Title

Securing feedstock supply of biogas plants – a managerial challenge

Authors

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Abstract

As stocks of fossil fuels get harder to access and exploit world-wide, renewable energies as sustainable option have entered the limelight in recent years. Bio-energy plays an essential role in the current mix of renewable energy technologies. In Germany, the state fosters insistently biogas technology within the concert of bio-energy options.

Literature suggests that long-term stable economic ties with supplying farmers are the pivotal managerial challenge of biogas plant operators to secure constant and competitively priced feedstock supply. Biogas plant operators are generally in a vulnerable position vis-à-vis their suppliers due to their substantial specific capital investment and a rather restricted economically viable catchment area. Transactional uncertainty due to volatile agricultural market prices, changing yield quantities, and unpredictable behavior of suppliers makes biogas plant operators aim for appropriate modes of governance.

Referring to the theoretical background of transaction cost theory, network theory and the relational view of strategic management, the paper aims by means of content analysis of expert interviews to explore how plant operators perceive their specific situation of transactional uncertainty and which instruments (concerning formal contracts and relational governance) they use for securing stable and constant feedstock supply.

Findings highlight that mutually reinforcing interaction of formal contracts, business partnerships, and equity participation with relational governance proves to be successful in establishing stable feedstock supply. While the specific rural societal culture impacts ambiguously governance design, local rootedness of biogas plant operators provides high levels of social capital and thus clearly facilitates the search for effective solutions satisfying all parties.

Keywords

Biogas, bio-energy, supply chain management, governance modes, relational governance, formal contracts, equity participation, local rootedness.

Introduction

On the one hand, various benefits of bio-energy find strong support in literature: Bio-energy may help reduce CO_2-emissions, preserves non-renewable resources, improves energy security, and promotes regional development as well as rural diversification and empowerment by generating jobs and income in often underdeveloped regions (Gold & Seuring 2010). On the other hand, critics pointing to adverse life-cycle sustainability balances of certain forms of bio-energy production bask in growing public and scientific attention. Possible negative side-effects of bio-energy comprise, for instance, acidification, human and ecological toxicity, eutrophication (von Blottnitz & Curran 2007), competing land use between biomass production for food, material and energy use (Kerckow 2007) as well as regionally severely exacerbated water shortages (Gerbens-Leenes et al. 2009). In addition, residents sometimes put up resistance against bio-energy plants or projects with arguments such as

traffic congestion, bad smells, visual appearance or diminished recreational value (Gold & Seuring 2010).

Hence, bio-energy plants operate between benefits and challenges and they are embedded in a diverse stakeholder framework embracing governmental bodies, NGOs, associations, consumers, residents, and the public in general (Gold & Seuring 2010). Biomass used for bio-energy conversion comprehends wood, agricultural and forestry residues, energy crops, human and animal excrement as well as industrial and municipal bio-degradable waste (Allen et al. 1998). Bio-fuels are solid, liquid, and gaseous fuels produced from biomass; bio-energy is energy (heat, electricity, mobility) from bio-fuels (McComick & Kåberger 2005).

The German government recently has thwarted biodiesel and vegetable oil through stepwise increasing taxation from 2006 on and reduced mandatory blending quota with fossil fuels in the next years. In contrast, the state fosters biogas technology within the concert of bio-energy options through the Renewable Energy Law. The last amendment of 2009 grants special feed-in tariff bonuses for biogas plants using innovative technology, renewable resources such as energy crops, and manure (EEG 2009). In addition, the German government aims for increasing upgraded bio-methane fed into the natural gas grid from around 200 million m^3 in 2009 to 6 billion m^3 by 2020, and 10 billion m^3 by 2030, which represents a very ambitious objective (dena 2009), for which the federal state might have to provide additional support to this specific technology in the next years.

Feedstock sourcing of biogas plant operators is economically limited to a certain catchment area, given the logistical challenges due to biomass characteristics, such as restricted handling options of silage or general low bulk density of manure and energy crops (Mayfield et al. 2007). For example, Börjesson and Berglund (2006) state that actual transport distances of biogas plants run on agricultural feedstock usually lie between 3 and 15 km. Hence, it is vital for biogas plant operators to establish and maintain stable economic ties to feedstock supplying farmers within a delimited area surrounding their plant, in order to secure long-term and affordable feedstock supply (Steinmann & Holm-Müller 2010). McCormick and Kåberger (2007) identify the dyadic relationship between plant operators and feedstock suppliers as pivotal within bio-energy chains. Plant operators and suppliers are mutually interdependent and both have to credibly show their commitment in the bio-energy project: “Investing in biomass resources is only possible if there are energy companies purchasing biomass, and establishing conversion technologies is only possible if there are biomass suppliers supplying biomass.” (McCormick & Kåberger 2007, p. 450)

From this reasoning we develop the following research questions, focusing on the perspective of plant operators:

(Q1) How do biogas plant operators perceive their situation of transactional uncertainty, which entails the risk of hold-up through non-delivery of suppliers and which increases overall the transaction costs of mere market arrangements?

