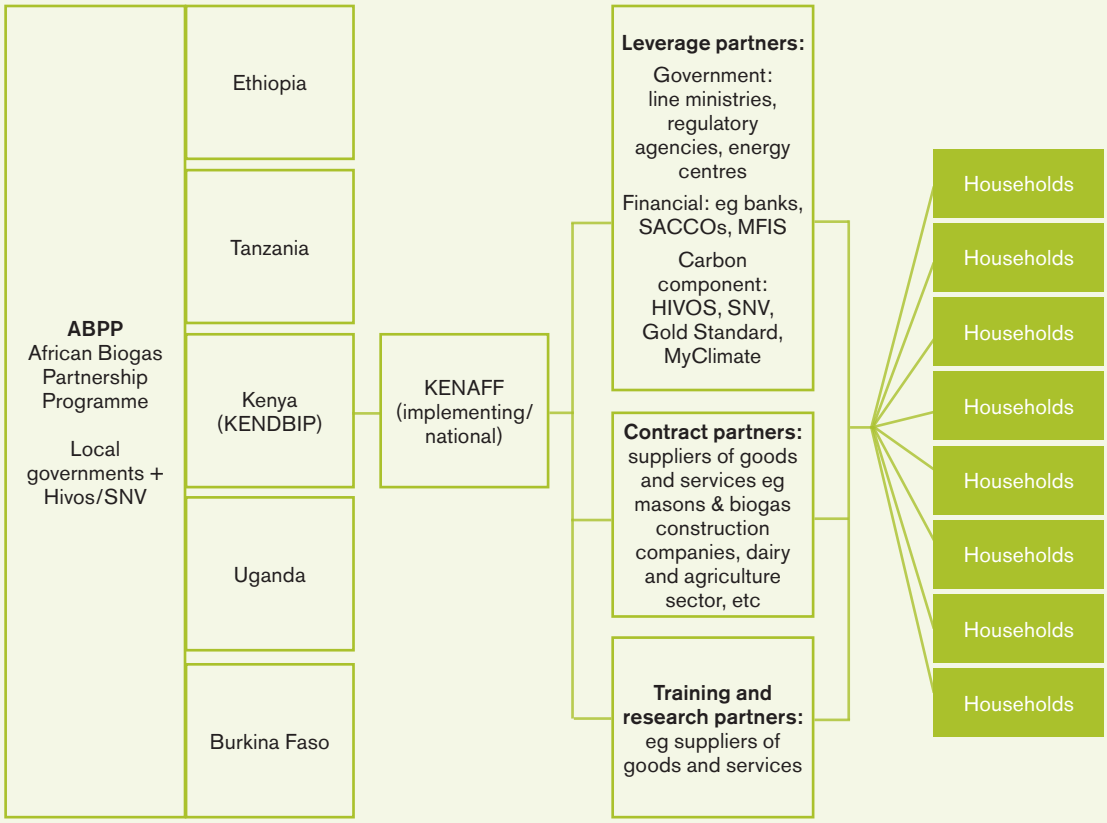
Source: Lundy *et al.* (2012)

government and regulatory agencies, finance organisations, contract partners supplying biodigesters, promotional approaches (including farmer-to-farmer outreach) and formalising training for masons.

KENDBIP has prioritised setting up a system that will last after the initial project has finished. This includes long-term support for biogas infrastructure, and extension services for farmers to ensure they reap ongoing benefits from biodigesters and capitalise on bioslurry. As we will see later in the report, KENDBIP proposes using revenues from carbon sales to set up and maintain these information and support services.

The introduction of a carbon component adds a whole new layer to the domestic biogas programme. Carbon offsets created at the farm level (through reduced use of firewood and charcoal) are transferred to KENAFF, with assistance from Hivos and SNV. After a rigorous process these offsets are verified by the Gold Standard and can be sold in international compliance and/or voluntary markets.

FIGURE 2. ORGANISATIONAL FRAMEWORK OF THE KENYA NATIONAL DOMESTIC BIOGAS PROGRAMME



Source: Adapted from Ngigi (2013).

From waste to richness: the biogester converts cow dung into slurry to be used as an agricultural fertiliser © I Porras

2.3 BIOGAS AND PES FROM THE FARMERS' PERSPECTIVE

Figure 3 presents a stylised view of the main value chain associated with biodigesters. Taking the dairy farm with a biodigester as the point of origin for generating carbon credits, the chain links:

1. **Main farm system outputs, for household consumption and farm enterprise:**
   a. **Food crops** (horticulture and grains, eg maize) both for household consumption and to sell, mostly via informal markets. This includes growing cattle feed for the farm.
   b. **Milk** – for household consumption, as well as local formal and (mostly) informal markets.
   c. **Cash crops** like coffee – traded in formal export markets.
   d. **Biogas** – as a source of energy for the household.
   e. **Bioslurry** – the 'processed' manure that comes out of the biodigester, a valuable input for farm production.
   f. **Carbon offsets** – for which farmers transfer the rights to KENAFF via a clause in their contract.
2. **Input providers to farm system, including:**
   a. **Masons** and biogas construction companies who provide the technology; these are set to play a larger role in the future of the programme as it scales up.
   b. **Cattle inputs and genetics**, including the public and private sector[3] working together to provide services that ensure the health and viability of the cattle herd.

3. For example the Ministry of Livestock Development, Department of Veterinary Services/Animal Production; institutes and parastatal training bodies, Livestock Genetic Society, ABS-TCM African Breeders Service, Kenya Dairy Farmers Federation. Non-profit NGOs and CBOs include Heifer Int, Technoserve, ACB-K, dairy companies such as Brookside, Spin-it and KCC.

c. **Agricultural inputs**, including seeds and tools. The introduction of biogas (and bioslurry) into the system eliminates most or all need for firewood and fertilisers within the farm household.

d. **Financial services**, including local savings and credit cooperative organisations (SACCOs), non-governmental organisations (NGOs), community-based organisations (CBOs), government departments, and special smallholder programmes – such as 4S@Scale.[4]

e. **Technical and extension service providers** for agricultural enterprise – such as Ecom Agroindustrial Corporation for coffee,[5] which also provides loans; and for help in maintaining the biodigester, using the bioslurry on the farm and generating carbon offsets and credits – such as KENDBIP, ABPP, Hivos and SNV. Cooperatives also provide loans.

3. **Main market outlets, including:**

   a. **Formal and informal markets for conventional farm produce** like vegetables, milk, and coffee.

