Transaction costs in payments for environmental services and command-and-control: A biodiversity conservation case from Nicaragua

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Abstract

This article examines the issue of transactions costs and transaction cost drivers as factors that affect the choice between protected area (PA) command-and-control (C&C) instrument and payments for environmental services (PES) as an area-based approach to conserving biodiversity.

This is done by comparing actual transactions costs and their drivers for a Nicaraguan PA C&C and PES instrument implemented for biodiversity protection in South-Eastern Nicaragua. An examination of the transaction cost drivers shows few inherently unique drivers to either system, with institutional flexibility of PES and frequency of the PES transaction as the most prominent exceptions.

Key words: transaction costs, C&C, PES, transaction cost drivers

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Introduction

Payments for environmental services (PES) are increasingly applied to conserve biodiversity in developing countries. PES are viewed as an attractive alternative to command & control (C&C) approaches for the provision of public, environmental goods, in particular where government systems are weak (e.g. Nathan and Kelkar 2001; Pagiola et al. 2004).

The two instruments are frequently presented as extreme, opposing alternatives, and a relative examination is therefore interesting. Being of a market-based and a regulatory nature respectively, PES and C&C differ in their specificity and modalities of implementation, and are generally considered unequal in their ability to secure their objective in a cost-effective manner. Indeed, it is often stated in the environmental economics literature that PES are generally more efficient than C&C regulation due to their potential for flexible targeting (e.g. Engel, Pagiola & Wunder 2008). This comparative advantage of PES is thought tempered by one or more of three factors: 1) private information rent harnessed by PES recipients; 2) social norms; or 3) transaction costs (TC). Nevertheless, very little empirical evidence exists on how these three factors influence the comparative advantage.

Opportunity costs (OC) can be calculated in individual policy cases to minimise information rents, or auction mechanisms may be used to minimise them (e.g. Jack & Ferraro 2009; Ferraro 2008). Auctions have, however, often been seen as politically and socially unpalatable, to carry significant transaction costs and have accordingly only been applied in a modest number of cases in the USA and Australia (Ferraro 2008, OECD 2010). Several authors have proposed auctions and investigated potential efficiency gains by using auctions in developing nations (e.g. Wünscher et al. 2008; Ferraro 2008), but only four actual PES-related auctions have been implemented in developing countries; Indonesia, Tanzania, Peru and Bolivia and several for policy *design* purposes primarily (Jack et al. 2009; OECD 2010; Narloch et al. 2011).

Social norms are less easily quantifiable (Ostrom 2000). They may minimise the need for monitoring in either system, thus lowering transaction costs, or as some research suggest undermine pre-existing norms of biodiversity protection by converting such standards to a commodity, so-called crowding out (e.g. Vatn 2010, Kosoy & Corbera 2010). They are also likely to be inadequate in a weak governance context and/or under high private opportunity costs to ensure biodiversity conservation on their own. At a political level, social norms may determine which policy types are acceptable.

Transaction costs remain the largest "black box" in terms of empirical data, in relation to both their quantification in individual PES and C&C cases and in understanding what factors influence them. Coggan et al. (2010) call for research that provides a more detailed understanding of the conditioning factors for transaction costs. And while the literature on transaction costs related to environmental policies has grown in recent years (e.g. Rørstad et al. 2007; McCann et al. 2005), transaction cost studies of PES are still few, and comparative studies even rarer. Wunder, Engel & Pagiola (2008) summarise TC for four PES cases in developing countries, though. This scarcity is likely a consequence of the rarity of PES schemes with documented TC, and the difficulties in encountering environmental C&C systems in developing countries, where C&C costs are known and willingly shared.

The present article contributes to the debate of the relative merits of PES and C&C, and the acclaimed comparative advantage of PES based on empirical cost patterns. This is done by investigating concrete transaction costs and drivers in a Nicaraguan PES and C&C initiative, respectively. The ambition is to shed light on which transaction cost drivers are important to consider when evaluating the potential cost-effectiveness advantage of PES over C&C in a specific situation.

Data collection

The Nicaraguan Ministry of Natural Resources and Environment (MARENA), is responsible for the management of the Reserva Biológica Indío-Maíz (RBIM) in South-Eastern Nicaragua and the environmental NGO Fundación del Río (FdR) is responsible for the implementation of the PES initiative in the buffer zone of RBIM. The C&C efforts in RBIM have previously been supported by the Danish Agency for Development Assistance (DANIDA), whereas the PES initiative has been supported by the Danish NGO "Forests of the World".

Data were collected during 3 months in El Castillo (PES implementing agency, ground staff), Boca de Sábalos (local C&C authorities, project staff), San Carlos (PES implementing agency, head office) and Managua (central C&C authorities) in 2009. Key informants at both central and local level in both the PES and C&C system were interviewed iteratively, and budgets, project reports and accounts from supporting partners were obtained and reviewed. In both cases efforts were at least periodically funded by external donors, which provided the advantage of relatively well defined budget items and periods covered. It also gave the advantage of stating explicitly the usually implicit staff-time expenses, enabling more accurate inclusion in overall transaction costs.

