A PES System for Azerbaijan (Preliminary Report)

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1. Introduction

An ecosystem (ES) is a group of plants, animals and micro-organisms in combination with the non-living physical components of their environment. All the biotic and abiotic components of ecosystems are interrelated and create unique nutrient cycles and energy flows. An ES may be considered a completely independent area with its own interdependent organisms (Flores and Abbasov, 2014). All the organisms in the ecosystems are interrelated and share same living space.

ESs are the sources of many vital products and services used by human beings (Daily et al., 1997). They are the only sources of resources, which are very important to human wellbeing and survival (Costanza et al., 1997;, Flores and Adeishvili, 2011). ES provided resources include a broad basket of goods and services used in people's daily life (Pearce and Atkinson, 1993). Goods and services provided by ecosystems will be simply called "ecosystem services" or ESS.

There are number of definitions of ESS. According to Schroter et al., (2005), ecosystem services (ES) are the conversion of natural assets – such as trees, snow cover, and soil fertility – into valuable benefits such as wood products, winter tourism, and arable land. ESS can be described as a "services provided by the natural environment that benefit people" (DEFRA, 2007: 10).

Ecosystems provide services such as water supply, pollination, seed dispersal, climate regulation, water purification, nutrient cycling, and control of agricultural pests. Many flowering plants depend on animals for pollination, and 30% of human crops depend on the free services of pollinators".

According to The Millennium Ecosystem Assessment ( ), ESS can be classified as provisioning, regulating, cultural and supporting services.

Provisioning services linked to forests and grasslands refer to the human use of products. They can be identified as the quantifiable goods from ecosystems. Food, water, timber, honey, medical plants are considered as a provisioning service of ecosystems. They provide direct use values for societies.

Regulating Services are the services that regulate natural processes. For example, forests regulate water flow in small streams and reduce risks of floods and droughts. Regulating services may also provide food and diseases control through regulation of air quality and soil processes.

Supporting services are directly related to the ecosystems and support living organisms providing them with shelter. These services create various types of use and non-use values for human beings.

Cultural services include all types of non-use benefits such recreation and tourism. Cultural services may also include existence and option values.

Natural resources should be used effectively and produce maximal gains for the society. Simultaneously, these maximal gains should not result in total degradation of the land and forests. Because "maximal gains" have been often interpreted without reference to their sustainability, however, they should be substituted by the notion of "effective gains". These are defined as the effects that maintain sustainable ecosystem management and produce stable gains over long-term periods. These stable gains can even be much lower than usual and certainly than maximal gains, since the latter could only last for limited and typically short periods of time. In this respect, land users should understand that maximal gains even over short term periods could result in a total degradation of the natural resources and loss of income sources forever.

In view of growing concerns of related to ecosystem degradation, it is very important to develop ways that would enable to manage ecosystems in a more sustained way. In order to promote conservation and protection of natural resources and improve services provided by ecosystems, various types of market driven mechanisms can be designed. An important class of market based mechanisms is known as payments for ecosystem services (PES). Through PES landowners are supported financially to change their land use styles and provide ecosystem services to buyers. These buyers can be direct users or non-users t interested in improving ecosystem services. Almost in all PES schemes, managers of natural resources and ecosystems are paid to manage their resources more effectively, protect land, biodiversity, carbon sequestration ability through, for example, replanting trees, reducing grazing and applying more nature friendly agricultural methods.

2. Aims, Objectives, scope and methodology

The overall aim of this study is to collect valid and reliable information and identify opportunities for future PES markets in Azerbaijan and the target area, assess main opportunities for future PES markets and provide a roadmap to full PES study. This is an initial or scoping study that will primarily identify main opportunities for PES.

Within this broad theme, the study had a number of specific objectives:

- ✓ to identify the existing ecosystem services of forest and high alpine grasslands in Ismailli and Shamakhi districts of Azerbaijan and classify them
- ✓ to identify target groups, sellers and buyers for future PES markets
- ✓ to collect the needed data for PES
- ✓ Identify institutional and administrative functions/frameworks (who can be the body to manage the ecosystem services)
- ✓ Develop pro-poor benefit-sharing mechanisms (mechanisms piloted to reduce over-grazing and restore critical ecosystem services generated by healthy summer pastures (forests) in the Greater Caucasus Mountains.
- ✓ Interlink PES with Pasture Users' Associations and Forest Users' Associations established in the region and identify income sources for PUA and FUA
- ✓ Prepare and submit the final draft report with the road map for the year 2017 to international expert and to UNDP
- ✓ To design WTP (Willingness To Pay) questionnaire of non-use values of ecosystems for potential buyers and pretest it

The methodology of the study is based on analyses and valuation of ecosystem services that will be developed fully in a subsequent, larger scale application of the PES study.

3. The PES System

A Pes Typology

Several types of PES schemes have been experimented with various degree of success all over the world. These schemes mainly include direct payments to landowners or their indirect support. Direct payments may include contracts between buyers (generally public bodies) and sellers (generally private parties), where buyers directly support service providers. Government subsidies, tax reductions, different types of programs through which farmers are financially supported to reduce soil erosion may be counted as direct payments. For example, a government program that is concerned with land degradation may provide financial support of landowners and help them to implement proper measures against land degradation. It may also be an experiment launched by government to find what types of land use patterns will provide more gains. Reverse auctions over the land use permits can also be counted as direct payments. In land use reverse auctions, government (or another buyer) purchases land use rights from the owners in an auction, where many landowners offer their rights at a bid price. Land use rights may be

purchased through direct negotiations with landowners. Parties may agree on foregoing rights for fixed periods of time (usually for 10-15 years) to the buyer and use their lands only for specific purposes, though which sustained ecosystem management will be maintained.

In some programs landowners are supported indirectly. Under indirect payments, for example, certain types of activities can be freed from taxes. Farmers may choose more sustainable activities through which land and ecosystems will be protected. For example, switching to beekeeping instead of cattle breeding in mountain regions can be supported by tax reductions.

PES types may be private, public or cap & trade. In private PES parties directly talk to each other through agreements and contracts. The parties include landowners, government, charity foundations or companies that are interested to improve quality of ecosystem services. For example, in private PES activities that are implemented in USA government and charity foundations directly support landowners**.** İn most cases buyers by use rights of lands and property rights remain in landowners.

In some cases public PES schemes are similar to private PES schemes. However, publis PES schemes mainly come as subsidies or tax reductions. In these kind of schemes buyers may motivate landwoners through various kinds of incentives that include reduction of taxes, subsidies, and government purchases.

Cap and trade schemes can be considerd as indirect PES. For examples, land owners can be given quotas to water abstraction or pollution. Within the designed PES schemes these quotas may be subject to trading. These kind of PES schemes cannot be implemented in all countries. For examples, water quotas may be subject to trade only in countries with high water shortages, where a solid background of environmental laws exists (Table 1).

Table 1: Main PES types

Main PES types		
Private PES	Public PES	Cap and Trade
✓ Beneficiaries directly pay to service providers ✓ Involved private parties' cost sharing ✓ Buying of land and contract with former landowner	✓ Fiscal mechanisms driven by government (e.g. Subsidies to land owners) ✓ Public agencies involve member fees ✓ Buying of land and changes use rights	✓ Launch of maximum amounts for pollution and water abstractions ✓ Water withdrawal and pollution permits ✓ Maximum allowable use permits

✓ Purchase of land use rights	✓ Voluntary payments to PES funds	✓ Trading with permits

While the PES schemes may have various origins and forms, they all are directed to reduce human pressures on ecosystems using the way that could be reasonable and practical. PES schemes sometimes may deny some short-term gains of stakeholders, bringing benefits for all sides in the long-term . In other words, PES schemes make ecosystem protection economically profitable and ensure sustainable use of resources.

In most of developed countries several forms are successfully applied. Most used PES formulas have following patterns:

- ✓ Government subsidies landowners to change land use type
- ✓ Landowners supported to reduce grazing through rotational grazing
- ✓ Landowners supported to reduce pasture grazing through special quotas
- ✓ Landowners supported to reduce water withdrawals though water saving technologies
- ✓ Landowners supported to change land use type
- ✓ Purchase of land use rights through reverse actions for 10-15 years

PES as a new market- environment friendly instrument

The PES is a form of a contract[1] that parallels, for certain aspects reproduces, and for other mirrors, the concession contract. While a concession contract typically aims to promote the development of a natural resource or other public resource efficiently taking into account the public good, a PES has the objective of avoiding or restraining development of the resource in order to pursue one or more conservation goals. While the concession generates rewards to the holder through exclusive rights over the use of the resource, the PES seeks to limit the right of the owner or user of the resource, paying in exchange a compensation. In the case of PES, therefore, it is the government that is, in a certain sense the concessionaire, while the private party is the granter of the concession in exchange for a fee. As shown by Scandizzo(2009) and

[1] We refer to PES as a class of contracts defined (Wunder, 2005, 2008) as: (a) a voluntary transaction where (b) a well-defined environmental service (or a land use likely to secure that service), (c) is being bought by a (minimum one) service buyer (d) from a (minimum one) service provider (e) if and only if the service provider secures service pro-vision (conditionality).

Scandizzo and Ventura (2015) in the case of the concession contract, the form of "reverse concession" constituted by PES has a number of interesting properties and, while potentially advantageous for both the community and the private owners, should be handled with care.

The first property of PES is that it seeks to align private and public incentives, recognizing the difference and properly charging the costs of the alignment to the public. In order to understand what is the possible role of PES, however, one does not have to limit oneself to imagine a pure transfer of payments to a set of private holders of rights over natural resources. Equally important, in fact, is the issue that privatized natural resource uses may have on the role of government. In this respect, a special position is assumed by the so-called "fundamental theorem of privatization", stated in 1987 by two American economists (Sappington and Stiglitz). This theorem, which in a short period has become the basis of innovative thinking on the relations between property and enterprise, turns upside down the traditional approach that sees normality as the condition in which property is private and the regime change is constituted by the attenuation of private control in favor of the public authority. By considering the opposite hypothesis of transfer of rights from the public to the private sector, this approach proposes to identify the conditions under which a complete delegation of production decisions to a private concern is socially desirable. The basic idea of the theorem, which identifies some stringent conditions under which the above social desirability exists, is basically a PES system, that is, an auction mechanism whereby a certain number of firms compete to acquire the right to produce a good or a service, for which a relevant public interest exists. The auction mechanism ensures separation between the public concern (the "government"), which opens the auction, and the winner (the private concern). It is designed, however, in a way that makes compulsory for the winner to pursue one or more public objectives (for example, the production of a given amount of environmental services, the maintenance of the resource according to given standards). As a consequence, the winner, even though she is completely distinct from the government, shares with it the objective function, by virtue of the fact that of having won the auction, and having to deliver the objectives, conditioned to sustaining the effective costs, which are thereby minimized.

According to the logic of the theorem, therefore, a PES system can be rationalized as a form of public intervention that preserves the separation of property from enterprise, which is characteristic of the capitalistic organisation of production. PES make in fact possible to privatise the pursuit of public interests, by preserving private property rights and utilising at the same time private concerns as the most efficient instrument of environmental conservation in a market economy. The conditions under which this perfect efficiency is achieved, however, cannot possibly hold in reality: they include, in fact, absence of risk aversion on the part of the firms, perfect competition, no transaction costs, no possibility of collusion, and perfect information. The authors suggest that the appropriate institutional response to the practical impossibility of achieving social efficiency through *perfect delegation* to the private sector is a process of *public regulation of production.*

Accepting such a process as the best solution to the problem of achieving social efficiency under private ownership, two different economists, Laffont and Tirole (1989 and 1990), have put forward a more daring theory. According to this theory, the separation between property and enterprise in modern capitalism requires a particular regulatory environment because it is the result of an *incomplete constitution*. The constituents (the *founding fathers*), since they operate under a *veil of ignorance*, are unable to design a complete set of rules (a *constitution)* that predicts and describes costlessly all future contingencies. If they were able to do so, the economy would be composed of only private subjects, while constitutional rules would be reduced to a set of detailed instructions that the private subjects would have to follow. The only public subjects would be, in this case, the courts of justice, which would have the task to make sure that the private subjects followed the instructions as prescribed by the constitution.

In the conditions of uncertainty that characterises the actions of the *founding fathers,* the rule that can be emanated cannot be detailed instructions, but only meta-rules, constraints and prescriptions of general type. Public agents are not any longer limited to the courts of justice: their role is more important precisely because their mandate is vague and does not include explicitly all the possible contingencies. One part of public agents (the *bureaucrats*) has the task to manage the lack of specific prescriptions.