(Q2) Consequently, which instruments (concerning formal contracts and relational governance) do biogas plant operators use for securing stable and constant feedstock supply?

The paper is structured as follows: A brief overview of previous research touching upon our research questions is given. Subsequently, an analytic framework containing relevant constructs and theoretical pre-considerations for answering the research questions – eclectically derived from the fields of new institutional economics, network theory and the relational view of strategic management – is presented. Afterwards, the methodology and procedure of data collection and analysis is described. In a next step, the findings of the

expert interviews are presented; on this basis the analytic model is modified and extended. The paper concludes with a final discussion of the findings.

Literature Review

There is a range of papers at the interface of bio-energy and Supply Chain Management which underline the interdependences of supply chain actors and the need for cooperation (e.g., McCormick & Kåberger 2007) as well as coordination throughout the chain (e.g., Heinimö et al. 2008), supply chain governance (e.g., Madlener and Bachhiesl 2007), long-term relationships (e.g., McCormick & Kåberger 2007), and communication (e.g., Mayfield et al. 2007) (for a complete overview, see the literature review by Gold & Seuring 2010). None of them though have examined, in an in-depth way, the perception of biogas plant operators concerning their specific situation of transactional uncertainty, entailing the risk of hold-up through non-delivery of suppliers and leading to specific modes of formal and relational governance. This is where the extant paper ties in by presenting such an analysis on basis of explorative interviews with biogas plant operators in Germany. In the following the theoretical concepts for analyzing the research questions are introduced.

Drivers for cooperation and integration

Transaction cost economics is generally based on the cognitive and behavioral assumptions of bounded rationality, defined as behavior that is "intendedly rational, but only limitedly so" (Simon 1961, p. xxiv) and opportunism, defined as "self-interest seeking with guile" (Williamson 1996, p.6). It is suggested that key dimensions of describing transactions are (1) asset specificity, (2) uncertainty, and (3) frequency, of which asset specificity is identified to be the most important and distinctive (Williamson 1996, p.45). Thereby, uncertainty refers to the unpredictability and number of adjustments necessarily to be done to the performance agreement (e.g., quality, delivery date, volume, price) during a transaction (Müller 2005). Asset specificity is mainly divided into site specificity, physical asset specificity, human asset specificity and dedicated assets, which are discrete investments made at the request of particular customers (Williamson 1985; Williamson 1991). Williamson (2008) points to the fundamental ramification of asset specificity: "because transaction-specific assets can be redeployed to alternative uses and users only at a loss of productive value, continuity preserving governance for such transactions is important." (Williamson, 2008, p.8)

Asset specificity entails behavioral uncertainty in the form of hidden intention: one transaction party appropriates rents at the expense of the other transaction party, which is bound by its specific investment, through an opportunistic exploitation of the situation (hold-up). The behavior of the opportunistic party is intentional and will be revealed ex-post to the less informed, aggrieved party, which considers the conduct as unfair without having the potential to oblige its counterpart to a quid-pro-quo though. Hold-up situations may be prevented by framework contracts, sanction potential or vertical integration (Müller 2005). Contrary, Duschek (2004) considers the various forms of asset specificity not only as a risk but also as a possible source of relational competitive advantage. For instance, relational human asset specificity may be developed through ongoing collaboration, which facilitates establishing a "common language, knowledge and routines etc. which represent more efficient communication structures" (Duschek 2004, p.63). Still, it is underlined that business parties will engage in substantial relation-specific assets only when there are effective safeguards in place (Dyer & Singh 1998; Williamson 1985). In addition, societal culture, such as culture imbibed by socialization in a rural agricultural context, serves as an important influencing parameter on the propensity of economic actors to exhibit opportunistic behavior or to engage into cooperative behavior (Williamson 1996).

