Financing communal bioenergy production and use in poor rural areas

A feasibility study

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Cover picture: Sorghum field in Tete, Mozambique. Photograph taken by Flemming Nielsen.

1. Introduction

The International Energy Agency estimates that over 1.3 billion people do not have adequate access to modern energy services (IEA, 2011), a condition that is often referred to as energy poverty in the public discourse. The implications of energy poverty for those afflicted by it are severe. Not only does inadequate access to energy impede economic development, it is also the leading cause of indoor air pollution in developing countries; a problem that is estimated to kill more than two million people every year. There is little doubt that increasing the access of the world’s poor to modern energy services would make a massive difference for the better in the fight against poverty.

The challenge is vast. Massive investments are required to successfully tackle this problem. Grids need to be built, generators need to be set up and modern fuels need to be made available at rates that are affordable to the poor, and not just in one community, but in hundreds of thousands, all over the world. The sheer scope of the challenge means that any viable long term solution to this problem must inevitably be based on commercial principles.

The principle objective of this study is to explore the feasibility of financing communal bioenergy production and use in impoverished rural areas. While bioenergy has been identified as having a lot of potential as far as mitigating energy poverty goes, which is mainly due to the fact that it can be produced and used on a local scale in a sustainable manner and is suitable for off-grid electricity generation, not a lot is known about the feasibility of financing communal bioenergy production and use, or put differently – can the capital invested in a communal bioenergy project be recuperated by the investor?

This study attempts to provide an answer to this question by looking at the financial viability of four bioenergy production and use models in impoverished rural areas. The discussion begins with an overview of these four bioenergy production and use models, and subsequently moves on to look at the challenges of financing communal bioenergy production and use in poor rural areas. Thereafter, an overview of the solutions with which these challenges could potentially be addressed is provided. In the concluding section, the discussion draws on the analysis of the preceding sections to provide an assessment of the feasibility of financing communal bioenergy production and use with reference to the bioenergy production and use models that were discussed in section two.

2. Bioenergy production and use models

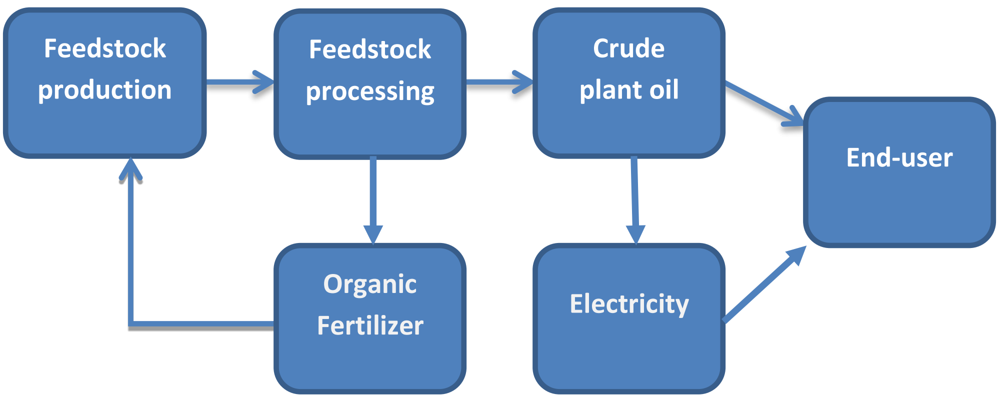
Bioenergy is a term that refers to renewable energy made from organic material. It comprises crude plant oil, biodiesel, bioethanol and biogas. Different types of bioenergy are associated with different production and use characteristics. To produce crude plant oil, for instance, feedstock needs to be cultivated and processed, but to produce biogas, organic waste will suffice. To give another example, biodiesel can be used in a standard diesel engine without any modifications to it being necessary, but this is not the case with crude plant oil, which can only be used in a diesel engine after it has been modified.

The principle objective of this section is to provide an overview of bioenergy production and use models that are based on established technologies, herein taken to include crude plant oil produced from feedstock; biodiesel produced from feedstock or waste oil; bioethanol produced from plants rich in sugars; biogas produced from crop residues, animal manure, human waste or a combination of these. It ought to be noted that certain assumptions are made regarding each of the bioenergy production and use models discussed in this study. For example, the waste that results from feedstock processing could conceivably be sold as organic fertilizer as opposed to recycled back into the production of feedstock, but as chemical fertilizers might be scarce or very expensive in poor rural, it is assumed in this study that the organic fertilizer produced through the processing of feedstock is recycled back into the production of feedstock.

2.1 Crude plant oil produced from feedstock

Crude plant oil is derived from plant material, often in the form of oil-bearing seeds. Palm kernel, Jatropha and Sunflower oil are all examples of crude plant oil. The viscosity of crude plant oil is higher than that of regular diesel, which means it can only be used in diesel engines after they have been modified. In this study, it is assumed that the plant oil produced is used to generate electricity in a modified diesel generator and as transportation fuel in cars with modified diesel engines.