An organisational form, which in a stylised form can be described as consisting of four components, may represent the problem of reconciling public concerns and efficiency, under these conditions: (a) the *firm,* (b) the *agency*, (c) the *founding fathers* and, (d) the *consumers.* The *firm* is a private concern that operates according to the principle of maximum profit or, where applicable, the minimum cost. It is characterised by variable costs that are common knowledge, and by fixed costs, technology and effort levels known only to management. The *agency* is endowed with regulatory and control power based on the *constitution* and the related system of laws. It may involve property rights relative to the operations of the firm. For example, it may be assigned control rights for the firm, or discretionary power to concede or revoke the authorisation to operate, or to nominate or revoke the administrators. The main role of the *agency* is to make sure that correct information on the firm's structure (technology, profits, benefits of managers and dependants) is passed on to the community. In doing so, however, the *agency* is tempted to collude with the firm, by sharing the advantages that can be gained at the expenses of the *consumers.* The *agency* thus receives a pay off only if its behaviour is beyond reproach both in terms of effort and in the lack of collusion with the firm. The *founding fathers* via legislation or executive action give the *agency* its mission and empower other organs of the judicial system to monitor and control its performance.

As an exemplary application, Laffont and Tirole (L-T) analyse the prohibition, common to many juridical systems, to make transfers to public operations or to private firms operating under regulation, to cover their losses. When the activity faced by the firm presents increasing returns to scale, in fact, social efficiency implied by the so called marginal cost rule (which wants the price of the service provided to the public just enough to cover the service cost) requires the transfer to be made. Application of the alternative average cost rule, on the other hand, is compatible

with the absence of losses on the part of the firm, but not with social efficiency. In the case of forests, this dilemma is exemplified by parastatal operations of various forms (Public Forest Administrations or PFAs), whose existence is justified by the fact that forests provide both private goods and a variety of externalities. Most of PFAs have indeed accumulated large losses, which, at least in part, can be attributed to their providing services over and above what mere private firms would provide.

According to the L-T argument, however, substituting a combination of private concessions and PES to PFA's operations would have the likely benefit to increase efficiency and avoid the collusion between the regulators and the firm (the parastatal operation or the concession holder). This would be achieved because the fact that PES de-couple the conservation payments from the management costs would mean that the government cannot intervene to fill the difference between revenues and costs of the regulated firm and this creates a conflict of interest between the consumers and other social groups and the possibly colluding regulators and regulated. Thus, consumers, grass-roots social, environmental and business groups may be motivated, if information costs are relatively low, while collusion costs are high, to control both the firm and the regulators to avoid collusion. This result may be mixed in some respect, but in its totality may have a greater efficiency than the usual bail out in the name of public interest.

Governance issues: making good rules

Given that an effective regulatory environment is crucial and that good laws may be more important than good organisations, how do we find the best rules to support PES? They may follow, in fact, many different forms and may be associated with different property regimes and institutional arrangements. Corresponding to these different forms, in forestry, grazing, fishing and other enterprises, the system of explicit and implicit rules regulating the various components of the activity establish the balance of power among the holders of rights that the activity generates, i.e. the so called stakeholders. To a lesser extent, these rules also affect the balance between the two key characteristics of stakeholders' claims: liquidity and control. We can say that a regulatory environment is characterised by a good set of rules (i.e. by *good governance*) when these eliminate or, at least, reduce *agency costs* and *transaction costs. Agency* costs arise from the difference of interests between *principal* and *agent*, while *transaction* costs derive from the need to finance search and information costs and to control *opportunistic* behaviour. This, in turn, originates from taking the opportunity to indulge in hidden information or hidden action to improve one's position in the implementation of a contract.

In the theory of law and economics, the problem of the external and internal rules of an organised activity in the private domain has predominantly been addressed at the level of the relationship between shareholder and manager (or shareholder and creditor, in financial terms). Consequently, the current literature tends to focus on the interactions between holders of explicit and implicit rights and the enterprise, with particular regard to the maximisation of individual objectives, controls and opportunistic behaviour. To an extent, this issue is the indirect

result of the emergence of an institutional form of dualism, inherent in the relationship between principal and agent. The fiduciary nature of this relationship, the presence of a conflict of interests and the failure to provide the same information to both parties causes a deviation from the boundaries of efficiency, which manifests itself as a rise in agency costs. Rational attempts to reduce these costs may take two forms: *monitoring* or the introduction of incentives (via so called *commitment* mechanisms).

Two basic premises underlie the process of monitoring. First, usage and benefit rights tend to become separated. Contracts make separate provisions for them in order to allow resource use to be determined by a different set of agents, than those collecting the benefits. This separation starts by granting the bulk of usage rights to one class of agents (e.g. sharecroppers, or tenant farmers) while benefits are shared, but corporate evolution has carried the process to its extreme conclusion (Coleman, 1990)[2] . Second, the holders of usage rights tend to create an independent constituency or interest group, which opposes other right holders. This opposition is levied against any power of control given by a fiduciary relationship with the owners of the resource base involved (for instance, via side contracts, special privileges, customary rules, representation of right holders). This latter notion does not only apply to the formal management structure. It also describes those figures who have acquired a portion of the powers of control through forms of negotiation other than shareholding. In the case of forests and forestry enterprises, for example, these figures include prospective parties in informal agreements between various stakeholders (government bureaucrats, landlords, industrialists and commoners).

PES can be seen as a novel attempt to bypass the separation between usage and benefit rights, by realigning the objectives of the two classes of stakeholders. PES in fact are paid by beneficiaries to actual or potential users to pursue specific objectives that would not be perceived in principle as being in the interest of the latter. However, incentives are also necessary in setting up PES contracts and organisations because monitoring is costly and can only go so far to reduce the agency costs. These arise from the fact that the holders of usage rights, as agents of the owners, tend to have their separate agenda, with possible conflicts with the holders of benefit rights. Under these arrangements, private enterprises to manage natural resources are selected on the basis of PES contracts containing various incentives designed to reconcile private and public interest. These incentives are generally based on some notion of benefit sharing, and attempt to throw a participatory net over the main decisions and outputs expected from the contract. For example, an interesting new institutional arrangement "Collaborative Forest Management (CFM)" has been tried (World Bank, 2001) as " … a working partnership among the key stakeholders in the management of forests and tree resources. Key stakeholders include local forest users and state forest departments as well as other actors, such as NGOs and the private sector." By providing a contract framed by a broad mechanism of mutual commitment of the actors involved, CFM seeks to link sustainable forest management with the promotion of social justice. Again according to the World Bank, "… The central feature of CFM is *control* over

[2] "**...** All corporate bodies "split the atom" of whatever resources are vested in them, taking the usage rights and leaving to members or owners the rights to benefits from that use. " (Coleman, 1990, p.457).

the *management*, not just the use, of forest land and resources, with a devolution of power to local forest users."

CFM main commitment mechanisms may be classifies under two headings that both include some form of privatisation: *user groups* and *joint management*. *User groups* are formed by granting local people, organised as primary users and traders of forest products, some decision power on how forest resources will be managed and utilised. Institutional arrangements attempt to provide contracts and decision mechanisms that generate agreement on forest use with other community members and governmental assistance and assurance of long-term benefits. *Joint management* arrangements provide for sharing the rights to manage forest resources between the local community and the forest authority. Local people not only have rights to harvest some forest products, but share management rights with government officials and jointly evaluate the performance of the partnership, the problems incurred, and the possible violations perpetrated.

While these commitment oriented mechanisms are slowly being tried by several countries, and high monitoring costs are being sustained, governance in the forestry sector remains unsatisfactory, in part because of the complexity of usage and non usage rights to forestry resources. Because residual rights have typically been vested onto the public sector, traditional usage rights have involved, in addition to the right of harvesting the trees for lumber, wood for fuel, fruits, game and amenities. These rights have been granted either through concessions, sales and auctions for services, or through customary rules. In the former case, *explicit contracts* are the primary source for governance rules. In the latter case, more common for non timber products, usage and governance rules tend to merge into *implicit contracts* expressed as codes of behaviour, mutual expectations and social norms.

Governance rules, furthermore, are not always followed, as illegal and rent seeking behaviour often threatens to jeopardise the rights of weak stakeholders, by imposing upon them extra costs or by depriving them of the access to the resource. Forest crime (illegal logging, arson and the smuggling of endangered species) is a problem all over the world and is particularly severe in developing countries. In Cambodia, for example, this problem was so severe that in 1997 the IMF suspended a support program for the failure of the government to collect more than 100 million $ of revenue from the logging industry.

An important characteristic of PES thus depends on its governance aspects. All contracts, whether they are explicitly stipulated or only implicitly expressed as mutually accepted rules and obligations, are variously subject to default and different types of breach and elusion. As a provider of a framework of discipline and recognised rules for all contracts, governance is an important component of local capacity to implement efficient contracts, but it may itself be the casualty of transgression and misbehaviour. In the case of PES, good governance requires transparent award policies. In most cases, however, the granting bodies may be the exclusive domains of government bureaucrats and industry lobbyists, while the participation of civil society may be lacking. Tender and auction systems, which have successfully been introduced in many countries, also lack a satisfactory, legally binding contractual anchor and a naturally enforcing environment. Corrupt and unfair practices to award and supervise concessions are widespread,

and abuses by government officials, local bureaucrats and concession holders are a constant feature of public ownership and management of users rights. Most countries have passed legislation on environmental protection (e.g. the Zambia Forest Act) and in other countries (e.g. most OECD countries and Papua New Guinea and Indonesia among the DCs), environmental management plans are developed in lieu of forest concessions. Nevertheless, bad contractual practices and illegal behaviour still dominate the performance of the public sector as the main motor of governance rules for forestry.

Because they are not the consequence of formal contracts, usage rights for non-timber products are even more vulnerable to abuses and illegal behaviour. In many cases competing claims are advanced by different groups, which may try to enforce them through both legal and illegal means. Except were the forests are under the strong control of an established community, governance structures appear weak and vulnerable to special interests, when the resource is publicly owned. In Brazil, for example, the Amazon forest has a plurality of legal users, among which the indigenous population is by law endowed with special rights and privileges. In reality, for many years the forest has been at the mercy of the migrant farmers practising “slash and burn” agriculture and of the large “rancheros”, who seek clear land to raise their livestock.

In most “frontier” cases, governance is to be the main problem faced by government, and trying to couple secure property rights with public good commitment to private agents through PES appears to be the best way to ensure co-operation and commitment to a rational use of natural resources. On the contrary, when the government is at the same time the owner and the regulator of the resource use, the ensuing conflict of interest lowers the credibility of public bureaucracies and may itself induce corruption and other abuses. An example of this conflict of interest is again the concession contract, which is a form of privatisation of control, while the government retains residual rights and broad supervision responsibilities. Under these conditions it is not surprising that concessions are characterised by several distortions, such as non transparency, discretionary granting and negotiating, as well as the pretence of completeness that contrasts with the uncertainty of harvest, resource use and sustainability.

To a large extent PES can be seen as a new form of contract in lieu of concessions, because of the failure of the latter to reconcile public and private interests. The “Collaborative Forest Management “(CFM) contracts are examples of PES as commitment mechanisms to encourage co-operative behaviour on the part of the various stakeholders involved. Other contracts, based on project financing or more sophisticated economic agreements are also being tested together with new regulatory institutions. A recent example of this new wave of contracts is given by the experience of a local NGO, the Centro de Suporte Tecnologico, operating in the state of Oaxaca in Mexico. This organization , through the use of several trust funds, the involvement of local communities and local business, has been able to implement an ambitious water management and reforestation program. The program is based on the innovative idea to provide PES as a form of adequate compensation to indigenous and peasant communities for environmental services that offer tangible benefits to downstream users. The new contracts and institutions experimented may consist of complex arrangements, whose immediate success or failure may

be largely a function of the context or the circumstances. Their ultimate functioning, however, will depend on the development of a new class of customary rules and social standards.

