THE INDONESIA DOMESTIC BIOGAS PROGRAMME

Can carbon financing promote sustainable agriculture?

BILL VORLEY, INA PORRAS AND ALEXANDRA AMREIN – 2015

SHAPING SUSTAINABLE MARKETS

Hivos people unlimited

CIAT International Center for Tropical Agriculture Since 1967 Science to cultivate change

iied

First published by International Institute for Environment and Development (UK) in 2015

http://pubs.iied.org/16597IIED
ISBN: 978-1-78431-220-6

For further information please contact: International Institute for Environment and Development (IIED), 80–86 Gray's Inn Road, London WC1X 8NH, United Kingdom. newbooks@iied.org, www.iied.org/pubs

Citation
Vorley, B, Porras, I and Amrein, A (2015) The Indonesia Domestic Biogas Programme: can carbon financing promote sustainable agriculture? IIED and Hivos.

Designed by
SteersMcGillanEves
01225 465546

Laid out by
Regent Typesetting
www.regent-typesetting.co.uk

Cover photo credits
A farmer mixes cattle dung with water for use in the biodigester. The bacterial process breaks down the organic matter to produce biogas (fuel for cooking) and bioslurry (an organic fertiliser) © Lotje-Putman van der Bie
Bioslurry has a high value as an organic fertiliser in agriculture, as it produces better yields than regular manure © Josh Estey

Edited by
Clare Rogers with Holly Ashley

Series Editor
Emma Blackmore

Shaping Sustainable Markets
Shaping Sustainable Markets is the flagship research project for the Sustainable Markets Group at IIED. Can markets be 'governed' to better benefit people and planet? This project explores the individual and combined impact of market governance mechanisms on sustainable development to find out what works where and why. Some of these mechanisms are well established. Others are innovative ideas yet to be tested in the real world. We want to improve and broaden understanding of how market governance mechanisms can be designed and used to secure livelihoods and protect environments. Find out more about our work at shapingsustainablemarkets.iied.org.

We welcome your comments on this publication or other aspects of Shaping Sustainable Markets. Please contact emma.blackmore@iied.org.

Disclaimer
This paper represents the views of the authors and not necessarily those of IIED.

Acknowledgments
Sincere thanks to IDBP staff: Ibu Agi Cakradirana, National IDBP Deputy Programme Manager; in East Java: Pak Wasis (IDBP Provincial Coordinator), Christina Haryanto (Bioslurry Officer) and Retno Utami (Administration Officer); and in Lombok: Pak Umar (coordinator NTB and Bali) and Pak Krisna (Quality Inspector, Lombok). Thanks also to the government officials, business people, farmers, co-op leaders, CPOs and masons interviewed during the study. Special thanks to Lingga Tri Utama for unstinting support during the week, and for the excellent translation. Funding for this research comes from Hivos and UK aid from the Department for International Development. However, its conclusions do not necessarily reflect the views of the UK government or Hivos.

About the authors
Dr Bill Vorley is a senior researcher at IIED with over 30 years' experience of sustainability in agriculture and food markets.

Dr Ina Porras is a researcher at the International Institute for Environment and Development (IIED), with long-standing experience in markets for environmental services to tackle rural poverty in developing countries. Corresponding author: ina.porras@iied.org

Alexandra Amrein is a consultant for inclusive business models at the International Center for Tropical Agriculture (CIAT). She is co-author of the LINK methodology and contributed to its implementation and capacity building with different stakeholders.

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 partner 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.

THE INDONESIA DOMESTIC BIOGAS PROGRAMME

Can carbon financing promote sustainable agriculture?

BILL VORLEY, INA PORRAS AND ALEXANDRA AMREIN – 2015

BOXES

FIGURES

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

BIRU	Biogas Rumah – the Indonesia Domestic Biogas Programme
CDM	Clean Development Mechanism
CIAT	International Center for Tropical Agriculture
CPO	Construction partner organisation
CSR	Corporate social responsibility
DAK	Special Allocation Fund
DOE	Designated Operational Entities (DOEs) validate Clean Development Mechanism projects (see glossary) and verify the offsets that are issued to a project
IDBP	Indonesia Domestic Biogas Programme
LPG	Liquefied petroleum gas
MEMR	Ministry of Energy and Mineral Resources
NGO	Non-governmental organisation
NTB	Nusa Tenggara Barat
PES	Payments for ecosystem services
UNFCCC	United Nations Framework Convention on Climate Change
VER	Voluntary emissions reduction

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 partner 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.

In Indonesia we look at the **Indonesia Domestic Biogas Programme** (IDBP, locally known as 'BIRU') to understand the potential of carbon-offset funding in relation to smallholder agriculture. This is the second of two biogas partner studies, the first being Kenya, in which carbon offsets from avoided use of fuelwood and non-renewable fuel are being sold on the voluntary carbon market. This research looked at the IDBP in East Java Province and Lombok in West Nusa Tenggara Barat (NTB) Province – both leading regions for biogas adoption. The IDBP Programme works in close collaboration with the Indonesian Ministry of Energy and Mineral Resources via an implementation agreement.

The cattle biodigester system currently promoted in Indonesia is a highly effective 'green' technology, both in terms of its primary product (biogas) and by-product (bioslurry). It fits well into smallholder dairy systems in East Java and mixed farm systems in NTB where cattle convert organic waste from the farm to dung to feed the biodigester. The technology can provide radical improvements in quality of life, in the household and via the farm enterprise.

Subsidies are the key driver of adoption; the growth of biogas adoption to date has been incentivised by subsidies, and future adoption will likely have the same dependence on subsidies. At full price, farmers' perception is that the economics of digester use in most Indonesian smallholdings do not favour household investment in biogas technology, compared to other investments such as cattle. At the moment, the required investment at farm household level is quite high relative to farm assets.

Co-financing by the government is important but it is uneven in terms of proportion of the subsidy and patchy in terms of availability. Also, because it often aims at 100 per cent subsidy (partly in the name of empowering poorer farmers), government

programmes distort the market because there is less incentive for providers to keep costs down. Reaching poorer households will require more subsidy, not less. But applying 100 per cent public subsidies in the name of 'inclusion' puts the technology even further out of reach for the majority of farmers who fall outside of the limited subsidised schemes that are on offer.

There are signs of market saturation in East Java for some farmers, where the IDBP Programme has focused on working with dairy cooperatives that supply Nestlé's large milk processing operations in the Province. IDBP has found this relationship with Nestlé and its suppliers to be an effective way of reaching scale. But a return to growth in this region would depend on reaching beyond the Nestlé suppliers to poorer farmers who are not cooperative members.

Income from the carbon market had just started to arrive in 2015. Carbon income is low: the carbon saving per digester verified by a Designated Operational Entity[1] (DOE) and the Gold Standard is only 2.6 tonnes per year, which is lower than other similar projects.[2] Carbon savings are based only on the reduced consumption of firewood and kerosene for cooking; taking into account improved manure management and carbon sequestration in the soil through bioslurry use would add savings of 2.4 tonnes per hectare per year. Until the standard is changed, this low level of income puts any prospect of using carbon finance to subsidise installation of biodigesters out of the question. The project demonstrates that carbon PES can be used most efficiently as aggregated programme income, used by groups of farmers, rather than transfers to individual farm households.

Bioslurry is the main link between the IDBP and sustainable/improved smallholder agriculture. The environmental and agricultural benefits of bioslurry in the dairy system are constrained by the fact that many dairy cow owners do not have land, and much of the remaining farmers' pasture is too remote to justify transporting bioslurry to put it back into forage production. Improving the value of bioslurry, creating a market for dried slurry as fertiliser and feed (in aquaculture for example), and closing the nutrient cycle between animals and pasture, could be a very positive use of earmarked carbon finance. Developing a market for bioslurry as a new commodity is a major strategic challenge for the IDBP.

1. Designated Operational Entities (DOEs) validate Clean Development Mechanism projects (see the glossary) and verify the offsets that are issued to a project.

2. See http://pubs.iied.org/16588IIED.

ONE
INTRODUCTION – BIOGAS AND PES IN SMALLHOLDER AGRICULTURE

Better agricultural practices can help protect, enhance, or reverse degradation patterns in the provision of ecosystem services such as carbon, biodiversity conservation and protection of water quantity and quality (MEA, 2005). There is growing interest (but also a number of challenges) in developing financing mechanisms that try to **bring these ecosystem services into markets**, creating new incentives to promote behavioural changes towards more sustainable practices.

Payments for ecosystem services (PES) are one of these mechanisms. They are proposed as methods to provide extra funding: either to 'tip the balance' in terms of cost-recovery from switching to better practices at farm level, or as co-funding for upscaling 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 and offer wider lessons on the design and implementation of PES.