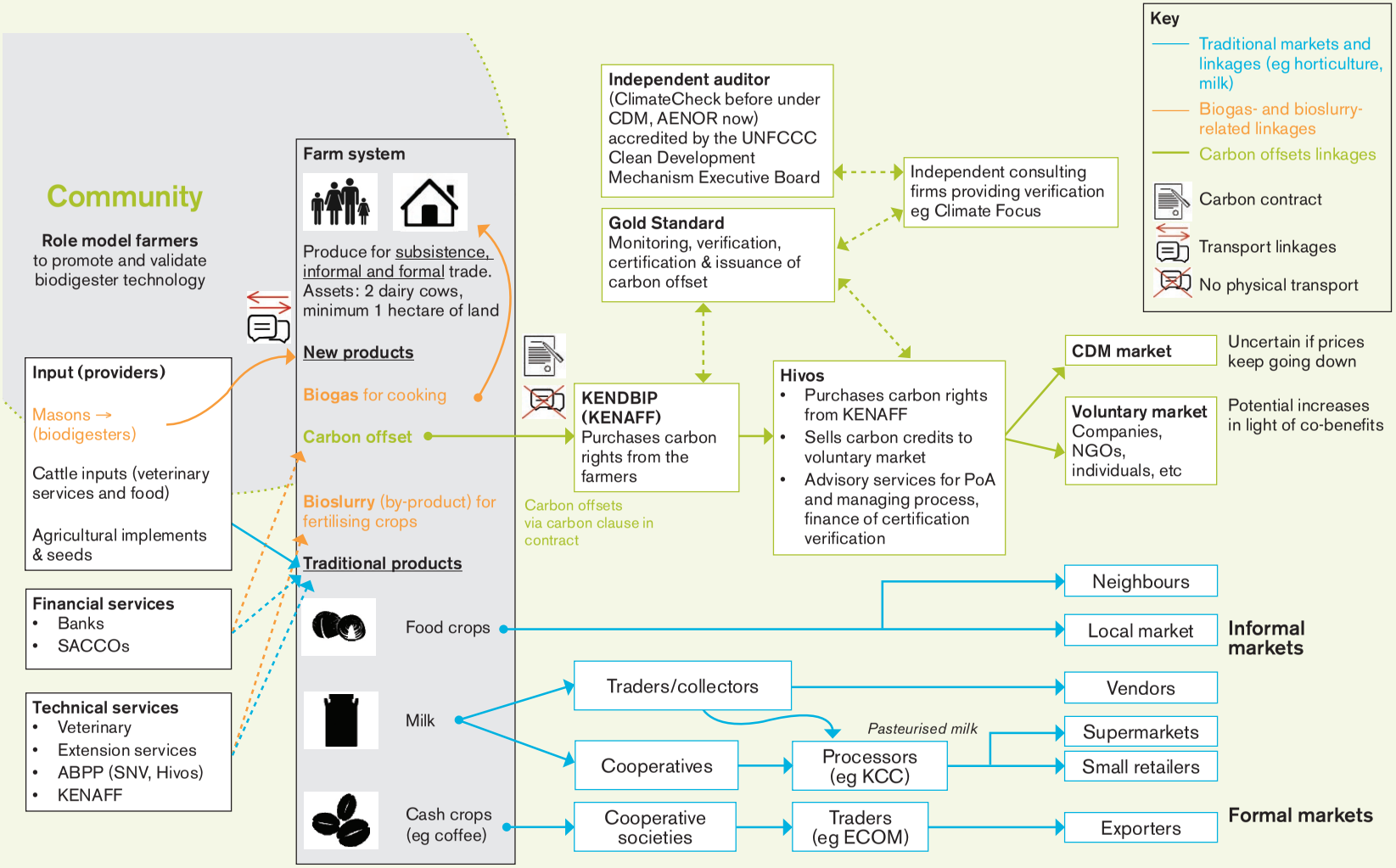
   b. **Carbon markets**: although the carbon offset is 'created' at the farm level, the commodification and trading process takes place off the farm through other stakeholders (KENAFF, Hivos/SNV, Clean Development Mechanism or CDM and the Gold Standard).

The level of detail provided from this value chain map puts the farming household at the centre of the domestic biogas/carbon proposition, highlighting their role within the proposition. This helps them to understand what the implications are – instead of the more 'top down' approach used by most biogas programmes (see for example Figure 3).

4. See: www.hivos.org/activity/sustainable-and-secure-smallholder-systems-scale

5. See: www.ecomtrading.com/en/about-ecom.html

FIGURE 3. TTHE KENYA NATIONAL DOMESTIC BIOGAS PROGRAMME VALUE CHAIN



Source: Value chain constructed following interviews with key informants from KENAFF, Hivos and Climate Focus. Notes: ABPP – African Biogas Partnership Programme; AENOR – Spanish Association for Standardisation and Certification; CDM – Clean Development Mechanism; KCC – Kenya Cooperatives Creameries; KENAFF – Kenyan National Farmers Federation; PoA – Programme of Activities, a modality of project development under the Clean Development Mechanism; UNFCCC – United Nations Framework Convention on Climate Change.

THREE
THE BUSINESS MODEL FOR FARMERS

Using another tool from the LINK methodology tool kit, we now focus on four key stakeholders in the value chain: the farmers, the Kenyan National Farmers Federation (KENAFF), Hivos and the African Biogas Partnership Programme (ABPP). We concentrate especially on farming households with biodigesters, looking in detail at their business model and how it functions within the value chain. Time limitations did not allow an analysis of the masons' business model at this stage, but this would be a useful exercise for the future.

3.1 METHODOLOGY

We use the Business Model Canvas, developed by Alexander Osterwalder (see Box 2) to describe the rationale of how an individual (person or firm) creates, captures and delivers value. Using a common language (eg **how, what, who** and **how much?**) the canvas describes how PES can aid/complement the main agricultural business model, or not. As a tool, the canvas facilitates the dialogue between farmers, development and business actors and, as a result, helps develop a clearer idea of how business processes can support social development and the provision of ecosystem services.

3.2 INTEGRATING BIOGAS AND CARBON INTO THE FARM

The introduction of a biodigester – for those who qualify and can afford it – creates two direct impacts: the biogas eliminates or reduces demand for firewood or other sources of fuel; and the bioslurry eliminates or reduces demand for fertilisers, and potentially increases farm productivity and resilience to changes in environmental and economic conditions. While biogas has been the primary driver of the initiative, bioslurry offers significant direct benefits for farmers who capitalise on this high quality fertiliser (there is no data from formal trials, but reports from field applications show high perceived values).

Figure 4 summarises the business model for farmers taking part in the biogas programme, highlighting the key opportunities and bottlenecks. The **what**, **how**, **who** and **how much?** components of the farmers' business model are discussed below.

3.2.1 What is the value proposition of the farm enterprise?

This is the bundle of products or services that create value for farmers using biogas. The key products of the farm system are: **agricultural crops** like coffee or tea; **milk**; **biogas** and **bioslurry;** and as a new product, **carbon offsets** (see Figure 4, centre).

The main benefits to the farm household are centred on their traditional produce (crops and dairy), and biogas and bioslurry. Besides being generated through the production of biogas, carbon offsets do not play a role in farm activities.

BOX 2. WHAT IS A BUSINESS MODEL CANVAS?

The Business Model Canvas is a useful tool to assess how a key business in the value chain functions, to develop a shared language to describe and assess a business model, and to create a baseline for the development of innovations in the business model. By providing a 'visual picture' of the organisation's business model, and the potential bottlenecks and (financial) imbalances, it can facilitate the dialogue between farmers and development and business actors. As a result, it creates a clearer idea of how business processes can support social development and the provision of ecosystem services. Its four core areas are **how, what, who** and **how much?** This canvas is useful to assess the 'triple bottom line' (Elkington, 1994) highlighting the fact that companies create economic, social and environmental impacts and carry responsibility for all of them. The 'how much?' section of the canvas is useful to identify these positive and negative effects, as well as understand their distribution in terms of winners and losers. Understanding these impacts beyond profit is necessary to develop affordable monitoring strategies.

The key questions in applying the canvas are:

- **What** is the value proposition? (The value delivered to the customer)
- **How** is value obtained? (The key partners, resources and activities needed to produce the outputs of the value proposition)
- **Who** are the outputs channelled to? (The main buyers or customers)
- **How much** are the costs and benefits? (The costs of the key activities and resources, and income streams received).

Source: based on CIAT (2012).

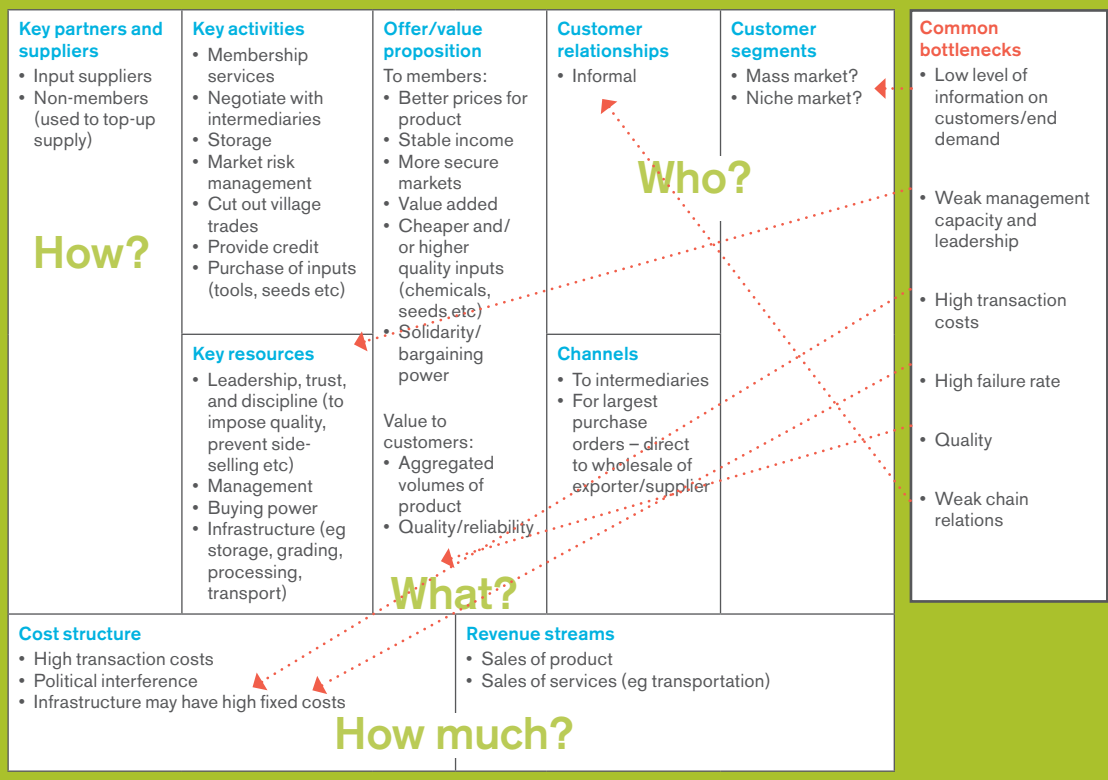


FIGURE 4. FARM BUSINESS MODEL: OPPORTUNITIES AND BOTTLENECKS

At the moment the farmer is very detached from the carbon process – information feels scarce and potential for misunderstanding high.

