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

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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, different types of incentives for planting diverse native trees on private lands in Lebanon. Mixed-methods surveys were conducted with 34 landowners from mountainous villages to determine past, present and future land-use strategies. Our aim was to understand landowners' attitudes towards three differently structured hypothetical Payments for Ecosystem Services (PES) contracts options; their likely participation; and the potential additionality they would provide. The three schemes (results-based loan, action-based grant, and results-based payments) differed in their expected risks and benefits to landowners. Although the results-based loan did deter uptake relative to the lower risk action-based grant, results-based payments did not significantly increase uptake, 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 PES. 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.

**Keywords:** Agro-ecosystems; biodiversity; conditionality; displacement; mixed-methods; participation; PES

## 1 **Introduction**

2 Economic theory postulates that many environmental problems exist because markets have not been  
3 fully developed for biodiversity or most ecosystem (or environmental) services (Pattanayak et al. 2010).  
4 Increasing demand for agricultural commodities has therefore undermined important ecosystem  
5 services such as carbon sequestration and watershed protection, making agricultural expansion one of  
6 the major drivers of deforestation and biodiversity loss globally (Gibbs et al. 2010). Despite the steady  
7 rise in protected areas in the last decade, conserving biodiversity is expected to become more  
8 challenging due to climate change and increasing competition for land (Pullin et al. 2013). However,  
9 policy instruments such as payments for ecosystem services (PES) and agri-environment schemes are  
10 being adopted widely to incentivise landowners to supply off-farm ecosystem services from private  
11 lands (Schomers and Matzdorf 2013).

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

25 Hitherto, PES have largely focused on use-restricting strategies, e.g. avoided deforestation, but are  
26 increasingly employed to finance reforestation (or afforestation), referred to as asset-building schemes  
27 (Wunder 2008). However, recent studies have criticised carbon-focused PES and Reduced Emissions  
28 from Deforestation and Degradation (REDD+) for incentivising monoculture plantations, negatively  
29 impacting biodiversity and local livelihoods (e.g. Lindenmayer et al. 2012). Locatelli et al. (2014).  
30 argued that carbon-focussed incentives would not automatically result in bundled co-benefits for  
31 biodiversity and local ecosystem services. Designing biodiversity-enhancing reforestation schemes  
32 (using even mixes of native species) that are both cost-effective and attract participants remains  
33 challenging. We administered a mixed-methods survey to explore the willingness of Lebanese  
34 landowners from highland villages to accept incentives for planting diverse native tree species on  
35 private lands. Survey participants were presented with three alternative PES contracts schemes: Scheme

1 1, a results-based loan (involving repayments conditional on seedling survival: negative conditionality);  
2 Scheme 2, an action-based grant (conditional on planting only); and Scheme 3, results-based payments  
3 (conditional on seedling survival: positive conditionality). Our aim was to understand landowners'  
4 attitudes towards these three differently structured hypothetical PES contracts options; factors  
5 influencing decisions to participate; and the likely displacement that could result.

## 6 *Reforestation in Lebanon*

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

20 Our study therefore assumes that ecosystem services (ES) buyers could be either the public sector (e.g.  
21 MOA/MOE), NGOs, or both (with funding often provided through partnering international donor  
22 agencies). We determined in a previous study that these reforestation stakeholders are interested in  
23 increasing forest cover to enhance a broad array of forest ES (including landscape beauty, soil and water  
24 conservation, as well as biodiversity) rather than paying for specific ES (e.g. carbon sequestration).  
25 However, the ES anticipated heavily depends on the kinds and ratios of species being planted and  
26 managed. For example, plantations of fast-growing trees (e.g. eucalypts) may sequester carbon much  
27 more efficiently than most slow-growing natives, yet may also limit certain regulating services (e.g.  
28 water and nutrient cycling, pollination, disease mitigation). In fact, stakeholders expressed concerns  
29 over the lack of species diversity in past reforestation as well as the recent increase in exotics (e.g.  
30 *Paulownia* spp.), and have begun addressing the importance of maintaining resilient forest ecosystems  
31 through diversifying the planting of native species (MOA, LRI and AFDC, *pers. comm.*, 2012). Fruit  
32 trees are commonly planted in these regions and apples account for a significant proportion of crop  
33 production. Apple orchards may contribute to certain ecosystem services such as carbon sequestration  
34 (Wu et al. 2012); however, commercial orchards often require high inputs (e.g. irrigation, pesticides

1 and fertilizers), which can negatively impact biodiversity and other ES (e.g. pollination and watershed  
2 maintenance).