Social standards are at the base of many clauses stipulated under PES contracts and, in the absence of specific stipulations, they act as norms of last resort to regulate usage and non usage rights for commons such as forests, grazing lands and water bodies. While a precise definition is difficult, social standards can be seen as key features of contracts that involve reciprocal obligations of competing parties, by stipulating that contingent rights be distributed by partitioning them into two parts. These are: the part below a given level of risky entitlement (the primary claims) and the part above such a level (the residual claims). In particular PES may be embodied in a contract where a private stakeholder, by committing itself to specific conservation practices, takes the residual claim on the performance of a commons based enterprise, while the public party maintains the primary claim. In this case the level of payment in every period represents a threshold for the income that the holder of the PES contract would earn in the absence of her obligation to perform the conservation services: if such an income is below such a threshold the residual owner can satisfy her obligation and exercise her claim to the payment. If the opportunity cost of satisfying the contract is above its payment, on the other hand, the primary holder is better off by not abiding by the PES contract obligation and, as a consequence, she has the option to become the primary claimant.

Because the private party has the option to exit the contract, should her opportunity cost become larger than the payment, PES contracts are subject to moral hazard and, if assigned competitively, to adverse selection. This is because the private parties willing to enter the contract will offer a more competitive price, the larger is potentially their pay off from abandoning it once the PES proves to be lower than the alternative income they could gain by not abiding to the conservation practices dictated by the contract. The design of a PES contract is thus a very delicate affaire, which requires not only legally binding agreements, but also appropriate incentives of personal and social nature. In general, these incentives may be more appropriately identified by considering the PES as a form of agreement that depends on the specification of a social standard. This means that a PES is a stipulation that a private party has the right to exploit and manage a given enterprise, for all states of the world, provided that she performs a certain number of tasks in line with the common good in exchange of a payment which is a social standard. This standard may be a minimum threshold (such as a poverty line under which commoners would use the resource disregarding conservation) or a maximum limit (such as a pollution quota). Accordingly, the contract may provide that an appropriate compensation be extracted from the benefits accruing to one claimant or set of claimants to improve the condition of another set. Thus, the PES as a social standard can be seen as a way of specifying a socially desirable distribution of benefits and costs for a variety of stakeholders.

Social standards are rapidly changing for commons all over the world (Scandizzo and Knudsen, 1980, 1996). Tropical forests, for example, were considered for long time as “empty lands” to be penetrated and colonised (Nelson, 1973). As a consequence, standards of exploitation were broad, lax, and uncontrolled. They focused on timber cutting and access for slash and burning agriculture. Competing claims were typically regulated by state ownership, customary rights and

brute force. Temperate forests, even though less prone to reckless exploitation, were also subject to threats by conflicting users, mismanagement and lack of short-term incentives to investment and maintenance.

More recently, however, the situation appears to have taken a turn for the better, with social standards being extended to sustainability, efficiency and environmental services. This change is also at the base of the interest for a new deal with the private sector aimed at internalising the drive for social efficiency within a set of incentive-compatible contracts, of which PES are the most notable and popular form. In addition to a renewed interest for the concessions as a way to involve private interests without giving up the ultimate control of the public good aspects of forests, PES are acquiring increasing importance as an instrument of privatization through participatory management. As for other government assets and enterprises, the transfer of property rights to the private sector involves the moulding of an institutional environment, where liberalisation and governance rules are crucial concurring policies

PES Typologies and Environmental Valuations

As a system of payments whose effectiveness depend on costs and benefits of the parties involved, PES design and implementation are crucially linked to the issue of properly valuing the environmental services to be provided. In this respect, contractual typologies become relevant. Wallow et al (2009) distinguish between contractual arrangements (CRES), compensations (CES) and rewards (RES) for ecological services . They define these three categories as follows: " CRES are contractual arrangements and negotiated agreements among ecosystem stewards, environmental service beneficiaries, or intermediaries, for the purpose of enhancing, maintaining, reallocating or offsetting damage to environmental services." A particular CRES contract or negotiated agreement will include a compensation or reward instrument or combination of instruments:
"Compensation for Environmental Services" (CES) are payments or other forms of restitution made to environmental service beneficiaries or ecosystem stewards to offset foregone entitlements to environmental services or ecosystem stewardship benefits.

- CES1—Compensation to environmental service beneficiaries for socially disappointing damage to ecosystem services by ecosystem stewards. This includes self-organized deals between stewards and beneficiaries, restitution payments ordered by intermediary organizations, and compensation payments made by intermediary organizations.
- CES2—Self-organized contracts, negotiated agreements or tradable allowance and permit systems that facilitate exchange of environmental service entitlements among environmental service beneficiaries. This includes cap-and-trade systems for emissions and conservation concessions.

“Rewards for Environmental Services” (RES) are inducements provided to ecosystem stewards to give them incentive to enhance or maintain environmental services.

- RES1—Rewards to ecosystem stewards for foregone stewardship rights or reduction of threats. This includes self-organized deals between ecosystem stewards and environmental service beneficiaries, public programs of reward made on behalf of beneficiaries and eco-labeling and certification schemes for products generated through good stewardship practices.
- RES2— Rewards to ecosystem stewards for undertaking extra investments or management practices that restore or enhance the ecosystem. This includes self-organized deals and public programs of reward.

Dixon and Pagiola (2001) distinguish between biological **resources** and biological **diversity**, where the former refers to a gene, species or ecosystem, while the latter refers to the variability of the resources. This first distinction is necessary to achieve a suitable green accountancy which can contribute to the normal accounting system of an economy and, on its basis, enhance a series of interventions and investments for the preservation of the biodiversity. The difficulty of the evaluation can result in an inadequate management of the ecosystem and consequently in a scarcity and tended extinction of ecosystem services (Liu et al 2010), but it can be attenuated by distinguishing several evaluation components and evaluating each of them separately. This is typically done by considering biodiversity Total Economic Value (TEV), which can be decomposed into the use value, including direct, indirect and option value and non-use value, including bequest and existence value. Table 2 shows a synthesis of several methodologies developed to “valuate”, i.e. to assign specific values, to ecosystem services.

Table 2: Valuation Methods

Valuation Method	Short description	Welfare measure
Contingent valuation	Hypothetical questions to obtain WTP	Compensating or equivalent surplus
Travel cost	Estimate demand (WTP) using travel costs to visit site	Consumer surplus
Hedonic pricing	Estimate WTP using price differentials and characteristics of related products	Consumer surplus
Production function	Estimate value as an input in production	Producer and consumer surplus
Net factor income	Assign value as revenue of an associated product(s) net of costs of other inputs	Producer surplus
Replacement cost	Cost of replacing the function with an alternative technology	Value larger thanthe current cost of supply
Opportunity cost	Value of next best alternative use of resources (e.g., agricultural use of water and land)	Consumer surplus, producer surplus, or total revenue for next best alternative
Market prices	Assigns value equal to the total market revenue of goods/services	Total revenue

Source: Brander et al 2005.

4. PES as a program to create opportunities: the real option point of view

Introduction

Unlike conventional instruments of agricultural policies, such as tax relief, subsidies and extension programs, PES aim at empowering the policy stakeholders: farmers, villagers and other operators from the government and the private sector. Rather than focusing on productivity increases for selected agricultural goods, PES systems concentrate their attention on the potential of stakeholders, their individual capabilities and the improvements that can be obtained by upgrading their skills, enhancing their management capabilities and integrating production and conservation activities. By expanding stakeholders' opportunities, PES thus create "real options". This is a relatively new concept in economics which has proven very useful to identify and quantify the opportunities created by successful development programs. In analogy with a financial option, a real option is defined as the faculty, but not the obligation, of undertaking a given action at a pre-determined cost. This definition is simple and operational and does not seem to depend on uncertainty, irreversibility or the other special characteristics that are generally invoked (see, for example, Pindyck, 2000; Damodaran, 2002,). By identifying a separate class of claims , that , at the same time, do not create counterpart obligations, its implications also shed new light on key concepts of law and economics, such as empowerment, vesting of rights and stakeholders. Contrary to the financial option, a real option does not necessarily depend on a formal contractual relation, but on a commitment of resources without the possibility of full recovery. Such a commitment, which in the case of PES is constituted by the fixed payment to the farmers, creates a sunk fund, with no apparent opportunity cost (bygones are bygones). This virtual fund has a counterpart in the voluntary adoption on the part of the farmers of a series of

practices and training activities aim to integrate production and conservation. The virtual fund created by PES has thus a potential value, since it constitutes a capability to explore future opportunities in management and investment. It is this potential that generates new options as added faculties of the participants to the program.

Historically, the concept of option value derives from two sources both from environmental economics: (i) potential future benefits , according to a notion first introduced by Weisbrod in 1964, whereby option value may be conceived as an insurance premium one may be willing to pay to ensure the supply of the environmental good later in time; (ii) the value of the information gained by waiting, analyzed in a series of studies conducted in the '70s (Cicchetti, Fisher and Krutilla, 1972; Arrow and Fisher, 1974) and strictly linked to the twin concepts of irreversibility and uncertainty. This latter value was denoted as of "quasi option" to distinguish it from Weisbrod's concept, which seemed to hinge more on demand characteristics such as willingness to pay and subjective risk premiums. The two concepts, however, are both included in the dynamic definition of option, which was started with Black and Sholes' famous paper (1972) and has gradually gained acceptance among the economists (Dixit and Pyndick, 1994). According to this definition, a real option combines a stochastic process (an evolving phenomenon such as soil degradation or climate change under dynamic, time dependent uncertainty) with an irreversible commitment of resources. As Table 3 shows, an irreversible action (for example an investment) destroys a waiting option, and may create new options (to expand, to grow, etc.). Both types of options can be decomposed into two separate values, concerning, respectively, information (the value of waiting)and opportunities and threats (the value of a contingent asset) . In both the case of the waiting option, and the options created, valuable information may be gained by observing the states of nature as they occur, but in one case, information is obtained from waiting, while in the other from acting. Both types of options present also a component linked to their nature of a contingent asset, that is the value derived from opportunities and threats. In the case of the waiting options, however, this component has the nature of a risk premium (the higher the downside risk, the higher the value of waiting), while the contingent value of the options created by the action lies in the capabilities created by the action, i.e. the potential response to exploit opportunities and avoid danger.

Table 3. Options created and destroyed and their components

	Main Options destroyed by action (e.g. investment)	**Main Options created by action**
Future states of nature	Information from waiting	Information from observing the action

Opportunities/Threats	Risk premium	Response capabilities
Types of Options	**Waiting Options**	**Switch, Expansion, Growth, Abandonment**

Real Options and PES

Formally, a ***real option is defined as the ability (or faculty), but not the obligation, to undertake an action with uncertain future benefits through an immediate commitment of available resources.*** Real options values are related to the concept of capability, a notion introduced by the economist Amartya Sen, which in our context can be defined as a person's opportunity and ability to undertake different actions that in turn depend on personal skills and external factors. It follows that the availability of real options can be expanded through investments in both human and non-human capital. In the case of PES, stakeholders join voluntarily a program that promises to pay them a given amount in exchange for their compliance to a set of practices. These include investments that may not only be undertaken in pursuit of direct benefits in terms of goods and services, but also to build capabilities of various sorts. These include in turn the ability to manage production and conservation activities and to respond to an uncertain future, i.e. to equip the actors involved with capabilities to flexibly respond to unexpected changes in their environment. ***The PES design and implementation, therefore, aims to build a strategy consisting of both more effective choices to act on the nexus between the environment and production but also of provisions to be able to act flexibly in the future***.

A robust capability/real option strategy rests on finding the right balance between the risk/benefit of taking early action with deferring decisions and thereby keeping options open, as well as building the capacity to react to future uncertain circumstances. ***The Real Options Strategy allows for analyzing adaptability and related build up of capabilities rather than being limited to estimating the cost/benefit ratio of PES programs .*** In an uncertain environment, options and capabilities can be displayed in different forms according to circumstances that can be foreshadowed only imperfectly and whose probabilities are unknown or on which there is disagreement among stakeholders. The value of options (adaptation measures) and the likelihood of farmers and other actors exercising them vary across farmers according to their information, risk aversion, endowments and beliefs.