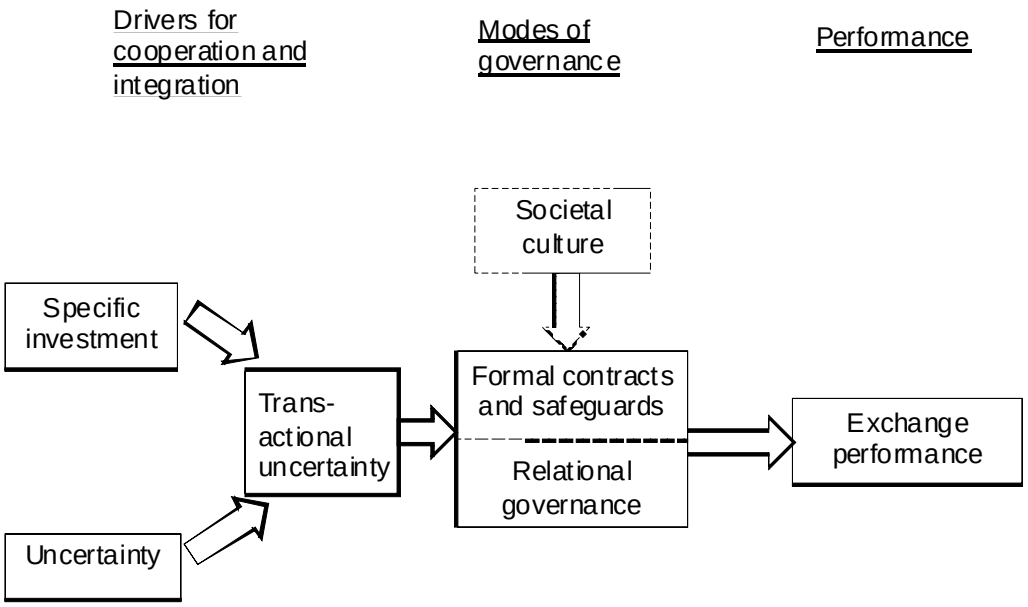
Modes of governance

Low uncertainty, low specific investment and low transaction frequency suggests the governance form of markets due to its low fix transaction costs. Growing asset specificity implying increasing behavioral uncertainty require more sophisticated agreements and controls, which enhance the variable transaction costs of market solutions and thus suggest governance forms of hybrids or hierarchies (Müller 2005; Williamson 1985; Williamson 1991). Applying this to a supply chain context: When the supply market is competitive and asset specificity is low, the buyer simply terminates the "arms-length" relationship characterized by little specific investment and minimal information exchange for any reason; however, when considerable up-front investments have been made or when there is only a restricted pool of appropriate suppliers, more formalized, more elaborated, and less flexible government mechanisms have to be devised (Hoyt & Huq 2000). When exchange involves a high level of transactional uncertainty, such as volatile prices, changing quantities or opportunistic behavior of suppliers, usually either specificity and elaboration of contractual agreements are increased or other formal safeguards such as equity participation or inclusive association of main suppliers into a business partnership are aimed for. Cannon et al. (2000) found that under conditions of high transactional uncertainty legal bonds without cooperative norms as important social complements to contracts are ineffective in enhancing supplier performance, whereas cooperative norms emphasizing shared values, solidarity, and mutual well-being of all transaction parties exert positive impacts on supplier performance under all levels of transactional uncertainty (Cannon et al. 2000). They argue for intertwining contracts and norms through plural form governance.

This statement is backed by many scholars who confirm that governance of inter-organizational exchanges – conceived as iterative exchanges entrenched in a social world – involves more than formal contracts. "Governance emerges from the values and agreed-upon processes found in social relationships. For such relationally-governed exchanges the enforcement of obligations, promises, and expectations occurs through social processes that promote norms of flexibility, solidarity, and information exchange" (Poppo & Zenger 2002, p.709f.). It is argued that self-enforcing agreements, which contribute towards trust-building among the partners, are more effective than contracts at thwarting opportunism and minimizing transaction costs. Contracts fail to predict all possible ways of cheating, and they feature higher (external) monitoring and adaptation costs (Uzzi 1997; Dyer & Singh 1998; Duschek 2004). Also Artz and Brush (2000) state that "relational norms, i.e., collaboration, continuity expectations and noncoercive communications, effectively reduced the impact of […] asset specificity on […] negotiation costs" (Artz & Brush 2000, p.356). Explicit formal contracts and vertical integration, respectively, and relational governance are frequently seen as substitutes in literature (Dyer & Singh 1998; Uzzi 1997). Poppo and Zenger (2002), in contrast, find empirical evidence that formal contracts and relational governance rather represent mutually reinforcing complements, so that elaborate contracts accompany high degrees of relational governance and vice versa. Li et al. (2010) differentiate for the case of China that formal controls (detailed, explicit contracts as primary mechanism of relationship regulation) and social controls (reliance on the partner, participatory decision-making and joint problem-solving, detailed information exchange) are substitutes in domestic and complements in international buyer-supplier relationships.