Crude plant oil production chain



The inputs needed to produce crude plant oil are fertilizer, seeds, labour, a seed press for extracting oil from the feedstock and for the electricity, a generator and a mini-grid for distributing it. Car owners wishing to run their cars on crude plant oil rather than regular diesel need an engine adaptation kit.

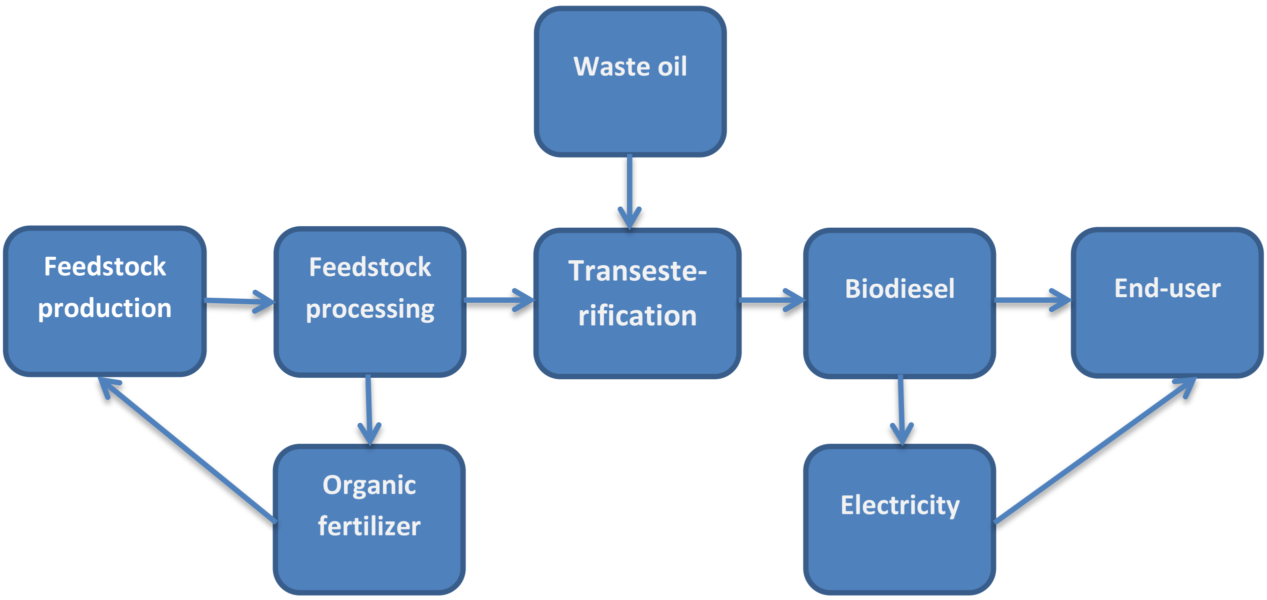
The waste left over from the processing of seeds into crude plant oil is recycled back into the production of feedstock as organic fertilizer. Sub-products include carbon credits from renewable energy generation and possibly carbon sequestration as well.

2.2 Biodiesel produced from feedstock or waste oil

Biodiesel is a fuel that is made from crude plant oil through transesterification and has roughly the same viscosity as petroleum diesel, which means that it can be used in a regular diesel engine without any modifications to it being necessary. Biodiesel can also be mixed with regular diesel and used in a regular diesel engine. It is assumed, in this study, that the biodiesel produced is used to generate electricity in a diesel generator, but also as transportation fuel in cars with regular diesel engines.

Where biodiesel is produced from feedstock, the process of producing biodiesel is identical to that of producing crude plant oil with the important exception that once crude plant oil has been extracted from the feedstock, it is processed into biodiesel through transesterification. When biodiesel is produced from waste oil, feedstock production is not necessary, which, in effect, shortens the production chain by a considerable extent.

Biodiesel production chain



The waste produced from the processing of feedstock into crude plant oil is recycled back into the production of feedstock as organic fertilizer. Sub-products include glycerine, which is a by-product of biodiesel production through transertification – it is a polyol compound that has a wide range of applications in the production of food and cosmetics, amongst other examples – as well as carbon credits from renewable energy generation and, depending on the type of feedstock that is used, carbon sequestration.

2.3 Bioethanol produced from feedstock rich in sugars

Bioethanol is a fuel that is made from plants rich in sugars through fermentation (BBI International, 2003). It can also be made from cellulose and starch, but only after they have been converted into sugars through hydrolysis (BBI International, 2003). Ethanol production is a capital intensive process, especially if the ethanol is made from feedstock rich in cellulose or starch where hydrolysis is required (BBI International, 2003). Because ethanol is more corrosive than gasoline, it can only be used in gasoline engines that have been modified. Ethanol can be used as both a transportation fuel in vehicles and to produce electricity in a generator.