1.2 CASE STUDY: THE INDONESIA DOMESTIC BIOGAS PROGRAMME

The Indonesia Domestic Biogas Programme (IDBP) – also known as the BIRU (Biogas Rumah) programme[3] – aims to develop a market-based and sustainable biogas sector in Indonesia, and expand the use of biodigester technology by farmers for improved waste management to reduce greenhouse gas emissions in the livestock and dairy sectors.

The installation and management of domestic biodigesters provides multiple benefits to the household; for example better health, as a smokeless cooking fuel, and accessible energy. It also provides benefits to the environment, especially the reduction of greenhouse gas emissions from cleaner energy sources and natural fertiliser in the form of bioslurry (a by-product of the biogas process). Both of these processes – the production of biogas and bioslurry – generate carbon offsets, which can be sold in international markets.

3. See www.rumahenergi.org or www.biru.or.id (in Indonesian).

A woman using a cookstove fueled by biogas © Bill Vorley

The purpose of this study is to look at the value proposition emerging from the potential development of a carbon offset-based market as a way to promote more sustainable smallholder agriculture.

1.3 METHODOLOGY

We present a brief value chain map and description of the basic business model underlying the domestic biogas-carbon proposition. We used a combination of desk-based analysis, Skype meetings with experts, and a field visit to two (out of eight) provinces in Indonesia where IDBP is being implemented: East Java Province and West Nusa Tenggara Barat (NTB) Province, where implementation is focused on Lombok island. We carried out a number of semi-structured interviews and focus group discussions with IDBP staff; farmers, farmers' cooperatives; masons and construction partner organisations; provincial and district government officials; and a dairy processor.

In addition, findings from the latest biogas user survey was conducted with 177 respondents in nine provinces (including 107 in East Java and 25 in NTB) between December 2014 and January 2015, and this was useful for supplementary information (RPI Research, 2015). We also drew on a baseline impact evaluation survey conducted in 2012 by Bedi *et al.* We carried out a brief analysis of the value chain and 'Business Model Canvas' (as explained below) through a series of meetings with these stakeholders, a review of the existing literature (published and internal documents) and Skype interviews. This allowed a deeper, though not exhaustive, understanding of how PES and carbon shapes the farmers' decision-making process in relation to how they manage their farms.

1.3.1 Value chain mapping

We use CIAT's LINK methodology to explore the advantages and disadvantages that the new carbon markets offer to farmers in timber processes and how both business components complement each other. This requires an understanding of the different actors involved along the value chains linking to crop and timber industries in the area. This includes for example input providers, those dealing with processing and trading, as well as those associated with the newly created carbon chain. At the upstream end of the supply chain, the potential for carbon revenues to promote the participation of small-scale farmers involved in timber growing (our target group) will depend on the different actors' business models, 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 (eg costs associated with research and development, or those associated with reaching small-scale and scattered farmers).

1.3.2 Business Model Canvas

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 helps to understand how PES can aid/complement the main agricultural business model, or not. As a tool, the canvas

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 (ie 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 (ie legislation or laws) or informal (ie cultural practices) operating at diverse scales. These institutions affect not only the value chains of different products (eg coffee, dairy) but also the potential of PES as an economic instrument that affects producers' decisions.

Source: Lundy *et al.* (2012)

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.

These questions were used to create descriptions of the basic business models underlying the domestic biogas-carbon proposition, as shown in Figures 3, 4 and 5.

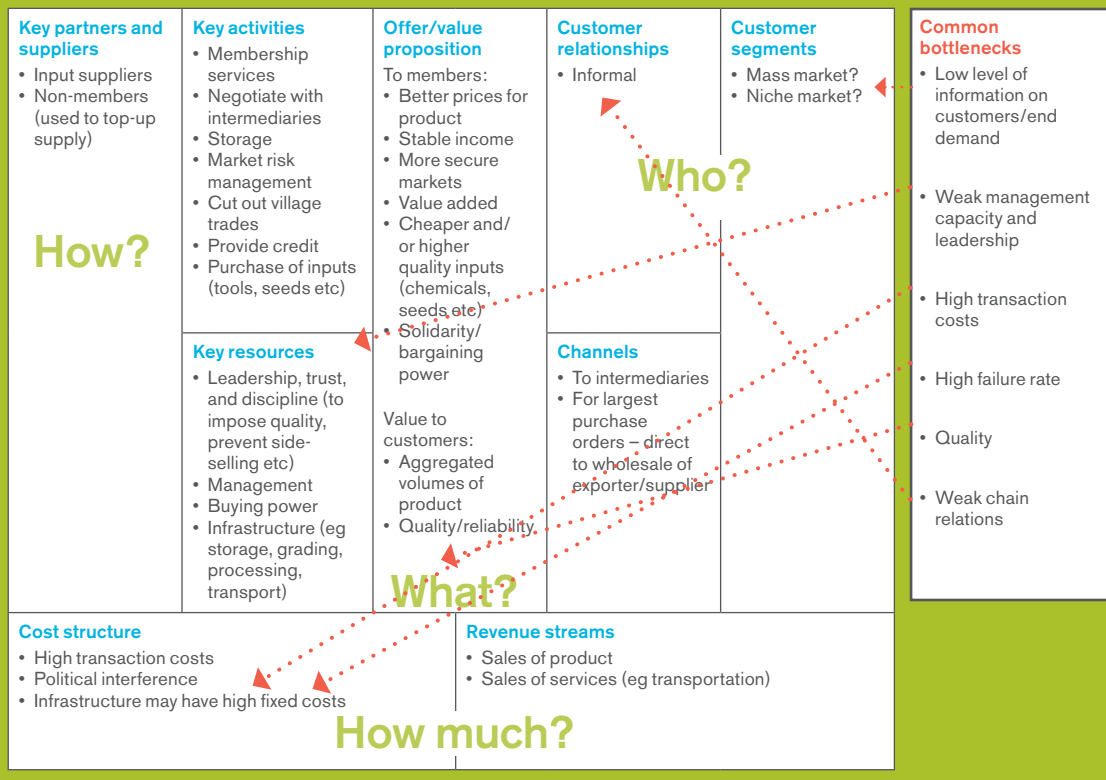
BOX 2. WHAT IS A BUSINESS MODEL CANVAS?

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).



TWO
THE DOMESTIC BIOGAS PROGRAMME IN INDONESIA

This section presents a summary of how the biogas domestic programme is evolving in Indonesia, and the key actors involved in its value chain. This sets the scene to understand how the carbon component enters the farmers' value proposition, as shown in Figure 1.

2.1 ACTORS INVOLVED

The Domestic Biogas Programme has been run by a local Hivos subsidiary, Yayasan Rumah Energi (YRE), since late 2013.[4] Hivos is the IDBP manager and YRE is the implementer, with provincial 'BIRU' (as IDBP is known) offices responsible for local implementation. SNV, an international not-for-profit development organisation,[5] supplied the design of the IDBP biodigester and provides technical support. It also advises on partner management, capacity building for the masons and supervisors who design and install the digesters, and knowledge dissemination with the Government of Indonesia.

The number of biodigesters installed has reached 14,478 across nine provinces (as of 19 March 2015). East Java's 6,990 units and Nusa Tenggara Barat's 2,921 units (including Lombok island) account for nearly three-quarters of installations to date. Of the 2014 target of 4,000 units, 2,861 were actually installed by the end of the year.

The cost of the IDBP Programme is around €1.7m per year, of which 33 per cent is used for subsidies for the biodigesters; 20 per cent for programme expenses such as promotion, quality management, institutional support, research and development, and training; and 47 per cent for human resources and management including biogas technical support, transportation and office expenses. In Phase 1 of the programme, from 2009 to 2013, the Dutch Ministry of Foreign Affairs (MFA) contributed €9m. Phase 2, from 2014 to 2016, has no MFA funds; during 2014 and the first half of 2015 it was supported by the Norwegian Embassy in Indonesia, as well as the Energizing Development Programme[6] managed by the German Society for International Cooperation. From late 2015 it is expected that funding will be provided by the Millennium Challenge Corporation. Phase 1 of IDBP had a target of 8,000 installations, and Phase 2 has a target of 26,000 installations.

Another source of development finance is Kiva,[7] which has run a crowd-sourced credit programme for biogas installation in Lombok since 2014. It channels credit to farmer groups via the construction partner organisations (CPOs), which is provided for a maximum of two years. Farmer profiles are presented on the Kiva website.

