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RESEARCH ARTICLE

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Asset-building payments for ecosystem services: assessing landowner perceptions of reforestation incentives in Lebanon

Arbi J. Sarkissian[1,2], Robert M. Brook[1], Salma N. Talhouk[2] and Neal Hockley[1]

[1]Bangor University; College of Natural Sciences; School of Environment, Natural Resources and Geography; Deiniol Road, Bangor, Gwynedd, LL57 2UW. United Kingdom. [2]American University of Beirut; Faculty of Agricultural and Food Sciences, Dept. of Landscape Design and Ecosystem Management; P.O. Box 11-0236/ AUB Riad El Solh, Beirut 1107 2020. Lebanon

Abstract

Aim of study: Incentivising landowners to supply ecosystem services remains challenging, especially when this requires long-term investments such as reforestation. We investigated how landowners perceive, and would respond to, distinct types of incentives for planting diverse native trees on private lands in Lebanon. Our aim was to understand landowners' attitudes towards hypothetical Payments for Ecosystem Services (PES) contracts options; their likely participation; and the potential additionality they would provide.

Area of study: Highland villages situated within eight of Lebanon's 20 Important Plant Areas.

Material and methods: Mixed-methods surveys were conducted with 34 landowners to determine past, present and future land-use strategies. Study participants were presented with three differently structured reforestation contract options (or schemes). The three schemes (results-based loan, action-based grant, and results-based payments) differed in their expected risks and benefits to landowners. Qualitative debriefing questions followed each of the schemes presented.

Main results: Although the results-based loan did deter uptake relative to the lower risk action-based grant, results-based payments did not significantly increase uptake or planting area, suggesting asymmetric attitudes to risk. Qualitative probing revealed economic, social (*e.g.* trust) and institutional factors (*e.g.* legal implications of planting forest trees on private land) that limited willingness to participate in the results-based contract option.

Research highlights: This study demonstrates the importance of combining qualitative and quantitative methods to better understand landowner perceptions of incentives and risks, particularly in challenging socio-political contexts.

Additional keywords: agro-ecosystems; biodiversity; conditionality; displacement; mixed-methods; participation; PES.

Abbreviations used: AFDC (Association for Forests, Development and Conservation), AUB-NCC (American University of Beirut – Nature Conservation Center); ES (ecosystem services); IPA (Important Plant Areas); LRI (Lebanese Reforestation Initiative); MOA (Ministry of Agriculture); MOE (Ministry of Environment); NGO (non-governmental organisations); PES (payments for ecosystem services).

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Correspondence: should be addressed Arbi J. Sarkissian: arbi.sarkissian@outlook.com

Introduction

Economic theory postulates that many environmental problems exist because markets have not been fully developed for biodiversity or most ecosystem (or environmental) services (Pattanayak *et al.*, 2010). Increasing demand for agricultural commodities has therefore undermined important ecosystem services such as carbon sequestration and watershed protection, making agricultural expansion one of the major drivers of deforestation and biodiversity loss globally (Gibbs *et al.*, 2010). Despite the steady rise in protected areas in the last decade, conserving biodiversity is expected to become more challenging due to climate change and increasing competition for land (Pullin *et al.*, 2013). However, policy instruments such as payments

for ecosystem services (PES) and agri-environment schemes are being adopted widely to incentivise landowners to supply off-farm ecosystem services from private lands (Schomers & Matzdorf, 2013).

PES are defined by Wunder (2007) as voluntary and conditional transactions between at least one buyer and one seller for the supply of additional units of a clearly-defined ecosystem service, or land-uses likely to generate those services. PES has become an attractive environmental policy instrument given its voluntary nature, allowing for public and private participation at various scales, and its flexibility in combining economic incentives with existing regulatory policies (Barrett *et al.*, 2013). Yet important challenges in designing PES include the trade-offs between efficiency and social equity, which can influence long-term ecological outcomes (Pascual *et al.*, 2014). From an economic perspective, PES investments often compete with existing land-uses (*e.g.* agriculture) and maintaining lower payments would attract landowners with lowest opportunity costs. This approach may have distributional consequences, since landowners with larger holdings and lower opportunity costs are favoured over those with smaller holdings whose incomes are tied to farming (McDermott *et al.*, 2013). Competitive PES schemes could also displace agriculture or other productive activities leading to land conversion and intensification elsewhere sometimes referred to as 'leakage' (Pattanayak *et al.*, 2010).

Hitherto, PES have largely focused on use-restricting strategies, *e.g.* avoided deforestation, but are increasingly employed to finance reforestation (or afforestation), referred to as asset-building schemes (Wunder, 2008). However, recent studies have criticised carbon-focused PES and Reduced Emissions from Deforestation and Degradation (REDD+) for incentivising monoculture plantations, negatively impacting biodiversity and local livelihoods (*e.g.* Lindenmayer *et al.*, 2012). Locatelli *et al.* (2014) argued that carbon-focussed incentives would not automatically result in bundled co-benefits for biodiversity and local ecosystem services. Designing biodiversity-enhancing reforestation schemes (using even mixes of native species) that are both cost-effective and attract participants remains challenging. We administered a mixed-methods survey to explore the willingness of Lebanese landowners from highland villages to accept incentives for planting diverse native tree species on private lands. Survey participants were presented with three alternative PES contracts schemes (Table S1 [suppl]): Scheme 1, a results-based loan (involving repayments conditional on seedling survival: negative conditionality); Scheme 2, an action-based grant (conditional on planting only); and Scheme 3, results-based payments (conditional on seedling survival: positive conditionality). Our aim was to understand landowners' attitudes towards these three differently structured hypothetical PES contracts options; factors influencing decisions to participate; and the likely displacement that could result.