The value of a real option depends on five key factors:

(i) the expected value of the benefits from exercising the option (called in analogy with financial options the "underlying" value),

(ii) the cost of the resources to commit to exercise the option (again in analogy with financial options named the "strike" value),

(iii) the amount of benefits per year sacrificed by holding the option, i.e. by postponing its exercise (the "dividend"),

(iv) the discount rate, measuring the opportunity cost of time (the return foregone by committing the resources required to exercise the option),

(v) the time of expiration, i.e. the time after which the option cannot be exercised any longer, An important parameter that follows from the estimation of the option value and depends on the five factors above is the **hurdle rate**. This defined as the multiple of exercise cost (e.g. the investment level) that the underlying benefit has to reach for the option to be exercised. Before an action is undertaken, the corresponding option to act is said to be "held" and "alive", while once it is undertaken, it is said to be "exercised" or "dead". A real option can be created explicitly through a contract as an agreement between two (or more) parties, or it can arise implicitly from circumstances. Joining a PES program for a farmer can in itself be considered a real option that, if exercised, can create or destroy other options (including the option to wait and join the program later in the same or modified form). A common way of learning about options and capabilities is to identify the capabilities already held by farmers in the form of human and/or non-human capital as well as to estimate the value of options (adaptation measures) already implemented by some farmers.

For PES to be effective in creating options to farmers and their communities, a number of specific investments have to be implemented at both farmer and institutional level. These investments concern enabling activities and include actions such as research, experimentation, information and training, that are non-farm specific, but are needed to address some of the main constraints limiting adaptation and increasing capability. Investments should also include the direct implementation of projects with the objective to experiment and demonstrate alternative options for conserving the environment and adapting to climate change. Most of these projects can be expected to have positive net benefits, but their major effects would be to create the critical capabilities that would enable farmers to improve management of natural resources, conserve the environment and adapt to climate change for a broad range of its possible outcomes.

In the context of PES, four general types of options can be created: (i) coping options that address the damage caused by transitory adverse events; (ii) rebound options that concern actions to recover and gain strength from negative developments/events; (iii) opportunity options that are related to taking advantage of opportunities from market developments, environment modification and climate change; and (iv) adaptation options designed for permanent changes in the environment as a consequence of past practices and in response to climate change. These options are identified with reference to farmers' response to the different impacts, which range from an unexpected anomaly in temperature and rainfall such as drought

or flood (coping options), to discontinuous recovery from extreme events (rebound options), to exploiting new opportunities from shifting weather patterns and atmospheric CO2 concentration (opportunity options), to long term responses to changed economic fundamentals caused by past environmental practices (or lack thereof) and climate change (long term adaptation options such as population movements, shifts of economic activities, abandonment of agriculture and forestry). These options form a continuum of capabilities-opportunities, are context specific and have to be interpreted flexibly (what is one person's coping could be another person's rebound).

An important element of the real option theory is to distinguish between expansion-contraction options, growth options, flexibility options and abandonment-suspension options. They may be present to various degrees in the options created by PES programs. Further it is inherent in the real options theory to classify options in terms of the underlying capability of stakeholders to implement them. An option is only available to a farmer or community if the means to implement it are at hand.

Related to all these options is the central concept of the Option to Wait. Because of their nature of contingent claims (i.e. faculties that can be exercised sooner, later or never based on the decision maker's analysis of circumstances), all options embed the faculty to wait in the sense that they can be held rather than being exercised immediately. The option to wait means that before committing resources to respond to a change, whose size, duration and properties are uncertain, farmers or institutions can wait to acquire more information on the persistence of the observed changes in order to establish if it is economically justified to invest in actions designed to respond to the change. By waiting, it is possible to learn more about the characteristics of the change and design a better response, which should aim at creating new options to face an uncertain future. When resources are irreversibly committed through an investment under uncertainty, the waiting option is destroyed but new options may be created, which may themselves be held or exercised. The option to wait is closely related to expiration time, i.e. to the time that the farmer can afford to wait before losing the opportunity to exercise the option. When a given investment is considered for adoption, ***"the option to wait" is taken into account by comparing net expected benefits with investment costs multiplied by a "hurdle rate***. As defined above, this is ***a multiple of the investment cost whose size depends on uncertainty***. The greater the uncertainty about future value added from the investment, the greater the hurdle rate necessary to convince the farmer to undertake the investment.

It is clear that the waiting option is more valuable, the wealthier a farmer is and the more diversified his/her income is. A wealthier farmer can afford to wait and see until the cost and benefit of an option is better understood and the hurdle rate has gone down. A poor farmer is much more exposed to risk than a well-endowed farmer, as a failure for the poor farmer may result in famine while the better off farmer can afford taking a risk. Thus, the expiration time of

her option to wait will generally be much shorter than for a richer farmer and in general her option to wait will have lower value because she will give a higher weight to the present as compared to the future (i.e. a poor farmer will generally have a higher discount rate than a richer one). This implies, for example that the coping option, which is very closely related to survival, may offer very little waiting time to a poor farmer while it could be substantial for well endowed farmers. These farmers also hold considerably higher waiting power with regard to rebound and exploitation options, which should be made available to less well off farmers by government providing them with adequate resources.

A good strategy on the part of government might therefore be to help poor farmers overcome the risk element through accepting the risk and compensating them for failure, but demand that they themselves meet the cost (or part of the cost) of the investment, should the proposed measure or practice be successful. An example of such a strategy is offering a PES program where some of the payment works as a form of insurance, with farmers being compensated for damages if the recommended practice or investment is not successful, but are required to pay a premium, which may be subsidized for poor farmers, if success is achieved. At the same time it is clear that, in order for many poor farmers to avail themselves of options that have proven to be economically justified, many would need access to credit to be able to avail themselves of such options and that the ability to access credit in a flexible way is itself a key option. It thus follows that a strategy of low resource commitment[3], learning and acting flexibly is suggested by the real option approach and that a PES system may have a a central role in creating options at farm and community level.

Projects and investments designed and appraised with the methodology based on the Real Options Theory have proven to result in much larger benefits than traditional cost/benefit estimates when they are associated with building capabilities[4]. The traditional project design and the related appraisal through cost/benefit analysis, in fact, are only aimed to increase and evaluate the expected NPV of the investment undertaken. The Real Options methodology adds the value of the options created and deducts the value of the options destroyed. In relation to investment choices, project design and appraisal, the Real Options methodology can thus be seen as embodying capability building in terms of human and non-human capital.

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[3] Under high uncertainty, a strategy that is especially relevant for poor farmers is to maintain resource commitment (i.e. irreversible investment) as low as possible, so as not to risk wasting critical resources by over-reacting to threats under insufficient information , and expand such commitment gradually as more knowledge becomes available.

[4] Examples of real option applications to capability assessment and real options, see: Winter Nelson et al. 1998, Ford, D. N., Lander, D. M. and Voyer, J. J. (2002) Dobes(2009), Scandizzo (2010, 2011) .

With respect to environmental damage and climate change, and in particular in responding to its uncertain long-term consequences in terms of timing, intensity and location of its impacts, the capability/real options strategy should be a crucial component of any adaptation strategy, since it allows for investing in adaptability rather than in mere adaptation.

The case of water resource projects : evaluation and the water supply conundrum

Virtually all regions of the world are witnessing a shift in perception and policy directions on the construction of new infrastructure to increase the availability of water and enhance its quality for all users. This shift is due to a combination of events, among which three phenomena stand out for saliency and economic significance. First, demographic and economic growth has increased more than proportionally the demand for water in all its uses. This has occurred in part because of the increasing requirements for high quality water for direct consumption, but also because water saving technological change for agricultural and industrial uses has been has not compensated for the growth of production in these sectors. Second, water has been generally priced much below its opportunity cost, especially if social costs associated to such phenomena as depletion and pollution are taken into account. As a consequence, serious problems have developed of deterioration and reduction of water as a stock of natural resources, and of its renewable capacity. Its increasing scarcity has been dramatized by shortages and temporary suspensions of supply, so that perception by the public has increased as to the fact that providing water to a set of stakeholders in many circumstances may not be considered a net benefit, but is a zero sum game, where communities and also private parties may undergo significant damages through negative environmental externalities. Third, climate change has injected a further negative element into the picture, by threatening the environment with more frequent droughts, higher volatility of rainfall, and extreme events such as water shortages and floods. These phenomena appear still to be evolving, but they clearly contribute to render more precarious , less reliable and socially more costly both the present mode of exploitation and the traditional form of investment in water resources.

Climate change (CC) raises also the question as to the capability to adapt of individuals and communities by saving water, and by developing more economic models to exploit water resources in ways different than in the past. As far as we can tell from the studies developed so far, CC appears to have the peculiar property of both reducing the traditional forms of water supply, and of reducing the holding capacity of land and of both natural and artificial reservoirs[5]

[5] It does so by reducing rainfall, concentrating it in a smaller number of days during the year and increasing the frequency of droughts and floods,

. Thus, CC not only may reduce economic growth, but it threatens to reduce also collective wealth, by lowering the amount of water resources available, the capacity of land and infrastructure to hold them and the adaptability of individuals and communities in the face of these negative external effects, that can largely escape the reach of markets and effective policies.

While market failure has been a prominent feature of water management in the past , its effects have accumulated over the years and are being aggravated by CC evolution. All over the world, disputes and litigations are increasing among different users, but also potential conflicts , a threat not matched by an increase capability to govern water resources, are growing. The reasons for this dynamic failure are several, but two of them appear particularly important. First, the need for reallocating water to reflect changing economic conditions which is not met by a correspondent expansion and diversification of water markets. Second, among natural resources, water generates a range of reciprocal externalities that are very difficult to capture and internalize into market mechanisms. Furthermore, these externalities are a function of rights and faculties, i.e. they depend on the distribution of capabilities of different users, whose claims over resources is directed or mediated by various forms of water supply.

For example, surface/groundwater connections tend to produce two distinct externalities: (i) surface water can recharge aquifers via canal seepage and/or in-field percolation. Groundwater pumpers thus develop un-priced claims on the water that passively seeps from canals through an unsaturated area hydraulically disconnected from the canals themselves . As a consequence, groundwater users' capability increases and they become the recipient of a one way externality; (ii) surface water can be hydraulically connected to groundwater, in which case a reciprocal externality materializes, since the pumping of groundwater increases canal seepage and ,given the water temperature differential between canal and groundwater, ultimately increases water supply capabilities both for pumpers and canal users. Note that whether these reciprocal externalities become positive or negative may depend on the capability of the recipient rather than of her counterpart user. For example, a given rate of seepage may be a positive externality if the capability of the groundwater user includes a lower water table and sufficient drainage, but becomes negative if the raise of the water table is such that soils are saturated and crops damaged . CC may , however, dramatize these differences and reverse the causal direction: for example, if canal water shortages is exacerbated by higher pumping, this may result in the lowering of water table, an unsustainable way of increasing water supply at the expenses of the overall capabilities of all users.

The reciprocal relationship existing between surface and ground water users is perhaps the main source of market failure, as well as of the failure to recognize, in traditional agricultural policies, the externalities implied by the fact that the capability of water supply is both the source and the

consequence of the distribution of rights (and faculties) over water. The perspective of real options in this respect appears particularly illuminating. The two groups of stakeholders : surface water users (SWUs) and ground water users (GWUs) hold different options on water as a natural resource. SWUs hold the faculty to capture the water through canals and convey these water in the aquifer by seepage or drainage, thereby determining a level of usage that in turn determines GWUs' level of the aquifer, as well as water supply . GWUs, on their part, hold the faculty to use the water supply by pumping more or less intensively the water available as a consequence of the degree to which the SWUs exercise their options. Without markets to regulate users' prices, the exercise of the two interdependent options is a function of the vagaries of the distribution of rights. When SWUs sell water rights to a distant city, for examples, GWUs are bypassed and the implicit value of their option is reduced without compensation. Conversely, when GWUs exercise their option and pump water beyond the sustainable rate, depletion of the aquifer may follow depreciating GWUs' capability.

When these conflicts are recognized in traditional policies through cost benefit analysis and shadow pricing, PES can make a more effective attempt to take them into account. For example, according to the traditional approach, an increase in domestic water supply in an urban center is appraised by considering as benefits the value of the incremental consumption of water priced with final users' willingness to pay and, as costs, in addition to investment outlays, the opportunity costs , i.e. the value of the output foregone by agricultural users. The real option methodology , however, suggests that traditional shadow pricing is not sufficient, since external effects do not concern only present but also potential water usage under alternative, future states of nature. Thus, benefits should also include the options created through the increased capability of urban water supply to satisfy local users under alternative scenarios, emergencies and (uncertain) outcomes of different source. At the same time, costs should include the options destroyed through the reduction of irrigation capabilities of both SWUs and GWUs by depletion of the aquifer, lowering of the water table, salinity and other forms of contamination and deterioration of the water quality(Scandizzo, 2008, Scandizzo and Notaro, 2008).