4. YRE was established in 19 November 2012. It is a 'foundation' in terms of its legal structure.

5. See www.snvworld.org/en/regions/world

6. Funding from a group of donors including Germany, the Netherlands, Norway, Australia, the UK and Switzerland. Covers provinces of Java only (West, Central, Yogyakarta and East Java) http://endev.info/content/Indonesia

7. See www.kiva.org

A farmer's plot in Indonesia © Bill Vorley

Before receiving the credit, the groups must strengthen their capacity in financial management. Zero interest credit for installation is also available to the dairy farmers who supply Nestlé in East Java, via a revolving fund organised as a public-private partnership between Nestlé and the IDBP Programme.[8] However, farmers – especially those with a small number of cows – report being wary of credit as opposed to subsidy, since they still have to repay the loan.

IDBP has maintained a constant level of subsidy for each biodigester installation of two million Indonesian rupiah (IDR; roughly equivalent to €140). In West Nusa Tenggara Barat Province there are two models for subsidies: one is IDR 2.5 million (€175) when the user receives no extra contribution from government, and the other is IDR 2 million, and a minimum of 30 per cent contribution from the user when there is co-finance from a third party. The subsidy also provides an important control mechanism for IDBP to monitor the quality of construction partner organisations.

Biodigesters are not cheap. A six cubic metre digester costs in the region of IDR 7.5–8 million (€525–560) to install – a major outlay for farm households. Construction material costs have increased since the introduction of the programme, resulting in increases in installation costs. Because the level of subsidy has remained constant, this means that the proportion that the farmer has to pay has increased over time. Of the IDR 2 million subsidy from IDBP, IDR 1.7m is used to support installation, and the remaining IDR 300,000 to cover two inspection visits from IDBP. IDBP also conducts random quality checks on 30 to 40 per cent of installations.

8. Nestlé (which has 30,000 milk suppliers) is motivated to promote biogas for environmental reasons, so if there are real or potential environmental issues with biogas, they are keen to intervene. Their local directors have ambitions of rapid growth of adoption (ie installations in the thousands).

Hivos works with construction partner organisations[9] (CPOs), which may be new or existing organisations. In East Java the 14 CPOs are a mix of masons' groups, NGOs, private construction companies, and cooperatives. In Lombok they are mostly NGOs, with a focus on empowering farming households in the dryland context, or with a focus on environment. The number of CPOs under IDBP has dropped from 89 to about 59 as poorer performers have left the market. Each CPO has a territory; IDBP has a policy to not let two CPOs operate in the same area. Some are very successful in terms of number of biodigesters installed, such as Yayasan Sumberdaya dan Lingkungan untuk Pelestarisn Pembangunan (YSLPP) in Lombok, which has installed 871 units, and KUD Sumber Makmur Ngantang in East Java which has so far installed 1,320 units.

2.2 THE ROLE OF THE INDONESIAN GOVERNMENT

The Indonesian government is actively supporting renewable energy, including biogas. The IDBP Programme works in close collaboration with the Indonesian Ministry of Energy and Mineral Resources (MEMR) via an implementation agreement. The agreement in 2013 was for a government subsidy of IDR 1.5m per biodigester unit to add to the IDR 2m IDBP subsidy, with the aim of installing 1,500 units in East Java Province.

Co-financing by the government is important but uneven in terms of the size of the subsidy, and because it often aims at 100 per cent subsidy (partly in the name of empowering poorer farmers), government programmes can distort the market because it discourages efficiencies in production and increased competitiveness between providers. There are also problems of a lack of after-sales service, as masons are only required to provide this service during a short guarantee period immediately after installation. In 2010 MEMR established a National Advisory Committee for Biogas, but coordination is still a challenge; different ministries have different financing mechanisms to fund domestic biogas projects and this creates confusion in market development. There are biogas programmes in some areas that receive full subsidy from departments responsible for agriculture, livestock/animal husbandry, public works, housing and public facilities, environment, cooperatives and even the army at the national and/or provincial levels, leading to potentially confusing signals at farm level. IDBP reported in East Java that some farmers are holding off on installing a IDBP biodigester in the hope of a fully subsidised installation.

At the district level, most ministries have a Special Allocation Fund (called DAK in Indonesia) from central government that bypasses provincial government. Since 2013, MEMR has allocated a

9. See www.biru.or.id/index.php/partners-cpo

DAK budget of IDR 20 billion per year to districts, 30 per cent of which must be allocated to biogas. The DAK stipulates that district governments must provide 100 per cent subsidy to farmers and most districts have complied with that model. In 2013, the MEMR and BIRU created a partnership to use DAK funding in eight districts of NTB including Northern Lombok.

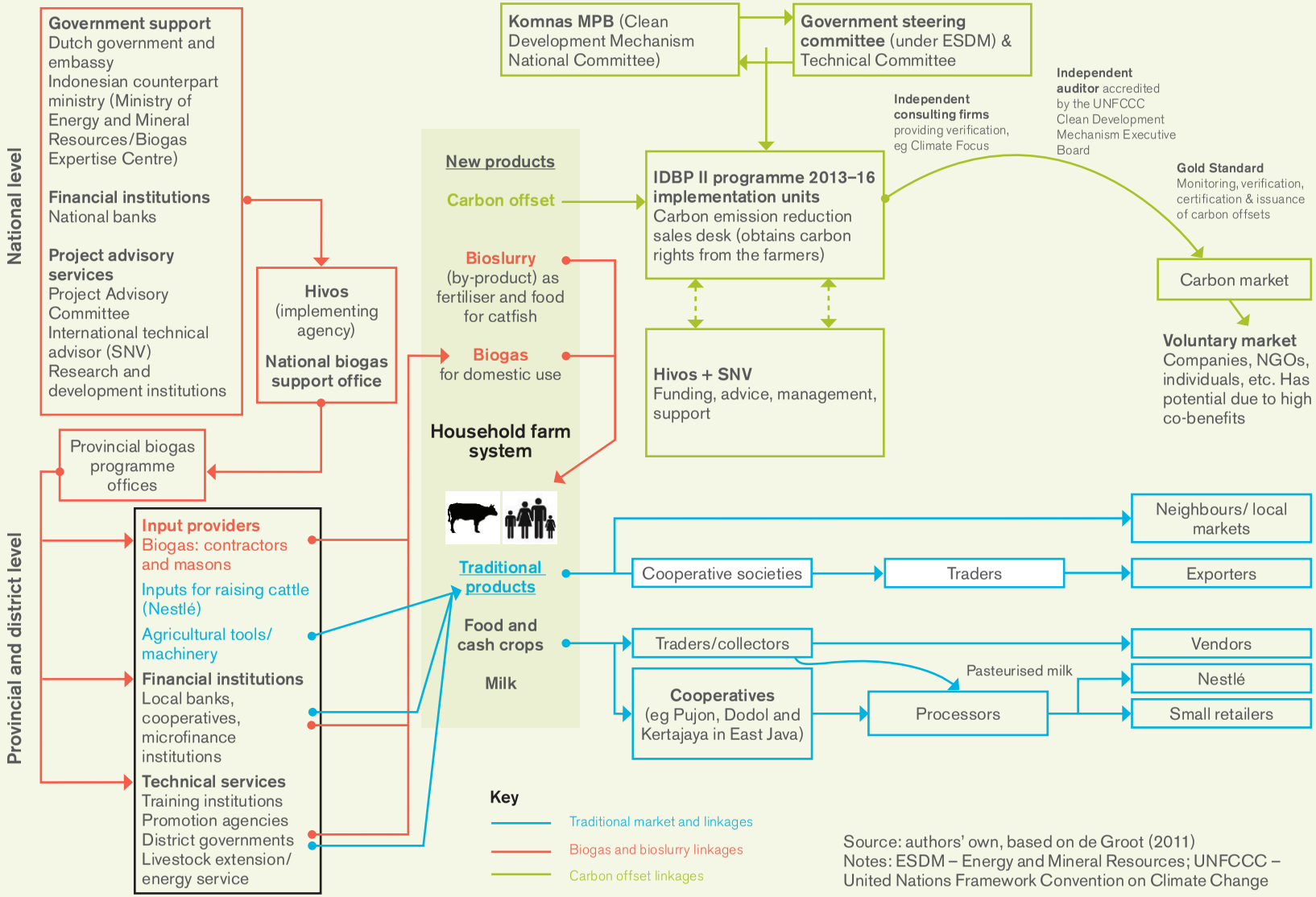
After reviewing the status of their installation and after-sales service, the North Lombok District Government decided in 2013 to modify DAK funding, moving from 100% subsidy towards a cost-sharing model with users/farmers. The North Lombok inspectorate agreed that this proposal was more efficient and effective than a 100 per cent subsidy. It allowed 500 rather than 100 farmers to be supported in 2013 via the same amount of public funding; the 2015 target for the district is 425 units. This kind of financing mechanism has been recognised by central government in Jakarta, and the North Lombok District government has won an award for innovation in renewable energy policy. In East Java, Malang District won a similar award in 2013, including at least three BIRU construction partner organisations in 2013 and 2014 respectively. The various initiatives of different government departments (such as Environment, Livestock, Agriculture) are being integrated under the district MEMR, including at sub-district and village level.