In this study, it is assumed that the ethanol produced is used to produce electricity in a purpose-designed generator and as transportation fuel in cars with either purpose-designed or modified gasoline engines.

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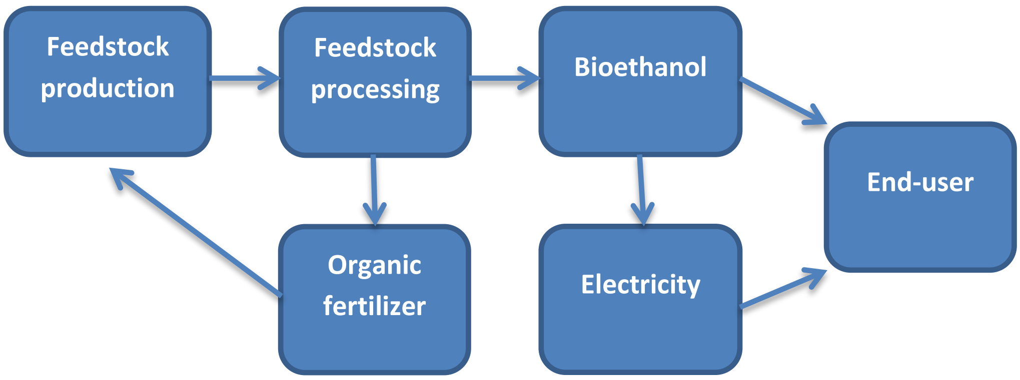
Bioethanol production chain



Given that producing bioethanol from feedstock rich in starch or cellulose through hydrolysis is a highly capital intensive process, this study is only concerned with bioethanol produced from feedstock rich in sugars where hydrolysis is not required.

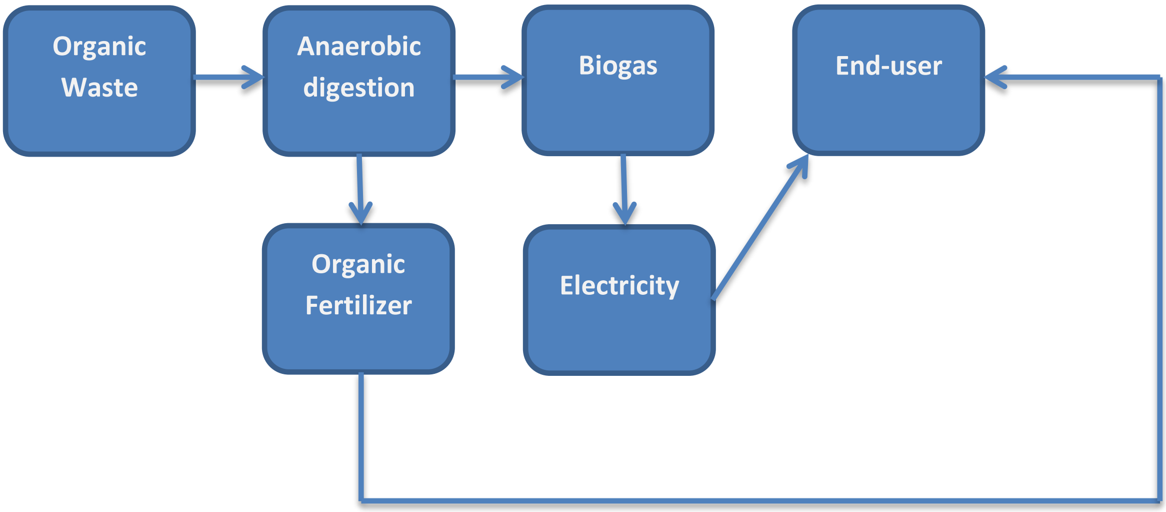
Inputs that need to be procured include fertilizer, labour, seeds, processing machinery, a purpose-designed generator for generating electricity and engine modification kits for vehicles with gasoline engines.

The waste produced from the processing of feedstock into bioethanol is recycled back into the production of feedstock as organic fertilizer. The only sub-products that can be produced in the bioethanol production chain are carbon credits from renewable energy generation.

2.4 Biogas produced from organic waste

Biogas is produced from the breakdown of organic material – which can be anything from animal manure, to human waste, to crop residues – by anaerobic bacteria. Unlike crude plant oil, biodiesel and bioethanol, which are liquid biofuels and are fairly easy to transport, biogas has to be used at the point of production in the absence of infrastructure through which it can be moved (Krich et al., 2005).

Biogas production chain



In this study, it is assumed that all of the biogas that is produced is used to produce electricity, which is distributed through a grid, in a purpose-designed generator.