The concepts presented above are merged and visualized in Figure 1. Drivers for cooperation and integration are linked to respective modes of governance and these modes of governance are further linked to exchange performance, while taking as well societal culture as influencing variable into account. This analytic framework has served as a basis for the elaboration of the interview guideline and as a starting point for empirical data analysis.

Figure 1: Drivers and modes of effective governance



Source: Own illustration

Methodology

Data has been gathered by means of 5 personal and 3 telephone semi-structured in-depth interviews, addressing biogas plant operators as experts (Saunders et al. 2007). The personal interviews range from 45 to 90 minutes, while the telephone interviews have a length of 5 to 15 minutes. While the personal interviews have been fully recorded and transcribed, the phone interviews have been journalized from notes and the memory of the researcher right after the respective phone calls. All in all, the interviews have yielded transcription material of around 50 pages. Where applicable and available, complementary information concerning the biogas plants under examination has been gained through further accessible information material, for example from an accompanying booklet of a governmentally organized biogas plant tour the authors were participating at formerly.

Expert interviews are an integral part of the methodological instruments of empirical social research. A person is considered an expert when s/he holds at least one of these two characteristics: (1) An expert is responsible for conceiving, enforcing, and controlling a problem solving. (2) An expert possesses privileged access to information about groups of people or decision processes (Meuser & Nagel 1991). In the extant study experts are people who actually operate, manage and/or strategically steer a biogas plant, or those people who hold in-depth knowledge about these matters. Six interviews were conducted with the biogas

operator, one with the biogas operator together with one additional partner, and one interview with a responsible official of a utility company. Biogas plants have been selected for covering a broad range of operating models.

Data was analyzed by means of qualitative content analysis following the five-step process model suggested by Gläser and Laudel (2009, p.203ff.):

1. Theoretical pre-considerations: Initially, the research question is formulated (see Chapter Introduction). Before starting empirical data collection, the research subject is analyzed on basis of existing theory. In the course of this, relevant variables and their influencing or causal connections among each other are assessed, thus constructing a hypothetic model referring to the research question.

2. Preparation of extraction (development of a search pattern): After having collected empirical data, the pre-defined model (variables and causal relations) is checked in the light of insights gathered during field work (see Figure 1). Search categories are factual dimensions of variables and influencing factors, respectively, complemented by causal and effecting dimensions assessing the relation between variables. Then the material to be analyzed is fixed: in the extant case it represents all of the interview transcriptions, notes and additional material.

3. Extraction: Material relevant to the research questions is identified, extracted in a condensed way and attributed to the various variables (as factual, causal or effecting dimension). Thereby, dimensions and indicators of variables are occasionally added and new variables may be built.

4. Processing: Quality of extracted information is enhanced by summarizing dispersed information and effacing semantic redundancies (cf. summarizing content analysis; Mayring, 2008), by correcting unambiguous errors within the material, while maintaining the whole variety of (sometimes also contradicting) information.

5. Analysis: Extracted and processed material is analyzed and presented, thus displaying the empirical dimensions of variables and distilling causal mechanisms by a comparative analysis of cases.

The discussion then reflects these empirical findings back to the theoretical pre-considerations presented in the chapter literature review, identifying specifications (e.g., distinction of cases) and new variables and causal relations. On this basis, a new, more differentiated model is proposed, thus developing theory for the special application case of biogas plants in Germany.

Findings

Classification of interviewed biogas plants according to main descriptive parameters

The electrical power of the biogas plant examined range from 250 kW to 1.6 MW, the majority holding around 500 kW installed electrical power. Feedstock usually is energy crops and other renewable resources as well as manure and/or slurry. Only one biogas plant is a so-called co-fermentation plant running on collected municipal and industrial bio-waste, which is sanitized in a special heating procedure. Most of the plants generate combined heat and power (CHP) on site, feeding the power to the grid and using the heat – in addition to running the digestion process – mainly for residential and communal buildings in the

proximity, swimming pools or further applications such as drying of wood chips. The biggest plant upgrades the bio-methane to natural gas quality in an additional technological procedure, feeding it then into the gas grid and generating CHP directly on sites of big heat customers such as industrial companies. Thus methane production and heat use are decoupled, facilitating optimal combined heat and power degrees of efficiency between 80 and 90%. The biogas plants use the legal forms of non-trading partnerships or limited partnerships, most frequently embracing 1 to 3 partners; in one case, however, around 40 farmers are incorporated as limited partners of a limited partnership with a limited liability company as general partner. The plants with external feedstock needs of 40% or more have around 20 external suppliers, others supply their plant almost exclusively from business partners, facing the challenge to coordinate and manage those appropriately.