Potential for stronger links to dairy sector.

Masons' sector developing and showing potential for better and cheaper technology.

Loans for full cost mostly from banks rather than SACCOs. Can result in exclusion of many farmers.

Perceived unclear connection between donors from the farmers' point of view.

Elimination of subsidy to farmers will reduce access if cost of technology does not go down.

Relatively high initial cost for digesters and zero-grazing system.

Very small carbon generation per biodigester means high transaction costs and low per unit return.

Perceived lack of transparency for benefits from carbon/PES.

Neighbour-to-neighbour training has potential but needs support.

Clear benefits from biogas and bioslurry (crop productivity increases and risk reduces) once installed.

Ecosystem approach provides long-term support of technology through **Maintenance and Capacity Support Fund**.

Partners

Input providers
- Cattle (Genetics)
- Agricultural implements
- Masons (certified by KENAFF)
- Seeds
- Agrochemicals
- *Firewood*

Financial services providers
- Banks
- SACCOs
- Self help groups
- 4S@Scale

Technical service providers
- Vet
- Extension providers
- Members of ABPP (SNV, Hivos)
- KENAFF

Donors
DGIS
Kenyan Government (participation in carbon-offset fund)

Activities

1) Production and marketing of agricultural crops
2) Maintaining livestock and marketing of milk
3) Sign carbon clause with KENAFF to surrender carbon rights
4) Produce biogas by feeding digester with animal dung
5) Produce bio-slurry and use it to fertilize fields in order to increase productivity

Resources

- Financial capital:
  - Cash/savings for bio-digester investment
  - Access to carbon offset fund
- Manufactured capital:
  - Bio-digester (6-12m³) to produce biogas and bioslurry (byproduct) and to allow for carbon offset creation with a lifespan of ~25yrs
  - Agricultural implements
- Natural capital
  - Land (lha) cultivated with crops and cero grazing set up
  - Cattle (min 2) to produce ~30kg of dung/day
  - Access to water
- Social capital
  Contact to a role model farmer that validated technology
- Human capital
  - Farmers with an innovative and entrepreneurial attitude
  - Time availability to dedicate to farm work

Value proposition

Towards the market:

(1) Agricultural crops
- Coffee/tea
- Horticulture
- Milk

(2) Carbon offset from reduced firewood (5.2tCO_2/digester)

Towards the farm household:

*(3) **Biogas** (used for cooking in HH)*

*(4) **Bioslurry** Used as a fertilizer within the farm*

Relationships

Personal relationship with frequent communication at farm gate

KENAFF's reputation creates trust

Channels

Pick up at farm gate by local traders

Carbon clause (Contract) to surrender rights of carbon offset to KENAFF

Trust based relationship with role model farmers that promotes viability of technology

Customers

(1) Agricultural market

Formal market
- Supermarkets
- Marketing agencies
- Institutional buyers
- Cooperatives

Informal market
- Local traders
- Neighbours

(2) KENAFF

(3&4) Local bioslurry market (composed of other smallholder farmers that do not have a bio-digester to produce slurry for fertilisation)

Cost structure

- One-off costs for bio-digester installation (75100Sh at 112sh/EUR=average 781 EUR)
- Recurrent costs:
  - Maintenance costs (low)
  - Interest for loan
  - Transaction costs for monitoring and verification that accrues on the farmer. Expected to be covered by carbon offset fund
- Other costs: Time loss to attend programme related activities and attend visitors

Benefits

Benefits from carbon offset trade: include a) initial subsidies for biodigester (currently eliminated for the farmer)), and b) access to client service call center.

Other benefits:
- Free training and maintenance of bio-digester for one year
- *Savings on firewood expenses*, animal feed & fertiliser expenses
- *Time savings (no firewood savings) & health improvement*
- *Cleaner kitchen*

(1) Income from sales of agricultural products: Milk (39Sh/l=traders & 25Sh/l=coop. Date November 2014)

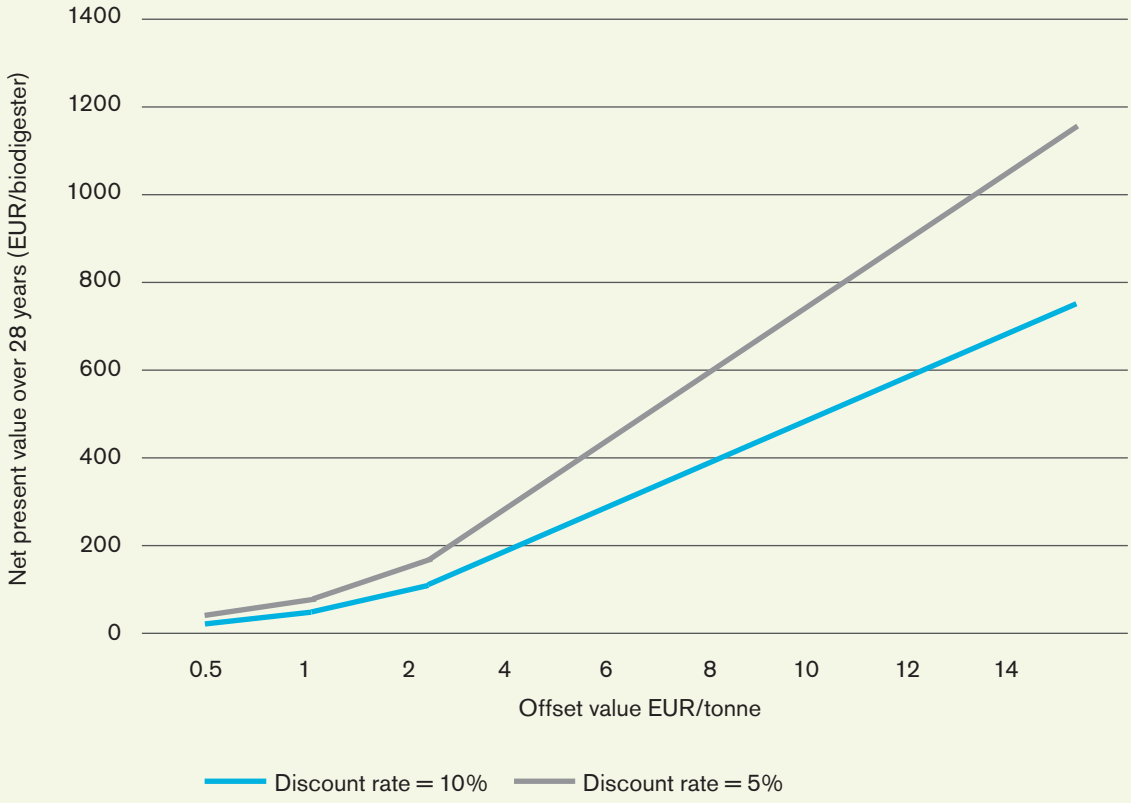
(3&4)Income from sales of bioslurry

Traditional products · Biogas and bioslurry · Carbon

Notes: Potential opportunities in **black** and potential bottlenecks in **red**.