All that is needed to produce to biogas, in addition to organic waste in some form, is a biodigester. To produce electricity from biogas, a purpose-designed generator is needed and a grid for distributing it to end users.

The waste left over from the digestion of organic material in a biodigester, often referred to as biogas slurry, is used as fertilizer by local farmers. Sub-products include carbon credits from renewable energy generation as well as avoided methane emissions, and possibly avoided fertilizer production.

3. Challenges of financing communal bioenergy projects in poor rural areas

Financing communal bioenergy production and use in impoverished rural areas is by no means a straight-forward matter. On the contrary, it is fraught with challenges. In this section, the challenges of financing bioenergy production and use at the community level in rural areas are discussed. It should be noted that some of the challenges discussed in this section are not relevant to all of the production and use models that were discussed in section two.

3.1 Scarcity of collateral

To make sure that loans are repaid, most financial institutions require that the borrower puts up some form of collateral; a house or a car, to name but two possibilities. The reasoning behind this practice is simple: without collateral, the borrower does not face a strong incentive to repay his or her debt. The problem in poor rural areas is that most people are not able to put up much in the way of collateral, thus creating a kind of Catch 22 where access to capital could make a big difference for the poor, but insufficient collateral means they cannot get a foothold on the financial ladder.

3.2 Transaction costs

Serving clients that live in rural areas tends to be costlier than serving clients that live in urban areas. This comes down mainly to the vast distances between clients that live in rural areas coupled with inadequate infrastructure, which makes serving them difficult and time consuming. Add to this equation the fact that people in poor rural communities only tend to borrow very small amounts, and it is often not economically feasible for financial institutions to do business in rural areas, as the transaction costs are quite simply too high.

3.3 Risk

Financing bioenergy production and use at the community level in rural areas is risky not only for the institution that is lending money, but also for those borrowing it. To see why this is the case, in the event of a failed harvest, for example, farmers have less produce to sell, and will therefore experience a fall in revenues, which could impact their ability to repay their loans, thus raising the spectre of over indebtedness. For the institution extending the credit, meanwhile, such a shortfall in revenues could leave it exposed and even threaten its continued survival. Minimizing the burden of risk faced by the lender and borrower alike is therefore essential for the viability of financing communal bioenergy projects.

Another risk-related issue that exerts a powerful influence on the to be or not to be of financing bioenergy projects at the community level in rural areas is the attitude of impoverished people to risk. A large number of studies have shown that poor people tend to be reluctant to adopt new technologies, even if they represent an improvement in economic welfare (IFPRI, 2008). Poor people, in other words, are risk averse. To understand why poor people exhibit an aversion to risk, one must be mindful of the fact that they often live on the margin; the smallest of setbacks can be the difference between being able to put food on the table for your family on the one hand, and starvation on the other (ISFAE, 2010). The problem here is clear: if the people of a community are averse to risk, they might not be willing to engage in bioenergy production and use, even if it would represent an improvement in economic as well as social welfare.

3.4 Non-existing markets

For financing bioenergy production and use at the community level in rural areas to be viable in the long run, borrowers must be able to repay their loans with income earned from the sale of bioenergy products and sub-products. In other words, a market with a sufficient level of demand has to exist for communal bioenergy production and use to be feasible.

A similar logic applies to the supply side of things. To produce bioenergy, inputs in the form of feedstock, processing machinery and labour are necessary. It therefore follows that for a community to produce and use bioenergy, it has to have access to these resources; a market, where the necessary inputs can be procured, must exist. With this and the importance of the demand side of things in mind, it is no exaggeration to say that the existence of markets is integral to the success of financing communal bioenergy production and use.

3.5 Scarcity of human capital

To produce and use bioenergy, very specific expertise is required. If crop based biofuels are to be produced, people with knowledge of agriculture and processing machinery are needed. Such expertise is, however, more often than not, in short supply in poor rural areas. In cases where there is a shortage of expertise, staff will have to be trained, which incurs additional costs. The problem is compounded by the fact that locals who have been trained and endowed with skills that are in-demand may very well leave the community to look for greener pastures.

3.6 Collective investments

All of the bioenergy production and use models that were discussed in section two involve what could be termed collective investments. To produce crude plant oil, for example, a seed press is required, but it would not make economic sense for every feedstock producing smallholder to own his own press. A better course of action is for a collective of feedstock producers to purchase a seed press together, so as to share the costs. The problem here, however, is that repayment of the loan with which the seed press was financed could be disrupted by free-riding, especially in communities that are characterised by low levels of social cohesion. The challenge, therefore, is to devise institutional structures and incentives that prevent free-riding behaviour.

3.7 Producing and selling carbon credits

On paper, it appears that communal bioenergy projects and carbon finance are a natural fit. Not only are greenhouse gas emissions reduced, the income earned from the sale of carbon credits reduces the amount of money that a community needs to borrow to finance a bioenergy project.