Table 1: Classification of biogas operating models

	Start of oper-ation	Size (electri-cal power)	Feedstock	Upgra-ding to natural gas quality	Business and operating model	Number of external suppli-ers	Ratio of externally supplied feedstock
Inter-view 1	2005	380 kW	energy crops & manure/ slurry	no	non-trading partnership of 3 farmers	16	50 %
Inter-view 2	2007	500 kW	energy crops & manure/ slurry	no	limited partnership with a Ltd. as general partner and 1 farmer + 2 further limited partners	around 25	70 %
Inter-view 3	2006	380 kW	energy crops & manure/ slurry	no	limited partnership of 2 farmers	around 20	40 %
Inter-view 4	2006	465 kW	energy crops & manure/ slurry	no	non-trading partnership of 1 farmer	n.s.	20%
Inter-view 5	2010	1,6 MW	energy crops & manure/ slurry	yes	limited partnership with a Ltd. as general partner and many (around 40) farmers as limited partners	few	10%
Inter-view 6	2006	500 kW	bio-waste	no	limited partnership with a Ltd. as general partner and 1 farmers as limited partners	3 to 5	100%
Inter-view 7	2006	500kW	energy crops & manure/ slurry	no	limited partnership with a Ltd. as general partner and 6 farmers as limited partners	0	0%
Inter-view 8	2009	250 kW	energy crops & manure/ slurry	no	non-trading partnership of 3 farmers	0	0%

Empirical dimensions of variables and causal relations between the variables

Specific investment

Biogas plant operators do considerable financial investments when setting up their biogas plants and, in one case, the additional upgrading facility. Initial investments oscillate according to the size of installed electrical power (cf. Table 1), between approximately 1 Mio € for 250 kW and 4 Mio € for 1.6 MW. The catchment area for energy crop feedstock actually lies between 5 and 15 km. The economically viable catchment area is generally considered to be restricted to 10 km (I1,1[1]; I2,3; I5,3). The catchment area of the co-fermentation plant is considerably broader up to 300 km, due to the much higher energy density of certain forms of bio-waste (I6,4). Strong competition for land, for example through high concentration of dairy farms (I3,1), or low feedstock buffer of only a few days as in the case of the co-fermentation plant (I6,7) additionally increases the specificity of the investment and hence the vulnerability of the operator.

Uncertainty

Main uncertainties affecting biogas plant operators aiming at securing constant and affordable feedstock supply are volatile prices on the agricultural and fertilizer markets (I1,1; I3,1; I5,2) and unpredictable yield per hectare arable land (I2,3; I7,3). Price changes necessitate frequent negotiations and sudden upswings imply high economic risks for biogas plants, since feedstock cost account for around 40-50% of all annual costs, exceeding clearly operation or depreciation costs. It is also argued that prices may rise in a vicious circle when certain farmers try to get additional leasehold at all costs (I2,5). In the case of co-fermentation plants, frequently changing suppliers (I6,1f.) and unpredictable quality of supplied bio-waste represent additional uncertainties to cope with and these challenges compensate for the extended economically viable catchment area in comparison to energy-crop-fed biogas plants (I6,2; I6,4).

Transactional uncertainty

Biogas plant operators' perception of their dependency on surrounding suppliers covers a broad scope: Many feel no or only little dependency (I1,1; I2,2; I4,1), at least under the favorable condition of current low corn and high fertilizer prices. Rising prices translate into increased vulnerability of plant operators, leading them to establish additional buffer storage (I3,1). Short-term profit-seeking suppliers imply serious risks for biogas plants to face feedstock supply shortages (I5,2). Consequently, behavioral uncertainty of supplying farmers may make plant operators plan their own production on a grand scale to be on the safe side (I4,1). Another possibility to mitigate the risk of opportunistic supplier behavior is to keep a multitude of small-scale suppliers (I2,4; I1,1).