Material and methods

Reforestation in Lebanon

While reforestation efforts were traditionally conducted by the Ministry of Agriculture (MOA), in 1998 the Lebanese parliament transferred funds instead to the Ministry of Environment (MOE) to develop a National Reforestation Plan (NRP) to increase forest cover from 13% to 20% (Regato & Asmar, 2011). Early phases of the NRP suffered high seedling mortality, partly due to a lack of funds for maintenance (*e.g.* irrigation and protection from grazing). Therefore, the last phase of the NRP (c. 2009-2012) was developed as a quasi-PES scheme, where selected municipalities were paid at different stages based on area planted and survival outcomes (MOE/UNDP/GEF, 2014). The Lebanese government has also shown interest in using the Kyoto Protocol's Clean Development Mechanism (CDM) to fund re/afforestation projects to reduce its net greenhouse gas emissions (MOE/UNDP/GEF, 2009). More recently, the MOA initiated a campaign to plant 40 million trees through its National Afforestation/Reforestation Program initiated in 2014 and intends to adopt a forest and landscape restoration approach (Mohanna *et al.*, 2017). Non-governmental organizations (NGOs) with interests in using PES have increasingly become active in re/afforestation in recent years (R. Paton, 2012, *pers. comm.*).

Our study therefore assumes that ecosystem services (ES) buyers could be either the public sector (*e.g.* MOA/MOE), NGOs, or both (with funding often provided through partnering international donor agencies). We determined in a previous study that these reforestation stakeholders are interested in increasing forest cover to enhance a broad array of forest ES (including landscape beauty, soil and water conservation, as well as biodiversity) rather than paying for specific ES (*e.g.* carbon sequestration). However, the ES anticipated heavily depends on the kinds and ratios of species being planted and managed. For example, plantations of fast-growing trees (*e.g.* eucalypts) may sequester carbon much more efficiently than most slow-growing natives, yet may also limit certain regulating services (*e.g.* water and nutrient cycling, pollination, disease mitigation). In fact, stakeholders expressed concerns over the lack of species diversity in past reforestation

as well as the recent increase in exotics (*e.g. Paulownia* spp.), and have begun addressing the importance of maintaining resilient forest ecosystems through diversifying the planting of native species (R Paton & S Bou Fakhreddine, 2012, *pers. comm.*). Fruit trees are commonly planted in these regions and apples account for a sizeable proportion of crop production. Apple orchards may contribute to certain ecosystem services such as carbon sequestration (Wu *et al.*, 2012); however, commercial orchards often require high inputs (*e.g.* irrigation, pesticides and fertilizers), which can negatively impact biodiversity and other ES (*e.g.* pollination and watershed maintenance).

Recent reforestation efforts in Lebanon have focussed predominantly on municipal lands. Some implementing stakeholders expressed doubts about transacting with private landowners due to uncertainties with long-term tree retention and costs (R Paton, 2012, *pers. comm.*). However, while opportunity costs may sometimes be lower on municipal lands, transaction costs (*e.g.* monitoring to ensure compliance) are often higher compared to private landowners with proper titles (Engel *et al.*, 2008), particularly under reforestation contracts that often extend beyond the political terms of elected mayors. Yet contract attributes that characterise conditionality are what mainly influence transaction costs, thus posing a significant challenge for designing cost-effective PES contracts (Peterson *et al.*, 2015). Risk and uncertainty appear to be ubiquitous in many farming decisions, *e.g.* crop-selection and adopting new technologies, where decisions are made based on both attitudes towards risks and subjective beliefs (Menapace *et al.*, 2013). These factors, along with opportunity costs and the institutional context where transactions occur, can influence landowner decisions to participate in PES schemes. Understanding Lebanese landowners' perceptions of asset-building PES is therefore critical for informing future reforestation policy.

Factors affecting PES uptake

While participation in PES schemes often depends on landowners' opportunity costs (Chen *et al.*, 2010), the literature has identified other factors that affect participation in asset-building PES schemes, including contract design and social-institutional factors.

PES must be conditional on verified actions (*e.g.* planting trees) or results (*e.g.* carbon sequestration), requiring monitoring of sellers to ensure compliance (Honey-Rosés *et al.*, 2009). In asset-building programmes like reforestation, with high short-term costs and delayed benefits, a fundamental issue of concern to PES buyers is ensuring long term delivery of ecosystem services (Pattanayak *et al.*, 2010). For PES buyers, contract designs often involve trade-offs between supplier uptake, transaction costs, and expected outcomes (Engel *et al.*, 2008). Contracts that are highly bureaucratic or involve excessive conditionality are perceived as being too onerous or risky, reducing landowner uptake (Hudson & Lusk, 2004). In contrast, lack of conditionality or monitoring could result in non-compliance (*e.g.* hidden action) by sellers (Wunder *et al.*, 2014). The choice of payment by actions or results, together with the optimal level of conditionality and monitoring, will depend on the context: the strength of the connection between actions and results, the ease of monitoring each, and the level of risk aversion of sellers and buyers (Gibbons *et al.*, 2011). Asset-building PES may therefore require a mixture of results- and action-based payments over time to cover high initial costs whilst ensuring tree retention (Wunder *et al.*, 2014). Payments are often frontloaded and gradually decreased once private benefits from planted trees were available to participants, but this is best suited to productive species (Hegde *et al.*, 2014). Setting conditions for ensuring mixed native species are planted and retained is more challenging (Montagnini & Finney, 2011).