However, in practice, things are not that straight-forward. While certification is not necessary to produce and sell carbon credits, most buyers only want to buy certified credits so as to be sure that the credits they buy represent actual reductions in greenhouse gas emissions. Getting a project certified is very costly, though, which means that, other things equal, it is often not worthwhile for small to medium sized projects to obtain certification. The current state of the world´s carbon markets, all of which have seen credit prices plummet over the past five years, does not help matters, either.

4. Potential solutions

The extent to which the challenges discussed in the preceding section affect the viability of financing bioenergy production and use at the communal level in rural areas depends on the availability of solutions with which they can be addressed. In this section, the solutions with which the challenges of financing communal bioenergy projects could potentially be addressed are discussed. It should be noted that not every challenge that was discussed in the previous section is associated with a solution with which it could potentially be addressed. For instance, if there is no local demand for bioenergy, there is little a project developer can do to change that; it is quite simply beyond the project developer´s control. Similarly, there is no easy way for project developers to train and retain staff. If an employee wants to leave in search of better opportunities, there is nothing the project developer can do to stop the employee from doing so. Naturally, the fact that some of the challenges discussed in the preceding section are not associated with an obvious solution has ramifications for the financial viability of the bioenergy production and use models discussed in section two, but these are discussed in the concluding section.

4.1 Lending to the poor without collateral: microcredit

Microcredit refers to the provision of financial services to clients who typically have no job, collateral and documented credit history (PFIP, 2009). The providers of microcredit are commonly referred to as microcredit institutions, and range from commercial banks to non-governmental and governmental organizations (Fallavier, 1994).

The conceptual origins of microcredit can be traced back to the notion that the poor have the skills needed to be successful businessmen, but that inadequate access to finance inhibits them from realising their potential in this regard. For a long time, it was thought that providing the poor with access to finance was not possible as it was deemed to be too risky, but also economically unwise in view of the small amounts involved in conjunction with the high transaction costs of serving the poor (SEARCA & SEAMEO, 2007). This changed, however, in the seventies when Muhammad Yunus founded the Grameen Bank and began extending small loans to the poor. Unlike conventional loans that are secured against collateral, the approach adopted by the Grameen Bank draws on a group approach to credit, which is commonly referred to as solidarity-lending. Solidarity-lending is a simple concept that utilizes peer pressure to make sure that loans are repaid. In order to qualify for a loan, a prospective borrower has to form a group with four other individuals. If one of the members of the group defaults, the other members are not liable to repay the outstanding amount, but they will not be able to obtain additional loans until the outstanding debt has been paid back (Jaffer, 1999). What often happens, therefore, is that the members of a solidarity-lending group monitor each other closely to make sure that everybody manages their loans and finances responsibly, so as to safe-guard their own interests. Moreover, in the event that a member defaults, it is often the case that the other members of the group pay that borrower's debt with the intention of getting it back at a later point in time to keep the group's record clean and credit flowing. In addition to making sure that loans are repaid, the solidarity-lending approach also circumnavigates the high transaction costs of extending credit to the poor, as the lender deals with a group instead of individual borrowers, which cuts down the time and resources it takes to serve them (Armendáriz de Aghion & Morduch, 2004).

Using this credit model, the Grameen bank has managed to achieve repayment rates around 95% for its loans and become financially self-sufficient, meaning that it is not reliant on donors for capital and is able to cover its operational expenses with the interest it earns from its loans (Ugur, 2006).

4.2 Reducing transaction costs: community-based finance institutions

The transaction costs associated with extending credit to poor people living in rural areas constitutes one of the greatest barriers to doing so. This problem could potentially be circumnavigated by establishing financial institutions that have their foundations in the communities they serve. Such institutions are commonly referred to as community-based finance institutions. When talking about community-based finance institutions, practitioners tend to make a distinction between models that are savings-led, on the one hand, and credit-led, on the other (World Bank, 2007). Community-based finance models that are savings-led could be described as a bottom up approach to credit in the sense that the funds from which loans are made are provided from savings deposited by the members of the community itself. The credit-led approach to community-based finance, meanwhile, works the other way around: communities receive funding from which loans can be made to their constituents, without any strings attached in the shape of savings requirements. In practice, however, most community-based finance models are a hybrid of the credit and savings led approaches. At the onset of a community-based microfinance project, the members of a community are required to save, build up a solid base of capital and show that they can manage their finances responsibly before they can get access to credit from outside sources. As such, the hybrid model allows finance institutions to assess communities before they make any commitments, which has the positive effect of reducing their exposure to risk. In addition to reducing the transaction costs of extending credit to the rural poor, community based finance models arguably also have the advantage of being a more participatory approach to finance, which is likely to create a stronger sense of ownership, the importance of which cannot be underestimated for the long-term success of rural development projects.