On average, a biodigester generates about 5.2 tonnes of carbon offsets per year through reduced firewood use. This does not translate into much potential revenue for the individual farm, especially taking into account the volatility of carbon market prices and the type of discount rate used to compare future flows of money in terms of net present value. A 'back of the envelope' calculation, given a sale price of about €6–8 per tonne, results in a net present value (NPV) of €320–430 over 28 years. At €14 per tonne – towards the top of the current price range – the expected NPV from one biodigester is €750, or €27 per year (at a 10 per cent discount rate). These calculations do not include any of the transaction costs incurred by entering the carbon market. Any potential carbon revenues at the farm level will therefore be highly dependent on market prices, and whether they are sufficient to cover the transaction costs of reaching international markets (see Figure 5).

FIGURE 5. CARBON OFFSETS GENERATED BY ONE BIODIGESTER



Source: author's own calculations using average market carbon offset prices

3.2.2 How is value created at the farm level?

The **activities** at the farm level include producing and marketing crop products and milk; operating the biodigester, through every stage from cattle pen to gas use in the household; and the work to ensure quality bioslurry and its use within the smallholding (see Figure 4, left-hand side: partners, activities and resources). Finally, by signing a clause to transfer the carbon rights to KENAFF, farmers begin the carbon commodification process.

The **key resources** for farmers accessing the biogas programme are:

- **Financial capital** – either cash or the means to repay a loan for the digester and its installation
- **Natural capital** – dairy cows, land and access to water
- **Manufactured capital** – agricultural and dairy implements and 'zero grazing'[6] housing for the cattle, generating milk of sufficient quality to sell, and working the agricultural plot to capitalise on the bioslurry
- **Social and human capital** – the entrepreneurial and technical skills required to use the technology and provide general maintenance; this includes trusted neighbours already engaged in biogas, and farmer-to-farmer capacity.

The **partners** include:

- **Input providers** – supplying cattle/genetics, agricultural implements, accredited seeds, agrochemicals and so on; this includes the masons who provide the biodigesters. (It no longer includes providers of firewood for household consumption, which biogas makes redundant.)
- **Financial service providers** are more important in the biogas model, including banks, and potentially savings and credit cooperative organisations (SACCOs), although they cannot currently provide sufficient finance for a biodigester; and self-help groups, as well as projects such as 4S@Scale (see Box 3).
- **Technical service providers** are key to ensuring the continued operation of the systems once the initial investments are in place. These include vets (to ensure animal health), extension providers, members of ABPP (SNV, Hivos – although their role is near invisible at the farm enterprise level), and KENAFF.
- **Donors**, such as the Ministry of Foreign Affairs of the Netherlands (DGIS), have had a varied role through the different stages of the biogas programme. Donors provided the biogas installation subsidy for farmers in the early stages of the programme, and the withdrawal of this subsidy was timed to coincide with increased participation by the Kenyan government, by proposing the creation of a Carbon Fund (see 'benefits' below).

6. A zero-grazing system is one where cows are kept inside and fed on cut grass.

A zero-grazing cattle pen in Kenya © I Porras

BOX 3. THE 4S@SCALE PROGRAMME

The 4S@Scale Programme works with coffee farming systems, with a target group of 90,000 farmers across East Africa. The programme promotes new technologies like biogas and bioslurry to improve productivity, supports coffee farmers in diversifying their income with dairy and/or horticulture, and strengthens market linkages. It is a public-private partnership between Hivos and Ecom Agroindustrial Corporation, funded by the Ministry of Foreign Affairs of the Netherlands (DGIS) and is due to run from 2013 to 2018.[7]

3.2.3 Who are the customers for farm products?

Most people taking part in the biogas programme run predominantly subsistence farms; their **customers** therefore tend to consist of local informal traders or neighbours buying any surplus produce (see Figure 4, right-hand side: customers, relationships and channels). Some cash crops like coffee and tea are marketed through cooperatives. There are also proposals for organised groups of farmers to market surplus bioslurry to other smallholders as an organic fertiliser, but currently it is only used within the farm.

Relationships and channels describe how farmers reach their customers. Most marketed produce (such as vegetables or milk) is sold through personal relationships, collected at the farm gate by local traders. For biogas systems, despite a growing number of information campaigns, the most important communication channels are still neighbour-to-neighbour, local masons promoting biogas, and KENAFF local

7. See more at https://east-africa.hivos.org/activity/sustainable-and-secure-smallholder-systems-scale

staff. Carbon, on the other hand, is an 'invisible' product, passed to KENAFF in the carbon clause surrendering offset rights. There seems to be great uncertainty among farmers as to what happens from that point on, when the right to the carbon credit is transferred to KENAFF without a clear system for the farmers to benefit from creating these credits.

3.2.4 How much? Costs and benefits involved

This part of the business model summarises the main costs and benefits (see Figure 4, cost structure and benefits).

Benefits: for farmers who can buy a digester the benefits are clear and tangible: improved health and time savings through using biogas, and increased fertility and agricultural productivity from using bioslurry.

Benefits to the farmer from carbon offsetting are less clear. When subsidies were available for biodigester installation farmers saw them as linked to carbon finance – although they were in fact sourced from official development assistance (ODA) – and this subsidy has now ended. Only negligible amounts of revenue from carbon offsets would be earned by individual biodigesters, especially taking into account the transaction costs of accessing international markets and the logistics of linking small, scattered farms. With a carbon price of €2–5 per verified offset (VER) and 5–6 VERS per digester per year, each digester only generates €10–30 per year in offsets. Hivos therefore proposes pulling these revenues together into a carbon fund (see Figure 6), rather than making small direct payments to each farmer. This fund would contribute to the creation of a client service centre, to provide information and technical assistance for biogas and bioslurry production, ensuring the long-term viability of the programme. KENAFF is also considering giving direct incentives to masons for each biodigester installed. For this to work in practice, the carbon fund must be established with a legal basis that ensures revenues from carbon are ring-fenced to benefit those whose activities reduce carbon emissions.

Costs: As is often the case with new technologies, the initial costs of installing a biodigester are high and not all farmers are able to afford them. Despite efforts being made to bring costs down, biodigester installation – and the zero-grazing system required to keep the cattle – is expensive, especially for poorer farmers; the average cost is KSH75,100, or roughly €780. The subsidies available in the first and second stages of the programme covered roughly 30 and 20 per cent respectively of the average cost of a biodigester (see Table 1), and had to be topped up with the farmer's savings or a bank loan. With the ending of the subsidy from 2014, the gap has widened between what households can contribute and the market cost of a biodigester. Currently there is only a small incentive to encourage masons' participation, equivalent to KSH5,000 (€4.5) per ten biodigesters installed.

TABLE 1. COSTS AND INCENTIVES OF BIODIGESTER INSTALLATION

COST OF BIODIGESTER FOR FARMER		IN KENYAN SHILLINGS 75–100,000	IN EUROS 670–890	% OF TOTAL INSTALLATION COSTS (APPROXIMATE)
Farmer subsidy	Mid-2009 to mid-2013	25,000	223.20	29%
	June 2013 to end of 2013	18,000	160.70	21%
	From 2014	0	0	0%
New incentive for masons		5,000 per 10 digesters	4.50	0.6%

Source: authors' own

It is not easy for farmers to get credit to cover the cost for biodigester installation. Interviews on the ground suggest that SACCOs are unlikely to offer sufficient credit for a biogas system, as their main remit is to provide microfinance for lower-income households. While there is consensus that, in contrast to other African countries, most farmers in Kenya have access to finance (Sikka, 2014), though not necessarily to bank credit – in most cases they must be able to demonstrate some sort of cash flow to guarantee these loans.

The recurrent costs of running a biogas system include maintenance (relatively low if installation is good), interest on loans, and the time and effort needed to work the digesters at the required standard. There will also be transaction costs for monitoring and verifying carbon offsets, which for farmers currently means time spent on programme-related activities and communicating with visitors (such as inspectors and for promotional purposes) although this does not amount to much time.

We revisit the main findings of the farmers' business model highlighted in Figure 4 in the conclusions section of this report.

FOUR
THE BUSINESS MODEL FOR THE BIOGAS PROGRAMME

We now apply the Business Model Canvas to Kenya's biogas programme as a whole. What are the key elements needed to upscale Kenya's biogas programme – particularly its PES or carbon funding component? Without going into as much detail as the farmers' business model, we continue to focus on *what*, *how*, *who* and *how much*: the biogas programme's 'value proposition', the resources available, the targeted customers and channels to reach them, and the cost/revenue structure of the proposal. This allows us to highlight the opportunities, and potential bottlenecks, of PES in the biogas project.