Transaction cost framework

Identifying the transaction referred to in "transaction costs" in a market-based system like PES is relatively straightforward as classical economic literature speaks of the contract as the central item transacted over. Here the definition of TC used by McCann et al. (2005) is employed, which states that "transaction costs are the resources used to define, establish, maintain and transfer property rights". Originally developed in the context of organization studies focusing on markets and firms, TC economics has since been applied also to analysis of government policies, leading to the development of broader conceptual frameworks. McCann et al. (2005) presents one such broader

framework for analyzing TC and is chosen specifically because its categorization allows for the comparison of TC across market and non-market based policy instruments. One important category in the framework in this respect is "administrative costs", which are seen as internalised transaction costs in relation to public policies. Including the costs of the internal work processes and expenses of public agencies is important to avoid biases in any comparison of public and market-based policies.

Cost categories	Baseline	Development	Early implementation	Full implementation	Established programme
Research & information					
Enactment/litigation					
Design & implementation					
Support & administration					
Contracting					
Monitoring & detection					
Prosecution & enforcement					

Table 1: Chronology and order of transaction costs during a policy life cycle (adapted from McCann *et al.* 2005)
Shaded areas indicate incurrence of costs in the relevant policy phase.

The McCann et al. (2005) framework divides a policy's life cycle into five chronological phases (**Fejl! Henvisningskilde ikke fundet.**): the baseline phase covers activities before actual policy-specific work is begun, i.e. recognition that some sort of policy intervention is desired or necessary. Once a policy intervention has been decided upon the development phase is entered, and information necessary for overall policy design and enactment is gathered. The early implementation phase encompasses activities to operationalize the policy. When these have been finalised the policy is considered fully operational and enters the full implementation phase. The next and last Established programme stage is dominated by known routine transactions.

For the PES system, actual recruitment and contracting marks the start of the full implementation phase. The C&C system is considered operational when legislation and operational enforcement is in place. Comparing two policies poses the additional challenge of differences in scale. Part of this challenge can be countered by focusing the comparison on budget shares dedicated to various budget items (as done by e.g. Rørstad et al. 2007).

The cost typology suits the purpose of this article well, as it has been developed specifically for use across different environmental policies. It has been slightly modified by the addition of one more category in each policy system: the cash payments themselves in the PES scheme and what has been dubbed "carrot initiatives" in the C&C system. These features are either directly (PES) or indirectly (C&C) targeted at stimulating compliance with the overall policy target by encouragement instead of punishment, and thus appear to target the same purpose and by an overall similar approach.

Framework for analysing transaction cost drivers

The transaction cost literature has evolved through organizational studies of the private sector and markets (e.g. Coase 1937), i.e. with "the firm' as the central entity. In this tradition Williamson (1985) summed up the generic drivers of transaction costs as i) asset specificity; ii) the frequency of transactions; and iii) the uncertainty of transactions. More recently, Coggan et al. (2007) added to this iv) the pre-existing institutional environment and v) transactor characteristics, i.e. the characteristics of the parties transacting. The latter may be divided into a) buyer/implementing agency and b) seller/local population, as these two types of transacting parties may be expected to differ in their characteristics. Below (**Fejl! Henvisningskilde ikke fundet.**) an overview of generic transaction cost drivers is provided along with a definition and an example of a natural resource relevant application.

DEFINITIONS/INTERPRETATION OF GENERIC TC DRIVERS		
ASSET SPECIFICITY		
Site specificity	A [natural resource] available at a certain location and movable only at great cost; Location of the asset affects the value of the transaction.	Site specificity drives TC through costs for information gathering to identify a site with the desired features..
Physical specificity	The inputs used during the transaction; e.g. a specialized tool designed for a single purpose.	Physical specificity drives TC through need for specialised equipment to e.g. monitor the environmental status of the resource.
Human specificity	Requirements for knowledge and capabilities of the labour used in the transaction.	High specificity drives TC through need for specialised staff in terms of education and/or experience. Inter-personal trust between staff and policy target group may also be considered a specific human asset.
Dedicated asset specificity	A discrete investment in a "production facility" that cannot readily be put to work for other purposes.	Dedicated assets drives TC by the need for investments in assets, e.g. physical infrastructure, which cannot be used for other purposes than the policy/production/ transaction in question, nor moved.
FREQUENCY OF TRANSACTION		
Frequency of transaction	The number, frequency and timing of transactions, and degree of standardisation obtainable.	High frequency of transactions drives TC directly. Recurring, standardised transactions tend to lower TC per transaction. C&C is generally considered as a one transaction phenomenon, i.e. the enactment.
UNCERTAINTY OF TRANSACTION		
State of nature	Uncertainty surrounding the expected ultimate impact of the (trans)action	This drives TC through a need for increased investment in information gathering to counter the uncertainty, e.g. choosing to monitor forest tree species diversity rather than forest cover as a proxy for biodiversity.
Contract clarity	Clarity of obligations of parties and implications of contract	Contract (un)clarity increases TC through increased need to explain contract implications to potential participants or a need for insurance against non-compliance for lack of participant understanding of contract implications.
Behavioural uncertainty	Opportunism, bounded rationality, risk perception	Higher behavioural uncertainty leads to higher "insurance costs' from the implementing agency, e.g. monitoring.
TRANSACTOR CHARACTERISTICS (linked to behavioural uncertainty)		
Bounded rationality	Transactors do not act perfectly rational, nor do they possess perfect information.	Bounded rationality drives TC through costs for collection and analyses of information before, during and after transaction decisions are made. Bounded rationality means that there will be limits to a transactor's ability to identify "efficient' transactions.
Opportunism	Transactors (sellers/target group) have incentives not to reveal their true opportunity costs or comply with legislation if risk of discovery is low	Opportunism drives TC through increased information gathering (to reveal opportunistic behaviour) or higher private information rents.
Trust, shared ideology and social connectedness	Common social norms and objectives	Shared ideology keeps TC down by lowering of recruitment and monitoring costs (Mettepenningen & van Huylenbrock 2009).
Social connectedness	A close, trusting relationship between family members, neighbours and community members	Social connectedness drives TC by keeping recruitment costs down, and may aid in lowering monitoring costs as neighbours exert social control.