Understanding farmers' identities and how they perceive risks or uncertainties towards livelihood changes is also important (Duesberg *et al.*, 2013). Social-institutional factors such as trust in (or experience with) incentive-based schemes, local norms and values, dependence on farm-based activities, as well as age and level of education also influence landowners' decisions to join PES schemes (Chen *et al.*, 2009; Fisher, 2012). Participants in asset-building PES tend to have relatively large landholdings, with enough land unsuitable for agriculture, and whose incomes are largely off-farm (Cole, 2010). The context under which the farming system is structured, along with secure tenure and technical or financial know-how may also determine uptake (Kosoy *et al.*, 2008). Factors such as commitment period and required percentage of landholdings allocated have also been found to affect farmer uptake into PES schemes (Kisaka & Obi, 2015). Building trust in the institutions responsible for ensuring payments often takes time, and poorer more risk-averse landowners may be less willing to participate (Fisher, 2012). These issues are particularly critical in cases where governments are buyers or intermediaries, yet have lost the confidence of farmers through previous policies. Beyond this, PES is even more challenging to implement under circumstances where legal and property institutions are weak, which is common in many developing countries (Matzdorf *et al.*, 2013). Even in developed countries like Germany, land tenure implications and contractual uncertainties

were principal reasons behind farmers' reluctance to join PES schemes (Schleyer & Plieninger, 2011).

Study area

Lebanon is a small (10,452 km^2), predominantly mountainous country located in the eastern Mediterranean basin and recognised as a centre for plant diversity (Davis *et al.*, 1994). Recognising threats to plant diversity in the eastern Mediterranean, a small team of scientists from the American University of Beirut's Nature Conservation Center (AUB-NCC) started a project to define Important Plant Areas (IPAs) in Lebanon (Yazbek *et al.*, 2010). Designated IPAs are also shown to represent the major ecosystems and unique habitats of Lebanon. Our study area comprised the western slopes of Mount Lebanon where eight of Lebanon's 20 newly designated IPAs are located (Radford *et al.*, 2011). These areas are characteristic of eu-mediterranean (> 1,000 m) to oro-mediterranean (2,200 - 2,800 m) bioclimatic zones, averaging between 1000-1200 mm/yr, precipitation mostly occurring between November and March. While this region has been characterised as being predominantly semi-arid, many microclimates can exist between and even within some IPAs selected for our study (Yazbek *et al.*, 2010). The vegetation types are typical of Mediterranean forest, woodland and scrub communities containing coniferous, deciduous and mixed forest/woodlands, interspersed with semi-natural agro-ecosystems (Makhzoumi *et al.*, 2012). The region produces a variety of tree crops, predominantly apples and stone fruits (Salibi, 2007). The main rainfed crops are cherries, often planted at much higher elevations. Irrigation is a major limiting factor for farmers in these steep and rocky landscapes, requiring extensive terracing to preserve soils and enable irrigation using canals. Irrigation comes from the numerous springs that form the tributaries of seasonal rivers and streams that flow along the western flank of Mt. Lebanon into the sea. Habitats are increasingly threatened by land-uses that include intensive agriculture, overgrazing, urbanisation and quarrying, as well as fires (Sattout & Abboud, 2007).

Sampling

We focused on IPAs with reforestation potential but were unable to conduct our research in high-risk parts of the country, *i.e.* the Bekaa Valley, South Lebanon and near the Syrian border. Eight of the 20 IPAs located along the west-facing slopes of the Mt Lebanon were selected for this study (Fig. 1). Due to security concerns, many villages in the Akkar district (LB07) near the Syrian border were also excluded. A total of 248 villages were identified using Google Earth images embedded with IPA layers that were copied and transposed over administrative maps showing all village/municipal boundaries. Villages were stratified according to IPA, estimated geographic size, population, rurality and elevation. A stratified random sample of 18 villages within these IPAs were selected (see Table S2 [suppl]). Security concerns also necessitated obtaining landowner contact details from mayors and other key informants from sampled villages who acted as our gatekeepers and facilitated our research. We obtained contact details for 52 landowners who were sole proprietors of their holdings, who were then telephoned. After at least two attempts we spoke to 46 landowners, informed them of the study objectives, and asked for their oral consent. Twelve landowners declined to participate because of a lack of land, land tenure issues (*e.g.* inheritance), age or inconvenience. The final survey was conducted with 34 newly recruited participants with their written consent who had not participated in a previous extensive pilot. Our research team was faced with substantial safety risks given the turmoil in Syria, which at the time began showing signs of potentially spilling over into Lebanon. This limited our sample size.