Figure 6 summarises the main stakeholders and relationships, which are discussed in more depth below.

4.1 WHAT IS THE VALUE PROPOSITION OF KENYA'S BIOGAS PROGRAMME?

The African Biogas Partnership Programme aims to build 100,000 domestic **biodigesters** in Burkina Faso, Ethiopia, Kenya, Tanzania and Uganda by 2017. At the time of writing in April 2015, 42,142 biodigesters have been installed (ABPP, 2014).

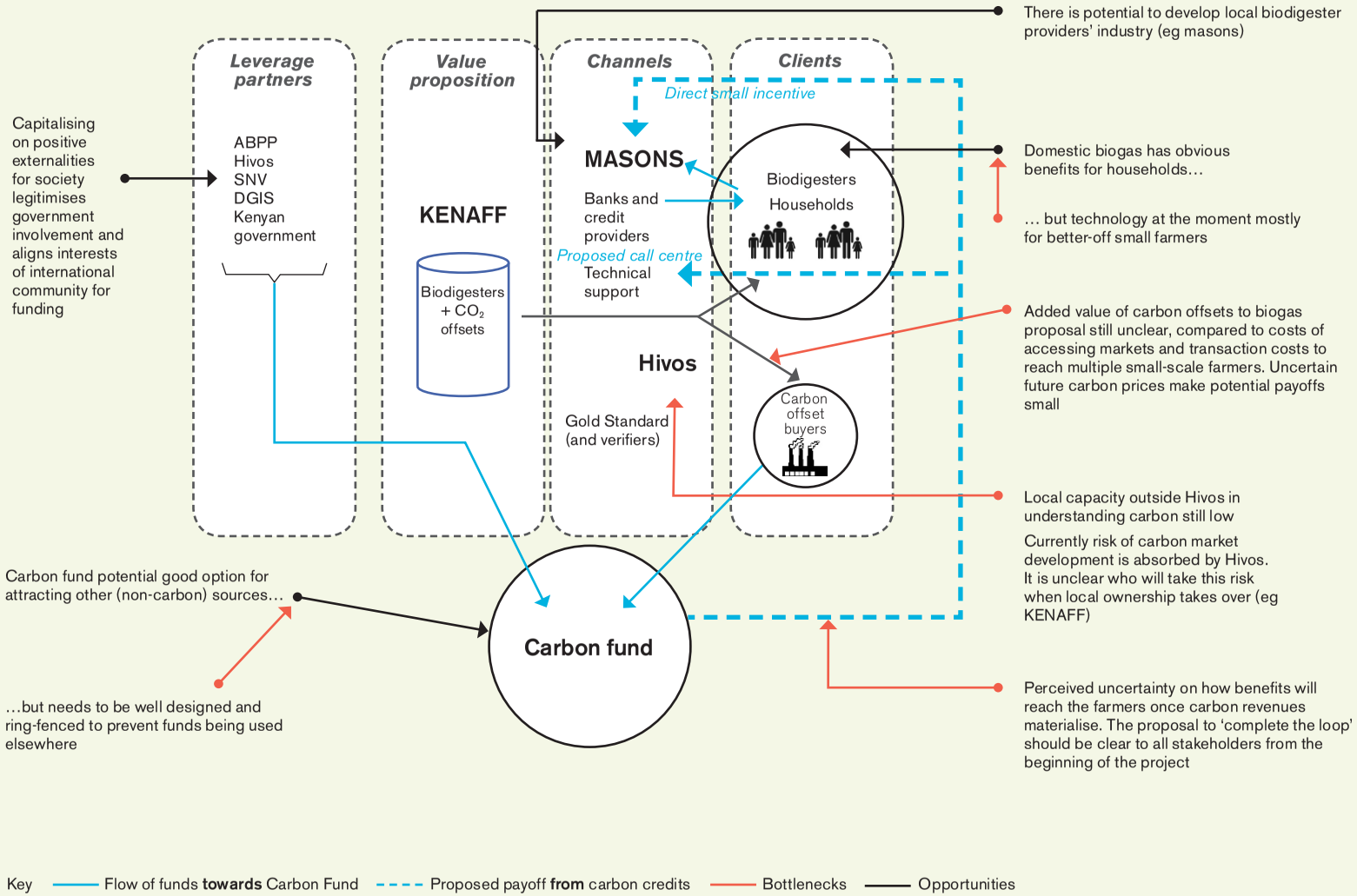
In Kenya, KENDBIP and KENAFF are in charge of the day-to-day management of the domestic biogas programme, excluding the carbon component. Their objective is to establish a sustainable and commercial domestic biogas sector in Kenya. They seek to achieve this by strengthening the institutions that will support the development of the sector, ensuring the continued operation of all domestic biodigesters installed under the programme, and optimising benefits for farmers that are currently under-developed. KENDBIP's target is to install 54,500 biodigesters by 2017, in the following phases:

- Phase 1 (2009–2013): install 11,000 digesters, with some subsidies for households.
- Phase 2 (2014–2017): install 27,500 digesters, without household subsidies (although there are proposals to subsidise masons).
- Through 4S@Scale: install 16,000 digesters, without direct household subsidies.

Carbon offsets: with each biodigester offsetting an average of 5.2 tonnes of carbon dioxide per year over their lifetime (28 years), the carbon saved over the lifetime of the ABPP project across the region is estimated at more than 14.5 million tonnes.[8] Upscaling on a large scale will be necessary to translate these figures into meaningful revenues for the domestic biogas sector.

8. 5.2 tonnes per biodigester over 28 years: 145.6t. For 100,000 biodigesters: 14.56 million tonnes.

FIGURE 6. UPSCALING THE BIOGAS AND CARBON MODEL IN KENYA



Notes: Potential opportunities in **black** and potential bottlenecks in **red**.

4.2 HOW IS VALUE CREATED? PARTNERS AND RESOURCES

Resources for the programme across ABPP's countries, including Kenya, come from a variety of partners:

- **Funding** – Ministry of Foreign Affairs of the Netherlands (DGIS)
- **Capacity building and knowledge management** – SNV
- **Programme and funding management** – Hivos
- **Promoting biogas technology among coffee farmers** through 4S@Scale in a parallel programme – Ecom Agroindustrial Corporation (via their subsidiary Sustainable Management Services)
- **Providing strategic, operational and technical support**, as well as funding for some incentives – KENDBIP
- **Formal accreditation of carbon offsets –** the Gold Standard

The programme in Kenya also relies heavily on KENAFF's networks and local offices across the country. A steering committee includes, among others, the Ministry of Energy, the Association of Biogas Contractors of Kenya, the Ministries of Agriculture and Livestock Development, the Energy Regulatory Commission of Kenya, the Kenya Renewable Energy Association (an NGO), the National Biogas Users Association, academics, and a representative from the private sector. Finance for the initial stages has come mainly from DGIS, and Hivos is working on engaging the Kenyan government to contribute as well.

Hivos plays a key role in the development of the biogas carbon component in the five ABPP countries. Its role is twofold: as a facilitator, it provides services to help KENAFF access international carbon markets, and as a broker, it engages directly in the marketing of carbon credits, while creating local capacities and partnerships to eventually transfer this role to local partners (ie KENAFF).

4.3 WHO ARE THE CUSTOMERS?

4.3.1 Biodigesters: customers and channels

For biodigesters, the customers are ultimately the **farming households** who buy them from contractors or masons. KENAFF works with the masons as extension service providers and credit providers (although credit is the household's responsibility). With the assistance of their technical and administrative staff, as well as an increasing network of implementing partners, KENAFF provides strategic support to the development of the biogas sector in Kenya. This includes:

- biogas promotion and marketing
- digester quality control and management
- user training
- sector actors capacity development
- research and development
- development of a conducive environment for a commercially viable biogas sector
- technical support via extension partners
- documentation and contract management
- database management
- conducting annual surveys to monitor firewood use.

4.3.2 Carbon offsets: customers and channels

KENAFF holds the legal rights to carbon offsets via a clause in the farmer's contract, which is signed when the biodigester is installed. KENAFF then transfers these rights to Hivos, which acts as a wholesale intermediary for carbon offsets in international markets.