3 Recent reforestation efforts in Lebanon have focussed predominantly on municipal lands. Some  
4 implementing stakeholders expressed doubts about transacting with private landowners due to  
5 uncertainties with long-term tree retention and costs (LRI, *pers. comm.*, June 2012). However, while  
6 opportunity costs may sometimes be lower on municipal lands, transaction costs (e.g. monitoring to  
7 ensure compliance) are often higher compared to private landowners with proper titles (Engel et al.  
8 2008), particularly under reforestation contracts that often extend beyond the political terms of elected  
9 mayors. Yet contract attributes that characterise conditionality are what mainly influence transaction  
10 costs, thus posing a significant challenge for designing cost-effective PES contracts (Peterson et al.  
11 2015). Risk and uncertainty appear to be ubiquitous in many farming decisions, e.g. crop-selection and  
12 adopting new technologies, where decisions are made based on both attitudes towards risks and  
13 subjective beliefs (Menapace et al. 2013). These factors, along with opportunity costs and the  
14 institutional context where transactions occur, can influence landowner decisions to participate in PES  
15 schemes. Understanding Lebanese landowners' perceptions of asset-building PES is therefore critical  
16 for informing future reforestation policy.

### 17 *Factors affecting PES uptake*

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

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

1 trees were available to participants, but this is best suited to productive species (Hegde et al. 2014).  
2 Setting conditions for ensuring mixed native species are planted and retained is more challenging  
3 (Montagnini and Finney 2011).

4 Understanding farmers' identities and how they perceive risks or uncertainties towards livelihood  
5 changes is also important (Duesberg et al. 2013). Social-institutional factors such as trust in (or  
6 experience with) incentive-based schemes, local norms and values, dependence on farm-based  
7 activities, as well as age and level of education also influence landowners' decisions to join PES  
8 schemes (Chen et al. 2009; Fisher 2012). Participants in asset-building PES tend to have relatively large  
9 landholdings, with enough land unsuitable for agriculture, and whose incomes are largely off-farm  
10 (Cole 2010). The context under which the farming system is structured, along with secure tenure and  
11 technical or financial know-how may also determine uptake (Kosoy et al. 2008). Factors such as  
12 commitment period and required percentage of landholdings allocated have also been found to affect  
13 farmer uptake into PES schemes (Kisaka and Obi 2015). Building trust in the institutions responsible  
14 for ensuring payments often takes time, and poorer more risk-averse landowners may be less willing to  
15 participate (Fisher 2012). These issues are particularly critical in cases where governments are buyers  
16 or intermediaries, yet have lost the confidence of farmers through previous policies. Beyond this, PES  
17 is even more challenging to implement under circumstances where legal and property institutions are  
18 weak, which is common in many developing countries (Matzdorf et al. 2013). Even in developed  
19 countries like Germany, land tenure implications and contractual uncertainties were principal reasons  
20 behind farmers' reluctance to join PES schemes (Schleyer and Plieninger 2011).

# 1 **Materials & Methods**

## 2 *Study area*

3 Lebanon is a small (10,452 km<sup>2</sup>), predominantly mountainous country located in the eastern  
4 Mediterranean basin and recognised as a centre for plant diversity (Davis et al. 1994). Recognising  
5 threats to plant diversity in the eastern Mediterranean, a small team of scientists from the American  
6 University of Beirut's Nature Conservation Center (AUB-NCC) started a project to define Important  
7 Plant Areas (IPAs) in Lebanon (Yazbek et al. 2010). Designated IPAs are also shown to represent the  
8 major ecosystems and unique habitats of Lebanon. Our study area comprised the western slopes of  
9 Mount Lebanon where eight of Lebanon's 20 newly designated IPAs are located (Radford et al. 2011).  
10 These areas are characteristic of eu-mediterranean (> 1,000 meters) to oro-mediterranean (> 2,000  
11 meters) bioclimatic zones, averaging between 1000-1200 mm/yr. precipitation mostly occurring  
12 between November and March. While this region has been characterised as being predominantly semi-  
13 arid, many microclimates can exist between and even within some IPAs selected for our study (Yazbek  
14 et al. 2010). The vegetation types are typical of Mediterranean forest, woodland and scrub communities  
15 containing coniferous, deciduous and mixed forest/woodlands, interspersed with semi-natural agro-  
16 ecosystems (Makhzoumi et al. 2012). The region produces a variety of tree crops, predominantly apples  
17 and stone fruits (Ministry of Agriculture 2014). The main rainfed crops are cherries, often planted at  
18 much higher elevations. Irrigation is a major limiting factor for farmers in these steep and rocky  
19 landscapes, requiring extensive terracing to preserve soils and enable irrigation using canals. Irrigation  
20 comes from the numerous springs that form the tributaries of seasonal rivers and streams that flow along  
21 the western flank of Mt. Lebanon into the sea. Habitats are increasingly threatened by land-uses that  
22 include intensive agriculture, overgrazing, urbanisation and quarrying, as well as fires (Sattout and  
23 Abboud 2007).