Data acquisition, survey instruments and analyses

The survey (see Table S3 [suppl]) was conducted in Arabic by the first author and a field assistant in the participants' villages, either at their farm, home, workplace, or the municipality office. After obtaining written consent, each participant was given an overview of the study and its objectives. After discussing current and intended land-use, the interviewer introduced the three hypothetical PES schemes in succession (see Table S1 [suppl]) to gauge their acceptability and to stimulate discussion of the key research themes identified above (the schemes were presented to each respondent in the same order for this reason). Entry into any of the schemes only required that they plant a minimum of 1,000 m^2 of contiguous land that they had titles to with the seedlings provided under the programme. Study participants were provided with a list of available native species (see Table S4 [suppl]) that would be used in the PES programme and told that the kinds and quantities of each species would be determined by the programme team. Seedling survival would be estimated by a monitoring team using randomly selected plots (Griscom *et al.*, 2005), assessed on a yearly basis during the five-year period. Follow-up questions were asked after each scheme was presented, which included where they would plant the seedlings and how much area. They were also asked whether the schemes would change

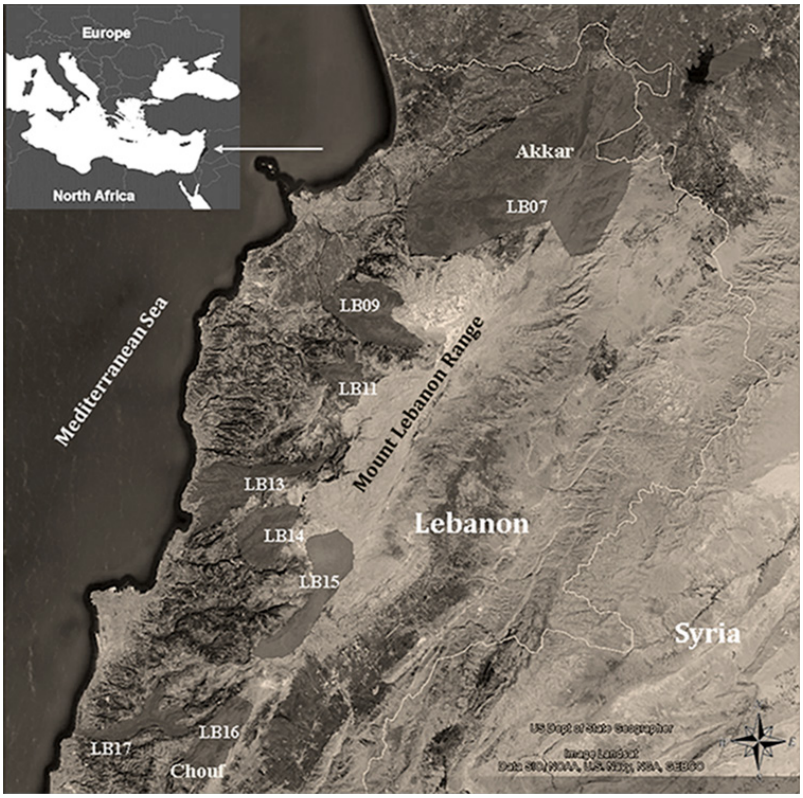

Figure 1. Partial map of Lebanon showing the eight important plant areas (IPAs) in the study area, indicated as shaded polygons (Yazbek *et al.*, 2010). Landowners from 17 villages located within these IPAs were sampled for this study. Source for base mapping: Google Earth.

their intended planting plans (*e.g.* to plant crop trees) for that plot. We did not specify what land-use/land-cover type would be replaced under each scheme, thus study participants were free to decide where to plant trees and how much area this would entail. Follow-up questions determined the extent of agricultural displacement expected (*e.g.* croplands *vs* abandoned/marginal lands). In addition, they were asked open-ended qualitative questions (coded with responses seen only by the interviewer) regarding perceived benefits of the proposed schemes. Respondents who did not wish to participate in any of the schemes were prompted to discuss why they would opt out. These questions were designed to assess the kinds of risks and uncertainties associated with PES schemes of this nature with respect to landowners' perceived benefits in being paid to reforest with diverse native species. The survey concluded by asking what sort of constraints or future land-use changes the participants envisaged, followed by some basic socioeconomic questions.

Quantitative data was analysed using SPSS version 20 (Pallant, 2010) to determine (i) whether there was a significant difference in uptake and area enrolled for reforestation under each consecutive scheme, and (ii) whether land-owner type, age or landholding size influenced participation and land enrolment into corresponding schemes. Qualitative data was transcribed and translated into English by the field assistant. Audio recordings and transcripts were analysed by the first author to identify important themes.

Results

Basic attributes of the sample

All participants in the sample (n=34) were males between the ages of 30 and 81 with a median age of 57. Median household size was five. Over three quarters of the respondents were permanent residents of their villages while the remainder (n=8) spent only summers there. This is likely to be an artefact of sampling but we believe our sample is broadly representative of the relevant population, *i.e.* landowners with some active level of interest in managing the land. Ninety-one per cent indicated that their landholdings were located

within villages where they resided. Respondents were generally well educated (Fig. 2a) and included full-time commercial farmers, part-time farmers and hobby or retired farmers (Fig. 2b). Aggregated landholding area of the sample was approximately 227 ha. Parcels ranged from 0.15 to 30 ha (median=3 ha). Nine landowners owned property over 10 ha, consisting of mainly hobby/retired farmers. Landholding size differed weakly between levels of education (Kruskal-Wallis H-test=7.810, p=0.099). Part-time and hobby farmers did not have smaller landholdings than full-time farmers (Kruskal-Wallis H-test=0.258, p=0.879; Fig. 2b).

Past and intended future planting (in the absence of PES)

The sample was highly skewed in terms of landholding size, recent planting area, and number of crop trees planted per respondent. Apples (*Malus domestica* Borkh) were the main commercial crop trees planted, followed by stone fruits (*e.g. Prunus* spp.). A large portion of the commercial tree crops were planted on previously abandoned croplands (Fig. 3). Four respondents indicated that they had planted productive native trees, *e.g.* stone pine (*Pinus pinea* L.), but none had planted other native trees. Nearly 75% had planted over 100 commercial saplings within the last 10 years.