The main buyers of carbon offsets include **individual buyers**, **voluntary offset buyers** and **organisational buyers**. Organisational buyers can be governments or NGOs. They might also be businesses such as Royal Dutch Airlines (KLM), via purchase, marketing or corporate social responsibility managers seeking to purchase offsets from the biogas programme to maintain or enhance its reputation, or as part of employee engagement and/or marketing differentiation. The main **channels** for reaching these customers are through partnership programmes with retailers such as the Climate Neutral Group and My Climate.[9]

Hivos is also exploring the potential of reaching coffee buyers through '**insetting**' activities[10] which allows coffee buyers to purchase carbon offsets produced within their own value chains, in order to offset emissions from their own commercial activities, such as coffee roasting or shipping. Linking to value chains through insetting is limited to coffee producers, however, and a large proportion of farmers taking part in the biogas programme are subsistence or sell to local markets only. However, the insetting market is developing and, where high value commodities like coffee exist, active marketing may provide the domestic biogas programme with a potential revenue channel for carbon offsets.

Agriculture and dairy value chains will be important in supporting the biogas and bioslurry components, for example, by maximising opportunities for large businesses in formal value chains (such as the Kenyan Cooperative Creamery) to help build farmers' capacity (via training); provide more opportunities for farmers to sell their produce; or act as potential sources of credit for purchasing biodigesters.

4.4 HOW MUCH? COSTS AND BENEFITS INVOLVED

This section focuses on the costs and expected benefits of upscaling the biogas programme, especially carbon sales.

4.4.1 Benefits

Income streams to finance the programme and subsidise installations have primarily relied on donor funding, mainly from DGIS, in the expectation that the government's participation will increase. Creating and maintaining partnerships is seen by all stakeholders as key to guaranteeing financial sustainability beyond relying on international ODA funding (see Figure 2).

The expected revenues from carbon trading for biodigesters is shown in Figure 7. Potential revenues from carbon sales are heavily dependent on market prices, and the costs of obtaining certification in order to benefit from those prices. According to Forest Trends State of Carbon Markets in 2014, energy efficiency and fuel switches (including biogas) constituted only 6 per cent of voluntary credits in 2014, compared to 45 per cent for forestry and land use and 31 per cent for renewables (Goldstein and Gonzalez, 2014). International markets for carbon offsets have been slow in developing, partly due to technicalities, but also due to confusion over approaches like REDD+ and the participation of the public sector.

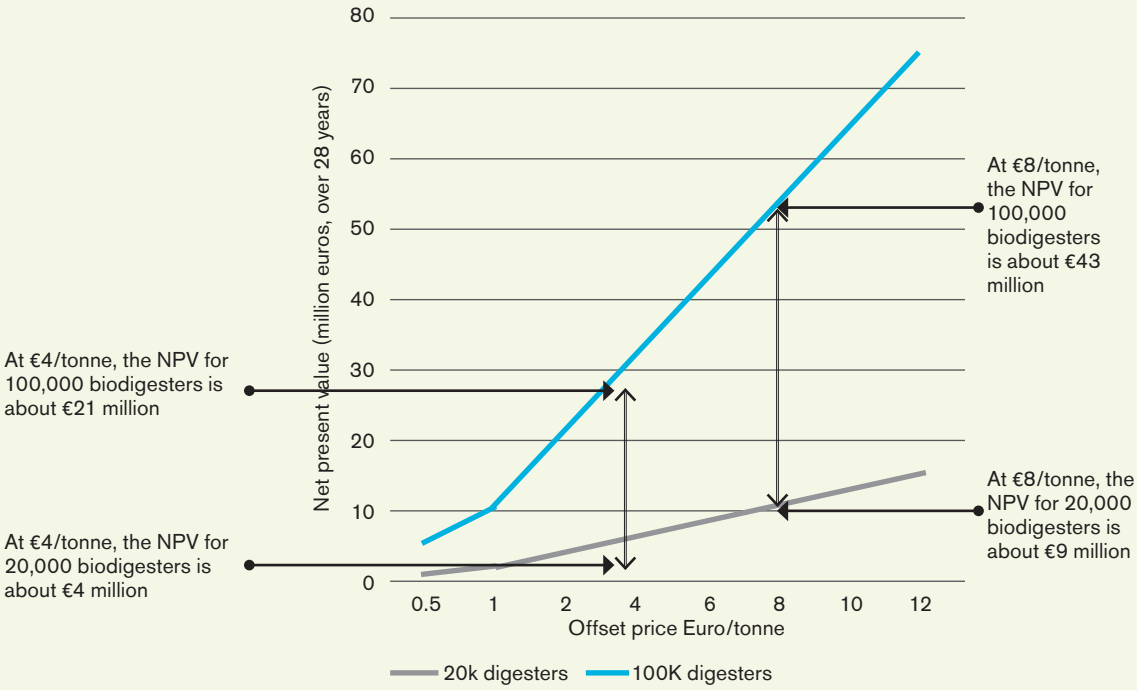
Most voluntary REDD+ offset credits are priced between US$3 and US$6 per tonne, and biogas projects at roughly US$9 per tonne. But with offset credits from non-voluntary compliance markets currently priced below US$1 per tonne and with competition from large-scale projects (large hydroelectric schemes, for instance) it is essential that smallholder-based projects focus on product differentiation, and have strict control of transaction costs.[11]

9. See eg http://climateneutralgroup.com/en and www.myclimate.org

10. See online video on *Insetting* here: https://www.youtube.com/watch?v=DtIMTAbqHh8 and https://www.youtube.com/watch?v=MaORMXMkG6Y

11. For example, this United States Department of Agriculture paper links herd size, carbon price and profitability of biodigesters in the USA: www.ers.usda.gov/media/132205/eb16.pdf

FIGURE 7. EXPECTED REVENUES FROM CARBON TRADING



Source: authors' own, using information supplied by Hivos.

Notes: net present value (NPV) for 10% discount rate over 28 years. The numbers in the figure are indicative only (ie they assume no change in future prices) but the graph shows the dependence of expected revenues on carbon prices, and the need to consider the relationship between fixed costs and revenues when upscaling the biogas programme.

4.4.2 Costs

The estimated cost of running the African Biogas Partnership Programme programme until 2017 is €87.9m (ABPP, 2014), 61 per cent of which is assumed will come from households (when they purchase the biodigester), 23 per cent from DGIS, 8 per cent from local government and 8 per cent from other donors. The financial sustainability of the programme will depend on a coordinated effort between these different sources, and the ability to access other funding sources – like PES or carbon finance.

Because carbon offsets are a by-product of the biogas programme, it is difficult to disentangle which costs are incurred by the carbon component alone. Much of the auditing and monitoring of the biogas programme is carried out by KENAFF in order to monitor the carbon component. Apart from these programme management costs, most of the costs associated with carbon are for certification and accessing international markets. A summary is presented in Table 2. One-off costs range between €60,000 and €130,000 and annual costs between €18,000 and €36,000. There are also costs to pay per offset unit, such as the Gold Standard registration fee at €0.222 per verified offset (VER). Transaction costs therefore absorb at least 40 per cent of market value.

Any subsidies (for instance to farmers or masons) should also be considered costs for the ABPP. Although the initial subsidy of €160 or €223 per digester (the subsidy varied depending on the size of the biodigester) was funded through donors, it was sometimes interpreted by the farmers as an ex-ante payment for carbon offsets – a wrong assumption creating the expectation that carbon payoffs would be a similar amount to the initial subsidy. This kind of expectation must be addressed in the design of a transparent revenue-sharing strategy.

As it currently stands, the risk of developing and accessing carbon markets is being borne entirely by Hivos. It is unclear who will take on this risk when the work of engaging with carbon markets passes to local ownership. The existing funding stream has also relied heavily on donor funding, although the aim is to shift towards a blend of public and carbon finance for years 5 to 10 of the programme, and eventually to end dependence on ODA. However, the phased shift from ODA has not functioned as planned. The removal of the subsidy for biogas is making the technology less accessible and other stakeholders who were expected to assist with extra funding have not.