Since the success of collaboration in North Lombok district, the IDBP Programme has been trying to replicate the cost-sharing model, but this has proved to be challenging, despite lobbying by IDBP of the district government. The government built 179 units in East Lombok, of which only one is (partially) functioning. This has caused reputational problems for biogas technology, and IDBP has needed to carefully differentiate its brand in terms of quality and reliability.

There is another important aspect of government subsidy if the biodigester is 100 per cent subsidised by government capital expenditure: liability or risk in case of malfunction. If the farmer contributes, ownership can belong to the farmer, which transfers the risk to the farmer.

The links between IDBP and the Indonesian Government at national, provincial and district levels can be seen in Figure 1.

FIGURE 1. IDBP MANAGEMENT



Source: authors' own, based on de Groot (2011)
Notes: ESDM – Energy and Mineral Resources; UNFCCC – United Nations Framework Convention on Climate Change

2.3 BIOGAS MARKET TRENDS

In East Java – which accounts for 39 per cent of Indonesia's cattle population and 57 per cent of its dairy production – there are signals that the biodigester 'market' is starting to stagnate. The rate of installation has dropped to around 25–50 per month. The Pujon CPO, which has so far installed 1,320 units, installed 394 units in 2012, and only 137 in 2014. Some cooperatives, such as Pujon, Dodol and Kertajaya in East Java, have already reached the farmers who are interested in participating and are struggling to expand to new farmers.

Cooperatives that supply Nestlé where biogas adoption has been low (such as Grati and Krucil in East Java) have different priorities than renewable energy and installing biodigesters, such as productivity or simply stabilising their organisations. The 'low-hanging fruit' of better capitalised and innovative farmers appears to have already been reached by the scheme. An additional provincial government subsidy of IDR 1 million per installation is no longer available, so the cost for the remaining farmers is higher.

In North Lombok there was also a decline between 2013 and 2014 in the rate of installation of biodigesters, from 517 to 200 units, caused by a delay in government support; but the outlook is good due to a renewal of government support and Kiva credit.

For households, the comparative advantage of biogas is limited by state subsidies for liquefied petroleum gas (LPG) as sources of energy. For farmers, the comparative advantage of bioslurry and the development of a bioslurry market are constrained by the heavy subsidies for chemical fertilisers. In addition, the required investment at farm household level for biodigester installation is quite high relative to farm assets. Investing IDR 6 million in a business with two cows worth IDR 25m is not a very attractive prospect. This reduces the attractiveness of biodigesters to farmers, where they are expected to part fund the technology and its maintenance and may affect the expansion and long-term stability of the programme Farmers defaulting on the agreements, or pulling out at the last minute, are a problem for other actors who have invested time and efforts in promoting the biogas industry. Some CPOs in East Java are reporting problems of this type, and this may limit their willingness to participate. Finding the right balance between the level of subsidy and cost-sharing is very difficult, but it is unlikely that the market expansion will work without subsidies.

However, for those who qualify and can afford it – introducing a biodigester creates two direct positive impacts: 1) it eliminates demand for firewood and expensive fossil fuels; and 2) slurry left over from this process is also an excellent organic fertiliser that can be used to improve crop yields. Carbon emissions reductions from energy efficiency (approximately 2.6 tonnes per biodigester) are certified and sold on international markets. These revenues are used to fund long-term support of the installed technologies. While obtaining biogas has been the primary driver of the initiative, bioslurry also offers significant direct benefits for farmers who are able to capitalise on the good quality fertiliser (see Section 3.1).

Carbon offsets from the IDBP Programme have been registered with the Gold Standard Foundation as a 'Voluntary Gold Standard Programme of Activities', meaning that they can be traded as voluntary emission reduction

(VER) credits on international markets.[10] The resulting carbon funding is expected to boost the maintenance of existing biogas technologies, and expand the programme to new users. The way in which carbon and biogas interact with different economic activities is presented in more detail in the following section.

2.4 BIOSLURRY – THE MAIN LINK BETWEEN BIOGAS AND AGRICULTURE

Bioslurry is the main link between the IDBP and smallholder agriculture, and – because carbon finance can potentially be targeted to bioslurry improvement – was a focus of our research. Well-managed biodigesters produce slurry that builds long-term soil quality, making it more porous and improving its capacity to retain water. The user survey reports an average 36 per cent reduction in chemical fertiliser use among farmers who use bioslurry (RPI Research, 2015). For some farmers this figure is much higher, up to 100 per cent. One dairy farmer in Pujon saves 200 kilograms through fertiliser reduction (worth IDR 270,000). But productivity improvement may be worth much more; for example if maize yields increase from 3.5 to 4 tonnes per hectare (as indicated from anecdotal evidence) the increase would be worth around IDR 1 million (see Warnars and Oppenoorth, 2014 for more details).

However, skill is required to get to high levels of fertiliser production from the biodigester, by running the digester optimally (not just running any type of manure into the digester, only cow manure), and applying the bioslurry to the field at the right time. For example if bioslurry is applied to rice paddies too late, the flush of nutrients can cause empty grains to be produced.

A remarkably high number of farmers report that their plants (such as fruit trees, vegetables and rice) treated with bioslurry are much less affected by pests and diseases (such as clubroot in cabbage). In addition, the harvested rice is said to taste better and store for longer when grown using biodigester-produced fertiliser. The user survey found that 80 per cent of those who use slurry reported plants with better resistance to pests and diseases compared to when following their usual practice of using chemical fertiliser (RPI Research, 2015). Focus groups in East Java reported shorter harvesting periods for grass. And in rice, the crop is said to be easier to harvest and plant leaves are said to be greener at harvest, leaving more quality forage to feed back to the cattle.

There are however serious issues around poor resource management. Only 75 per cent of farming households are using bioslurry as a fertiliser for their farms (ibid). And few households use all of their cow dung; only 47 per cent feed 76–100 per cent of it into their digester.

Without recycling bioslurry by using it in cropland, it is a wasted resource and a pollutant with a high threat to water quality. In the user survey, 22 per cent of households report dumping it into an open drain, and nine per cent dump it into lakes or rivers (RPI Research, 2015).

The biggest constraint to effective bioslurry use is the lack of cropland, and the distance between the biodigester and farmers' fields. This is a particular issue in East Java where the cows and stable are close to the house, but pastures may be more than two kilometres away. In Pujon, 80 per cent of dairy farmers don't have their own cropland; they gain access to state forest land for

10. The Gold Standard Foundation is a certification body. See more at www.goldstandard.org/about-us

KAN Jabung's bioslurry fertilising service truck and container © Christina Haryanto

pasture for up to five months in the year, and/or use sugarcane crop residues as cattle feed.

Bioslurry is easier to transport when dry, but the drying process is difficult in the wet season. Consequently, some interviewees reported only using bioslurry in the dry season. It takes around a week to reduce its water content from 90 per cent to 70 per cent. In Lombok a group of around 20 farmers is selling dried bioslurry for IDR 1,000 per kilogram.

An alternative is to create a market in bioslurry so that surplus or unused material can be purchased by farmers who need manure. In Pujon, East Java, Nestlé have tried to encourage this through supporting a bioslurry application service. Farmers are charged IDR 60,000 per tonne for application of bioslurry (the actual cost for the service is 100–120,000 per tonne; the cooperative subsidises around half of the cost). One tonne covers 0.1 hectare, so the cost to the farmer is IDR 600,000 per hectare, compared to IDR 360,000/ha for chemical fertiliser. Suppliers of bioslurry are not paid, which is problematic – the funds currently go to the cooperatives who fund the cost of transporting the bioslurry; they therefore do not see the by-product as having any value. In Jabung, the farmers' cooperative is proposing to allocate IDR 72 million per year to subsidise a liquid bioslurry spraying scheme by around 88 per cent, whereby the farmer pays just IDR 20,000 per tonne, dropping to 50 per cent from 2016. There are now 10–15 pumping units in operation (see photo of KAN Jabung's truck and container). Take-up has been limited due to the same problem of reaching pastures far from main roads, and possibly the lack of incentive for farmers supplying the slurry.

Another challenge of bioslurry is storage. Nestlé have intervened here as part of their involvement with biogas, offering a 50 per cent subsidy towards the IDR 1 million cost of installing permanent slurry storage pits on farms. To further reduce the cost burden for farmers, the Pujon cooperative will pay upfront and deduct the cost of application from the farmer's milk payment.