4.3 Mitigating the risks of communal bioenergy production and use: insurance and savings

Generally speaking, insurance refers to the protection of people against a specific hazard in exchange for a fee that is proportionate to the probabilities and costs associated with it (Roth & McCord, 2008). Insurance could potentially play two important roles in increasing the viability of financing communal bioenergy production and use. First, it could, in principal, allow producers of feedstock to guard themselves against the risk of lower-than-expected yields, which also serves to protect the financial institution itself from the risk of borrowers defaulting on their loans. To this end, two types of agricultural insurance products have been developed. The first is a so-called crop-insurance, which covers the losses incurred on a farmer by lower-than-anticipated yields (Skees, 2003). The second is what practitioners commonly refer to as an index-based insurance, which pays out a pre-determined amount of money to farmers covered by the scheme when specific conditions, often weather-related, are reached in the index (WFP & IFAD, 2011). By protecting the income of farmers from year-to-year fluctuations around an average, whether it be in terms of crop-yields or weather-related events, insurance could conceivably also play the vital role of reducing smallholders' aversion to risk, and thereby make them more likely to embrace bioenergy technologies that could serve to enhance their welfare.

An alternative course of action for building up the resilience of feedstock producing smallholders to risk would be to require that borrowers save a certain amount every month in a savings account, which is only paid out either at an agreed upon date or in the event of an unforeseen production shock. Where microinsurance schemes prove difficult to set up, this could be a very attractive option for mitigating the risks feedstock producers and financial institutions face.

4.4 Curbing free-riding behaviour in the case of collective investments: innovative contractual arrangements

Curbing free-riding behaviour in the case of collective investments is not an easy task, but given the potential ramifications of free-riding for the institution that finances a communal bioenergy project, it has to be done if such projects are to be viable in the long-run, not to mention scalable. As hinted at in section three, the key to curbing free-riding behaviour is to provide all stakeholders with tangible incentives not to engage in such behaviour. Referring back to the example of the seed press, one way in which this could be achieved is by leasing the seed press at a premium rate for a pre-determined amount of time. When this period has expired, the seed press becomes the property of the feedstock producers themselves. Should the lease-fee not be paid on time, the institution that leases the seed press can simply take it back. If it is assumed that feedstock producers can sell their oil at a profit, it is clear that they have a strong incentive to pay their part of the leasing-fee for the seed press.

5. Assessing the feasibility of financing communal bioenergy production and use in poor rural areas

In this section, the feasibility of financing bioenergy production and use in poor rural areas is assessed with reference to the production and use models that were outlined in section two. The assessment is divided into four parts. The first part looks at bioenergy production and use models that show little or no potential. In the second part, the focus shifts to production and use models with some or a considerable degree of potential. Thereafter, in the third part, the discussion shifts to institutional and contractual issues that have an influence on the feasibility of financing communal bioenergy projects. The feasibility of linking communal bioenergy projects to carbon finance is then discussed in part four. In part five, the findings of this study are synthesized into the contours of a model for financing bioenergy production and use in impoverished rural areas.

5.1 Bioenergy production and use models with little or no potential

The main problem of financing production of crude plant oil, biodiesel or bioethanol from crop-based feedstock is the considerable risk associated with the cultivation of feedstock. Below-expected yields – or in the worst case, a failed harvest – can severely affect cash-flows and thereby the financial viability of such projects.

Needless to point out, it is very difficult for lenders and borrowers alike to shoulder this risk. This is particularly true where perennial crops are used as feedstock. Insurance was discussed as an antidote to the risky nature of cultivating feedstock earlier in this paper, but there are legitimate reasons for doubting the potential of insurance in adequately tackling this problem.

First of all, it would be overly optimistic, to say the least, to assume that smallholders would readily pay an insurance premium when it is far from certain that they understand and appreciate the concept of insurance as a mean for managing risk. Indeed, experience on the ground indicates that smallholders often choose not to insure themselves even when insurance is available on the market (ILRI, 2012). While this problem could probably be augmented with time, it is not the only question mark surrounding the potential of insurance as an instrument for enabling smallholders to cope with the risks associated with the production of feedstock. In the case of conventional crop insurance, the ever present threats of moral hazard and adverse selection raise the spectre of fraud; a problem that is exacerbated by the informational asymmetries that are bound to be the rule rather than the exception in a rural context. Measures could be taken by finance institutions to counter these problems, but the small amounts involved in conjunction with the cost of doing so mean that only in the rarest of cases is this likely to be economically feasible, if ever.

Index insurance avoids the pitfalls associated with conventional crop insurance, but nevertheless it has problems of its own, the main issue being that there is no way to guarantee that the amount paid out when a point is reached in the insurance index corresponds to the actual losses incurred on the client.