## 24 *Sampling*

25 We focused on Important Plant Areas (IPAs) with reforestation potential but were unable to conduct  
26 our research in high risk parts of the country, i.e. the Bekaa Valley, South Lebanon and near the Syrian  
27 border. Eight of the 20 IPAs located along the west-facing slopes of the Mt Lebanon were selected for  
28 this study (Figure 1). Due to security concerns, many villages in the Akkar district (LB07) near the  
29 Syrian border were also excluded. A total of 248 villages were identified using Google Earth images  
30 embedded with IPA layers that were copied and transposed over administrative maps showing all  
31 village/municipal boundaries. Villages were stratified according to IPA, estimated geographic size,  
32 population, rurality and elevation. A stratified random sample of 18 villages within these IPAs were  
33 selected (see Appendix S1). Security concerns also necessitated obtaining landowner contact details  
34 from mayors and other key informants from sampled villages who acted as our gatekeepers and

1 facilitated our research. We obtained contact details for 52 landowners who were sole proprietors of  
2 their holdings, who were then telephoned. After at least two attempts we spoke to 46 landowners,  
3 informed them of the study objectives, and asked for their oral consent. Twelve landowners declined to  
4 participate because of a lack of land, land tenure issues (e.g. inheritance), age or inconvenience. The  
5 final survey was conducted with 34 newly recruited participants with their written consent who had not  
6 participated in a previous extensive pilot. Our research team was faced with substantial safety risks  
7 given the turmoil in Syria, which at the time began showing signs of potentially spilling over into  
8 Lebanon. This limited our sample size.

## 9 **[FIGURE 1]**

### 10 *Data acquisition, survey instruments and analyses*

11 The survey (see Appendix S2) was conducted in Arabic by the first author and a field assistant in the  
12 participants' villages, either at their farm, home, workplace, or the municipality office. After obtaining  
13 written consent, each participant was given an overview of the study and its objectives. After discussing  
14 current and intended land-use, the interviewer introduced the three hypothetical PES schemes in  
15 succession (see Appendix S3) to gauge their acceptability and to stimulate discussion of the key research  
16 themes identified above (the schemes were presented to each respondent in the same order for this  
17 reason). Entry into any of the schemes only required that they plant a minimum of 1,000 m<sup>2</sup> of  
18 contiguous land that they had titles to with the seedlings provided under the programme. Study  
19 participants were provided with a list of available native species that would be used in the PES  
20 programme and told that the kinds and quantities of each species would be determined by the  
21 programme team (see Appendix S4). Follow-up questions were asked after each scheme was presented,  
22 which included where they would plant the seedlings and how much area. They were also asked whether  
23 the schemes would change their intended planting plans (e.g. to plant crop trees) for that plot. We did  
24 not specify what land-use/land-cover type would be replaced under each scheme, thus study participants  
25 were free to decide where to plant trees and how much area this would entail. Follow-up questions  
26 determined the extent of agricultural displacement expected (e.g. croplands vs abandoned/marginal  
27 lands). In addition, they were asked open-ended qualitative questions (coded with responses seen only  
28 by the interviewer) regarding perceived benefits of the proposed schemes. Respondents who did not  
29 wish to participate in any of the schemes were prompted to discuss why they would opt out. These  
30 questions were designed to assess the kinds of risks and uncertainties associated with PES schemes of  
31 this nature with respect to landowners' perceived benefits in being paid to reforest with diverse native  
32 species. The survey concluded by asking what sort of constraints or future land-use changes the  
33 participants envisaged, followed by some basic socioeconomic questions.