Nestlé are now thinking more radically, and supporting the establishment of pastures managed by cooperatives and close to roads where surplus bioslurry can be applied. Cattle fodder is harvested from these pastures and sold

for a fee by the cooperative. There are big hopes to scale up from a 0.8 hectare pilot to develop a grass fodder/bioslurry business model. Around 1,000 hectares of grassland would be needed to provide fodder to those dairy farmers who do not have access to cropland.

There are innovations in adding value to bioslurry, though small in percentage terms. In East Java 40–45 farmers in three groups are feeding the slurry to earthworms, which are sold as feed to shrimp farms. The worm castings[11] are also reported to make excellent fertiliser and soil conditioner. Bioslurry can also be used as a component of catfish feed – apparently giving a higher quality and better tasting fish.

In short, while there is potential for a bioslurry market, there is also a great need for farmers to see bioslurry use demonstrated, especially by other farmers in their social networks, to convince them of its long-term benefits. If carbon finance is to forge a closer link between biogas and smallholder agriculture, it is this aspect of better use of bioslurry that could strongly benefit from research and promotion. Currently, the East Java IDBP programme has taken the extra step of employing a manure management officer, Cristina Putri, to further this part of IDBP development.

2.5 CARBON FINANCE AND THE IDBP

Carbon finance has always been a consideration for the IDBP, going back to early discussions with KfW, a German government-owned development bank who wanted to support certification under the Clean Development Mechanism (CDM) (as defined in the glossary). At least three government agencies have also tried to register biogas under the CDM, without success.

In 2011 Hivos decided to look instead at the voluntary market, and opted for registering with the Gold Standard Foundation in order that biodigesters can qualify for voluntary emission reduction credits (VERs). Registration with the Gold Standard began in November 2012; local stakeholder consultation took place in Jakarta in February 2015. Validation was completed during 2013 and 2014.

The carbon saving per digester, verified by a Designated Operational Entity (DOE, as defined earlier) and the Gold Standard, is only 2.6 tonnes per year. This is much lower the equivalent savings verified for similar projects in other countries eg Kenya.[12] Carbon savings are lower in Indonesia because 1) households in East Africa use more firewood than in Southeast Asia, and 2) the fraction of firewood consumption that is non-renewable biomass is lower in Indonesia. There are also methodological issues – Hivos consider that IDBP's digesters save 3.2 tonnes of carbon per year, but this figure did not correspond to that provided by the Gold Standard review. This is because carbon savings are based only on the reduced consumption of firewood and kerosene for cooking, not improved manure management and soil sequestration. If that were to be factored in, an additional carbon saving of 2.4 tonnes per hectare per year could be included.

In late 2014 Hivos sold 32,000 tonnes of carbon dioxide equivalent (CO_2e) offsets dating back to 2011. Hivos sold them at a price of €6.50 per

11. Worm castings are an organic form of fertilizer produced from earthworms. Also known as vermicast, worm castings manure is essentially earthworm waste, otherwise known as worm poo.

12. See http://pubs.iied.org/16588IIED.

VER, which is high in the currently depressed voluntary carbon market; this price is guaranteed for 2014, 2015 and 2016. In December 2014 Hivos transferred €168,000 to IDBP after deducting costs for administration and so on. This represents a payment back to the project end of the carbon finance chain of €5.25 per VER; this is 80 per cent of their retail value.

That means that if there is no recovery in the voluntary carbon market, and no accounting of verified emission reductions from soil carbon, project income from carbon finance would only be €14 per unit per year, or a total programme annual income of just over €200,000 from the current total of installed units. This is considerably less than IDBP's programme costs for promotion, quality management, institutional support, research and development, training, and puts any prospect of using carbon finance to subsidise installation out of the question, even if the number of installed digesters were to meet the Phase 1 and Phase 2 combined target of 34,000 installations.

We draw the same conclusions as in Kenya where we felt that carbon PES is likely best used as aggregated programme income rather than transfers to individual farm households.[13] To reinforce the link between biogas technology and agriculture in Indonesia, carbon finance could be ringfenced for improving the value of bioslurry for farm households, rather than simply adding carbon market income to general programme operation costs.

In terms of governance, farmers themselves are not involved in the carbon finance element. IDBP explains to farmers that signing their carbon rights over to Hivos can allow other farmers to benefit from the programme. There were no concerns expressed by farmers or producer organisation about ceding carbon rights to Hivos. However, one focus group stressed the need for CPOs to be properly informed about the carbon credit mechanism – that will make it easier to explain to farmers in a simple way why and how Hivos is collecting these credits and how they will be used.

The governance of carbon finance in a collaborative programme with the government can however be unclear to some actors involved. As the IDBP is a joint programme with the government, carbon finance should be jointly managed and allocated. The process is written into the Letter of Implementation between Hivos and the Directorate General of New, Renewable Energy and Energy Conservation (DGNREEC) under MEMR, and this agreement is much stronger than any at provincial level. However, one province (South Sulawesi) has not signed carbon rights to Hivos, despite many efforts to explain the approach of the IDBP Programme to them. They thought that Hivos would be taking all the benefits of carbon credits from them. However, there are complications due to the regional authority of the province. The IDBP is in the process of discussing this with the DGNREEC at the national level.

13. Download the Kenya National Domestic Biogas Programme report also in this series here: http://pubs.iied.org/16588IIED

THREE
VARYING PERSPECTIVES AND BUSINESS MODELS ALONG THE VALUE CHAIN

In this section we present three different perspectives along the value chain presented in 1, following the Business Model Canvas principles presented in Section 1.3.3, as examples of how carbon offsets affect existing value chains. These are:

- The dairy-pasture model in East Java, working with Nestlé as dedicated customer
- Beef cattle in mixed farming in Lombok
- The masons' and CPOs' model.

3.1 THE DAIRY-PASTURE FARMER'S BUSINESS MODEL IN EAST JAVA

Figure 2 presents a summary of the main relationships for a dairy farmer in the biogas programme in East Java. The associated value chain is roughly depicted in the lower part of Figure 1, with milk delivered from the farm to cooperatives like Pujon KUD or KAN Jabung; and from there to Nestlé and other large processors via formal markets. Carbon credits generated by the biodigesters are transferred to Hivos as managing agency of the carbon component, certified by the Gold Standard, and from there placed on the voluntary carbon markets. Technical services are provided by CPOs affiliated to IDBP.

The farmers involved in IDBP are members of dairy cooperatives. The large Pujon dairy cooperative (Kooperasi SAE Pujon) has approximately 7,000 members (roughly 5,000 of whom are active) and 1,200 digesters – a high adoption rate. It is a dedicated Nestlé supplier: 81.5 per cent of production, 83 tonnes per day, goes to the company. Dairy accounts for a half to two-thirds of farmers' income. A farmer with three cows producing 35 litres of milk per cow per day, at IDR 4,500 per litre, would generate an income of up to IDR 47,250 (€33) per day. Lower levels of productivity give much lower incomes – for example there is one farmer considering biogas installation who gets 13–14 litres per day at IDR 4,500 per litre, or IDR 60,750 (€4.3) per day which is not enough to pay for installation costs. Despite its size, the cooperative is not in a position to negotiate milk prices with Nestlé; prices are pegged to the world market.

Through SAE Pujon, members can access Nestlé's zero per cent interest credit scheme for three years for biogas installation (non-members can also access cooperative credit for installation at an interest rate of 1.5 per cent per month). A farmer with an income from dairy of IDR 60,000 per day, who has a three-year credit line for a six cubic metre biogas installation,[14] would incur a deduction by the cooperative of around 10 per cent of milk income.

The dairy cooperative in Jabung (KAN Jabung) has around 1,857 members. It has a more diverse customer base, selling around 66 per cent of its production to Nestlé, 13 per cent to Ultrajaya, and 20 per cent to Indolakto. A very small percentage is processed locally into yoghurt and pasteurised milk.

14. After subsidy.

FIGURE 2. BUSINESS MODEL FOR SMALLHOLDER DAIRY FARM COOPERATIVE MEMBER, EAST JAVA

Key partners

Input providers:
Cooperatives, IDBP, CPOs

Finance service providers:
1) Cooperatives
2) cooperatives (channel subsidy from Nestlé)
3) cooperatives – 0% interest credit
4) IDBP
5) Provincial and district government

Technical service providers:
1) IDBP
2) Cooperatives
3) CPOs

Key activities

- Milk production (1/2 to 2/3 of business)
- Pasture and forage production and collection
- Value added from bioslurry eg earthworm production, aquaculture (minority)

Resources

Human capital: Organisation into cooperatives gives farmers economies of scale, market access, some market power.