Trust	Interpersonal trust between to or more persons, who know each other, and general trust as the degree of trust with which strangers are met.	Trust drives TC by affecting the search, recruitment and monitoring costs of transactors (Mettepenningen & van Huylenbrock 2009; Ducos et al. 2009; and Ducos and Dupraz 2006).
INSTITUTIONAL ENVIRONMENT		
Formal and informal institutions	Consistency of new policy with pre-existing formal and informal institutions, such as government organisation, laws and social norms	Pre-existing formal institutions drive TC through the possible need for new physical and human infrastructure. Also, compatibility of proposed new policy with existing institutional environment reduces uncertainty and opposition. Incompatibility of new policy with existing norms will increase
Point of policy application (PoPA)	Point of policy application refers to whether the policy is directed at a commodity or e.g. a public good such as landscape features	A commodity borne policy (e.g. tax) exhibits a different TC pattern than a policy based on land use changes.

Table 2: Generic transaction cost drivers. Sources: Williamson (1985, 1996) and Coggan et al. (2010).

Boundaries between some of the drivers are fluid: transactor characteristics are closely related to behavioural uncertainty, as well as closely related to informal institutions/social norms. Site specificity is likely to influence the need for dedicated assets and increase the importance of pre-existing formal institutions.

Results

Costs for the two policy cases are presented in **Fejl! Henvisningskilde ikke fundet.**. The left half of the symmetrical figure shows costs of the PES initiative, whereas the right half shows C&C costs. Costs have been broken down to three and two policy phases respectively in compliance with McCann et al. (2005) and available data. For each phase, transaction costs have been categorised. Within each phase, the internal distribution of costs is specified between cost categories. The share of each phase as a proportion of cost for development, early implementation plus one year of full implementation is stated below each phase to provide a relative measure of the importance of start-up costs as compared to running costs.

Cost info based on years		Cost type	Actual costs PES (US$/year) *	%	%	Actual costs C&C (US$/year) *	Cost type		Cost info based on years
	Development	Information gathering	12,032	57	Data not available		Information gathering	Development	
		Lobbying	4,955	23			Lobbying		
2006		Administration	4,247	20			Administration		Pre-2006
		Total	**21,234**	**19**			**Total**		
	Early implementation	Administration	Data not available		Data not available		Administration	Early implementation	
2007		Operational design	9,909	100		0	Operational design		1996
		Infrastructure	0	0	100	980,227	Infrastructure		
		Total	**9,909**	**9**	**93**	**980,227**	**Total**		
	Full implementation	Payments	9,570	12	33	25,681	Carrot initiatives	Full implementation	
		Monitoring	18,375	23	40	30,878	Monitoring		
		Administration	574	1	7	5,766	Administration		
		Fundraising	11,484	15	0	0	Fundraising		
2007-09		Information gathering	0	0	11	8,650	Information gathering		2008-09
		Infrastructure	0	0	9	7,134	Infrastructure		
		Baseline	12753	16			Not relevant		
		Recruitment & contracting	25506	33			Not relevant		
		Total	**78,263**	**72**	**7**	**78,109**	**Total**		

* Adjusted to 2009 values

Figure 1: Policy phases and associated costs in the El Castillo case study

Empirically observed drivers of TC for each instrument are described below together with policy costs according to policy phase and summarised in Tables 3-5.

Development phase costs and drivers

For the development phase only costs for PES were retrievable. These indicated information gathering as the dominant cost, which makes sense given the high site specificity of the case. The costs for information gathering were costs for investigating the local link between the proxy (habitat) and the desired ES (biodiversity/Green Macaw), and the distribution and the nature and level of threats to the forest. The costs for this were decreased relatively by use of previous research from the area.

PES was already a legal option in national legislation so “lobbying” covered only building support among local public agencies and assessing initial interest among the target group.

Fundraising for the PES scheme was likewise made easier by existing institutional ties with an interested buyer (Danish NGO).

POLICY PHASE	**DEVELOPMENT**	
Generic TC driver	**Empirical TC driver**	
	PES	**C&C**
Site specificity	High site specificity: biodiversity of RBIM buffer zone, especially Green Macaw. Cost of target area identification.	High site specificity: biodiversity of RBIM impacts information gathering costs to identify key area.
Human asset specificity	Medium-high specificity needed for information gathering. Need to build capacity from scratch related to market based instruments and contracting. General knowledge of area pre-existing.	Medium-high specificity: Knowledge of general environmental legislation existing, area-specific knowledge needed to be built up.
Frequency of transaction	Enactment of PES as legal option pre-existing (1st order transaction).	Low frequency of formal transaction: Enactment of RBIM as PA a one-off activity.
Uncertainty of transaction: "state of nature"	Medium uncertainty: Uncertain link between proxy and ES (trade-off with information costs) and threshold/ fragmentation effect. Some pre-existing information.	Low uncertainty: The considerable size and cohesiveness of the area protected is likely to continue sustaining the pre-existing biodiversity.
Point of policy application	Point of policy application is land use at municipal level, necessitating actions at local, municipal level.	Point of policy application is land use at municipal level, necessitating actions at local, municipal level.