34 Quantitative data was analysed using SPSS version 20 (Pallant 2010) to determine 1) whether there was  
35 a significant difference in uptake and area enrolled for reforestation under each consecutive scheme,



1 and 2) whether land-owner type, age or landholding size influenced participation and land enrolment  
2 into corresponding schemes. Qualitative data was transcribed and translated into English by the field  
3 assistant. Audio recordings and transcripts were analysed by the first author to identify important  
4 themes.

## 1 **Results**

### 2 *Basic attributes of the sample*

3 All participants in the sample (n=34) were males between the ages of 30 and 81 with a median age of  
4 57. Median household size was five. Over three quarters of the respondents were permanent residents  
5 of their villages while the remainder (n=8) spent only summers there. This is likely to be an artefact of  
6 sampling but we believe our sample is broadly representative of the relevant population, i.e. landowners  
7 with some active level of interest in managing the land. Ninety-one per cent indicated that their  
8 landholdings were located within villages where they resided. Respondents were generally well  
9 educated (Figure 2a) and included full-time commercial farmers, part-time farmers and hobby or retired  
10 farmers (Figure 2b). Aggregated landholding area of the sample was approximately 227 ha. Parcels  
11 ranged from 0.15 to 30 ha (median = 3 ha). Nine landowners owned property over 10 ha, consisting of  
12 mainly hobby/retired farmers. Landholding size differed weakly between levels of education (Kruskal-  
13 Wallis H-test = 7.810,  $p = 0.099$ ). Part-time and hobby farmers did not have smaller landholdings than  
14 full-time farmers (Kruskal-Wallis H-test = 0.258,  $p = 0.879$ ; Figure 2b).

### 15 **[FIGURE 2, PANELS A & B]**

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

17 The sample was highly skewed in terms of landholding size, recent planting area, and number of crop  
18 trees planted per respondent. Apples (*Malus domestica* Borkh) were the main commercial crop trees  
19 planted, followed by stone fruits (e.g. *Prunus* spp.). A large portion of the commercial tree crops were  
20 planted on previously abandoned croplands (Figure 3). Four respondents indicated that they had planted  
21 productive native trees, e.g. stone pine (*Pinus pinea* L.), but none had planted other native trees. Nearly  
22 75% had planted over 100 commercial saplings within the last 10 years.

### 23 **[FIGURE 3]**

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

### 29 *Participation and land enrolment in the PES schemes*

30 Twenty-two landowners would be willing to participate in the results-based loan (Scheme 1), offering  
31 21.9 ha of land for reforestation (approximately 10% of total landholding area). Participation increased  
32 to 27 farmers with 35.5 ha land enrolled (c16%) for the action-based grant (Scheme 2), but the results-

1 based payments (Scheme 3) did not change the number participating, and only slightly increased the  
2 land area to 37.5 ha (17%). A Friedman test indicated a statistically significant difference in land  
3 enrolment between schemes (Friedman's ANOVA  $\chi^2(2) = 25.10, p < 0.001$ ). *Post hoc* Wilcoxon tests  
4 found a significant increase in land enrolment from Scheme 1 to Scheme 2 ( $T = 169, r = -0.62, p <$   
5  $0.001$ ) and Scheme 1 to Scheme 3 ( $T = 198, r = -0.60, p < 0.001$ ), but not from Scheme 2 to Scheme  
6 3 ( $T = 77.5, r = -0.27, p = 0.116$ ). We tested whether total landholding size (in ha), age, and landowner  
7 type (divided between 'full-time farmer' and 'other') influenced participation in each of the three  
8 schemes using logistic regression following preliminary analyses to ensure underlying assumptions of  
9 models were not violated (Pallant 2010). Younger landowners and those with larger holdings were more  
10 likely to participate in Scheme 1, but these effects disappeared for Schemes 2 and 3 as a greater number  
11 of older landowners and landowners with smaller holdings were attracted to the schemes (Table 1).