Financial capital: 1) Own capital 2) Bank loans and microfinance

Manufactured capital: 1) Zero-grazing dairy housing 2) Biodigester (mainly 6m^3, though increasing number of 4m^3)

Natural capital: 1) Dairy cattle (2–3 per household) 2) Land for pasture ~1ha (though land ownership not essential)

Value proposition

Towards the market

- Quality milk supply for modern processing sector
- Carbon offsets from reduced use of non-renewables (LPG, firewood)

Towards the farm household

- Gas is primary attraction of the technology – reduced cost of LPG, reduced time to collect firewood. Quality and reliability of IDBP installation
- Organic fertiliser (bioslurry) as high-value by-product. Reduction in fertiliser costs

Main relationships

- Cooperatives. No sight of product beyond Nestlé (ie to consumer)
- IDBP reputation (quality, after-sales service) creates trust in CPO
- CPO and mason

Channels

- Deliver to cooperatives for sale to modern dairy-processing sector
- Farmer signs carbon clause with IDBP to cede rights to Hivos
- Hivos to voluntary carbon market

Customers

Cooperatives and from there to Nestlé

Cost structure

- Cows
- Labour
- Farmer cost-share for digester (up to IDR 6 million)
- Time and space for drying bioslurry – 1 week to dry down from 90% to 70% water content
- Time and effort for transporting bioslurry to crops and pastures. Difficult to apply in rainy season
- Labour cost of applying slurry IDR 400,000/ha (compared to IDR 50–100,000/ha for chemical fertiliser)

Income/benefits

- Sale of milk to dairy processor (Nestlé, Ultrajaya, Indolakto): price from cooperative up to IDR4,700/l if high quality. Large farmers (5–10 cows; 25% of cooperative members) deliver 50l/day. Half of cooperative members (1–2 cows) deliver <10l/day. A 3-cow system at 35l/day and IDR4,300/l would give sales of IDR150,000 (€10.6) per day
- 0% interest credit from Nestlé for installation
- Biogas – savings on LPG
- Cost savings from reduced fertiliser use: eg reduction of 200kg/ha worth around IDR270,000
- Higher crop productivity: eg maize yield increase of 0.5t/ha worth IDR 1 million/ha
- Potential sale of bioslurry
- Potential added income from value-added activities from bioslurry use – worm cultivation, aquaculture etc

Traditional market linkages (food, milk) Biogas and bioslurry linkages Carbon offset linkages

Source: authors' own, based on interviews and desk-based review.

KAN Jabung has an IDR 5.2 billion credit fund for scaling up farmers' productive capacity; since 2009, it has used IDR 1.4bn for biogas installation and installed 223 units. The target for 2015 is 75 units. The interest rate is six per cent per year. Less than 2.5 per cent of loans are non-performing (ie a loan on which the borrower is not making any repayments). Farmers can choose how they want to use the credit and can borrow up to 100 per cent of biogas installation costs. The cooperative also help build biodigesters for non-members, though does not offer a credit scheme. KAN Jabung has not taken up the Nestlé credit scheme, in order to retain independence and bargaining power. They consider the zero per cent interest from Nestlé to be distorting the biodigester market.

Poorer farmers may take part in a cattle-sharing model – they do not own the animals but take a share of revenues or have ownership of some of the offspring.

3.2 A BEEF-CATTLE MIXED FARMING BUSINESS MODEL IN LOMBOK

The biogas model in Lombok is different from East Java – see Figure 3. Here, farmers are categorised as beef cattle producers but in fact the farming system is a mixed cow/crop system rather than beef cattle production *per se*. The cows (one to three per household) are household assets that are only sold if a big financial outlay is needed, such as a health emergency. They are marketed to traders for the local and national market.

A farmer applying bioslurry to her crops © Josh Estey

FIGURE 3. BUSINESS MODEL FOR A MIXED FARM WITH CATTLE, LOMBOK

Key partners

Input providers: Cooperatives, IDBP, CPOs

- **Finance service providers:** IDBP (subsidy from District Ministry of Energy and Mineral Resources or MEMR) and Hivos via CPOs
- Kiva (via small farmer groups)

Key activities

- Mixed farming (rice, maize, vegetables, pasture, beef)
- Wage labour (other farms)
- Sales of dried bioslurry (minority – new business)

Resources

Human capital: Farmers not organised into cooperatives, but some group around collective stables

Financial capital: 1) Own capital 2) Bank loans and microfinance 3) Government programme of subsidising cows: Bumi Sejuta Sapi (BSS)

Manufactured capital: 1) Zero-grazing dairy housing 2) Biodigester (mainly 6m^3, though increasing number of 4m^3)

Natural capital: Beef cattle (1–3 per household – minimum 2 to operate digester) convert household waste. May not own the animals (cattle-sharing system)

Value proposition

Towards the market

- Supplier of rice, maize, vegetables, beef for local and regional markets
- Carbon offsets from reduced use of non-renewables (LPG, firewood)

Towards the farm household

- Gas is primary attraction of the technology – reduced cost of LPG, reduced time to collect firewood. Quality and reliability of IDBP installation
- Also used for lighting, as 35% of Lombok is off the grid.
- Organic fertiliser (bioslurry) as high value by-product: reduction in fertiliser costs
- Subsistence produce

Customer relationships

- Traders and local market – mainly informal
- **IDBP** reputation (quality, after-sales service) creates trust in CPO
- **CPO** and mason

Channels

- Deliver cattle to local market for sale
- Farmer signs carbon clause with IDBP to cede rights to Hivos

Customer segments

Domestic market

Cost structure

- Cow(s)
- Labour
- Farmer cost-share for digester (up to IDR 2.4 million; IDR 1.74 million in N Lombok)
- Time for collecting and applying bioslurry (>using chemical fertiliser)
- Time and space for drying bioslurry
- Water (which is scarce in N Lombok) to mix with slurry in the dry season

Income/benefits

- Sale of crops (maize, rice, fresh fruit and vegetables)
- Sale of labour
- Sale of beef cattle
- Biogas – savings on LPG
- Cost savings from reduced fertiliser use.
- Higher crop productivity: eg maize yield increase of 0.5t/ha worth IDR 1 million/ha
- Potential sale of dried bioslurry (IDR1,000/kg)

Unclear benefits from carbon market

Traditional market linkages (food, milk) Biogas and bioslurry linkages Carbon offset linkages

Cows make great converters of organic waste into energy and bioslurry. There are three basic systems for cattle management and collecting dung: a stable next to the farmer's house, a collective stable from which dung is transported by barrow to the households' digesters, and (in Sumba Island) cattle graze in fields and farmers collect dung from the ground to take back to the digester.

Most farms have cropland for rice, maize, soybeans, and/or vegetables. Income is mainly from those crops and also from selling labour to other farmers. This is a relatively poor part of Indonesia; Northern Lombok has the lowest per capita income in West Nusa Tenggara Barat (NTB) Province (39 per cent of people live below the poverty line). Poorer farmers will operate a share-cropping (*kadas*) system as in East Java. Farmers are not organised into cooperatives, but may be in small groups, for example around the collective stables. In NTB village leaders play an active role in promoting biogas, such as Bun Mudra, in Central Lombok, where there are 50 biodigesters.

Most biodigesters promoted in the area are four cubic metres in size. A minimum of two cows is required to operate the digester. In Lombok little value is added to bioslurry. Compared to East Java, there is less of a mismatch between bioslurry production and the availability of cropland on which to apply it.

In North Lombok, the farmer's contribution to biodigester installation is IDR 1.4 million out of a total installation cost of IDR 7.5m. Government subsidy in 2012 was around IDR 3 million. In 2014 the farmer's contribution rose to IDR 1,740,000, and in 2015 to IDR 2,400,000. The farmer's cost can be reduced if they can contribute some materials and labour to the construction, or if the digesters can be constructed through group work.

Gas for cooking is the primary motivator for households to have a biodigester, but biogas as a light source is also very attractive, since 35 per cent of households are not connected to the electricity grid. Water – which is used to mix with the cow dung – is a key constraint to the functioning of the digester in this dry region of Indonesia, especially in the dry season.

3.3 THE BUSINESS MODEL FOR MASONS AND CPOS

Masons and CPOs play a key role in delivering the biogas technology to the farmers, and the programme's capacity to upscale is linked to their capacity to guarantee supply and product quality and maintenance. Since the beginning of the programme, IDBP has trained a total of 983 masons and 176 supervisors from all partner organisations. Figure 4 presents a brief description of the key aspects linked to their business model in relation to the domestic biogas industry.

Installing biodigesters can be a profitable enterprise for masons and private CPOs. Prices are fixed according to region and size of biodigester. In East Java the mason receives between IDR 1.4m and IDR 1.8m depending on the size of the digesters (usually the construction team is hired and paid with a lump sum fee) for five to six days labour – this is considerably more than the equivalent amount of work on housebuilding. The cost of materials is around IDR 3 million – and increasing, especially for cement. Each CPO receives approximately IDR 1 million per digester after costs. Masons are not paid until construction is finalised. This means that masons must be quite well capitalised to be able to carry out the work until they receive payment. There seem to be high levels of customer satisfaction in the IDBP Programme with after-sales care and the performance guarantee that it provides.