Table 3: Transaction cost drivers in development phase of PES in El Castillo (shaded text not empirically founded observations).

Early implementation phase costs and drivers

The 100-fold higher initial investment (in physical infrastructure alone) of the C&C system reflected a much larger scale compared to the PES scheme, and no pre-existing formal institutional presence of MARENA in the area. The RBIM enactment meant establishment of a MARENA office in Boca de Sábalos, control posts along the RBIM border, equipment to monitor and enforce protection and permanent staffing in each site. Driving the extent of this investment was an assessment by MARENA and the funding donor that continuous on-site presence was required to ensure the integrity of RBIM. The infrastructure constituted a dedicated asset with little alternative use value.

Opposed to this, the lower absolute initial investment in the PES scheme reflected the pre-existence of a Fundación del Río office in El Castillo with project-contracted staff easily employed and re-directed between projects and tasks. Staff had no experience with PES, though, which necessitated capacity building (specific human assets). International consultants were involved in operational design. Contract variables included only area and position of forest, but also stipulated the obligation to enrol farms as private forest reserves in a government programme, the implications of which turned out to be unclear for participants. A second condition was a prohibition to use the payments to invest in cattle. The latter two contract conditions contributed to the uncertainty of the transaction. Likely the vagueness of the prohibition to buy cattle for payments, caused two participants violated this condition. This theoretically increased the need for monitoring and suggests a need for more education of the target group or both to insure against future breaches of contracts.

POLICY PHASE	**EARLY IMPLEMENTATION**	
Generic TC driver	**Empirical TC driver**	
	PES	**C&C**
Dedicated asset specificity	No need for dedicated assets thanks to pre-existing Fundación del Río office.	Control posts and demarcation of area necessary to protect area integrity (ties in with point of application) meant high dedicated asset specificity.
Human asset specificity	Capacity related to market based instruments had to be built. General knowledge of area pre-existing.	Knowledge of general environmental legislation existing constituting medium-specific skills. Area-specific knowledge had to be built.
Transactor characteristics, behavioural uncertainty and informal institutions: *Implementing agency*	Livelihood concerns from buyer and NGO meant a maximum on hectares eligible per farm to spread social benefit. The shared ideology between buyer and intermediary NGO has likely kept down reporting requirements and thus TC, and made fundraising for pilot phase easy (cheap).	
Transactor characteristics, behavioural uncertainty	Flat rate PES based on roughly estimated private OC, based partly based on information from target group.	

and informal institutions: *Supplier/target group*	The TC saved in estimation of OC may have left room for opportunism/private information rent.	
Formal institutional environment	Fundación del Río already established with staff and office, lowering lobbying and information gathering costs and with a network of institutions and persons upon which to draw, incl. contact to future ES buyer. Property regime not perfect, but allows PES without problems.	Institutional as well as agricultural frontier, meaning weakly developed or non-existing formal institutions. MARENA had no or little pre-existing representation in the area. MARENA HQ had PA experience and donor contacts.

Table 4: Transaction cost drivers in early implementation phase of PES and C&C in El Castillo

Social concerns of the buyer and implementing agency in the PES case influenced operational design, setting a relatively low maximum area of forest enrolment to permit more and small scale forest holdings to enter, increasing transaction costs per hectare in the process. Likewise, a flat rate payment was adopted for reasons of perceived equity and policy legitimacy, but also lowering information gathering costs since more complex policy and contract design was avoided. Also, the flat rate represented a trade-off between the risk of lowering policy efficiency by paying above actual individual opportunity costs rates vs. information gathering costs to determine more precise opportunity costs.

Full implementation phase costs and drivers

Minor differences appeared comparing costs for information gathering, infrastructure and administration of the two instruments. Information gathering is ongoing for C&C, occupying a 10% share of annual expenditure, whilst the PES scheme revealed no plans for further information gathering after the development phase. Maintenance of infrastructure constituted a 9% share of annual C&C expenditure, while being absent from the PES scheme. Both instruments had modest administration shares. The large cost share allocated to “carrot initiatives” in the C&C policy (33% of annual expenditure) stood out, and may reflect the political concerns of the implementing

agency, as well as the social norms (transactor characteristics) of the target group, which may respond better to information than the threat of prosecution. The C&C policy did, however, also use the "stick", reflected in the 40% of costs dedicated to monitoring and enforcement. The C&C system used satellite information to monitor outbreak of fires and major infractions, while common minor infractions (poaching, small scale illegal felling) were not detectable this way and left a need for on-the-ground patrols. Costs of the latter are affected by much the same drivers as monitoring in the PES scheme, primarily inaccessibility of the area.

In the full implementation phase, several things stood out related to PES. First, 15% of costs were devoted to fundraising. Second, 23% of costs were allocated to monitoring during full implementation, and including the contract baseline measurements necessary for later monitoring of compliance brings the figure up to 39% - or the same level as monitoring in the C&C policy. The monitoring and baseline measurement is done on foot, on-site, and using low-tech means (hand-held GPS). The dispersed nature and modest number of PES participants exacerbate the costs of monitoring and baseline measurement, making both number of contracts and area per farm a direct cost driver. Additionally, transactor decisions likely based on the uncertainty of the transaction and behavioural uncertainty regarding compliance lead to monitoring of all contracts annually, and 100% of the forest area under each contract.