TABLE 2. COSTS OF CARBON CERTIFICATION IN DOMESTIC BIOGAS

TYPES OF CARBON CERTIFICATION COST		RANGE	
Registration (one-off cost)	Elaboration of PoA-DD, VPA-DD and GS documents (PoA Design Consultation Report, Local Stakeholder Consultation Report, PoA Passport, VPA Passport), including validation support for the above	€40k	€65k
	Validation fees for DOE	€10k	€40k
	GS registration fee	€0.222/VER	
Inclusion of additional VPAs (one-off)	Elaboration of one VPA-DD, and validation support	€5k	€10k
	Inclusion fees for DOE	€5k	€15k
Monitoring and Issuance	Elaboration of Monitoring Report & verification support	€10k	€20k
	Verification fees for DOE	€8k	€16k
	GS issuance fees	€0.222/VER or 2% of issued VERs	

Source: Gold Standard, Climate Focus (Galt, 2014).

Notes: DOE – designated operational entity; GS – Gold Standard; PoA – Programme of Activities (a modality of project development under the UNFCCC CDM; VER – verified offset; VPA-DD – Programme of Activity Design Document Micro-Scale Voluntary Project Activity.

In addition, at the project's outset, the price per offset was predicted to be US$14/ton in compliance markets – in reality, it is closer to US$2/tonne, which is insufficient to replace the subsidy if the aim had been to use carbon funding to subsidise the technology once donor funding ceased. Anecdotal evidence during our field work points to the fact that the withdrawal of the subsidy, with little expectation of replacement using carbon funds, has given the biogas market a severe shock.

4.5 CREATING A CARBON FUND

A significant proposal by KENDBIP/Hivos for the programme at national level is to create a 'carbon fund', drawing together the different organisations into a financial partnership and pooling revenues from carbon offsets. This carbon fund could channel resources back towards the carbon offset providers: the farmers. Because of the high transaction costs and low carbon offsets per biodigester, the idea is not to transfer small cash payments to farmers, but to finance a 'client service centre' to provide technical assistance to farmers for biogas, bioslurry, as well as potential sources of credit and market opportunities for their produce. The fund could also offer incentives to masons to promote the expansion of local market providers and, eventually, to bring down the cost of biodigesters. This is expected to contribute to the long-term viability of domestic biogas in Kenya, and to make generating carbon offsets sustainable.

Although it is too soon to say, the withdrawal of the farmers' subsidy from 2014 will undoubtedly have had an immediate impact on the ability of poorer farmers to access the technology, taking it further out of their reach. Even when a subsidy to cover 30 per cent of the installation cost was available, only the wealthier smallholders were able to make use of it. And based on current estimates of revenues from carbon offsets, it is clear that a carbon fund would not be able to provide enough in subsidies to make a meaningful contribution towards the installation of biodigesters. Biodigesters can provide many benefits to relatively poor small farmers through cleaner technology. For this to happen, some form of subsidy will be needed and it is unlikely to come from carbon sales. As demand grows, and more research and development take place, the price of the technology is likely to become more accessible to poorer households – assuming that greater demand on construction materials does not increase it.

FIVE CONCLUSIONS

We have analysed Kenya's biogas programme from several different angles and used a number of different tools to examine the value chains and business models of individual farm households and for the biogas programme as a whole. The picture that emerges is complex, with potential opportunities and obstacles both for the development of Kenya's biogas sector and the contribution that PES can make to it. PES could benefit and support the sector as a whole, within certain parameters, if carbon revenues (and stakeholders' expectations) are managed carefully. Our findings and recommendations follow.

5.1 MAIN FINDINGS

5.1.1 Environmental and social benefits of biogas

The dairy cow biodigester system at the heart of Kenya's national biogas programme is a highly effective 'green' technology, both in terms of its primary product (biogas) and its by-product (bioslurry). It can drive radical improvements in quality of life, both in the home and via the farm enterprise. Biogas's climate-friendly technology is demonstrated by three of its impacts: avoiding deforestation (using less firewood and charcoal by switching to biogas), avoiding the use of chemical fertilisers (by switching to bioslurry), and higher crop productivity (by fertilising with bioslurry). There are also strong positive impacts on health and time savings, especially for women.

5.1.2 A viable technology for the smallholder

Domestic biogas clearly benefits those smallholder farmers with access to some basic capital, with similar results to those found in cookstove projects in Kenya (Lambe *et al.,* 2015). The technology is viable for smallholder farmers who have some basic resources: two cows in a zero-grazing system, a two-acre smallholding, and access to funding to install the biodigester. From field observation, it seems that the technology also requires the farmer (or wage labour) to be present, in order to fine-tune the system and ensure the continuous use of bioslurry, which is key to recouping the investment in the digester. This means that it may not suit part-time farming.

As it stands, domestic biogas is not yet able to benefit the poorest farmers; but this should not diminish its importance for the development and resilience of smallholder farming in Kenya. Also, as demand grows it is expected that the technology will get cheaper, allowing poorer famers to benefit as well.

5.1.3 A carbon fund

Potential income for individual farms from PES via the carbon market is fairly trivial, at least when calculated as avoided deforestation from reduced use of firewood or charcoal. With a carbon price of €2–5 per verified offset (VER) and 5–6 VERS per digester per year, each digester only generates €10–30 per year in offsets. Aggregating offsets at higher levels (such as district, national or regional) is probably the only way to capitalise on carbon sales and recoup the transaction costs involved in accessing these international markets. The fund may also allow for pooling funds from different sources (markets, governments, investors, donors, carbon-offset buyers) and across time (eg future carbon sales).

Creating a carbon fund which could pool funds from carbon sales and other sources – such as national government and donors – could help to ensure long-term financial sustainability of the

A cookstove run on biogas © I Porras

domestic biogas programme. Besides keeping better control of transaction costs through bulking and trading, it will be able to investigate time-linked transactions such as retrospective emissions (from digesters installed before the certification process was concluded), and/or aggregate future multi-year VERs. In the case of Kenya biogas, depending on carbon prices, a fund that contemplates future VERs plus two years retrospective VERs could generate significant amounts of funding (see Figure 8 for examples of potential revenue streams). This fund could then channel benefits back to the country, for example as technical support via a client service call centre (see below) or by providing subsidies to masons to increase the local supply of improved biodigesters. The fund may potentially be used to seek matching funding from other sources, like donors, in order to reinstate some level of subsidy for biodigesters directly to farmers to help with capacity building/long-term support. However, it needs to be designed carefully to prevent the leakage of funds towards other activities.

5.1.4 Upscaling the biogas programme

The idea of using the carbon market to expand the reach of technology to poorer farmers is sound in principle. But in practice, carbon finance will only go a small way towards bridging the gap left by the withdrawal of the direct subsidy (Figure 5), which represented about 30 per cent of the total cost to farmers. Thus the withdrawal of subsidy and shift to carbon-based funding is taking the Kenyan biodigester market in the opposite direction – towards the top of the pyramid, further out of reach of all but the wealthier smallholders. The phased shift from ODA has not worked as planned, and the subsidy's withdrawal appears to have given the biodigester market a severe shock (although interviews with installers or masons would be needed to back up this observation). Importantly, ABPP's Phase 2 subsidy could only fund a form of technical insurance or de-risking to ensure that biodigesters will be operational after the first year. This loss of subsidy to farmers must be addressed; as suggested above, a carbon fund might be able to reinstate some level of subsidy, but only if donors or government can provide matching funds.

5.1.5 Carbon revenues reaching the farmer

Currently the emphasis of the carbon component has been to set up the carbon segment of the value chain (see Figure 3), rather than providing direct value to individual farms. This emphasis is understandable given that the 'project' is responsible for aggregating carbon offsets and interacting with the carbon market. But it is a temporary structure that should eventually be subsumed into the market. Seeing it as a project makes it more challenging to establish a direct link to farmers – who are the actual producers of carbon savings. It also creates governance problems for KENAFF who have to explain to their farmer members why the flow of carbon finance back into Kenya stops with KENAFF rather than the farm or the producer organisation, and why farmers have to sign away their carbon rights.

Our analysis suggests that PES as carbon finance will continue to only make a weak contribution to biodigester technology in mixed Kenyan smallholder agriculture – unless a carbon fund is created, along with direct clear benefits to farmers such as a client service call centre. As we saw earlier, farmers misinterpreted the initial subsidy for biodigester installation as a carbon payment, distorting their expectations of future revenue from carbon offsets. More work will be needed to improve the fairness (perceived and real) and transparency of carbon revenues reaching farmers with biodigesters. Whatever form these benefits take – such as a service call centre – farmers will need clarity from the moment they enter the project about what happens to their carbon credits and how are they going to benefit from them.