Causal relation between specific investment and transactional uncertainty

Two interviewees directly state that the size of investment impacts the transactional uncertainty of the biogas plant operator: Large-scale operating companies investing into biogas face difficulties of getting enough suppliers within a certain radius (I2,5). When thinking about investing into an extension of the plant, one operator conceives the reliable management of the increased feedstock need as major challenge (I4,1).

[1] These codes indicate the sources within the transcription material.

Causal relation between uncertainty and transactional uncertainty

One strong line of argumentation highlights that current low corn prices reduce transactional uncertainty of biogas plant operators by providing an abundance of willing suppliers. On the other hand it is acknowledged that rising prices will severely exacerbate the management risks (I3,1; I2,4f.; I5,2; I7,4), since it is "difficult to keep the suppliers at it" (I4,1). This unpredictability of future price developments and the related behavioral uncertainty of supplying farmers alert plant operators: "Maybe corn prices will be so high that no one accepts a contract any longer." (I2,4f.) Furthermore, changing yields and qualities make flexible arrangements necessary and contribute to transactional uncertainty (I7,3; I7,2; I6,2). If actual harvest exceeds need, one part is used for different purposes or it is sold (I7,2; I2,3); if need exceeds actual harvest, short-term purchase from other resources is organized (I2,3). If in the case of co-fermentation plants, feedstock qualities turn out to be below-average, price or quality has to be re-arranged (I6,2).

Formal contracts and other safeguards

The range of business partnerships or associations by equity participation is from non-trading partnerships of one farmer to limited partnership with a Ltd. as general partner and up to 40 farmers as limited partners (cf. Table 1). Contracts with suppliers go from oral agreements, re-negotiated each year (I1,2; I3,1), to long-term formalized contracts of 5 to 10 years (I5,2; I2,2). While cost increases may be considered within contracts, prices are not adjusted to development on the agricultural markets (I5,2; I2,2). However, it is emphasized that "prices [of long-term contracts] are rather comfortable" for the supplier (I5,2). Feedstock supply through business partners reduces the risk of wrongly estimated feedstock prices (I8,1). It becomes clear that contractually confirmed feedstock supply over several years is also important to get bank credits (I3,1; I5,10).

Relational governance

For facilitating economic interaction with suppliers and between business partners, supportive (I5,1), preventive (I5,4; I7,2) and conflict handling (I6,4; I1,2f., I3,1) communication concerning both concrete operating processes and general mutual understanding is of paramount importance. Communication comprehends goal-oriented dyadic acts of personal or telephonic communication (I1,2), spending time drinking beer together (I8,6), summer barbecue or Christmas parties (I2,2), and official shareholders' meetings (I5,4). Trust and a non-coercive partnership approach are considered catalysts for decision-making within business partnerships (I7,2; I5,5) as well as for negotiations with suppliers (I3,1).

Relation between relational governance and formal contracts and other safeguards

The way how relational governance and formal contracts and other safeguards may interact can be classified as follows:

Table 2: Types of relation between formal contracts and other safeguards and relational governance

Types	**Relation between formal and relational governance**			**Principal modes of relationship**
Type 1: Emerging business idea (I7,1; I8,1ff.)	t1: Satisfying former relationship (division of work and equipment sharing) develops common norms and trust	t2: In the context of these experiences a common business idea emerges	t3: Business partnership for implementing and running a biogas plant	equity participation/business partnerships
Type 2: Externally implemented project (I5,1)	t1: Business purpose of external operator/investor	t2: Building trust among farmers through communication and commitment in the initiation phase	t3: Equity participation and formal long-term contracts of farmers	equity participation/business partnerships
Type 3: Substituting (I2,2)	Contracts substitute for trust and solidarity			supplier-buyer relationships
Type 4: Reinforcing (I2,3)	t1: Suppliers start with yearly agreements or contracts	t2: Satisfying relationship develops common norms and trust	t3: Suppliers are ready to engage in long-term contracts	supplier-buyer relationships

Note: t1 to t3 denominate the chronological order

Causal relation between transactional uncertainty and formal contracts and other safeguards

The feeling of dependency on the suppliers is mitigated by operating models where business partners – at least in a pinch – are able to supply their plant from own lands (I2,2; I4,1; I7,1). Behavioral uncertainty of suppliers in the context of volatile agricultural markets and involved management efforts for year-to-year negotiations make plant operators rather head for long-term leasehold (I3,1) or for the association of farmers in the business partnership combined with long-term supply contracts (I5,2). Variable yields may, in some case, render written contracts futile and rather call for a collaborative agreement (I7,3). On the contrary, the co-fermentation plant does not feature the critical size to get long-term contracts with waste disposal contractors in order to escape from its perceived inferior position (I6,4).