Third, the full implementation phase of the PES policy also implied the first round of recruitment and negotiation with participants, which consumed 33% of total costs. This resulted in a significant cost of US$ 1,700 per contract (see **Fejl! Henvisningskilde ikke fundet.**). The high cost per contract was partly due to the relatively few contracts secured, which again related to the low level of generalised trust in the area, as two-thirds of willing and eligible participants left the negotiation at the very point of contract signing for fear of land robbing (see also Vinqvist

unpublished). Adding the US$ 1,062 cost of baseline mapping brings the total cost per contract to US$ 2,762 even before beginning the contract period, and disregarding other transaction costs.

Fourth, and by default given the high cost shares reported so far, only a modest 12% of total costs were dedicated to the actual PES payments.

POLICY PHASE	**FULL IMPLEMENTATION**	
Generic TC driver	**Empirical TC driver**	
	PES	**C&C**
Human asset specificity	Locally versed and known staff facilitated interpersonal trust, which all else being equal enabled shorter recruitment and contracting periods	Locally known staff facilitated a certain degree of interpersonal trust, increasing cost-effectiveness of common conservation measures and information exchange (e.g. on infractions)
Frequency of transaction	Monitoring frequency low (annual), but intensity high (100%).	Not relevant
Uncertainty of transaction – behavioural uncertainty	Risk perception by participants kept numbers down and thus increased TC per contract.	
Uncertainty of transaction – contract clarity	Some ambiguity concerning contract obligations increasing monitoring and information need.	Not relevant.
Uncertainty of transaction – "state of nature"	Only proxy monitored, keeping TC down.	The relationship between monitoring intensity and frequency to de facto protection is unknown.
Transactor characteristics, behavioural uncertainty and informal institutions: *supplier/target group*	Low general trust, social capital/connectedness varied, but was generally modest. Risk perception by participants kept numbers down and thus increased TC per contract. The dispersed nature of farms and the difficult terrain meant high costs of recruitment and low-tech baseline measurement & monitoring.	Social norms in favour of conservation were not strong in the poverty-stricken agricultural frontier area, as evidenced by both large organised and small individual infractions; i.e. policy validity is not universally recognised. The difficult terrain makes reaching carrot initiative target group costly.
Transactor characteristics and informal institutions: *Implementing agency*	Livelihood concerns have meant more, smaller contracts driving TC per hectare up.	Policy validity concerns eventually lead to substantial investment in multi-stakeholder management plan, and may play a substantial role as reason for "carrot initiatives". Policy validity concerns may also be behind continued information gathering costs.

Table 5: Transaction cost drivers in full implementation phase of PES and C&C in El Castillo

To diminish the influence of scale, the per hectare and per household/contract expenses were calculated for each instrument (see **Fejl! Henvisningskilde ikke fundet.**). In column 6 the assumption was made that the C&C system primarily "manages" households situated in a 5 km wide buffer zone along the Reserve border (app. 63 km), and in column 4 likewise primarily patrols the outermost 5 km of the Reserve along the border instead of the entire area (column 3). The calculation is made entirely to estimate the magnitudes of costs per unit area and "human component", and using only information from the full implementation phase.

Cost item	C&C (El Castillo part of RBIM) (US$/ha/year)	PES (US$ /ha/year)	C&C cost "inside border periphery"* (US$/ha/year)	PES cost (US$/contract)	C&C cost relative to # households in RBIM 5 km buffer zone** (US$/household)
Payments	0.4	38	0.8	798	36
Monitoring	0.5	72	1.0	1,531	43
Administration	0.1	2	0.1	48	8
Fundraising	0	45	0	957	0
Contracting++	0	151	0	2,762	0
Total	**1**	**309**	**1.9**	**6,096**	**87**

Table 6: Semi-constructed comparison of annual unit-based costs for C&C and PES in El Castillo

*Assuming buffer zone is app. (36 km (terrestrial)+27 km (water)=63 long border between PA and outside, and a strip 5 km wide inside the PA, i.e. 315km2=31,500ha

**Assuming buffer zone is app. (36 km (terrestrial)+27 km (water)=63 long border between PA and outside, and a strip 5 km wide, an average population density of 13 persons/km2, i.e. 4095 persons and an average household size of 5,75 = 712 households.

Given the assumptions stated, PES appears 150-300 times more expensive per hectare than C&C in running costs. Looking at households, PES is "only" 70 times more expensive than C&C. From **Fejl! Henvisningskilde ikke fundet.** it thus becomes apparent that the concrete PES case cost-wise is much more (x20) sensitive to number of households compared to area enrolled, stressing the importance of fixed costs and activities per contract. The C&C system, however exhibits an ever greater sensitivity (x46). The relationship between human population and costs is less straight forward in the C&C system, but the direct interaction would primarily be the "carrot initiatives" targeted at buffer zone inhabitants.

Discussion

There are few examples of quantified transaction costs in PES schemes in developing countries, and no chronologically differentiated transactions cost measurements for PA C&C in developing countries have been found. Table 7 shows the transaction costs encountered for PES cases. The column "Start-up costs" covers transactions costs for the early implementation phase, and the first round of contracting in appears to have been included in reported "start-up costs" as well.