Reciprocal externalities constitute a global problem in evaluating water supply policies and projects (P/P). Not only ground water aquifers and surface water irrigation sustain each other, but also different areas of surface irrigation are closely interdependent. Climate change makes these connections more dramatic since existing hydrological equilibriums are challenged by the collapse of basic links and the creation of new, unexplored pathways within a very complex network of waterways, canals and wells. Because of the increasing unreliability of water supply, conflicts among holders of different claims are to be expected to multiply and increase in intensity as well. P/P appraisal cannot afford to ignore hydrologic externalities not only as they are deployed by different users and producers, but also as they develop as a consequence of the

redistribution of capabilities determined by the joint effect of market failures and climate changes.

PES that foster watershed planning and water resource management are an important example of real options related to environmental challenges. While a good workable knowledge exists of the physical processes that drive the hydrologic change, non stationarity implies that the past hydrological records is a poor guide to construct models that accurately forecast the future conditions of the watershed (Hashimoto et al., 1982) and that a much wider range of information is needed in addition to water fall data, such as data on stream flow , soil moisture, groundwater, snow pack, and glacier measurement . Especially hard is the challenge to translate climate changes into watershed changes and these into changes in hydrologic response for some of the processes with long lag times, such as deforestation-reforestation or groundwater depletion.

In this context of increasing uncertainty, dominated by climate change and the perspective of major shifts in hydrological patterns (Carter, 1996), PES may be a key ingredient to create capabilities for water management and water supply strategies that adjust over time and balance risks. For example, hazardous watershed conditions are characterized by different threats such as wildfire hazard, flooding or debris flow hazard, soil erodibility, and water uses . These threats can be countered by PES designed to build up knowledge, experience and skills that create specific options to prevent, to defend, to conserve and to modify the natural environment of the watershed.

5. The elements of a PES design: Identifying capabilities and options

Involving stakeholders

Capabilities and options are abstract concepts and can be difficult to understand and apply in specific cases. They can be used as the main components of relevant scenarios only if their definition comes from the stakeholders involved. The reasons for constructing scenarios by interacting with the stakeholders are several. First, defining who the stakeholders are, and what is their degree of participation and empowerment, is already a way to find an effective first boundary for the PES design. Second, because contingent wealth relates to property or access rights of specific agents, or sets of agents, scenarios that are predicated on capabilities and options can only be defined in terms of these agents. Third, stakeholders are defined as agents who may hold claims against the PES in question. Once identified, they may have the most interesting and useful knowledge to the design the PES itself, as well as on the surrounding

environmental, historical and political conditions. Finally, the interaction of the analyst with the stakeholders and among the stakeholders, with the analyst acting as a facilitator, may generate new valuable information and awareness on the PES potential and on the options open to the stakeholders themselves.

Identifying the stakeholders is an important step. In general, stakeholders will include various government ministries and bureaus, as well as possible beneficiaries, both positive and negative, of the PES program in question. On one hand, the number of stakeholders should be as small as possible, as the boundary of the analysis should be defined by the immediacy and the relevance of the claims actually or potentially held against the PES examined. On the other hand, this should not deter the analyst from choosing a panel of agents, who may have something to say because they represent in a more general way the interests involved. In this respect, the choice of stakeholders should incorporate the Delphi technique, which is based on the idea that experts and representatives of the civil society should be consulted to define future scenarios. Representatives of important economic, environmental, and cultural sectors should thus be consulted and their opinion and views checked through an interactive and iterative process , until a consensus is reached on a scenario or a range of scenarios.

Eliciting scenarios and narratives

A critical element to involve the stakeholders in an active definition of the scenarios is their interpretation of reality through narratives elicited in several rounds of conversations. If we think of a PE.S system necessarily including climate change prospects, in particular, these narratives can be used, in the course of a PES project design, to explore the main options to adapt, as well as the corresponding capabilities, through opinions and viewpoints of the people involved. These are important both to elucidate the critical areas where the greater risks and opportunities are believed to be located and to identify the most important capability gaps for environmental management and adaptation. In particular, once the main stakeholders had been identified, formal and informal interaction (Knudsen and Scandizzo, 2005) can be used to elicit objective information and opinions. The interaction concerns the context as well as the main features of the trade off between production and environmental management, as well as the adaptation process to climate change, as perceived and rationalised by stakeholders, on the basis of narratives[3] and stylised facts obtained both from participative interviews and systematic survey techniques.

Narratives should be collected to illustrate the main points of view of the stakeholders, but also as a way to organise their thoughts amid the controversies on natural resources and

development among different experts, policy makers and political parties (Scandizzo, 2009 a, b) . As a consequence, they can be expected to be scattered throughout a wide range of perceived data, interpretations and opinions and to be largely complementary, dwelling on different aspects of the problems investigated and thus not incompatible with one another. They will also be taken to illustrate how the same pathologies of under-development and environmental degradation are interpreted differently, both from the point of view of the diagnosis and the therapy, under alternative cause-effect models, historical representations and ideological assumptions.

Table 4 shows some of the narratives collected , that could be the base to design a PES system for Azerbaijan, and for an experimental area in particular. The narratives are organised according to four components (i) a story as a succession of events over time, (ii) a series of perceived threats that are already implicitly contained in the display of the story, but can be singled out in more detail as a specific set of scenarios to be feared for the future, (iii) a series of opportunities that are perceived as possibilities to overturn the negative tendencies of the past (as expressed in the generally dismal recounting of the past) or as possible 'lucky breaks' that can materialise if things turn out well than predicted, (iv) a set of options, defined as faculties that may be acquired as a consequence of specific actions, in response to the threats and the opportunities presented.

The narratives presented are conceived to be the base to design a PES system empowering the stakeholders to implement a series of activities that are both environmentally friendly and economically efficient. They are thus action oriented, as they correspond to the points of view of stakeholders who are active in agriculture and rural development, and they generally agree in presenting a stark picture of deteriorating resource base and impoverishment of the rural population. The narratives, however, are remarkably different in their recounting of the salient features of the recent evolution of agriculture. These differences tend to reflect political ideologies, but also alternative interpretations suggested by professional beliefs, social commitments and a variety of individual experiences. As for climate change (CC), it is interesting to see how its notion tends to be interwoven as an aggravating factor in all accounts of resource degradation and increasing poverty. Also remarkable, amidst all the dissonances of the different narratives, is the consensus on CC main characteristics, which virtually in all interviews were identified as increases in: (i) average temperatures, (ii) variability and/or irregularity of rainfall, and (iii) frequency of droughts and floods.

Table 4. PES Possible Objectives: narratives on threats, opportunities and options

Narrative main plots	Threats	Opportunities	Options that could be created by PES
The curse of modern agriculture: • Loss of agro-biodiversity; • Inflexible agricultural practices; • Inappropriate water management techniques • Overgrazing • Deforestation • Soil erosion and desertification	• Irreversible loss of land races and traditional techniques; • Mismatch between cultivation techniques and changes of soil structure and water regimes; • Mismatch between cultivation techniques and changes of season caused by CC; • Higher irregularity of rainfall	• Seed banks; • Re-generation of traditional varieties; • Re-introduction of traditional varieties; • Alternative agriculture (organic, biologic, regenerative); • Farm level experimentation	• Redirect selection based on traditional varieties; • Boost research on appropriate biotechnologies; • Rehabilitate farmers towards more flexible agricultural practices; • Introduce appropriate water management techniques/improve the existing ones
The effects of the oil economy: • Agricultural migration linked to the raise of the urban economy and the Dutch syndrome; • Loss of traditional agricultural skills; • Loss of agro-biodiversity and increase in food imports; • Diffusion of purchased and GM seeds; • Increased use of purchased inputs and water	• Population growth and land tenure problems; • Education systems neglecting agricultural knowledge and rural traditions; • Diffusion of television causing alienation from the traditional values of the rural communities; • Younger generations moving out of agriculture • Rising temperatures and dwindling water supplies; Loss of resilience and knowledge of local communities	• Return to traditional agriculture (land improvement and natural water harvesting practices); • Fine tuning of cultural operations and wise usage of a diverse mixture of local varieties; • Modernization (i.e. higher land intensity of the cropping patterns)	• Higher levels of training; Educational system focused on agricultural applied knowledge; Cooperation among the farmers to purchase machinery and to manage the commons; • Creating local value chains by building up small agro-industries and supporting tourism • Encouraging entrepreneurs (with special emphasis on youth and women) • Urban agriculture

Urban bias and loss of human capital: • Feminization of farming and loss of critical skills caused by agricultural migration; • Degradation of soil and territory maintenance; • Low prices for agricultural products due to insufficient marketing (transport and distribution) infrastructure	• Soil degradation ; Soil Erosion; Desertification; Destructive floods and landslides; • Lowering of the water table; progressive salinity of water; • CC as an aggravating factor, especially for drought prone areas	• Liberalization of marketing activities; • Modernization of cropping patterns; • Rehabilitation of mountain slopes; • Young rural people training and education on sustainable agricultural practices; • Infrastructure maintenance techniques and CC risks	• Improvement of the governance structure; • Training and human capital formation; • Ensuring remunerative prices for farmers
Property rights and market power: • Agricultural growth stifled by land tenure problems, t lack of investment in post harvesting activities, over-expansion of livestock	• Insecurity of land tenure for peasant farmers; • Population growth; • Loss of income to absentee renters ; • CC aggravating the conditions of poor and landless peasant farmers	• Investment in post-harvesting activities	• Cooperation for water management; • Post-harvesting activities; • Diversification of cropping pattern; • Improvement of land tenure security
The livestock economy: • Domination of livestock (especially sheep) production as a profitable cash crop • Domination of livestock as an investment and a liquid asset in agriculture	• Exceeding land carrying capacity • Overgrazing • Loss of opportunities of modernization through the expansion of fruits and vegetables	• Use livestock as a vehicle for modernization; • Encourage intensive animal husbandry (reduce the number of animals and increase unit profit); • Discourage migrant patterns of production; • Create local value chains by investing	• Processing and other post harvesting activities; • Marketing; • Rehabilitation of mountain slopes;

		in processing and marketing;	
The evolution of agriculture : • Diffusion of part-time farming; • Men's migration; • Older people and women increasingly dominating agriculture; • New generations aiming to find employment outside agriculture; • CC accelerating this movement	• Increasing erosion of the land and the water base; • Deepening poverty; • Environmental damage and CC making agriculture unreliable as a source of livelihood; • CC determining the progressive degradation of agriculture	• Use migration and outside employment as an opportunity to modernize agriculture and develop rural industry	• Training for non-agricultural jobs; • Marketing and post harvesting activities; • Cooperation among farmers to exploit scale economies in mechanization and marketing
Women in agriculture: responsibilities without power: • Crucial role of women in the rural communities; • Rural women have little power in socio-economic decision-making processes; • Rural women lack of adequate education, skills and tools to efficiently manage and perform agricultural activities	• No advances in the rural women socio-economic conditions; • Failure of the empowerment process; • Increasing health risks; • CC aggravates rural women's plight; • CC causes further impoverishment of rural women conditions given their lack of knowledge of traditional cultivation techniques	• Improve rural women capabilities and education level; • Develop rural women capacity to efficiently cope with future CC uncertainty; • Raise rural men awareness about the importance of women's role in agriculture; • Improve future development projects' design and management at the institutional level	• Constant training for a long-term sustainable empowerment of rural women on farming practices, water management techniques, health and environmental risks; • Involvement of rural men aimed at their full understanding of women potential capabilities and contributions to rural community; • Rethinking of the design and management of development projects at the institutional level

BOX:

Key criteria that are needed to enhance PES effectiveness include (OECD, 2010[2]):

1. Removing perverse incentives: For a PES programme to produce effective incentives, conflicting market distortions, such as environmentally harmful subsidies, should be removed.
2. Clearly defining property rights: The individual or community whose land use decisions affect the provision of ecosystem services must have clearly defined and enforceable property rights over the land.
3. Clearly defining PES goals and objectives: These help to guide the design of the programme and enhance transparency.
4. Developing a robust monitoring and reporting framework of biodiversity and ecosystem services.
5. Identifying buyers and ensure sufficient and long-term sources of financing. The article '**How to attract PES investment from private business?**' examines how much private companies are prepared to invest in PES schemes for tropical forests and what can be done to motivate them.
6. Identifying sellers and target ecosystem service benefits: Accounting for spatial variation in ecosystem service benefits via economic valuation, benefit scoring, and mapping tools allows payments to be prioritized to areas that provide the highest benefits. If the PES budget is limited, this can substantially increase the cost-effectiveness of the program.
7. Establishing baselines and target payments to ecosystem services that are at risk of loss, or to enhance their provision: A PES program should only make payments for ecosystem services that are additional to the business-as-usual baseline.
8. Differentiating payments based on the opportunity costs of ecosystem service provision: PES programs that reflect the cost of an alternative action that must be avoided (e.g. deforestation) to as to enhance ecosystem service provision are able to achieve larger ecosystem service benefits per unit cost.
9. Consider bundling or layering multiple ecosystem services: Joint provision of multiple services can provide opportunities to increase the benefits of the program, while reducing transaction costs. This is clearly demonstrated by the article '**Bundled' PES schemes to boost cost-effectiveness**'.
10. Addressing leakages: Leakage occurs when measures to enhance ecosystem services provision in one location leads to increased pressures for conversion in another. If leakage risk is expected to be high, the scope of the monitoring and accounting framework may need to be expanded so as to detect, and consequently address, leakage.
11. Ensuring permanence: Events such as forest fires may undermine the ability of a landholder to provide an ecosystem service as stipulated in a PES agreement. If the risks are high, this will impede the effective functioning of a PES market.