Savings were proposed, in this paper, as an alternative way of reducing the risks faced by feedstock producing smallholders. Although it is true that micro-saving facilities enable smallholders to guard themselves against unforeseen calamities by allowing them to build up a buffer of capital, just as in the case of index insurance, it is far from certain that the amount saved is enough to make up for lower-than-expected yields. An additional problem is that the idea of micro-savings as a way to reduce risk is conditional upon smallholders having enough money to be able to put some of it aside for a protracted period of time.

With this in mind, biodiesel, crude plant oil or bioethanol production from crop-based feedstock does not appear to be a good fit for communal bioenergy projects from a strictly financial perspective. The stakes are, quite simply, too high.

While risk is arguably the most significant barrier to financing crop-based bioenergy production, it is not the only one. To produce crop-based bioenergy, very specific expertise is needed, but this expertise is likely to be absent or in short supply in poor rural areas. At first glance, this problem could be tackled by simply training locals so that they have the necessary expertise, but as mentioned already, there are no guarantees that locals that have received training can be retained for a protracted period of time. In this sense, producing biodiesel, crude plant oil or bioethanol from crop-based feedstock is a difficult proposition because of the expertise needed to do so.

5.2 Bioenergy production and use models with some or a lot of potential

While bioenergy produced from crop-based feedstock is not suitable for communal bioenergy projects due, in large part, to the risks involved in feedstock production, bioenergy produced from waste streams shows considerable potential in this regard as the opportunity cost of waste is very low, if not zero.

Out of the production and use models discussed in section two, two revolve around bioenergy production from waste streams. First, biodiesel production from waste oil. Second, biogas production from organic waste.

While biodiesel production from waste oil is to be preferred to biodiesel production from crop-based feedstock in poor rural areas, this production model still has one crucial drawback, namely the expertise that is needed to operate and maintain a biodiesel refinery. If a part of a refinery breaks down, and there is nobody available that can fix it, there will be no more biodiesel produced and as a result revenues will stop flowing which, in turn, makes it unlikely that the institution, which financed the investment, will get its money back.

This is not to say that biodiesel production from waste oil is not feasible and should be discouraged altogether in poor rural areas. What does not work in one context might very well work in another. Project developers should carry out careful assessments of existing expertise, social cohesion and other relevant factors when deciding on the suitability of biodiesel production from waste oil in a given community.

While biodiesel production from waste oil has a certain degree of potential, biogas from organic waste is arguably the most promising of the bioenergy production and use models that were covered in section two. Not only can biogas be produced from waste, which renders the cultivation of feedstock unnecessary, it is also a very simple, cost-effective and robust technology that can be operated by people with little or no expertise, which makes it ideal for bioenergy production and use in poor rural areas. With relatively few inputs, electricity can be produced and sold to local businesses and household at a low cost. Add to this the fact that biogas slurry can be used as organic fertilizer to improve crop yields, which serves to improve food security, and the biogas from organic waste production and use model gains further appeal. The only drawback of biogas is that it cannot be used as fuel for motorised vehicles.

5.3 Institutional and contractual issues

Biodiesel production from waste oil and biogas production from organic waste are well-suited on a technical level for communal bioenergy projects in impoverished rural areas. However, the fact that it can be done does not necessarily mean that an investor can recover the money she has invested in a communal bioenergy project.

If borrowers can put up collateral, there is arguably no problem, but in reality, the poor seldom have any assets against which a loan can be secured, which makes matters more complicated as lending money without collateral is a massive risk for any investor, the reason being that all the risk is placed on the shoulders of the investor, not to mention the reduced incentive for the borrower to repay their loan.

Microcredit was discussed as a solution to this problem in section four. However, the applicability of microcredit to the biodiesel from waste oil and biogas from organic waste production models is limited at best as they only involve collective investments – namely a biogas digester/biodiesel refinery, electricity generator and grid – for which, as was explained in section three, other solutions are needed.

One such solution, which was presented in section four, is to lease the required equipment for a pre-determined amount of time. Once this period has expired, the equipment becomes the property of the community itself. If, however, the lease fee is not paid on time, or not paid at all for a protracted period of time, the investor can reclaim the equipment. If the bioenergy produced with this equipment is of value to the community, it follows that a strong incentive exists for the community to repay its loans. The best way of organizing a leasing scheme of this kind would be for the community to form an institution that is in charge of the equipment being leased, selling the electricity produced from the biogas and paying the leasing fees. The electricity would be sold at a small profit; the profit would be used for repairs and procuring waste where it is not freely available.