PES initiative	**ES / proxy**	**Start-up costs**	**Running transaction costs**	**Monitoring**	**Scale**
PSA, Costa Rica	All ES by forest cover proxy	No information	25% (18% legal maximum for intermediaries)	Yearly site inspection of samples	270,000 ha
Pimampiro, Ecuador	Hydrological services by land cover proxy	76 US$/ha 69 US$/ha*	7 US$/ha/year 17%*	Quarterly site inspection ('faulty')	496 ha
PROFAFOR, Ecuador	Carbon sequestration by re-/afforestation	184 US$/ha	3 US$/ha/year* 6 US$/ha/year** 26%	Yearly site inspection	22,300 ha
Los Negros, Bolivia	Hydrological & biodiversity services by land cover proxy	17 US$/ha **8000/HH **67,6 US$/ha	1 US$/ha/year	Yearly site inspection	2,774 ha
PSAH, Mexico:	Hydrological services by forest proxy	No information	4% (legal limit)	Yearly satellite image analysis; few random site visits	600,000 ha

**Table 7: Transaction costs for PES programmes in developing countries. ***Source: Wunder, Engel & Pagiola 2008. **Source: Wunder and Albán 2008.

In *absolute* terms the cases presented here are not directly comparable; not the two concrete cases from El Castillo, nor the cases in Table 7. They differ in design, funding, scale, maturity and most likely in environmental performance. The comparison puts some of the PES schemes at a

comparative disadvantage in terms of scale and maturity, since expected efficiency gains from accumulated learning, increased coverage, trust-building, and recruitment by word of mouth have not materialized. In addition it should be kept in mind that regardless of this, both policies in our concrete cases from El Castillo demonstrate imperfections in design and implementation alike, leaving room for improvement in cost-effectiveness terms.

Nevertheless, and despite incomplete information on policy phase costs and differences in scale, some interesting differences between the PES and C&C case examined and the cases reported in Table 7 are observed when looking at the timing of transaction cost incurrence and the unit-based transaction costs; as well as in the patterns of when and why drivers of transaction costs materialise.

In terms of scale, the Pimampiro water service programme in Ecuador is most akin to the present PES case. It uses forest cover as proxy for water quality and quantity and operates in a rural area with severe poverty. At the onset of the programme (2000), 27 households participated. This was reduced to 19 in 2005. The programme had start-up costs of USD 37,500 covering policy design, recruitment, and negotiation with the initial 27 households amounting to US$ 76/ha and US$ 1,389/household – start-up costs of roughly the same magnitude as the El Castillo PES case. For comparison, using the original infrastructure cost and the internal 5 km “border” of the El Castillo part of the PA C&C, the establishment costs per hectare were 31.1 US$.

The Bolivian Los Negros scheme reported trust as an issue in getting the scheme off the ground, and so compares well with the present PES case in that respect too (Vinqvist unpublished). Start-up costs appear low at first glance, but recalculating to include only the first contracting round gives very high costs per contract (~ 8,000 US$). Together the two small scale cases from Table 7 thus seem to support representativeness of the El Castillo case in terms of cost magnitudes for small scale PES initiatives, the relative cost of the start-up phases and the potential importance of supplier transactor characteristics for transaction costs.

Overall transaction cost figures vary significantly between the cases cited above (4-25%) and the definition of transaction costs is unclear, with e.g. monitoring occasionally treated separately.

Monitoring is in most cases, except Mexico's PSAH, conducted by physical site visits. In Costa Rica, Wünscher et al. (2008) reports annual monitoring by sampling – not covering 100% of the contracted area, nor all contracts, thus serving to keep monitoring costs down. In contrast, Mexico's PSAH scheme uses satellite imagery for most of the monitoring, which is a likely explanation for the comparatively low transaction costs reported. The scheme includes collectively held areas, which aids further to keep down costs per ha.

From the Pimampiro case, Wunder and Albán (2008) report 9-11% of total costs expended on monitoring. The much lower monitoring cost share compared to our El Castillo case (23%) appear to originate partly from what the authors coin a "faulty" implementation of an intended quarterly monitoring of a sample of contracts.

Still, comparing total transaction costs per hectare (7US$/ha/year) to the payments per hectare (6-12 US$/ha/year) in the Pimampiro case supports the present case findings that small scale PES schemes do indeed have transaction costs of a significant magnitude. In the Pimampiro case monitoring expenses are 58% of TC, also supporting that monitoring is one of the most important TC items, just as in the El Castillo case, pointing to cheaper monitoring solutions as key to lowering TC for PES schemes.

The level of detail in the reported TC above do not allow for a thorough review and comparison of TC drivers, except for a few pointers such as the aforementioned monitoring frequency and intensity, and in the Bolivian case transactor characteristics. When discussing TC drivers in the three policy phases investigated in the present study, they will however be included where possible.

Development phase

The development of the PES scheme stressed the importance of the pre-existing institutional environment, as well as pre-existing information. The fact that donor projects had previously supported registration of land tenure was a precondition for the PES scheme to find eligible subjects to work with. Were this not the case, transaction costs for preparing the ground for PES would have increased significantly. The C&C case on the other hand benefitted from a relatively uninhabited area at the time of its establishment, otherwise expropriation would have been a significant social and economic burden on PA establishment. Despite the lack of information for the C&C development phase, anecdotal evidence indicates a typical top-down policy with no investment in consensus building up-front with nearby local communities, perhaps deemed feasible because of the low initial population density. As population pressure increased in the decades after RBIM establishment, a perceived trade-off between and need for increased enforcement may have modified C&C implementation, and lead to the prioritisation of "carrot initiatives".

The voluntary nature of PES, however, makes it inherently dependent on supplier/target group transactor characteristics from the outset, and the buyer therefore devoted time and cost to investigating acceptability of the scheme up-front.