12. Delivering performance-based payments and ensure adequate enforcement: Payments should be ex-post, conditional on performance. When this is not feasible, effort-based payments (such as changes in management practices) are a second best alternative, provided that changes in ecosystem management practices will bring about the desired change in service provision.

The importance of stakeholder inputs for the design and implementation of PES are demonstrated in '**Future agri-environmental schemes need co-ordinating across landscapes**' as well as the need to develop tools and policies for improving PES design. The article '**An alternative conceptual framework for 'Payments for Environmental Services on offer**' describes a framework, incorporating the social aspects of PES, which can be used by practitioners, such as governments, to design and implement a variety of PES schemes. At a global level, PES is prominent in the discussions under the Convention on Biological Diversity on resource mobilisation for biodiversity[3]. One such mechanism is the potential role of REDD+[4] in providing biodiversity co-benefits.

Recognized as an important implementation tool, the role of PES schemes has been promoted in the EU Biodiversity Strategy to 2020[5], and their potential is further highlighted in the Roadmap for a Resource Efficient Europe (COM(2011)57)[6]. Regarding Parties' commitment under the Convention for Biological Diversity to substantially increase financial resources from all sources, the Strategy recognises the need for increases in public funding, but also the potential of innovative financial mechanisms, including PES. There are ongoing reforms within the EU where PES can play an important role, in particular, agri-environmental schemes in the CAP (Common Agricultural Policy) reform and similar support payments in the proposed European Maritime and Fisheries Fund. The establishment of Green Infrastructure is another areas where PES could potentially play a role.

http://environment-ecology.com/biodiversity/625-enhancing-the-effectiveness-of-payments-for-ecosystem-services-pes.html

6. A PES System for Azerbaijan

The Effectiveness of the Present Agricultural Policy

In Azerbaijan, agriculture accounts for about 5% of GDP and 37% of employment. The present regime of government intervention is based on tax exemption, credit and input subsidies and direct subsidies to farmers for production of wheat and paddy. Indirect (and perhaps unintended

subsidies) are also present. For example, pasture land is rented out by municipalities on very favorable terms to migrant herders, compared with opportunity costs in terms of forage at market prices. From the point of view of a sustainable pattern of production, the combination of population pressure, general subsidization and unregulated land and input use appears to have resulted in severe damage to the environment. These include a high and progressive level of soil erosion, salinization of water for irrigation, extensive deforestation. These phenomena are correlated as they all depend on various forms of market failure. In the case of Azerbaijan this appears to be due to the underdevelopment of the market system, still lacking an adequate value chain connecting producers to consumers. It also depends on the inability of traditional markets to price natural resource inputs such as water, pastures and forests. As a consequence, the price system in agriculture does not reflect either the national priorities for production and food security, nor the opportunity cost of natural resources. Producer prices tend to favor natural resource intensive and environmentally detrimental activities such as extensive animal husbandry and wasteful irrigation, while they provide little incentive for diversification and resource conservation.

Animal husbandry activities, consisting mainly in the raising of sheep through grazing may be already past the land carrying capacity in the case of many mountain pastures, which are grazed so intensively that they appear to be past their maximum sustainable yield. In practice, this means that the carrying capacity of the land is being exceeded and that the only way to revert to a sustainable situation would be to reduce the number of animals. On the other hand, this simple prescription is difficult to implement because livestock still represents by far the main means of investment in agriculture, and the only asset that can be easily turned into cash for a farmer. Without a parallel development of an adequate market infrastructure and a network of local industries, therefore, the economic advantage of livestock production will remain too high to be challenged in the name of a sustainable production system. While the rationale behind these agricultural policies is not always clear, the most recent evolution of economic theory has pointed out that taxes and subsidies have to take into account their costs and benefits both through direct and indirect effects on the economy. These effects impact not only production, incomes and consumption, but also, more importantly, human capital and capabilities involved in agriculture.

Capability and PES design

Capability, or the quality of being capable, (Sen, 1984,1990, 2002, 2005) is an essential component of any policy measure, yet it is typically neglected in policy evaluation both in scope and extent. All policies can be considered the attempt to steer the commitment of scarce resources towards a specific direction in the hope of future benefits. These benefits, however,

include both expected benefit flows, and power over future resources. For example, subsidizing wheat production may be expected to bring benefits to producers not only through lower costs and higher revenues, but also in terms of an expanded range of choices and enhanced business opportunities. This second, empowerment component, can be considered a form of contingent wealth, since its value will depend not only on the expected benefits from an average scenario, but also on the wider range of alternatives to which the policy may give access . Thus, for example, subsidizing production by increasing access and use of local varieties may recover traditional methods of cultivation, increase the possibilities for diversification and improve the resilience of the farming systems , ultimately enhancing farmers' capabilities. Similarly, subsidizing agricultural inputs such as fertilizers, agricultural machinery and credit, as in the case of Azerbaijan, can be justified as an attempt to cultivate farmers' capabilities in the choice and the use of the modern technologies, ultimately achieving increases in efficiencies and well being that go beyond the mere increases in income from enhanced production efficiency.

The policies to promote environmentally friendly and sustainable agriculture can themselves be considered an attempt to build a specific set of capabilities, more than a set of direct targets in terms of reduction of environmental damages. Compared with the traditional objectives of taxes and subsidies policies in agriculture, however, their nature is at the same time more pervasive and more indirect. Environmentally friendly agricultural practices (EFAP), in fact, cut across production sectors and input use, as they may require different techniques of production, as well as the reduction of some products and the expansion of others. As a consequence, implementing EFAPs requires a reconstruction of agricultural capabilities and this in turn implies a re-thinking of the whole set of agricultural policies and, in particular, of the system of taxes and subsidies.

The link between policies, choices and capabilities can be illustrated with reference to the so called logic framework models. These models, which have been used for several years in project selection (Maclaughlin and Jordan, 1999), investigate investment impact through narrative or graphic descriptions of the processes that projects originate . The models analyze these processes as sequences of cause and effect relations and identify both the underlying assumptions and the actions that are planned to achieve the results desired. A typical approach (McCawley, 2010) of a logic model distinguishes inputs, outputs and outcomes , defined respectively as resources needed (inputs), and results expected in terms of both instrumental products (outputs), and benefits and costs (outcomes). In the case of EFAPs, application of the logical model would thus account for the results of the measures in terms of expected increases in incomes, consumption and other measurable outputs, separating these effects from the increases in capabilities. These may involve conservation techniques both for traditional and new activities, and adaptability, i.e. the capacity to face environmental difficulties, natural disaster and climate change with greater resilience and lower vulnerability.

Application of a logic framework suggests that the fact that policy benefits and costs that have traditionally been evaluated as expected incomes and consumption, rather than as increases in capability , can be largely ascribed to a confusion between policy output and policy outcomes. Whereas output can be conveniently measured by the increases in flows of goods and services that the policy allows or helps to achieve, outcomes involve more fundamental variables that can only specified via a theory of change. These variables may include stakeholders' power over resources, their standing in terms of wealth and prestige, and their confidence, flexibility and resilience in facing an uncertain future. An increase in capability may thus consist of several outcomes that may be associated with an increase in expected economic flows , since it corresponds to a more radical change in the way of being of stakeholders as economic and social subjects. As Table 5 shows, using the logic model differentiation, we can re-interpret policy outcome components as formed of two broad categories: (i) the changes in stakeholders' capabilities (i.e. their ability to generate valuable outcomes by seizing opportunities and avoiding risks), and (ii) the changes in the options available to them as a consequence of the policy . The table demonstrates that a consistent correspondence may be created between classes of inputs, outputs, capabilities and options, which, in a world of uncertainty, all contribute to the success (or failure) of the policy.

Table 5 : The logic model as a framework for capability changes in agriculture

Policy Inputs	**Policy Outputs (1)**	**Policy Outputs (2)**	**Policy Outcomes (1)**	**Policy Outcomes (2)**
Inputs needed to implement the policy	**Direct consequences of policy implementation in terms of intermediate and final products**	**Direct consequences on stakeholders**	**Changes (w.r.t. the situation without the policy) in stakeholders' capability, defined as the ability to generate valuable outcomes**	**Options created and destroyed (w.r.t. the situation without the policy) in stakeholders opportunities to generate valuable outcomes**
Human resources, (staff, volunteers, partners, and local people);	Teaching and extension products (training delivered, number of people attending	The proportion or number of people in the target group that were reached;	Human capital endowment (broader knowledge base, higher technical and cognitive skills, greater ability to	Options to cope with change by improving decision making and practices;

natural resources(land, water, energy);	and graduation, certified results etc.); decision aids (software, worksheets, models); infrastructure (water canals, terraces, roads etc.);	learner objectives and achievements for program participants; number of sessions or activities attended by participants; level of satisfaction participants expressed for the project	implement environmentally friendly policies and undertake complex decisions); natural resource conditions (in terms of renewal, access, long term availability, air quality, water run off etc.); economic conditions– changes in economic and financial stability; economic adaptability to external change, in potential for economic development, greater power over resources;	options to change external conditions (e.g. mitigate climate change, reduce over exploitation of natural resources) through individual or community actions; options to change use (options to switch, to suspend operations, to abandon etc.) ; options to change of location (option to move, to change resource allocation across space and time, etc.); options to use economic and financial resources through savings, financial and economic (contingent) wealth; options to innovate, discover and

				apply technical change;
fiscal resources (appropriated funds, special grants, subsidies, payments for environmental services (PES), donations, and user fees); financial resources (savings, borrowings, other types of financial wealth);	changes in expected incomes, consumption, leisure activities; changes in uncertainty, risk, volatility	changes in wealth, authority, prestige etc. changes in individual commitment to social values for sustainability and conservation of the environment	changed social conditions (e.g. reduced violence, improved cooperation); social capability (e.g. improved institutional and organizational adaptability to external change, more flexible institutions, enhanced civil society);	options to use community contingent wealth (solidarity funds, microcredit etc.) to react to adverse change or to exploit opportunities; options to discover and apply institutional innovations (cooperatives, credit associations, action groups);
other inputs, necessary to implement the policy (facilities, equipment, materials, etc.)	facilities and equipment (tractors, water pumps, storage; vehicles);	policies adopted by businesses, governments, or organizations; technologies employed by end users; management strategies implemented by individuals or groups		options to introduce new practices (e.g. post-harvesting activities, precision irrigation, plasticulture) ;
knowledge base for the policy and related projects (teaching materials, research results, certification or learning standards etc.)	Information and communication activities (meteo news, early warning systems etc.) discovery and application activities (research plots,		political capability (e.g. changes in participation or opportunities, institutional responsiveness to citizens, social animation, communication and deliberative democracy	options to change political organization (active citizenship, petitions, lobbying, consumer and producer groupings, new alliances for the

cooperating agents and institutions - involved in planning, delivery, and evaluation	demonstration plots, and product trials).		characteristics of institutions, associations and civil bodies).	environment, etc.).

The application of the logic framework implies that agricultural policies cannot be evaluated in isolation, but should be combined with ecological and social policies both in design and assessment. This means that the structure of subsidies should be such as to steer the agricultural economy in the direction of sustainable and environmentally friendly agriculture, and , at the same time, that specific resources should be devoted to conservation and other direct environmental objectives. From the point of view of farmers and other agriculture operators, agricultural policy measures should be seen as a system to build up their capabilities to adapt, innovate and re-construct farm management practices in the direction of a more balanced and virtuous relationship between production and conservation goals.