Causal relation between transactional uncertainty and relational governance

It is argued that changing feedstock quality, quantity and price can be more easily arranged by following a collaborative approach based on norms such as personal, direct and transparent communication as well as solidarity (I2,3; I7,3; I6,2; I8,6). Moreover, flexible agreements involving high levels of communication are necessary for smoothly organizing the harvest operations of big biogas plants (I5,4). Hard to detect bio-waste quality attributes an important role for exchange stability and continuity to the development of trust in the course of the buyer-supplier relationship (I6,4). “That is why one has to test a little bit in the beginning whether it works with a certain supplier or not […] but after a while one realizes how the wind blows.” (I6,4)

Societal culture

Societal culture of farmers with whom energy-crop-fed biogas plants have to deal with may be categorized into the following main features: (1) Culture of solidarity makes farmers not to chase prices for leasehold and fodder, especially with regards to dairy farms (I1,2; I3,1; I4,1). (2) Culture of obstinacy makes farmers reluctant towards new developments such as renewable energy technologies (I5,6) or towards long-term contracts, even if these are profitable – “They rather prefer to be poor but free.” (I2,6) (3) In addition, there is a culture of agricultural entrepreneurship and profit seeking (I3,1; I5,5). “Every farmer is a gambler and tries to sell where he gets the best prices according to the market situation.” (I3,1) This renders long-term contracting difficult (I3,1). On the other hand, a culture of reliability and trading trust among farmers generally favors cooperative partnerships: “If [farmers] once say a word, this has almost the value of a signature.” (I5,6)

Local rootedness

Coming from the same region and knowing each other is generally of importance for establishing long-term economic transactions, since it immediately generates a certain level of trust (I2,2; I5,6). Big investors coming from another region and, of necessity, from another milieu have to struggle hard in order to compensate for that disadvantage (I5,6). Usually they neglect relational governance: “Big operating companies that are not rooted in the region only rely on their contracts and neglect the personal aspect.” (I2,3) Sometimes local embeddedness seems to favor the approach of year-to-year negotiations, since it facilitates acceptable solutions for all sides on an on-going basis, which is pointed up by the sentence: “I still wish to be able to send my children to school with a clear conscience.” (I1,2)

Performance

Good indication for high exchange performance is the subjective satisfaction of both feedstock suppliers and plant operators (I2,4; I8,8). This indication is substantiated if suppliers are explicitly willing to supply additional feedstock in the future (I5,7) and if plant operators plan to extend their plant (I7,2; I8,2; I2,2).

Causal relation between formal contracts and other safeguards and performance

Generally, formal contracts with suppliers help securing constant and affordable feedstock supply and impact positively exchange performance (I5,2; I2,2). It should be noted that also supplying farmers appreciate formal long-term contracts, since these contracts guarantee calculable stable income (I2,2; I7,3). Farmers commit themselves even more if they are involved into a biogas plant via equity participation (I5,2). While on the one hand the lack of contracts is considered to alienate and discourage suppliers (I7,3), on the other hand long-term contracts are seen as problematic, since either buyer or seller may feel fleeced by the deal (I8,1).