Eighteen respondents intended to plant more trees in the near future. Fifteen hectares was the approximate total area expected to be planted with over 75% taking place on previously abandoned lands. Apples, stone fruit, and nut-bearing trees were the main commercial trees to be planted, with mean anticipated areas of 7.1, 5.5 and 2.1 ha, respectively. None mentioned intentions of planting native forest trees in the future other than stone pine.

Participation and land enrolment in the PES schemes

Twenty-two landowners would be willing to participate in the results-based loan (Scheme 1), offering 21.9 ha of land for reforestation (approximately 10% of total landholding area). Participation increased to 27 farmers with 35.5 ha land enrolled (c16%) for the action-based grant (Scheme 2), but the results-based payments (Scheme 3) did not change the number participating, and only slightly increased the land area to 37.5 ha (17%). A Friedman test indicated a statistically significant difference in land enrolment between schemes (Friedman's ANOVA χ^2 (2)=25.10, p<0.001). *Post hoc* Wilcoxon tests found a significant increase in land enrolment from Scheme 1 to Scheme 2 (T=169, r=−0.62, p<0.001) and Scheme 1 to Scheme 3 (T=198, r=−0.60, p<0.001), but not from Scheme 2 to Scheme 3 (T=77.5, r=−0.27, p=0.116). We tested whether total landholding size (in ha), age, and landowner type (divided between 'full-time farmer' and 'other') influenced participation in each of the three schemes using logistic regression following preliminary analyses to ensure underlying assumptions of models were not violated (Pallant, 2010). Younger landowners and those with larger holdings were more likely to participate in Scheme 1, but these effects disappeared for Schemes 2 and 3 as a greater number of older landowners and

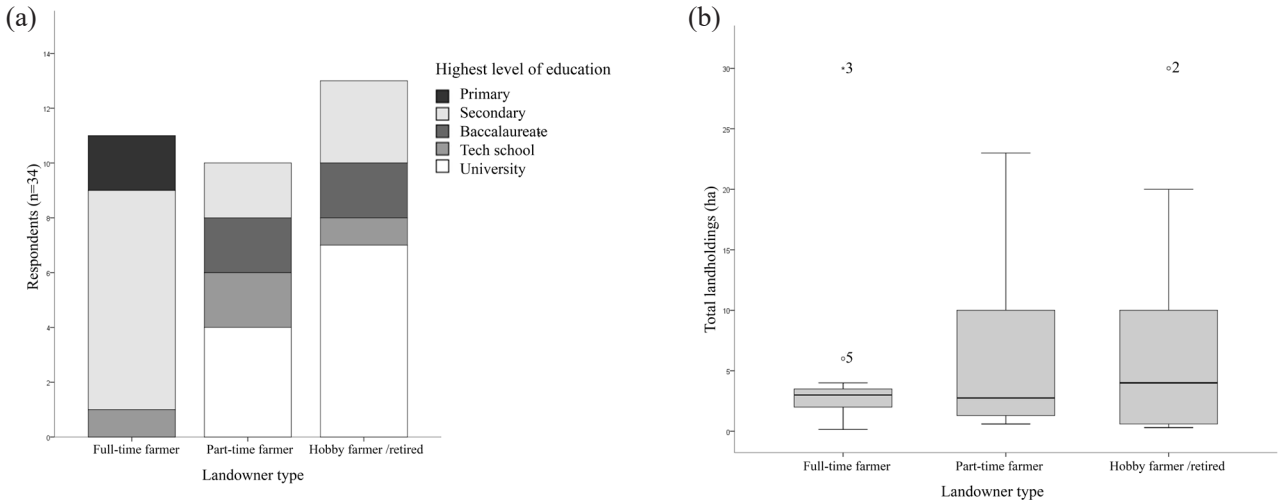

Figure 2. Landowner type subdivided by education (a). Total landholdings by landowner type (b). Landowner type was divided between full-time farmer (most income derived from farming), part-time farmer and hobby / retired farmer.

Table 1. Logistic regression for predicting likelihood of enrolling in PES schemes[a]

		B	SE	Wald	d.f.	Sig.	OR	95% CI for OR	
								Lower	Upper
Scheme 1	(Constant)	3.969	2.235	3.152		0.076	52.911		
	Landowner type	1.182	1.079	1.200	1	0.273	3.260	0.393	27.015
	Age	-0.090	0.043	4.342	1	*0.037	0.914	0.839	0.995
	Landholding size	0.368	0.183	4.044	1	*0.044	1.4450	1.009	2.068
Scheme 2	(Constant)	0.689	1.994	0.119		0.730	1.991		
	Landowner type	-1.808	1.271	2.024	1	0.155	0.164	0.014	1.979
	Age	-0.009	0.036	0.065	1	0.799	0.991	0.923	1.063
	Landholding size	0.863	0.557	2.399	1	0.121	2.370	0.795	7.064
Scheme 3	(Constant)	2.574	2.092	1.514		0.219	13.112		
	Landowner type	-0.072	0.997	0.005	1	0.943	0.931	0.132	6.568
	Age	-0.039	0.036	1.159	1	0.282	0.962	0.896	1.032
	Landholding size	0.319	0.236	1.821	1	0.177	1.375	0.886	2.185

[a]Collinearity diagnostics showed that there was no violation of multicollinearity assumptions with the variables tested (VIF=1.015). Normal probability plots of the regression standardised residuals showed there were no outliers (critical value=13.82; Mahal maximum distance=8.84). *p<0.05

landowners with smaller holdings were attracted to the schemes (Table 1).