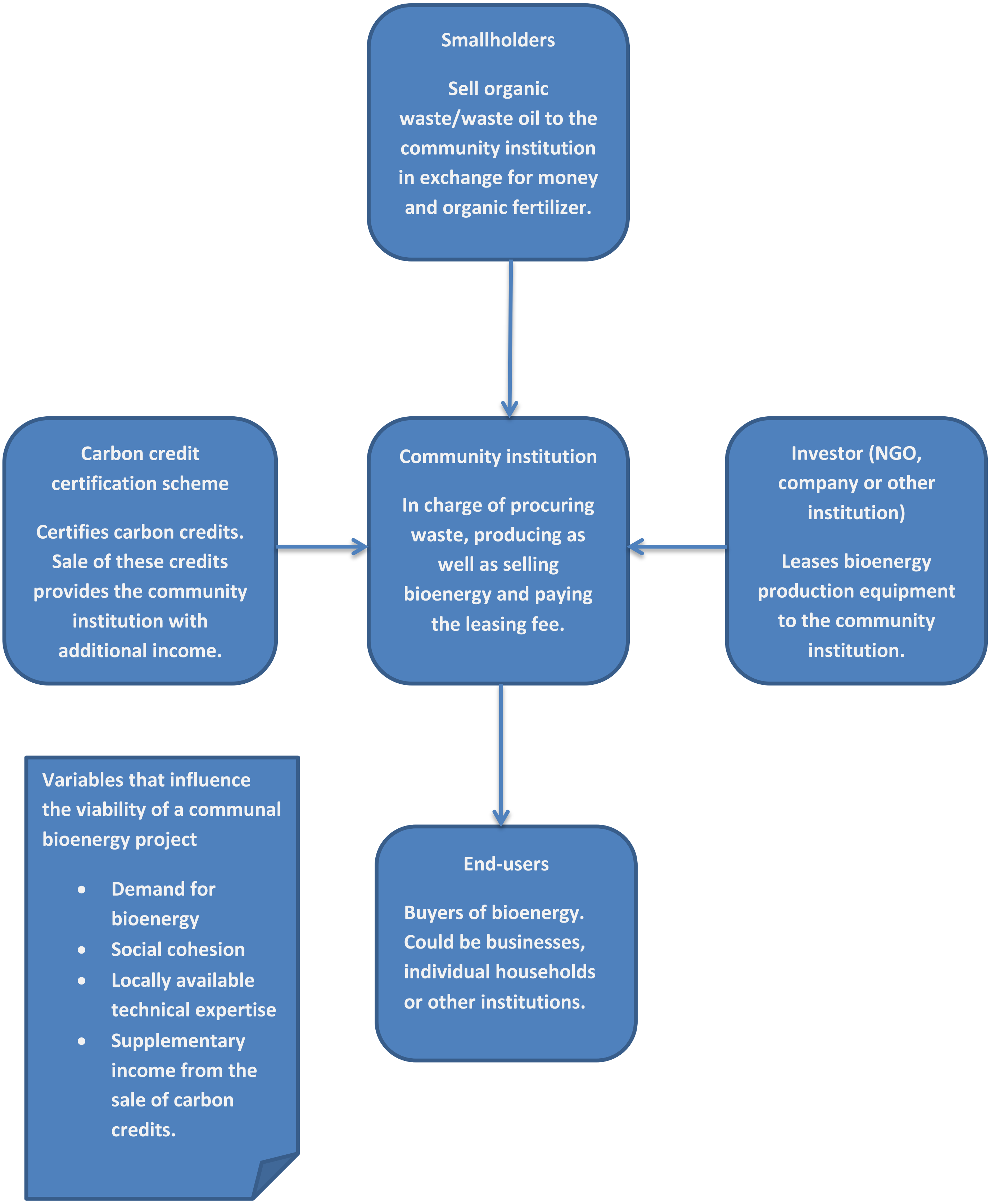
Needless to say, the feasibility of the institutional model discussed above depends on the extent to which the community is characterised by social cohesion, but also whether there is demand for bioenergy. If there are no buyers of bioenergy available locally, there will not be any revenues from which loans can be repaid, which effectively means that the project is not feasible. It is therefore of the utmost importance that project developers carefully assess potential revenue streams before they go ahead and finance a communal bioenergy project.

5.4 The feasibility of linking carbon finance to communal bioenergy production and use

Carbon finance could make communal bioenergy production and use more viable on a financial level. The problem, though, as was pointed out in section three, is that the cost of certification, in combination with low permit prices, means that it is only worthwhile for large-scale community bioenergy projects to produce and sell carbon credits.

A change in one or both of these variables would increase the synergy between carbon finance and medium to small-scale communal bioenergy projects. Regarding the price of carbon credits, it is unlikely that it will rise within the foreseeable future as there is an excess supply of permits on the market and policymakers appear to be reluctant to do anything about it; in large part because of the on-going recession. With respect to the cost of certification, things look a bit brighter. Most certification schemes, the Clean Development Mechanism included, are developing procedures for pooling multiple projects of a similar type into one umbrella project, thus allowing small projects to join forces and share the cost of certification, which, other things equal, bodes well for the feasibility of linking communal bioenergy production and use to carbon finance.

5.5 The contours of a model for financing communal bioenergy production and use in poor rural areas



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