## 12 [TABLE 1]

13

### 14 *Agricultural displacement under PES schemes*

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

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

### 31 *Landowner perceptions of PES schemes*

32 The hypothetical schemes were used to initiate a discussion of landowners' perceptions of PES schemes  
33 in general, and specific characteristics of the three schemes. Respondents' views of PES varied with a

1 greater portion seeing advantages of providing financial and technical support for farmers. One  
2 respondent claimed he would buy more land to enrol if these types of support were genuine and  
3 trustworthy. Unsurprisingly, respondents showed a greater keenness towards the action-based grant  
4 (Scheme 2) over the results-based loan (Scheme 1) due to relaxed conditions of the latter (i.e. lower  
5 risk), but the results-based payments (Scheme 3) was no more popular. Some respondents discussed  
6 higher payoffs as the main advantage that Scheme 3 had over Scheme 2. One respondent mentioned  
7 continuity of payments as a major advantage, and increased the enrolled land by 1 ha from Scheme 2  
8 to Scheme 3:

9 *“The 3rd [scheme] ensures a certain continuity to the [reforestation] plan by [incentivising]*  
10 *the farmer to [put] more effort in [ensuring] high rates of [survival] so he can get the highest*  
11 *amount of money” (Resp. #6)*

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

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

29 In general, respondents’ comments on PES schemes would suggest that opportunity costs were too high.  
30 Yet institutional factors may also influence uptake. For example, at least three of our respondents  
31 referred to the legal implications of planting forest trees. Since permits are required for cutting or  
32 removal of native conifers even on private lands (Law 85/1996), landowners (especially farmers) may  
33 be reluctant to plant non-productive species on productive farmlands. And while Lebanon’s current  
34 forestry policies may have contributed to relative gains in forest cover on abandoned farmlands, they  
35 may also have hindered effective forest management and made landowners reluctant to plant more  
36 forest trees:

37 *“In the past, forests were well managed and protected by the local people because they were a*  
38 *source of [fodder], wood, and medicinal and aromatic plants... Today, more restrictions have*

1           *been implemented by the MOA to protect forest areas, but this has actually discouraged people*  
2           *to preserve their forested lands because [these new laws have made forests] ‘useless’. Now*  
3           *violations, neglect and forest fires have increased... [because only] when people find a benefit*  
4           *from something, they will work to protect [it].” (Resp. #1)*

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

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

11 There were other factors respondents mentioned that contributed to lack of uptake and/or land-  
12 enrolment besides land availability and the land-use types in question (e.g. lack of land unsuitable for  
13 agriculture). In addition to negative attitudes towards native species, changing trends in land market  
14 prices were also important factors respondents raised that impact participation. Fewer younger  
15 landowners are actively managing their holdings than before, hence age will likely be a factor affecting  
16 uptake as well. Respondents in our sample were quite aged (median 57), which is reflective of a  
17 declining agricultural sector driving many households into cities in search of work. For instance, one  
18 respondent chose not to subscribe to any of the schemes both due to his age and the fact that his children  
19 no longer live in the village. He gave interesting insights that point to potential constraints in  
20 implementing a PES programme with landowners in Lebanon:

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

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

## 1 **Discussion**

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

### 13 **[TABLE 2]**

14 While it plays an important role in asset-building schemes, conditionality tends to limit participation if  
15 landowners perceive it as too risky (Chen et al. 2009). The PES schemes in our experiment were  
16 designed specifically to investigate how landowners perceive risks related to conditionality. The first  
17 two schemes (results-based loan and action-based grant) differed substantially in their level of risk to  
18 landowners, and a reduction in risk predictably increased enrolment. However, surprisingly the addition  
19 of results-based payments (Scheme 3) did not significantly increase uptake, despite higher payoffs in  
20 the long run. This may be due to landowner perceptions of risk and uncertainty in general, particularly  
21 for those with incomes tied to farming and forestry (Menapace et al. 2013; Blennow et al. 2014), as  
22 well as risks specifically attributed to results-oriented schemes (Burton and Schwarz 2013). For  
23 example, monitoring could be viewed as both an annoyance and loss of autonomy (Hudson and Lusk  
24 2004). Lack of trust was a key issue raised in the study by a handful of study participants and qualitative  
25 probing revealed some interesting responses by landowners with regards to trust in the schemes, as well  
26 as with PES in general. PES was as a novel concept to most of the study participants with only few ever  
27 having participated in reforestation. It would be expected that participants would feel some degree of  
28 uncertainty and distrust in PES until they could see how well it works in reality (e.g. experiences shared  
29 by neighbouring farmers participating in a PES programme). While compliance to monitoring appeared  
30 to have discouraged some respondents, this was not shared by most. There is also the possibility that  
31 Scheme 3 was not considered to be credible over the long timescale required to ensure tree retention by  
32 landowners; especially in a country which has experienced considerable socio-political turmoil.