Agricultural displacement under PES schemes

Seventeen per cent of reforestation would be on cultivated lands (or land in use) under the results-based loan (Scheme 1), 11.5% under the action-based grant (Scheme 2), and 12.4% under the results-based payments (Scheme 3). However, over 65% of respondents that indicated cultivated lands under any of the schemes mentioned they would plant at the margins (*e.g.* borders) of existing cultivation. Eight respondents stated their intended planting plans would change under schemes (*i.e.* native trees would be planted in place of crop trees) of which four mentioned plantings would take place on cultivated lands.

Respondents who declared they would participate in at least one of the three schemes (n=29) were asked if they would foresee any possible land-use changes that may impact the trees in the future. Twelve mentioned no foreseeable changes, ten indicated they may build on those plots, four mentioned passing lands onto children, and three indicated possible agricultural land-use changes. Ten respondents mentioned on-farm benefits of forest trees as possible reasons for maintaining trees beyond the life of the scheme. These included erosion prevention, regulating local climates, filtering the air, and as windbreaks. Four respondents also mentioned increasing landscape beauty as a benefit, related to potential future investments in ecotourism activities. Finally, over half of the participating respondents indicated they would be interested in longer term payments.

Landowner perceptions of PES schemes

The hypothetical schemes were used to initiate a discussion of landowners' perceptions of PES schemes in general, and specific characteristics of the three schemes. Respondents' views of PES varied with a greater portion seeing advantages of providing financial and technical support for farmers. One respondent claimed he would buy more land to enrol if these types of support were genuine and trustworthy. Unsurprisingly, respondents showed a greater keenness towards the action-based grant (Scheme 2) over the results-based loan (Scheme 1) due to relaxed conditions of the latter (*i.e.* lower risk), but the results-based payments (Scheme 3) was no more popular. Some respondents discussed higher payoffs as the main advantage that Scheme 3 had over Scheme 2. One respondent mentioned continuity of payments as a major advantage, and increased the enrolled land by 1 ha from Scheme 2 to Scheme 3:

"The 3rd [scheme] ensures a certain continuity to the [reforestation] plan by [incentivising] the

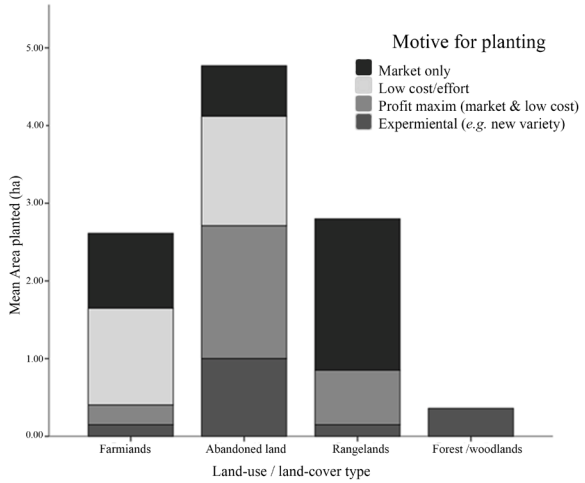

Figure 3. Mean area planted with commercial crops under different land-use/land-cover types subdivided by farmers' motives for planting the crops mentioned. 'Low cost / effort' refers to easy management of the trees, 'Market only' refers to high market value of the crop, and 'Profit maxim' denotes respondents who mentioned both low cost and high market value. *Note:* An outlier was excluded to better present the results in this figure.

farmer to [put] more effort in [ensuring] high rates of [survival] so he can get the highest amount of money" (Resp. #6)

Yet, fifteen respondents enrolled the same amount of land for all three schemes. Availability of land unsuitable for agriculture was the main constraint to participation and land enrolment mentioned. While there was a marginal increase of land enrolled for those who would participate in all three schemes (n=6), one respondent would enrol less land for Scheme 3 than Scheme 2. His reasoning was that since there is no need for maintenance under the action-based grant (Scheme 2), he would plant a much larger yet more remote plot with limited access, whereas he would plant borders of his orchard under the results-based payment (Scheme 3) for ease of care. However, many non-participants simply did not see any benefit of planting native trees regardless of the contract type or money offered. Most of the respondents who opted out of all schemes shared a dislike of non-productive native trees and/or diversified land-uses. For instance, one respondent mentioned he would not even consider diversifying his production, preferring to plant one profitable crop ("nothing beats apples in this region"). If given the option to plant native trees, the most likely candidate would be stone pine for its revenues from pine nuts, but most might still prefer to plant apples:

"Landowners won't grow forest trees on their agricultural lands for the following reasons: Fruit trees are more profitable [in the short-run] because they require less time to produce as opposed to [productive] forest trees; fruit trees can be secured as a source of revenue while the majority of forest [species] don't generate revenues" (Resp. #34)

In general, respondents' comments on PES schemes would suggest that opportunity costs were too high. Yet institutional factors may also influence uptake. For example, at least three of our respondents referred to the legal implications of planting forest trees. Since permits are required for cutting or removal of native conifers even on private lands (Regato & Asmar, 2011), landowners (especially farmers) may be reluctant to plant non-productive species on productive farmlands. And while Lebanon's current forestry policies may have contributed to relative gains in forest cover on abandoned farmlands, they may also have hindered effective forest management and made landowners reluctant to plant more forest trees:

"In the past, forests were well managed and protected by the local people because they were a source of [fodder], wood, and medicinal and aromatic plants... Today, more restrictions have been implemented by the MOA to protect forest areas, but this has actually discouraged people to preserve their forested lands because [these new laws have made forests] 'useless'. Now violations, neglect and forest fires have increased... [because only] when people find a benefit from something, they will work to protect [it]." (Resp. #1)

Lack of experience with incentive-based mechanisms, or attitudes towards government-sponsored agricultural programmes such as the MOA's 'Green Plan' (subsidies aimed at rehabilitating abandoned farmlands), may have also contributed to negative perception of PES schemes in general:

"...the lack of trust in the governmental institutions and the incapacity of the farmer to invest in such [agricultural] projects is the main reason most farmers won't apply [for] the Green Plan." (Resp. #21)

There were other factors respondents mentioned that contributed to lack of uptake and/or land-enrolment besides land availability and the land-use types in question (*e.g.* lack of land unsuitable for agriculture). In addition to negative attitudes towards native species, changing trends in land market prices were also important factors respondents raised that impact participation. Fewer younger landowners are actively managing their holdings than before, hence age will likely be a factor affecting uptake as well. Respondents in our sample were quite aged (median 57), which is

reflective of a declining agricultural sector driving many households into cities in search of work. For instance, one respondent chose not to subscribe to any of the schemes both due to his age and the fact that his children no longer live in the village. He gave interesting insights that point to potential constraints in implementing a PES programme with landowners in Lebanon:

"Nowadays, the younger generation is not interested in agriculture and the older generation is no longer able to maintain the land... so [younger landowners] are selling their lands instead of [maintaining] and cultivating them…" (Resp. #17)

This suggests that reforesting private lands may be hindered by a lack of human resources to manage land on some farms and by development on others.

Discussion

Asset-building PES such as reforestation requires long-term maintenance to ensure future additionality of off-farm ES. Though results-based schemes may be more effective in ensuring long-term tree retention than action-based schemes, they depend heavily on landowners' perceptions of the credibility of such long-term payments. Frontloading payments to cover direct costs of planting and maintenance is common in PES using productive trees with private benefits (Hegde *et al.*, 2014), but this is much more challenging under biodiversity-focused PES as in this study. Cost-effective PES aimed at enhancing biodiversity therefore involve trade-offs for both buyers and potential suppliers with respect to risks (Banerjee *et al.*, 2017). For example, buyers would have to weigh trade-offs between efficiency (*e.g.* low payments, transaction costs, and displacement) and effectiveness (*e.g.* supplier uptake, extent of land enrolled, tree retention) when designing contracts while sellers weigh the risks and reward of those contracts (Table 2).

While it plays a key role in asset-building schemes, conditionality tends to limit participation if landowners perceive it as too risky (Chen *et al.*, 2009). The PES schemes in our experiment were designed specifically to investigate how landowners perceive risks related to conditionality. The first two schemes (results-based loan and action-based grant) differed substantially in their level of risk to landowners, and a reduction in risk predictably increased enrolment. However, surprisingly the addition of results-based payments (Scheme 3) did not significantly increase uptake, despite higher payoffs in the long run. This may be due to landowner perceptions of risk and uncertainty in general, particularly for those with incomes tied to farming and forestry (Blennow *et al.*, 2014; Menapace *et al.*, 2013), as well as risks specifically attributed to results-oriented schemes (Burton & Schwarz, 2013). For example, monitoring could be viewed as both an annoyance and loss of autonomy (Hudson & Lusk, 2004). Lack of trust was a key issue raised in the study by a handful of study participants and qualitative probing revealed some interesting responses by landowners with regards to trust in the schemes, as well as with PES in general. PES was as a novel concept to most of the study participants with only few ever having participated in reforestation. It would be expected that participants would feel some degree of uncertainty and distrust in PES until they could see how well it works in reality (*e.g.* experiences shared by neighbouring farmers participating in a PES programme). While compliance to monitoring appeared to have discouraged some respondents, this was not shared by most. There is also the possibility that Scheme 3 was not considered to be credible over the long timescale required to ensure tree retention by landowners; especially in a country which has experienced considerable socio-political turmoil.

In Lebanon, national agricultural policies have overshadowed multifunctional land-use strategies traditionally employed by local communities for managing natural resources (Makhzoumi *et al.*, 2012). This has led not only to poor management of forests (*e.g.* thickets prone to fires), but has also discouraged landowners from planting forest trees. Within this institutional context, landowners may be especially reluctant to plant trees that offer little private benefit in the long-run (as is the case with most native tree species). With respect to asset-building PES such as reforestation, additionality of most ecosystem services occurs over much longer time scales than with use-restricting PES. Perceptions of PES schemes and their subsequent adoption require evaluating long-term uncertainties (*e.g.* tenure, opportunity costs, market or political stability, climate, etc.), often affected by present day conditions of institutions and policies (Zanella *et al.*, 2014). The Lebanese may inherently exhibit more caution and scepticism in making decisions that require long-time commitments due to historically persistent political instability (Makdisi, 2004). Likewise, some participants mentioned having a general distrust in public institutions (*e.g.* MOA) due to previous experiences in subsidized programs like the 'Green Plan'. This raises questions on whether perceptions of PES would change based on who the buyers are, *e.g.* government *vs* NGOs *vs* private sector. Recovery from a 15-year civil war is being hampered by socio-political divisions that continue to paralyze the nation's public institutions. The public sector's inability to regain control of its institutions, due also in part to its lack of transparency, leads to widespread corruption (often

referred to as '*wasta*', which appears to have become a social norm). A growing number of NGOs have begun to fill this void and have gained more trust than government institutions (Solberg, 2014) Such factors may have negative implications for PES in Lebanon as government institutions desperately try to re-establish oversight of the forestry sector through consolidating re/afforestation efforts and enforcing policies.