The point of policy application, land cover at municipal level, was theoretically similar for both instruments, and was likely a more expensive solution for the implementing agencies than if a commodity-based policy had been adequate in securing the policy objectives. Both instruments nevertheless saved costs by the central pre-existence of a legal framework for protected areas within which to establish one additional PA (C&C), and the specific inclusion of PES as a legal option for environmental protection, respectively. Lobbying for establishment or inclusion of additional pieces of national level legislation could have meant very high costs.

Site specificity as a cost driver showed most important in the development stage, i.e. requiring an investment in information gathering to identify and locate specific desirable site characteristics. In the concrete PES case it meant identifying target communities having both high occurrence of the Green Macaw and being close to RBIM to minimise effects of fragmentation. The C&C is likely to have incurred parallel costs in the investigation of where to draw the border of the RBIM, although this was not reported, and transactor characteristics of the implementing agency appear to have rendered a detailed investigation of specific biodiversity superfluous.

In addition, both instruments in the concrete case enjoyed the advantage of existing links to organisations or agencies that were willing fund development of the instruments, rendering the first level of search and negotiation for policy funding less costly. As evidenced by later efforts of Fundación del Río such costs can be significant (15% of annual expenditure).

Early implementation phase

The pre-existing institutional environment and point of policy application had a very direct influence on early implementation costs, as exemplified by the need to establish new infrastructure related to the PA C&C. The C&C in question sought to protect a conservation area allowing only recreational and scientific activities in a poverty stricken area with an active agricultural frontier and a reported history of both smaller and larger infractions. As such, it appears characteristic of traditional PA-related C&C in developing countries in the requirement for physical presence to preserve the integrity of the PA. As typically coherent areas, PAs offer minimum risk of ecological fragmentation (less uncertainty concerning the "state of nature"), but require physical delineation and control posts along the border and potential entry points (dedicated assets).

The pre-existence of the Fundación del Río office and staff is evidence in itself of less dedicated assets, and early implementation costs for PES were not dependent on the number of hectares, combining to a less all-or-nothing approach.

Human asset specificity showed up as an important cost driver in particularly the PES policy, where international expertise had to be brought in to assist in the operational policy design, which by nature was a one-off expense, though. Of importance was also the familiarity of PES staff with local communities and the natural geography of the area.

Buyer/implementing agency transactor characteristics continued playing a major role in the design of interventions. The decisions by PES buyers to use flat rates and put a ceiling on the maximum area of forest enrolled were consciously taken to accommodate more households rather than fewer into the scheme, and allow smaller (perceived poorer) land owners to participate on equal terms with larger ones. The use of forested area as a combined proxy for biodiversity conservation and the Green Macaw is likewise acquiescence from the ultimate buyer and a trade-off to lower transaction costs at the expense of precise measurement of the desired environmental service.

The latter phenomenon is frequently observed in PES (e.g. all of the cases in Table 7), and may be less controversial with biodiversity proxied by forest cover. In other cases, and particularly where it is hoped that more unmitigated market forces may ensure ES provision, a less lax measurement is likely and may be a major driver of transaction costs in PES programmes. The incipient findings from marketing carbon sequestration and related efforts to certify carbon credits points in that direction.

Related to this, and lamented in much PES literature (e.g. Ferraro 2009), few schemes incorporate a counterfactual to demonstrate additionality. The willingness of buyers to accept little or no proof of additionality is an important transactor characteristic potentially diminishing

transaction costs significantly. It does however constitute a trade-off with the risk that e.g. anecdotal evidence of ES-proxy is discredited at some later stage, that leakage is documented or that participant behaviour remains unchanged by PES. The latter is a possible consequence of misjudged private opportunity costs, which may be costly to obtain precise and accurate estimates of. Indeed, based on general knowledge of the area, Fundación del Río used an average figure for the profitability of extensive cattle ranching, thus keeping information gathering costs down, but failing to capture variation in private opportunity costs and potentially lowering cost-effectiveness of the scheme.

Full implementation phase

A great many of the TC cost drivers may only materialise in the full implementation phase, but are founded in the early implementation phase during operational policy design, and/or represent trade-offs between different phases as to when costs are incurred. The importance and magnitude of some TC drivers are in other words decided early on.

First and foremost the full implementation phase brings forth an inherent difference between the two instruments, as the PES scheme requires two sets of distinct actions not required in a C&C policy: recruitment/contracting and individual contract baseline measurement. This lies at the heart of PES, which by definition operate on a principle of conditionality. Both actions are intimately related to the formal transaction, contracting, and thus cost-wise depend on contract period, design and monitoring, and the underlying TC drivers (e.g. difficulty of terrain, low-tech monitoring, trust issues protracting recruitment) for each action increase proportionally with frequency of the transaction. Shorter contract periods, more frequent monitoring and net growth phases of PES schemes thus all mean increasing TC, and need to be weighed against transactors' willingness to commit for longer, rather than shorter, periods of time; against risk of non-compliance; and

importance of net growth to achieving policy targets. It is imaginable that in areas, where trust is an issue, recruitment & contracting is rendered even more difficult if contracts stipulate long, legally binding commitment, indicating another potential trade-off between contract period and recruitment rates.