FIGURE 4. BUSINESS MODEL FOR MASONS AND CONSTRUCTION PARTNER ORGANISATIONS

Key partners	Key activities	Value proposition	Relationships	Customers
• CPOs • IDBP • Cooperatives • Promoters	• Construction of biodigesters (40–80% of turnover) • Rest of business, housing construction, installing appliances etc **Resources** • IDBP standard • IDBP guarantee of performance • IDBP promotion • CPOs	• IDBP standard • Guarantee of performance ('won't go home until it works') • Access to subsidy	• Post-installation customer care/after-sales service, dealing with teething problems • There is no association of masons **Channels** • IDBP • Cooperatives • Network of promoters (including village heads) paid IDR50,000 per new user • CPO	• Cooperative members especially Nestlé suppliers (East Java) • Individual farmers or farmers grouped around collective stables or village (Lombok)

Cost structure	Income/benefits
• Own and hired labour • Carry cashflow risk – no payment until installation finalised and approved • Promotion (may pay promoters IDR50,000 per new installation), field demonstrations • Insurance (though rarely used at present)	• **Masons** receive IDR 1.25–1.85 million (fixed price) for 5–6 days' labour. Can clear IDR 1 million per digester after costs. CPOs receive IDR 1 million per digester • Construction of biodigesters more profitable than alternative construction jobs (eg housing) • Other enterprises: housebuilding, farming on own land etc

Traditional market linkages (food, milk) Biogas and bioslurry linkages

Source: authors' own

FOUR
OPPORTUNITIES AND BOTTLENECKS

Figure 5 presents the main opportunities and potential challenges involved in the current model and proposals for upscaling the biogas-carbon proposition, focusing on farmers and masons. We discuss some of these opportunities and challenges below.

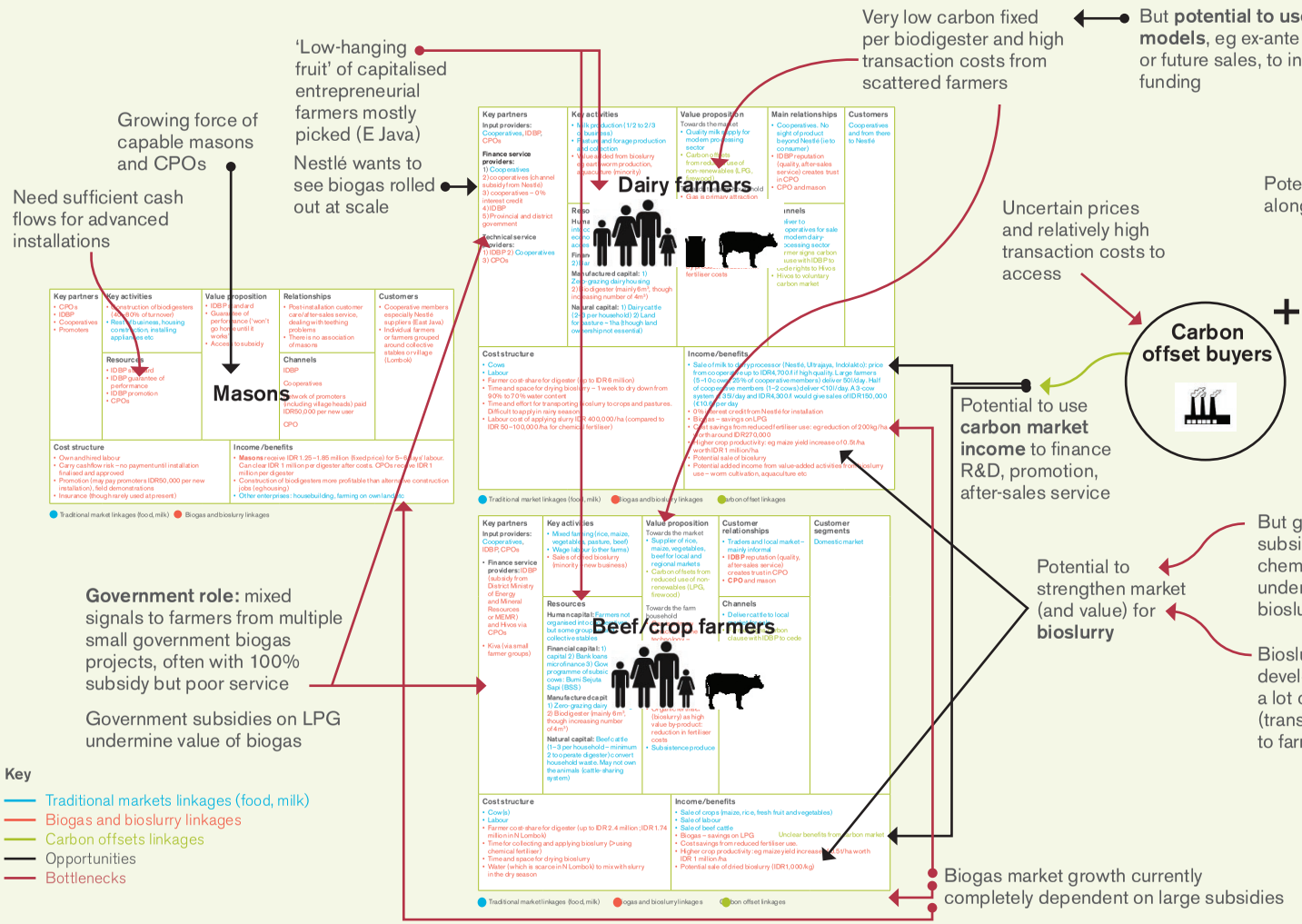
4.1 POTENTIAL FOR INSETTING

In a vertically coordinated chain such as the milk chain that links dairy cooperatives with Nestlé, there are opportunities for 'insetting', whereby Nestlé offsets carbon emissions from its dairy processing facilities directly via its own dairy supply chain. Insetting would allow Nestlé to link their investments in biogas more explicitly to emission reductions. A follow-up enquiry to Nestlé on this issue was unanswered. The partner studies in Nicaragua[15] and Guatemala[16] further explore the potential for insetting along the coffee chain and highlight gaps. Better coordination between projects, to cross-learn on strategies to reach vertically along the value chains, would benefit Hivos's Green Entrepreneurship Programme

15. http://pubs.iied.org/16599IIED

16. http://pubs.iied.org/16600IIED

FIGURE 5. OPPORTUNITIES AND BOTTLENECKS FOR THE DOMESTIC BIOGAS-CARBON PROPOSITION IN INDONESIA



Source: authors' own

4.2 LEVERAGING CARBON FINANCE FOR PROGRAMME SUPPORT AND INNOVATION

The low levels of carbon offset per biodigester – added to the high transaction costs of reaching multiple smallholders – make individual carbon payments fairly negligible. But there is potential for revenues from carbon sales for group benefits; as we saw earlier, Hivos has transferred 80 per cent of the carbon revenues back to IDBP. A key concern is whether this income will be enough to cover the costs involved, especially with international carbon prices decreasing. Focus group discussions conducted for the fieldwork shed some light on different perceptions of how these revenues could be used. In each focus group, farmers, masons, CPOs and officials were asked about the use of carbon finance to support a type of service centre concept. The discussions came up with a number of interesting proposals:

- **Research and development on bioslurry use**, for instance on improving bioslurry use to increase its value
- **Market development bioslurry.** This year one of the CPOs in Lombok is setting up a utilisation project – a nutrient garden – in Kebu Gisi
- **Training and capacity building for CPOs,** such as in bioslurry utilisation
- **Developing masons' capacities,** for example to increase efficiency and business strategies;
- **Clearer differentiation of IDBP,** CPOs and masons via a quality brand and associated uniforms
- **Developing new appliances** – lamps, stoves and so on – and technology to generate electricity from biogas in communities that are off the grid
- **Improving access to appliances** (lamps, stoves) in remote provinces at Java prices, perhaps through stores that can also double as service centres
- **Servicing and maintaining** biodigesters
- **Establishing a biogas call centre** to deal with any problems; it may be difficult for users to call the mason who installed the system
- **Promoting biogas technology**, including via demonstrations
- **Dealing with other limiting factors** of smallholder agriculture, such as water harvesting in northern Lombok
- **Sector coordination** – for example link between ministries of agriculture and energy – networking and coordination
- **Establishing a revolving fund** for access to cheaper credit.

A farmer support function could also help convince provincial governments to allow carbon finance to be reinvested in smallholders.