Many studies have found that participation in asset-building PES is contingent upon farm-based incomes (*i.e.* opportunity costs), farming systems (*e.g.* available marginal lands), landholding size, and age (*e.g.* Cole, 2010; Kisaka & Obi, 2015). Recent studies on incentives for re/afforestation have also shown that decisions to participate in such schemes may not be solely based on actual or perceived opportunity costs, but also on non-financial factors related to risks and uncertainties (Duesberg *et al.*, 2013). Our results suggest that consideration of opportunity costs was ubiquitous amongst respondents, especially if they could foresee possibilities of bringing land in disuse back into cultivation, or the prospect of developing their land in the future. Moreover, landowners' opportunity costs could vary from one plot to the next, and perhaps even within the same plot (Wunder, 2007). Respondents in our sample owned modest size holdings, and may have been conservative with how much land they would be willing to enrol. Landowners would have to consider important trade-offs when selecting plots with the lowest opportunity costs, such as direct costs of planting and irrigating seedlings on difficult terrain. This is particularly critical for less experienced tree planters who may underestimate the level of difficulty or work involved, which is especially relevant for those that are quite aged. Reasons why landowners in our study (particularly full-time farmers) would opt out of schemes accord with other studies, particularly if livelihoods would be affected by having native species on farms, such as loss of tenure and negative perceptions of biodiversity (Zubair & Garforth, 2006). More recent studies have also indicated that uptake of asset-building PES initiatives depends more on landowner attitudes and perceptions of how such policies affect future livelihoods (Trevisan *et al.*, 2016).

Table 2. Trade-offs between efficiency and effectiveness of schemes

	Scheme 1	**Scheme 2**	**Scheme 3**
Farmer uptake	Medium	High	High
Area enrolled	Low	Medium	Medium
Displacement	Medium	Low	Low
Risks (to farmers)	High	Low	Low/Medium
Transaction costs [a]	High	Low	High
Payment costs [a]	Low	Med	High

[a] These are reasonable estimates of the costs to buyers involved in mounting the schemes

The overall success of an asset-building PES programme in Lebanon requires not only long-term tree retention, but would have to factor in the programme's potential for displacing agriculture. This is important to consider in the context of an agricultural sector that is changing rapidly with emigration of rural households, combined with urbanisation and increasing land prices in some areas. Our results suggest that these schemes would not result in significant displacement, as they are not competitive with agriculture, but may therefore result in small and fragmented reforestation. Of the estimated 9,800 ha of abandoned farmlands in the six districts where our study was conducted, more than half was suitable for agriculture (Salibi, 2007). Many are abandoned due to lack of access to water and roads, in which case road-building and agricultural development projects could potentially increase opportunity costs. If an asset-building PES programme were implemented these infrastructural improvements could be stimulated by the programme itself.

Finally, we acknowledge that a more representative sample size would have helped tremendously in quantitative analysis of each scheme and would have helped draw a more cohesive picture of landowner perceptions to conditionality. However, this study was concerned with developing a more qualitative assessment of PES and the schemes presented, as has been conducted in other case-studies (*e.g.* Zanella *et al.*, 2014). We also acknowledge the limitations of mixed-methods studies in that it would have been difficult to combine qualitative analysis with a much larger sample size. A more representative sample would also have to include absentee landowners, whose incomes are presumably not tied to farming. Therefore, our study focussed on full-time residents, most with vested interests in farming. Despite this, there was considerable heterogeneity amongst farmers and their preferences, yet social and institutional aspects appeared to play an important role in uptake for most. These included issues with credibility and trust in new institutions as well as legal implications of planting native trees on private lands, resulting in high opportunity costs and unforeseeable risks in the future. Future research may want to examine whether absentee landowners, presumably having larger holdings with little or no commercial farming, are less risk averse

than those in our sample, and thus may display a greater willingness-to-accept PES and enrolling more land. If PES buyers would prefer targeting absentee landowners with lower opportunity costs over farmers, they must be reminded that long-term ecological outcomes are closely tied to efficiency and equity trade-offs.

Conclusion

This paper examined the potential for PES to incentivize landowners to plant diverse native trees on private property. The objective of this mixed-methods study was to examine how Lebanese landowners perceive PES schemes and how different forms of conditionality might affect participation. Combined qualitative and quantitative methods enabled us to gauge landowners' perceptions towards schemes, helping to identify factors that would influence uptake, land enrolment and establishment of native trees on private property in the long run. Lebanese landowners from montane villages are heterogeneous in their occupations, landholdings, and preferences. Despite this, many appeared willing to participate in asset-building PES aimed at enhancing biodiversity. Qualitative probing revealed some of the constraints and challenges perceived by landowners, which helped strengthen our quantitative results. We found that the addition of results-based payments (Scheme 3) did not increase participation or land enrolment, possibly due to a lack of trust in long-term programmes, especially in a society facing constant turmoil. We also identified the importance of uncertain future opportunity costs in a rapidly changing rural context. This study demonstrates the importance of combining qualitative and quantitative data collection in studies of PES and shows that the potential for tailoring PES schemes to supply off-farm ecosystem services will depend on understanding landowners' perceptions.

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