33 In Lebanon, national agricultural policies have overshadowed multifunctional land-use strategies  
34 traditionally employed by local communities for managing natural resources (Makhzoumi et al. 2012).

1 This has led not only to poor management of forests (e.g. thickets prone to fires), but has also  
2 discouraged landowners from planting forest trees. Within this institutional context, landowners may  
3 be especially reluctant to plant trees that offer little private benefit in the long-run (as is the case with  
4 most native tree species). With respect to asset-building PES such as reforestation, additionality of most  
5 ecosystem services occurs over much longer time scales than with use-restricting PES. Perceptions of  
6 PES schemes and their subsequent adoption require evaluating long-term uncertainties (e.g. tenure,  
7 opportunity costs, market or political stability, climate, etc.), often affected by present day conditions  
8 of institutions and policies (Zanella et al. 2014). The Lebanese may inherently exhibit more caution and  
9 scepticism in making decisions that require long-time commitments due to historically persistent  
10 political instability (Makdisi 2004). Likewise, some participants mentioned having a general distrust in  
11 public institutions (e.g. MOA) due to previous experiences in subsidized programs like the 'Green Plan'.  
12 This raises questions on whether perceptions of PES would change based on who the buyers are, e.g.  
13 government vs NGOs vs private sector. Recovery from a 15-year civil war is being hampered by socio-  
14 political divisions that continue to paralyze the nation's public institutions. The public sector's inability  
15 to regain control of its institutions, due also in part to its lack of transparency, leads to widespread  
16 corruption (often referred to as '*wasta*', which appears to have become a social norm). A growing  
17 number of NGOs have begun to fill this void and have gained more trust than government institutions  
18 (Solberg 2014). Such factors may have negative implications for PES in Lebanon as government  
19 institutions desperately try to re-establish oversight of the forestry sector through consolidating  
20 re/afforestation efforts and enforcing policies.

21 Many studies have found that participation in asset-building PES is contingent upon farm-based  
22 incomes (i.e. opportunity costs), farming systems (e.g. available marginal lands), landholding size, and  
23 age (e.g. Cole 2010; Kisaka and Obi 2015). Recent studies on incentives for re/afforestation have also  
24 shown that decisions to participate in such schemes may not be solely based on actual or perceived  
25 opportunity costs, but also on non-financial factors related to risks and uncertainties (Duesberg et al.  
26 2013). Our results suggest that consideration of opportunity costs was ubiquitous amongst respondents,  
27 especially if they could foresee possibilities of bringing land in disuse back into cultivation, or the  
28 prospect of developing their land in the future. Moreover, landowners' opportunity costs could vary  
29 from one plot to the next, and perhaps even within the same plot (Wunder 2007). Respondents in our  
30 sample owned modest size holdings, and may have been conservative with how much land they would  
31 be willing to enrol. Landowners would have to consider important trade-offs when selecting plots with  
32 the lowest opportunity costs, such as direct costs of planting and irrigating seedlings on difficult terrain.  
33 This is particularly critical for less experienced tree planters who may underestimate the level of  
34 difficulty or work involved, which is especially relevant for those that are quite aged. Reasons why  
35 landowners in our study (particularly full-time farmers) would opt out of schemes accord with other  
36 studies, particularly if livelihoods would be affected by having native species on farms, such as loss of

1 tenure and negative perceptions of biodiversity (Zubair and Garforth 2006). More recent studies have  
2 also indicated that uptake of asset-building PES initiatives depends more on landowner attitudes and  
3 perceptions of how such policies affect future livelihoods (Trevisan et al. 2016).