5.1.6 A client service call centre

The idea of a 'client service call centre' with long-term funding provided by the carbon fund is a good one, as 'light-touch' institutional support. Biogas installation is entirely market-driven and installers are the central actors. It would match market demand with supply, ensure users receive training and ensure quality of installation, promotion, cost reduction (such as testing alternative technologies), resources for customers, and improved access to bank credit (since SACCOs are not appropriate for funding biodigesters).

5.1.7 Carbon insetting within the value chain

In some cases, carbon offsets can be targeted to buyers alongside valuable cash crops (such as coffee or tea) through 'insetting'. Within a mixed farm system, or with products aimed at the local market, there are limited opportunities to inset carbon payments. But a high-value cash crop, such as coffee, with a traceable chain to an international buyer allows far better opportunities: the buyer (trader and/or processor) can offset the emissions of their processing facilities or transport, for instance, by channelling carbon payments back to their own grower-suppliers, or to the growers' cooperative. The transaction could be in the form of a price premium (similar to Fairtrade premiums), and be paid back directly to the farmer or by reinvesting at the cooperative or community level.

A farmer removes the cover of his biodigester for a routine maintenance check © I Porras

5.1.8 PES for bioslurry?

The potential benefit of bioslurry in adding value to the farm enterprise needs more research, as this could strongly boost interest in biogas. The onsite benefits to the farmer are clear, and effective within a short time of installing the digester. There is potential to consider PES for using bioslurry, given its impact on ecosystem services: it reduces the use of chemical fertilisers and has a positive impact on organic agriculture (see the report on PASCAFEN's PES experiences in Nicaragua in this series), but is not yet quantified within any PES scheme. This 'externality' – or beneficial by-product of biogas production, which is not reflected in a payment to the farmer – will require more work for farmers to be able to benefit from it, such as clarifying who (or what) the new 'clients' or beneficiaries of the externality will be.

More work will be necessary to improve the fairness (perceived and real) and transparency of carbon revenues reaching the farmers who install the biodigesters resulting in carbon credits. Independently of the form these benefits take – eg through the proposed call centre – stakeholders need clarity from the moment they enter the project on what happens to their carbon credits and how are they going to benefit from them. This will be difficult, as the initial subsidy created an *ipso facto* distortion in the expected carbon payoffs, as it was interpreted by farmers as carbon payment. Within the existing carbon market outlook, it is unlikely that sales of carbon offsets will generate any meaningful revenue to individual farmers. However, pooled together, these revenues can be used to provide long-term support for the use of biodigesters.

REFERENCES

ABPP (2014) Africa Biogas Partnership Programme website. See: http://africabiogas.org

BIF (2011) What is 'inclusive business'? Briefing Note 1, Business Innovation Facility (BIF) and Innovations Against Poverty (IAP). See: http://tinyurl.com/bif-2011-inclusive-business

Biogas for Better Life (2007) Promoting biogas systems in Kenya: A feasibility study. http://kerea.org/wp-content/uploads/2012/12/Promoting-Biogas-Systems-in-Kenya_A-feasibility-study.pdf

CIAT (2012) LINKing smallholders: a guide on inclusive business models. See: http://dapa.ciat.cgiar.org/linking-smallholders-a-guide-on-inclusive-business-models

Coase, RH (1960) The problem of social cost. *Journal of Law and Economics* 3, 1–44.

Elkington, J (1994) Enter the triple bottom line. In: Richardson, AHJ (ed.) The triple bottom line: does it all add up? Assessing the sustainability of business and CSR. London, Earthscan.

ESMAP (2013) Results-based financing in the energy sector. The International Bank for Reconstruction and Development, Washington DC. See: www.esmap.org/sites/esmap.org/files/FINAL_Results-Based Financing in the Energy Sector_TR004-13_Short1.pdf

Ferraro, PJ (2009) Regional review of payments for watershed services: sub-Saharan Africa regional review of payments for watershed services. *Journal of Sustainable Forestry* 28, 525–550. See: www.fao.org/fileadmin/user_upload/kagera/resource/Ferraro%20PES.pdf

Galt, H, personal communication with authors, December 2014

Global Value Chains Initiative (2014) Concept and tools. See: https://globalvaluechains.org/concept-tools

Goldstein, Allie and Gonzalez, Gloria (2014). Turning over a new leaf: State of the forest carbon markets 2014. Forest Trends' Ecosystem Marketplace, Washington DC. www.forest-trends.org/publication_details.php?publicationID=4770

Henderson, C (2014) Insetting: a user guide. Plan Vivo Foundation, Edinburgh, UK. See: http://planvivo.org/insetting/wp-content/uploads/2014/12/InteractiveManual.pdf

KENAFF (undated) Kenya National Farmers' Federation (KENAFF) website. See: www.kenaff.org/node/30

Kossoy, A, Oppermann, K, Platanova-Oquab, A and Suphachalasai, S (2014) State and trends of carbon pricing. World Bank Group, Climate Change, Washington DC. See http://documents.worldbank.org/curated/en/2014/05/19572833/state-trends-carbon-pricing-2014

Lambe, F *et al.* (2015) Can carbon finance transform household energy markets? A review of cookstove projects and programs in Kenya. *Energy Research & Social Science* 5, 55–66.

Lundy, M, Becx, G, Zamierowski, N, Amrein, A, Hurtado, JJ, Mosquera, EE, Rodríguez, F (2012) LINK methodology: a participatory guide to business models that link smallholders to markets. International Center for Tropical Agriculture (CIAT), Cali, Colombia. See: http://dapa.ciat.cgiar.org/link-methodology-version-2-0/

Marc, J (2014) personal communication with authors, November 2014.

MEA (2005) Ecosystems and human well-being: biodiversity synthesis. Millennium Ecosystem Assessment, Washington DC. See: www.unep.org/maweb/documents/document.354.aspx.pdf

Nagayets, O (2005) Small farms: current status and key trends. Background paper prepared for the Research Workshop on the Future of Small Farms, Wye, UK: IFPRI, Imperial College and the Overseas Development Institute.

Ngigi, A (2013) Kenya National Domestic Biogas Programme: Programme Implementation Document 2009-2013. Integral Advisory Limited. See http://tinyurl.com/lvllfyx

Pagiola, S and Benoit, B (2009) Estimating the costs of REDD at the country level. Forest Carbon Pagiola, S and Bosquet, B (2009) Estimating the costs of REDD at the country level. Washington D.C: Forest Carbon Partnership Facility, World Bank. See: http://mpra.ub.uni-muenchen.de/18062/1/MPRA_paper_18062.pdf

Pattanayak, SK, Wunder, S and Ferraro, P (2010) Show me the money: do payments supply environmental services in developing countries? *Review of Environmental Economics and Policy*, 1–21. See: www2.gsu.edu/~wwwcec/docs/Pattanayak%20et%20al%20REEP%20Online%202010.pdf

Pigou, AC (1920) The economics of welfare. MacMillan and Co, London. See: https://archive.org/details/economicsofwelfa00pigouoft

Porras, P, Grieg-Gran, M and Neves, N (2008) All that glitters: a review of payments for watershed services in developing countries. IIED, London. See: http://pubs.iied.org/13542IIED.html

Sikka, M (2014) Personal communication with Marc Sikka, November 2014.

Suich, H (2012) Conceptual framework: poverty. London: ESPA, DFID, ESRC, NERC. See: www.espa.ac.uk/files/espa/ESPA-Poverty-Framework.pdf

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THE KENYA NATIONAL DOMESTIC BIOGAS PROGRAMME

CAN CARBON FINANCING PROMOTE SUSTAINABLE AGRICULTURE?

The Kenya National Domestic Biogas Programme promotes the installation of biodigesters in agricultural smallholdings across the country. Biogas provides on-demand energy in the home and is demonstrably better for the environment as it reduces dependence on firewood, and better for health as a smokeless fuel. It also qualifies for payments for ecosystem services (PES) in the form of carbon offsets. Can carbon finance therefore play a role in upscaling the biogas industry to allow more, and poorer, households to participate? Or are the returns too low, especially given the transaction costs involved? And how can farmers benefit directly? This report examines the value chains and business models involved in the biogas programme to see what contribution carbon finance can make – if any – to growing Kenya's domestic biogas industry.

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