Still, the high per unit cost and share of total costs devoted to monitoring in the PES scheme, amounting to the same share as in the C&C system (39% versus 40%) if PES contract baseline measurement is included, is surprising. It may not be entirely atypical, though, as indicated by the Pimampiro case. Driving the level of monitoring for both instruments is buyer/implementing agency transactor pressure to ascertain some degree of security in delivery of the environmental service; meaning the risk profile of transactors influences policy design in the development phase and materialises as a requirement for more or less monitoring, and for human asset specificity required to conduct such monitoring, in the implementation phase. Both the risk profile of the target group risking capture and fines or worse, as well as the implementing agency in terms of evaluating appropriate level of monitoring and punitive measures, influences monitoring intensity and frequency and hence costs.

No doubt monitoring costs are lower as a result of only monitoring the proxy, forest cover, in accordance with the findings of Rørstad et al. (2007) that easily observable proxies will lower control related TC. Where policy designs incorporate direct ES measurement, higher physical and/or human specificity may enter the picture as a cost driver, if e.g. special equipment is required to measure suspended solids in water or calculation of a complex biodiversity as in the RISEMP project (Pagiola et al. 2004). To the extent that e.g. a certain flora or fauna species or indeed any other ES is the declared rationale behind e.g. a PA the same applies for C&C.

Human asset specificity may also have a potentially important continued role to play in light of the importance of trust. Where generalized trust is low, interpersonal trust may substitute and

prove essential in keeping recruitment rates higher. It was undoubtedly a factor in PES recruitment, but may also play a role for the C&C target group when C&C staff liaises with the target group on infractions or when engaging in common conservation measures.

Buyer/implementing agency concern over social acceptability of the policy instrument, including an assumption of such acceptability being conducive to higher compliance rates, is the likely driver behind the carrot initiatives of the C&C. Likewise, The continued information gathering activities of the C&C instrument serve to justify the PA existence. The increasing population density in the municipality and thus pressure on agricultural land will have further motivated this.

In the case of the PES scheme social acceptability was also a concern from the buyer's side, but took on a different shape as participation is voluntary: instead it materialized as flat rate payments to avoid suspicions of favouritism and a low maximum area of enrollment to allow a wider participation in terms of household numbers. With flat rates, the motivation for investing in gathering detailed information on private opportunity costs may also have diminished, saving expenses in earlier phases at the risk of increased payment expenses during the implementation phase.

Perhaps less of a difference that it appears for lack of information on the C&C fundraising costs, the fundraising cost for the PES scheme were nevertheless significant and continuous and constitutes a 1st order transaction, the frequency of which should be included as a TC driver. For the C&C policy, the pre-existing institutional environment within which it was embedded would have provided a better starting point for fundraising, all else being equal.

Conclusions

The case study highlights the value of a critical look at the policy setting through the lens of transaction cost drivers before designing a biodiversity conservation intervention.

It is evident that the pre-existing institutional environment plays a significant role in determining TC of both the PA C&C and PES case in question. The very basic conditions of secure tenure and private or public land as a point of departure for PES and C&C, respectively, represent near-killer assumptions, and potentially huge up-front investments. And whereas the large investment in dedicated assets by the C&C policy is not an inherent requirement, it looks likely as a characteristic of PA C&C in developing countries.

Compared to this, the PES system is expensive per hectare to get off the ground, but appears flexible in terms of starting small and growing larger, i.e. constitutes a smaller investment in absolute figures with the concrete point of policy application in mind. More generally PES policies offer a wider choice of possible pre-existing formal institutions to use as intermediaries, and thus stand a better chance of finding cost-saving institutional settings. These may even be (decentralized) government agencies.

In both instruments transactor characteristics of both the buyer/implementing agency and supplier/target group transactors influence TC significantly. The risk profile of the buyer/implementing agency end determines the amount of up-front information gathering and consensus building, the sufficient level of policy legitimacy, required certainty in the proxy-ES link and monitoring intensity.

The seller/target group end influences TC via behavioural uncertainties such as social norms, bounded rationality, level of trust and opportunism, which all affect the complexity and smoothness of policy implementation, more immediately so for PES due to its voluntary nature. Indeed, what may in one light be described as policy imperfections (i.e. less than efficiency-optimal policy design) may well reflect buyer/C&C side characteristics concerning least/most preferred trade-offs between e.g. cost-effectiveness and policy legitimacy. The decision to allocate a significant share of the PA C&C budget to carrot initiatives is another case in point, and emphasizes that also PA C&C

implementation is susceptible to seller/target group side transactor characteristics. Also, quite a few PES schemes are found to compromise conditionality to accommodate socio-economic considerations (e.g. Wunder & Albán 2008; Wunder et al. 2008), and increase transaction costs by deliberately including poorer/smaller farmers in marginal areas. Likewise, buyers seem willing to settle for anecdotal evidence of ES-link with proxies and additionality at best (e.g. Wunder et al. 2008), decreasing transaction costs required for information gathering, and thus carrying a disproportionate part of the risk of non-compliance.

Looking at the present study and how the policy instruments are implemented in reality, not how they could have been implemented more efficiently, thus leads to the conclusion that there are few unique, inherent TC drivers separating PA C&C and PES, with the institutional flexibility of PES and frequency of the (PES) transaction as the major difference.

It also leads to the conclusion that TCs of a particular policy is to a much higher degree dependent on the characteristics of the concrete transactors and the concrete institutional setting rather than inherently and generically linked to the policy instrument type as such. This would stress the importance of policy makers deciding up front the priorities of the policy targets, since this is more likely to shape TC than the choice of instrument per se.

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