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

15 Finally, we acknowledge that a more representative sample size would have helped tremendously in  
16 quantitative analysis of each scheme and would have helped draw a more cohesive picture of landowner  
17 perceptions to conditionality. However, this study was concerned with developing a more qualitative  
18 assessment of PES and the schemes presented, as has been conducted in other case-studies (e.g. Zanella  
19 et al. 2014). We also acknowledge the limitations of mixed-methods studies in that it would have been  
20 difficult to combine qualitative analysis with a much larger sample size. A more representative sample  
21 would also have to include absentee landowners, whose incomes are presumably not tied to farming.  
22 Therefore, our study focussed on full-time residents, most with vested interests in farming. Despite this,  
23 there was considerable heterogeneity amongst farmers and their preferences, yet social and institutional  
24 aspects appeared to play an important role in uptake for most. These included issues with credibility  
25 and trust in new institutions as well as legal implications of planting native trees on private lands,  
26 resulting in high opportunity costs and unforeseeable risks in the future. Future research may want to  
27 examine whether absentee landowners, presumably having larger holdings with little or no commercial  
28 farming, are less risk averse than those in our sample, and thus may display a greater willingness-to-  
29 accept PES and enrolling more land. If PES buyers would prefer targeting absentee landowners with  
30 lower opportunity costs over farmers, they must be reminded that long-term ecological outcomes are  
31 closely tied to efficiency and equity trade-offs.



## 1 **Conclusion**

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

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## **Conflict of interest**

None declared.

## **Ethical standards**

The study received ethics approval from both Bangor University and AUB review boards.

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## Figures



Figure 1: Map of Lebanon showing the eight Important Plant Areas (IPAs) in the study area in green (Yazbek et al. 2010). Landowners from 17 villages located within these IPAs were sampled for this study. Source for base mapping: Google Earth.

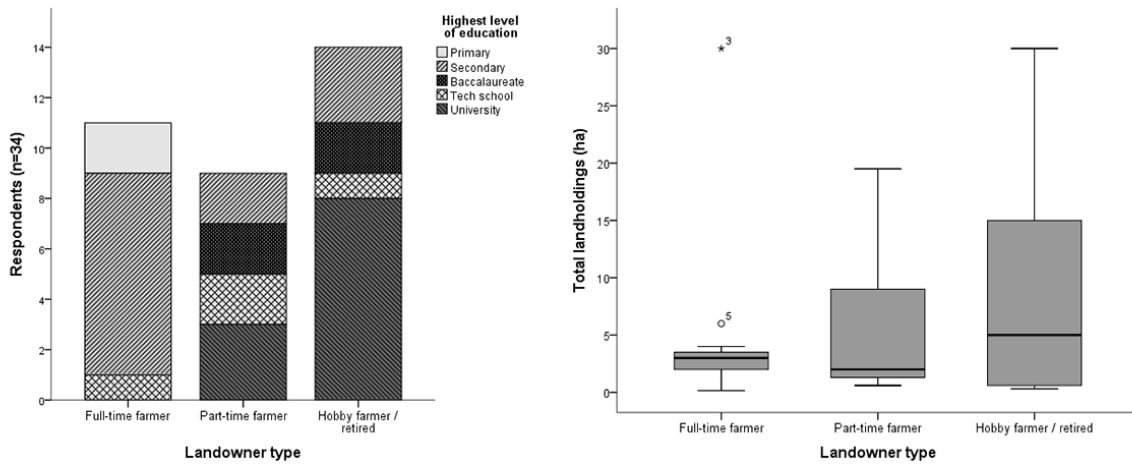


Figure 2: a) Landowner type subdivided by education (left panel). b) Total landholdings by landowner type (right panel). Landowner type was divided between full-time farmer (most income derived from farming), part-time farmer and hobby / retired farmer.