PES in Practice

The majority of OECD countries engages in payments to farmers to induce them, on a voluntary basis, to adopt environmentally friendly farming practices as well as direct conservation measures. These programs, characterized as PES (Payments for Environmental Services) recognize the potential nature of agriculture as a production and conservation activity, which can provide, at the same time, goods and services for the market and the environment. The typical PES offers a single payment in exchange for a voluntary commitment to follow a set of environmentally friendly practices, and, in some cases, of conservation activities. The practices may include reduced tillage, limits on fertilizer and pesticide usage, limits on grazing and usage of natural resources such as water, forest land and wild life (Table 6).

Table 6a. Payments for Farming Practices in OECD Countries (Vojtech, 2010)

		2003	2004	2005	2006	2007	2008
EU	EUR million	5133	5527	6118	6525	5620	6809
Norway	NOK million	683	695	712	874	966	998
Switzerland	CHF million	213	224	231	233	239	245

United States	USD million	4093	4550	4911	4946	4524	4876

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Table 6b. Payments for Farming Practices in OECD Countries (Vojtech, 2010)

Farming Practices	**Payment characteristic**
- Land improvement;	Indirect payment (Investment subsidies) and PES
- Payment for nitrate reduction;	PES
- Nutrient management plan;	PES
- Extensive crop and livestock production;	Disincentives to land intensive animal husbandry amd PES
- Organic farming;	Subsidies and PES
- Integrated production wine, fruits and vegetable;	Subsidies
- Integrated farming;	Subsidies and PES
- Traditional methods of cultivations;	Subsidies and PES
- Reduced tillage/Mechanic weed control;	PES

- Crop rotation;	PES
- Bilological plant protection measure;	PES
- Green manure crops;	Subsidies and PES
- Green set asside;	Subsidies
- Cash crops, green/winter cover;	Subsidies and PES
- Extencsive management of all land;	Subsidies and PES
- Extensive grassland management ;	Subsidies and PES
- Convention of arable land into grassland;	Subsidies and PES
- Grassland/biodiversity/habitat schemes;	PES
- Biodiversity (local breeds);	Special projects and PES
- Protected environmentaly sensitive areas;	Subsidies and PES
- Lanscape elements;	Subsidies and PES
- Maintaing and improving groundcover;	Subsidies and PES
- Water conservation;	Subsidies and PES
- On-farm Enery Conservation.	Subsidies and PES
??Payments for land retirement:	Subsidies and PES
- Long term set-aside;	Subsidies and PES
- Afforestation;	Subsidies, specia; projects and PES
- Conversion of farm land;	Subsidies and PES
- Converting pasture to perennial veg	PES

While PES systems are gaining increasing currency in agriculture, they face two major challenges. First, a single payment does not recognize the heterogeneity of the farmers involved and may thus display low cost effectiveness in policy implementation. Second, the voluntary nature of the system, combined with low monitoring and enforcing capacities, makes it vulnerable to opportunistic behavior and various forms of contract failure. In particular, since farmers and government officials have asymmetric information on the nature, extent and effectiveness of the practices involved, compliance may be reduced by opportunistic behavior on the part of the farmers, through hidden information and/or hidden action.

More generally, PES can be considered a form of private-public partnership (PPP) akin to a concession, where, however, it is the private party that voluntarily relinquishes, for a fee (the

fixed PES) part of its property or user rights, rather than the other way around as in the case of the ordinary concession contract. Unlike typical agricultural subsidies, therefore, PES can be considered a form of joint venture between the private and the public sector, where both parties, by way of a contract voluntarily subscribed by both, agree to pursue some common goals by sharing parts of the costs and the benefits. It is important to recognize, however, that the objectives of the PES explicitly recognized in the contract only partly reflects the real goals of the contracting parties. PES long run scope both for the government and the farmers, in fact should have the broader goal of building up farmers' capacity and skills to provide a range of agro-ecological services, in the form of developing conservation skills and more balanced forms of agricultural and environmental activities. PES should thus be considered an investment in capabilities, whose benefits and costs should be assessed in terms of their expected changes of the agricultural system in the direction of sustainable economic activities and environmental services.

Because of its long run objective, the PES system should be considered a departure from the traditional way of pursuing agricultural development, which tended to be narrowly focused on objectives of production or income increases. In addition to its productive and income effects, in fact, PES impact on agriculture should consists mainly in the creation of new opportunities for farmers and rural communities. These opportunities, which expand the set of production and management choices, can be evaluated as **real options**, a concept increasingly used in cost benefit analysis to assess projects under uncertainty.

7. Designing PES schemes for the target region

The Target Region

The target region for the study includes forest and mountain grasslands of Shamakhi and Ismailli Districts of Azerbaijan. High mountain areas (>2700 m) are characterized by upland cold desert climate, while in lower territories (1500-2700 m) cold winter climate with abundant rainfall is dominant. The hydrological network is characterized by mountain streams with high spring flow. Due to intense water withdrawals, some of these streams may go dry between July-September. The rivers are characterized by flash floods, debris and mudflows, with Girdman, Vandam, Aksu and Pirsaat being the major basins of small streams. Water resources of these streams are widely used in drinking water supply and irrigation. Several water reservoirs are built to collect and reserve water. Sustainability of grasslands and forests is essential to regulate these streams.

The area is characterized by extensive farming which mainly include cattle breeding. Overgrazing and illegal logging are the main issues that concern current land use activities. Recent activities

make the area very vulnerable in terms of land degradation and erosion that in turn reduce quality of ecosystems and ecosystem services provided by grassland and forests. Most of the activities happen over the summer months. Pasturing, honey production, and tourist activities reach their peak during the summer months. This makes stakeholders' problems more severe. For example, honey gathering and pasturing fall in almost the same season.

Ecosystem Services provided by forests and grasslands in the target region

Forests and grasslands provide a broad range of ecosystem services and goods. Forests reduce summer and increase winter temperatures, purify water, regulate streams' flows, and reduce disaster (flood and drought) risks (Douglas, 2001; Costanza et al., 2007). Grasslands provide a broad range of regulating, supporting and cultural services as well. They are an important source of food resources, milk and honey. Mountain grasslands are also providers of clean water to downstream communities. They provide habitat and conservation of wildlife, maintain soil fertility and regulate water. Forests also purify water through soil stabilization and removing contaminants. These types of ecosystem services may significantly reduce water treatment costs. For example, a study by R.S. de Groot et al reports that the preservation of natural watersheds in New York, avoided the construction of a $6 billion water treatment plant, so this implies that the watershed is worth $6 billion (Groot et.al. 2002). Forests filter sediments from water, thereby considerably reducing power generation costs by increasing effectiveness of work of the hydropower dams. It is believed that correct watershed management can avoid expenses related to the water treatment. Sediment filtering also contributes to improving of fish habitats (Costanza at.al 1997).

Forests and grasslands also provide a reliable shelter for many types of living organisms and essential for biodiversity protection. Recreation, soil protection and cultural peculiarities of forests are the most important ecosystem services that forests provide (Costanza et al., 1997; Pearce and Atkinson, 1993). Timber and all types of non-timber products have always been important sources of securing the necessities of life (Abbasov, 2014). Grasslands provide food, clean air, water and many types of non-use values.

Forests cover about one third of the terrestrial world. According to national statistics, in Azerbaijan, they cover more than 11% of the total area, and exist mainly in mountain regions of the country (Abbasov 2014). There is no exact information regarding the areas of grasslands in the country. In the project area forests provide wooden construction materials, fuel, food, mushrooms and animals for local people. Over the long periods, forests were only heating sources for local communities. Many medicines, biocides, honey, spices are derived from forests. Grasslands provide honey, medicinal plants, meat, and milk. Recently, in most of the rural areas

of Azerbaijan fuel wood is a major source of energy. Wood is used to bake bread, prepare meals and heat houses during the winter. According to a recent study (Abbasov 2014), nearly 2 million of people in Azerbaijan consume non-treated clean water, which comes mainly from forested areas. During the Soviet period, most of the villages in Azerbaijan used to use coal from Ukraine, the price of which was relatively cheap. Several studies confirm that average household wood use is nearly 12-15 m^3 (Noack and Hidayatov, 2006).

Cattle breeding is a central activity for all rural regions of Azerbaijan. Livestock and dairy products are the main products of rural regions in Azerbaijan. An official statistics confirm that more than 50 percent of the local incomes contributed by livestock rearing. During the summer periods, grasslands and forested areas are used as the primary grazing areas. Table 7 describes forms of these services provided by forests and grasslands in Azerbaijan.

Forest and grassland vegetation increase soil porosity, as a result of which large amount of water can be deposited in the ground. This in turn notably increases infiltrations and positively change downstream groundwater discharges. This enables to provide water for all long lasting dry periods. Both forests and grasslands may be considered as provisional and regulatory services for water storage enabling. On one hand, for storing water in the ground, these ecosystems buffer floods and droughts, while, on the other hand water storing increase groundwater discharges during dry seasons creating additional economic value.

Table 7: Ecosystem Services provided by forests and grasslands in Ismailli and Shamakhi

	Provisioning Services	Regulatory Services	Cultural Services	Supporting Services
FORESTS	Construction materials	Maintenance of water quality (natural filtration and water treatment)	Recreation and tourism	Role in nutrient cycling (role in maintenance of floodplain fertility), primary production
	Plants and animals for food and medicines	Buffering of floods erosion control through water and land interactions and flood control infrastructure	Existence values	Predator/prey relationships and ecosystem resilience
	Non-timber forest products (mushrooms, plants)	Natural regulation of stream flows; Prevention of droughts	Option values	
GRASSLANDS	Meat	Carbon sequestration	Recreation	Pollination
	Milk	Buffering of extreme events	Existence values	Pest control
	Honey	Flow regulation	Option values	Maintenance of soil fertility
	Medicinal Plants	Erosion regulation		Removal of nitrogen from soils

In addition, regulatory services of forests enable to protect small mountain streams in Azerbaijan from going dry in summer periods. Small mountain streams are the preferred spawning grounds for Caspian Sturgeons that have extremely high value. The Caspian Sea contains over 90% of the world's sturgeon population (Williot et al., 2002). The most valuable representatives of Caspian sturgeons are beluga (Huso-Huso), Iranian sturgeon (A. persicus) and Russian sturgeon (A. gueldenstaedti). These species migrate to rivers small mountain rivers and streams in the areas close to outlets (Abbasov and Smakhtin, 2009). Another valuable fish is the Caspian salmon that migrates to the sources of the mountain streams, located in the mountain regions. The Caspian Salmon is included in the Red Books of Russia, Kazakhstan, and Turkmenistan. In Azerbaijan and Iran, it is now marked as a species with a sharply declining population (CEP, 2002).

Almost in all forested regions of Azerbaijan, forests provide clean and filtered water for the local population, so that there is no need to build water treatment plants. In other words, the mountain forests of Azerbaijan provide a sufficient low-cost water supply for the local populations. Estimatesby Abbasov R. (2014) confirm that more than 2 million of people in Azerbaijan use naturally purified water from forests.

Because mass logging reduces filtering ability of ecosystems and reduces infiltration rates (Abbasov and Mahmudov, 2010), as a result of the intense deforestation in the 1990s, sediment flow in the Kura river increased notably. This resulted in increasing water treatment costs in the downstream regions. Several studies confirm that logging processes are directly associated with increased frequency of erosions ( ).

Forests in Azerbaijan are also the main natural regulators of temperature. They considerably reduce summer temperatures and increase winter temperatures. Reduced difference between summer and winter temperatures makes areas more attractive with respect to agricultural and tourist activities. In addition, this circumstance reduces heating expenses in winter and cooling expenses in summer. For example, the Gobustan district, which is very close to Shamakhi, has no forests and as a consequence, its yearly temperature amplitudes are much higher and so are, cooling and heating expenses.

Forests have also a big function in carbon sequestration. According to Second National Communication to the United Nations Framework Convention on Climate Change (2010) volume of carbon removal by woodlands in 2005 was more than 3,800 Gt. This amount makes 7% of the country's total CO2 emissions (SNC, 2010).

Finally, forests and grasslands of Azerbaijan have high value with regard to cultural services. Generally, both ecosystems have very important functions that support tourism and recreation. Grasslands and forests are the preferred touristic attractions for local and international tourists. Hiking, hunting, gathering and other touristic activities can be considered as the high economic values. Several studies confirm that number of tourists visiting the area closely depend on mountain landscapes that include forests and grasslands (Abbasov 2014) .