4.3 GOVERNMENT PARTICIPATION

The government's participation as a biogas promoter has been very important for the development of the biogas industry. Subsidies have been key to the adoption of the technology. However, it has seemed to send mixed signals, and the varying levels of subsidies can disincentivise the development of a privatised industry geared towards cost sharing rather than full subsidies. Subsidies for chemical fertilisers, for example, could hinder the development of bioslurry as a business opportunity.

FIVE
CONCLUSIONS AND RECOMMENDATIONS

The Indonesia Domestic Biogas Programme is a success story in terms of the biodigesters' proven technology, high standards of installation and sustained operation, backed by a strong, motivated team at national and provincial levels. National policy is favourable for the biogas sector, with a strong government drive towards renewables. Sector coordination is improving (for instance around construction standards) although there is still some way to go to harmonise subsidy regimes.

Subsidies are a key driver of adoption. Subsidies trump low interest credit, though credit is clearly important for low-income households to make up the farmers' contribution. There seems little prospect of installation costs for the biodigester's decreasing; costs of materials are actually increasing. Farmers make rational investment decisions, and see that at full cost price, the economics favour investing in productive assets – more cattle – rather than in biogas.

The market for biodigesters in the province with the lowest subsidy, East Java, has seen a marked downturn. This appears to be a fundamental challenge to IDBP in the province and seems likely to continue unless the market receives strong signals – such as higher government subsidy for biogas, lower fertiliser subsidy, lower LPG subsidy, or new technology with lower installation costs. The priority in East Java must be to stabilise and grow the market, especially for poorer farm households who are not members of cooperatives.

Reaching poorer households will require more subsidy, not less. But offering public subsidies covering 100 per cent of installation costs in the name of 'inclusion' puts the technology even further out of reach of the majority of farmers who fall outside the limited subsidy schemes on offer. To prevent a technology boom and bust, to support long-term commercial viability, to present consistent signals to farmers, and to make better use of limited public budgets, there is strong justification for having a national voluntary code that stipulates a **minimum level of farm household co-finance** (in cash and in kind) – for example set at 30 per cent.

There is also a much larger issue of government **policy incoherence** in the form of perverse incentives from other sectors (like the LPG subsidies). Subsidies for chemical fertiliser distort the relative value of bioslurry, and subsidies for LPG do the same for biogas. Future reductions in those subsidies would certainly tip the balance in favour of biogas. IDBP needs an advocacy strategy at national level to tackle this issue.

Even though subsidies for biogas will continue to be central to upscaling biogas adoption, there are good reasons to make those subsidies smarter; biodigesters receive subsidies whether they are run at their full potential or far below it, or even if they are abandoned shortly after installation. An analysis of biogas in China proposed **use-based subsidies** in which various cash rewards are provided to biogas user households, if the actual amount of biogas used within a year reaches certain levels (Xia, 2013).

The carbon saving per digester verified by a DOE and the Gold Standard is only 2.6 tonnes per year, much lower than the equivalent savings verified for a similar project in Kenya. This income puts any prospect of using carbon finance to subsidise installation out of the question.

Carbon PES can best be used as **aggregated programme income** rather than transfers to individual farm households. But there is also potential to use aggregation models, eg ex-ante accreditation or future sales – see glossary, to increase start-up funding.

Bioslurry is the main link between the IDBP and sustainable/improved smallholder agriculture. The environmental and agricultural benefits of bioslurry in the dairy system are constrained by the fact that a significant minority of dairy cow owners do not have land, and many of the remaining farmers' pasture is too remote to justify cycling bioslurry back into forage production. Improving the value of bioslurry, and closing the nutrient cycle between animals and pasture, could be a very positive use of **earmarked carbon finance**. Extending the bioslurry optimising programme, and developing a strategy to create new markets for bioslurry as a commodity, must be a priority for the next phase of IDBP.

REFERENCES

Bedi, A *et al.* (2012) Impact evaluation of the Indonesia Domestic Biogas Programme: a baseline report. Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI), Germany and International Institute of Social Studies (ISS), Erasmus University, The Netherlands.

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

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.

de Groot, R (2011) Governance and institutional aspects of decentralized dissemination of a sustainable biogas sector in Indonesia. Presentation at RenErGO Workshop, Wageningen, 22–23 May 2011. See: http://tinyurl.com/oepx6ry

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.

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

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

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

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

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/wp-content/uploads/big-files/2012/LINK_Methodology.pdf

MEA (2005) Ecosystems and human well-being: biodiversity synthesis. Millennium Ecosystem Assessment, Washington D.C. 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.

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

RPI Rsearch (2015) Indonesia Domestic Biogas Programme: biogas user survey, February 2015. Prepared for Hivos International.

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

Warnars, L. and H. Oppenoorth (2014). Bioslurry: a supreme fertilizer. A study of bioslurry results and users. The Netherlands, Hivos.

Xia, Z (2013) Domestic biogas in a changing China: Can biogas still meet the energy needs of China's rural households? IIED, London.

PAYMENTS FOR ECOSYSTEM SERVICES IN SMALLHOLDER AGRICULTURE SERIES

In this series of research reports, IIED and Hivos explore the feasibility of payments for ecosystem services (PES) as incentives to promote a shift to sustainable smallholder agriculture. The reports are free to download.

Porras, I, Vorley, B, Amrein, A, Douma, W and Clemens, H (2015) Payments for ecosystem services in smallholder agriculture: lessons from the Hivos-IIED learning trajectory. IIED and Hivos.
See: http://pubs.iied.org/16598IIED
ISBN: 978-1-78431-221-3

Amrein, A, Porras, I and Vorley, B (2015) Organic coffee production and carbon sequestration in Guatemala: can carbon financing promote sustainable agriculture? IIED and Hivos.
See: http://pubs.iied.org/16600IIED
ISBN: 978-1-78431-223-7

Amrein, A, Porras, I and Vorley, B (2015) Reforestation, coffee and carbon in Sierra Piura, Peru: can carbon financing promote sustainable agriculture? IIED and Hivos.
See: http://pubs.iied.org/16602IIED
ISBN: 978-1-78431-225-1

Porras, I, Amrein, A and Vorley, B (2015) Coffee and carbon offsets for smallholders: can carbon financing promote cleaner coffee in Nicaragua? IIED and Hivos.
See: http://pubs.iied.org/16599IIED
ISBN: 978-1-78431-222-0

Porras, I, Vorley, B and Amrein, A (2015) The Kenya National Domestic Biogas Programme: can carbon financing promote sustainable agriculture? IIED and Hivos.
See: http://pubs.iied.org/16588IIED
ISBN: 978-1-78431-170-4

Porras, I, Amrein, A and Vorley, B (2015) Reforestation, carbon sequestration and agriculture: can carbon financing promote sustainable smallholder activities in Nicaragua? IIED and Hivos.
See: http://pubs.iied.org/16601IIED
ISBN: 978-1-78431-224-4

Vorley, B, Porras, I and Amrein, A (2015) The Indonesia Domestic Biogas Programme: can carbon financing promote sustainable agriculture? IIED and Hivos.
See: http://pubs.iied.org/16597IIED
ISBN: 978-1-78431-220-6

THE INDONESIA DOMESTIC BIOGAS PROGRAMME

CAN CARBON FINANCING PROMOTE SUSTAINABLE AGRICULTURE?

Indonesia's cattle biodigester system is a highly effective 'green' technology, radically improving smallholders' quality of life both in the household and via the farm enterprise: the main product, biogas, is a smokeless cooking fuel and the by-product, bioslurry, is a high-value fertiliser. The biodigesters also qualify for carbon offsets from the avoided use of fuelwood and non-renewable fuel.

Carbon income is currently low, however, and the potential of bioslurry – both to earn carbon offsets, and as a market commodity for the farmer – has yet to be realised. And while there has been a rapid uptake of biogas technology, with 14,500 digesters installed across nine provinces, this trend is slowing down. One-hundred-per-cent subsidies have distorted the market, and poorer farmers who lack capital or cooperative membership are yet to be reached.

This report, the second of two biogas partner studies by the Hivos-IIED Learning Trajectory Programme on payments for ecosystem services, looks at the Indonesia Domestic Biogas Programme to understand the potential of carbon-offset funding in relation to smallholder agriculture.

iied

The International Institute for Environment and Development is one of the world's top policy research organisations working in the field of sustainable development. With its broadbased network of partners, IIED is helping to tackle the biggest issues of our times – from climate change and cities to the pressures on natural resources and the forces shaping global markets.

International Institute for Environment and Development
80–86 Gray's Inn Road
London, England
WC1X 8NH
Tel: +44 (0)20 3463 7399
Fax: +44 (0)20 3514 9055
email: info@iied.org
www.iied.org