Causal relation between relational governance and performance

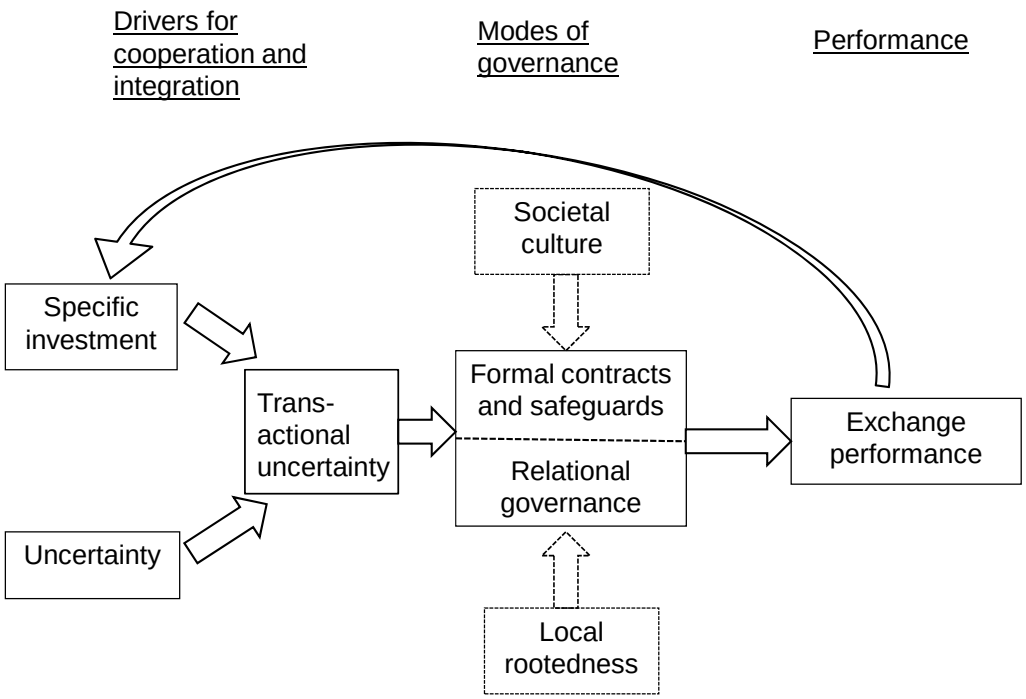
Secured supply through successful collaboration with suppliers is a precondition when plant operators plan to extend their plant (I2,2; I7,2). For ensuring long-term commitment of suppliers it is important to show them that the plant operator as well “is interested in something sustainable” (I5,10). Quality problems and mistakes by the suppliers are smoothed out in solidarity by an assisting partnership approach, which thus re-establishes high performance standards (I1,2f.; I2,3).

Discussions and conclusions

Empirical data generally reflects well the research model preliminarily developed from literature. As one amendment to the model we add the construct “Local rootedness” as factor influencing the way transactions are governed through formal contracts and other safeguards

as well as relational governance. This goes in line with literature where local rootedness and social capital in its sense of enjoying goodwill and trust is acknowledged to be an effective catalyst of economic exchanges (Duschek 2004). The effects of social capital "flow from the information, influence, and solidarity it makes available to the actor" (Adler & Kwon 2002, p.23). Furthermore, satisfaction with exchange performance increases the willingness in doing further specific investments, i.e. planning plant extensions. Therefore we insert an arrow from "Exchange performance" back to "Specific investment". The extended model is presented as Figure 2.

Figure 2: Drivers and modes of effective governance – extended version



Source: Own illustration

Considering the relation of formal contracts and other safeguards and relational governance, it can be seen that in all biogas plants under examination those two modes of governance closely interact. Hence, intertwining contracts and norms through plural form governance, which Cannon et al. (2000) argue for, is actually reality for the analyzed biogas plant sample; there is just the question of the right mixture (regarding the specific situation) of these two governance modes. Local rootedness may help biogas plant operators to find a viable combination, whereas big investors are suspected of merely relying on – toughly negotiated (I8,10) – contracts and of neglecting relational governance (I2,3).

Even if one biogas plant operator states that trust and solidarity does not hold that much importance because of long-term contracts (I2,2; cf. Table 2, Type 3: Substituting), an thorough examination of this case shows that this plant operator indeed uses rather intensely various forms of relational governance, such as harmonious conflict solving (I2,3), communication (I2,2) or price negations in solidarity (I2,2). In addition, he reports that

suppliers with short-term agreements and contracts have finally aimed for long-term contracts this year. He explains this by the low corn prices and the privileged supply relationship with long-term partners. It is very probable, though, that satisfying experience of the business relationship, having developed common norms and trust, laid the ground for this decision in the first place (I2,3; Type 4: Reinforcing). This confirms the proposition of Poppo and Zenger (2002) that formal contracts and relational governance mutually reinforce each other.

Examining how biogas business partnerships emerge and are implemented, the outstanding relevance of trust as well as common norms, values and visions – being time and experience dependent parameters – becomes evident. Type 1 business partnerships (Emerging business ideas) usually arise from former long-standing close collaboration, for example in the form of machinery sharing or extensive division of work, which entails the need for agreements on tasks, responsibilities, and risk and reward sharing. Externally implemented projects (Type 2) rely on a decisive initiation phase when the investor – under time pressure – has to convince the supplying farmers by open communication and credibly conveyed long-term commitment. Thereby, coming from the same region is a door-opener (I5,5) as it implies a certain natural social capital stock (Adler & Kwon 2002) and offering equity participation is a sign of aiming for relationships on eye level (I5,4).

Follow-up research activities may take up the findings of the extant study being based on a limited number of qualitative interviews with biogas plant operators in Germany. From this groundwork, hypotheses can be developed, which may be tested via an extended survey with countrywide or at least regional coverage.

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