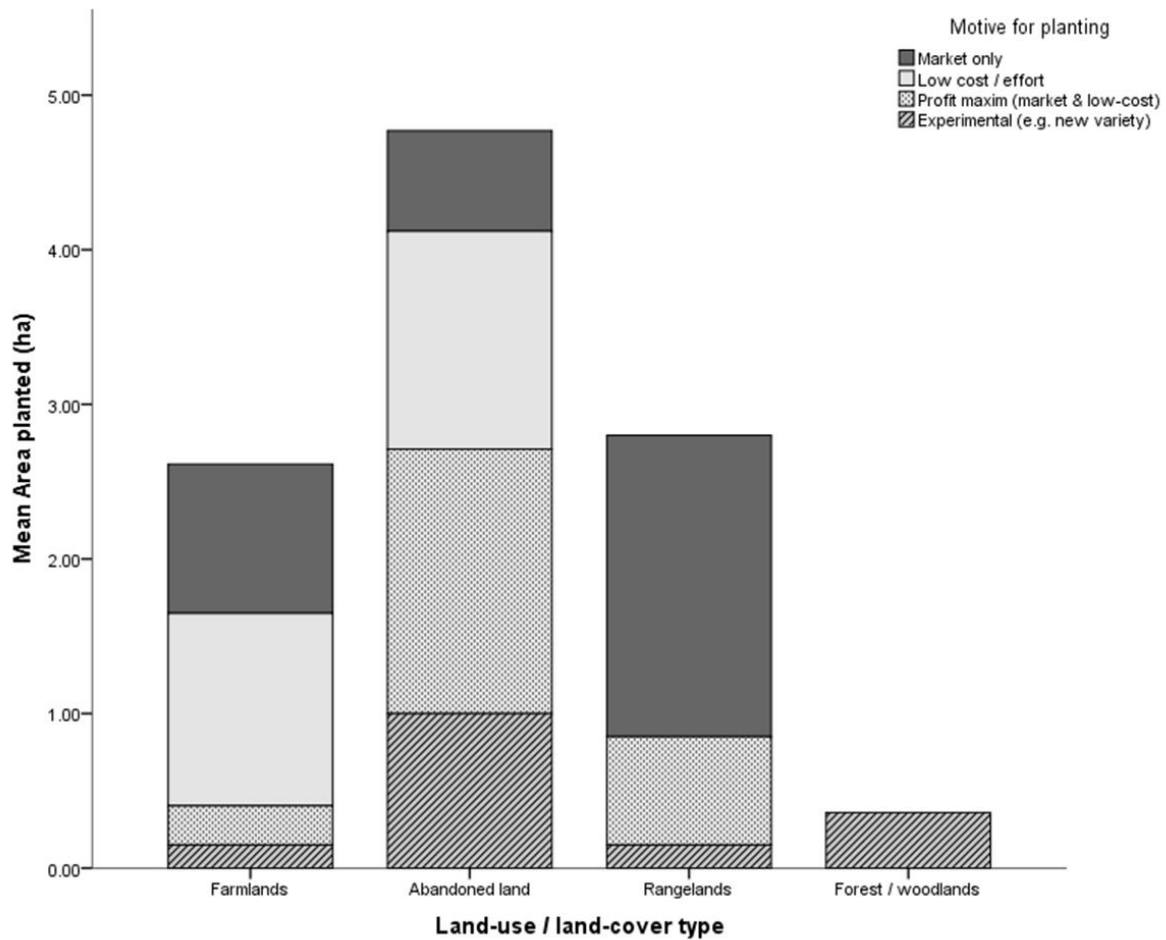


Figure 3: Mean area planted with commercial crops under different land-use/land-cover types subdivided by farmers' motives for planting the crops mentioned. 'Low cost / effort' refers to easy management of the trees, 'Market only' refers to high market value of the crop, and 'Profit maxim' denotes respondents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

## Tables

Table 1: Logistic regression for predicting likelihood of enrolling in PES schemes<sup>‡</sup>

		B	S.E.	Wald	d.f.	Sig.	Odds Ratio	95% C.I. for Odds Ratio	
								Lower	Upper
Scheme 1	(Constant)	3.969	2.235	3.152		.076	52.911		
	Landowner type	1.182	1.079	1.200	1	.273	3.260	.393	27.015
	Age	-.090	.043	4.342	1	*.037	.914	.839	.995
	Landholding size	.368	.183	4.044	1	*.044	1.4450	1.009	2.068
Scheme 2	(Constant)	.689	1.994	.119		.730	1.991		
	Landowner type	-1.808	1.271	2.024	1	.155	.164	.014	1.979
	Age	-.009	.036	.065	1	.799	.991	.923	1.063
	Landholding size	.863	.557	2.399	1	.121	2.370	.795	7.064
Scheme 3	(Constant)	2.574	2.092	1.514		.219	13.112		
	Landowner type	-.072	.997	.005	1	.943	.931	.132	6.568
	Age	-.039	.036	1.159	1	.282	.962	.896	1.032
	Landholding size	.319	.236	1.821	1	.177	1.375	.886	2.185

<sup>‡</sup>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).

\* $p < 0.05$

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

	<b>Scheme 1</b>	<b>Scheme 2</b>	<b>Scheme 3</b>
Farmer uptake	Medium	High	High
Area enrolled	Low	Medium	Medium
Displacement	Medium	Low	Low
Risks (to farmers)	High	Low	Low/Med.
Transaction costs*	High	Low	High
Payment costs*	Low	Med	High

\* These are reasonable estimates of the costs to buyers involved in mounting the schemes