Over the past 20 years, the population of Azerbaijan has increasingly given importance to the existence values of valuable species. These services are seen as the supporting services of local ecosystems. There are many types of valuable species that live in forests and grasslands. Shahdag national Park that is located in the target region is home to East Caucasian tur (*Capra cylindricornis*), Caucasian chamois (*Rupicapra rupicapra subsp. caucasica*), Bezoar ibex (*Capra aegagrus aegagrus*), domestic goat (*Capra aegagrus hircus*), lynx (*Lynx lynx*), brown bear (*Ursus arctos*), wild boar (Susscrofa) etc. These species are highly valuable in terms of existence value, which can be valu ed as the willingness to pay of the society for protection of natural assets.

Because forests and grasslands naturally reduce risks of erosion and flow of debris, in areas where slopes are very steep, levels of erosion and risks of landslides are high and make the areas very vulnerable.

8. A PES Design and Scope for the Project Area

Identification of potential economic benefits

Benefits from the PES schemes are expected from both use and nonuse value creation.

Table 8 . Potential Economic Benefits from PES Strategies

Outcomes	Economic Benefits
Reduction of overgrazing Reduction of erosion Reduction of deforestation	Avoided costs of hazard protection Avoided costs of water treatment Avoided damages to infrastructure (roads, private and public property, etc) Increase in property values Increase in non-timber forest products Increase in esthetic values Increase in non-use values Reduction of risk of diseases Improved recreational fishing Improved recreational activities Improved ecosystems Protection of valuable species

Potential Sellers

Several potential sellers can be identified for pasture and forest use in the area. These sellers include various types of needs and requirements and can be divided into internal and external sellers.

Sellers mainly consist of local population, landowners, land renters and municipalities. The social structure for local population of the target region is very simple. Most of the people are involved in agricultural activities and have a pastoral or semi-pastoral type of life. Despite the fact that the living conditions in the village are not high, they are mostly the same across the population and most people do not consider themselves poor.

Creation of an economic background should be the main goal of this project (integrated erosion management program) through which erosion could be controlled as well. This economic background should be protected by solid and sustainable income sources.

As we have noted, the main income source of the local communities is cattle breeding, which in turn causes intense loss of fertile soils, erosion, and creates high risks of future disasters. Therefore, supporting all types of economic activities that will in turn produce diverse income sources for the community is the only way to support local ecosystems as well. These economic activities should be environmentally friendly and maintain sustainable development in the target region. Therefore, capacity building for "environmentally friendly economic activities" should be an important part of the project.

Several potential participants (sellers) of PES schemes can be identified in the area, with various types of needs and requirements (figure 1). These stakeholders are identified based only on their income sources.

1. **Cattle breeders.** Cattle-breeding is the most traditional, important work and the only income source of the local communities. Almost all the cattle breeders adopt a semi nomadic style. In October, they move their cattle to winter pastures located in the central and non-mountainous part of Azerbaijan. The cattle is then moved back to summer pastures in May- early June. Since cattle-breeding is the only source of income, these people are highly interested in dense grasslands. However, these pastures are subject to the tragedy of common and nobody cares about conservation, protection and overusage. All types of payments for ecosystem services should thus be concentrated on

cattle breeders, in order toreduce the number of cattle and change the traditional semi-nomadic practices.

2. **Beekeeping.** Beekeepers are the second largest group in the area and honey harvesting is the second most important resource of local communities. Bees are kept in wooden beehives during winter time and, starting from May, they are released to the area to collect honey. Beekeepers are highly interested in having permanent flower and bush cover in pastures and forests, since high quality plant cover is required to produce high quality honey. They are also interested in introducing new flowery plant species that could serve as a source of honey. Local forests and grasslands thus offer high quality beekeeping services.
3. **Fruits and vegetable producers.** Intensive cultivation of fruits and vegetables was one of the main activities in the past. While the villagers can produce high quality apples, over the past 20 years market problems caused the loss of much of apple growing economic appeal. Although the trees still exist in some villages, apples are not collected and do not serve as an income source of local people. However, apple tree owners are still interested in selling their products and would be also interested in processing of fruit products.
4. **Wild fruit and berry gathering.** Wild fruit gathering has a large potential for future employment. Hippophae, barberry, hips, wild medlar, wild pear, and wild apple are the most important berries and fruits that can be gathered. Most of these products are occasionally used in herbal medicine (e.g. thyme). People make various types of natural jams, molasses and various types of syrups. These natural products are highly valued in the local market and tourists that visit the area are often interested in obtaining them. In order to produce high quality wild fruit products, local tree and bush cover should be protected well. Groups of people that gather fruits are interested in protecting these trees and bushes. Of late, a rather large group of people have been involved in gathering wild fruits. Like apple growers, this group of people is also interested in processing fruit products.
5. **Pasture lessees.** Pasture lessees are people who lease summer pastures for use. These people are not local residents. Every year, a considerable part of the land is leased by local to them by municiplaities . According to legal regulations, not more than 8 sheep (or goats) per ha are allowed to pasture.
6. **Local Municipalities.** Local municipalities are the big landowners in the region. They own vast summer pastures that are almost completely rented out to pasture lessees. However, neither the municipality nor community members have a sufficient opportunity to control leasers' activity . Because they are not owners, pasture lessees use these pastures as much as possible and are not interested in protection. This causes great danger to the sustainable use of pastures in the future. Although leasing brings high

income to the municipality, some community members suggest that this activity threatens future existence of pastures.

7. **Tourism workers.** Although tourists are still a relatively small group, the attractive landscape and the biodiverse and pristine characteristics of much of the environment hold a great potential for various forms of eco-tourism. Development of recreational activities may also create a large group of people that will be interested in using land in a sustainable manner. On the side of the local population, young people are very interested in the development of tourism in the village, since this may create attractive employment opportunities. Construction of small size hotels, hostel-houses, hiking routes, and services may help to develop tourism in the area. Tourism may also aid the development of wild fruit production, carpet manufacturing, and juice and jam processing and other related business.

Potential Buyers

Potential buyers are the parties which could pay for ecosystem services. These are people, companies, government or foundations that are interested in improving the supply of ecosystem services or protection of the environment in the region. In other words, every side that is ready to support (to pay) local landowners or communities with the purpose of nature protection can be classified as potential buyer. These buyers may have various needs and concerns in terms of ecosystem services' quality and nature protection.

1. **Government of Azerbaijan.** The Government of Azerbaijan (GoA) is highly interested in improving quality of ecosystem services as well as protection of valuable ecosystems in mountain areas. State policy of Azerbaijan on protection of ecosystems is well reflected in various laws and programs. For example, the National Program on Environmentally Sustainable Social-Economic Development specifies that future development of resources of the Azerbaijani Republic should be environmentally sustainable and that all natural resources, including forests and grasslands, should be carefully managed and protected. This program covered the period of 2003-2010 and under this program extensive activities have been carried out. The National Forestry Program of Azerbaijan covers the period of 2015-2030 and under this program extensive protection and forestation measures have been implemented . GoA is interested in protecting both use and non-use values of ecosystems. Its support to landowners may come in the form of subsidies or direct contract to farmers. In many countries governments run programs directed to protection of ecosystems through farmer support. GoA may also run similar programs in short and long term periods. It is important to point out, however, that,while GoA has some experience with subsidies that worked efficiently over the last 15 years, PES schemes would require a complete change in both the targets and the ways of implementing agricultural policies.

The following government organizations may represent government in activities related to PES:

a. Ministry of Ecology and Natural Resources. The Ministry of Ecology and Natural Resources (MENR) is the central body of executive power that realizes the state policy on the protection of environment, organizing of the use of nature, efficient use and restoration of natural resources. MENR is also in charge of protection of forest resources, their efficient use, restoration of fallen forests, and establishment of new forest strips. It can thus manage PES schemes that directly support environmental protection (e.g. for PES cap and trade sytems for pollution and water abstractions, maximum allowable use permits and trading can be managed by MENR). MENR can count on well developed local structures withlocal offices in every administrative district.
b. Ministry of Agriculture. The Ministry of Agriculture of the Republic of Azerbaijan (MOA) is a body of executive power that forms and implements state policy in the field of agriculture. MOA provides practical assistance to local executive structures in conducting agrarian reforms. It has exclusive authority in organizing breeding, quarantine and sanitary measures. It also manages government subsidies that support various types of agricultural activities. MOA can thus manage all types of PES schemes that support fiscal mechanisms driven by government (e.g. Subsidies to land owners). These may include activities related to implementation of new agricultural practices, changing agricultural activities or supporting environmentally friendly agricultural works. The MOA managed PES schemes could include erosion management, quotas for cattle and support for beekeeping and pilot farms

2. **Azersu Join Stock Company.** This company is the main drinking water supplier in Azerbaijan. Azersu manages large water sources in the downstream part of the Girdmanchay river. One example of the amount of eater available from these sources is the Kululu water source, is located in downstream areas of Girdmanchay, with roughly 0.5 m^3/c of high quality water that can approximately supply 50000 people with 24/7 service. By developing higher service standards, Azersu could increase water tariffs and part of these resources could go to PES.
3. **Amelioration and Water Economy Open Joint Stock Company (AWE)**. This is a state owned company that is responsible for provision of water supply to the agricultural bodies and amelioration of lands. All existing irrigation schemes, distribution channels, collector-drainage networks in the country are in the balance of this institution. The institution also deals with irrigation schemes that are under construction now. In most regions, the departments responsible for irrigation channels and collector-drainage

networks operate separately. Recently, AWE has established extensive water withdrawal points in the basins of Girdmanchay, Pirsaatchay and Goychay. The water withdrawn comes from upstream areas and is regulated by forests and grasslands. Therefore, AWE can implement PES schemes that directly support farmers and upstream population. AWE also has Winter Pastures Water Supply Systems Operation Offices that manage the water supply of winter pastures. Therefore, it would be possible to develop a PES scheme (for example, in the form of free water for winter pasture), that would increase effectiveness of winter pastures and reduce pressure on summer pastures.

4. **Visitors.** Tourists (about 20000) come into the area mainly during summer. New hiking routes and development of infrastructure may increase touristic activities in the future. Visitors are interested to pay for nice landscape, clean water, clean air and calm suburban environment. These payments may flow through local touristic enterprises including hotels, resorts, restaurants, etc.
5. **Potential visitors.** Potential visitors include all the people who live in big cities of Azerbaijan and would visit the area. Potential visitors are the people who would willing to pay for option and existence values or simply interested in protection of ecosystems, animals, forests, grasslands etc.
6. **Foundations and other non profit institutions (FNPI).** In most of countries, where PES schemes are applied successfully, FNPI are present as service buyers. In other words, foundations give support to landowners to apply environmentally friendly practices that enable increased quality of services. For example, in United Stated of America, trust funds use voluntary tools such as conservation agreements, land purchases, land donations, cooperative acquisitions, and a landowner registry program to conserve lands for ecological, scenic, and open space values. Presently, there are no FNPIs in Azerbaijan that could support PES schemes. However, several foundations that currently work on issues related to sustainable development might make some pilot projects. Another option is to establish land conservation funds that could work in PES.
8. **UN agencies**. The main UN agency that would be interested on pilot PES project is UNDP. Currently, within its various types of environment related projects and studies UNDP tries to find ways to develop PES practice in Azerbaijan. In the future, UNDP could support one small scale PES scheme in the target region.

9. A Preliminary Ecosystem Valuation through Meta-Analysis

Introduction

PES systems require a careful assessment of the values embedded in the different ecosystems. These values should take into account the different ecosystem services and should be based both on subjective and objective evaluation criteria. The best method to assign values in PES can be obtained through the so called reverse auctions, whereby stakeholders such as farmers, pastoralists, and villagers are asked to submit an offer based on their willingness to accept payments for specific eco-services. However, both to plan the PES characteristics and to define the value basis for the auction, two different types of prior evaluation should be implemented. These are, respectively, a preliminary valuation based on data from other sites, and a survey of willingness to pay and willingness to accept attitudes on the part of selected stakeholders.

The more reliable methodology for the preliminary valuation is a meta-analysis of ecosystem studies. Meta-analysis (MA) itself is a methodology for investigating the research of different studies on the same topic and synthesize the results with a common effect using regression techniques (Stanley, 2001; Brander 2012). MA was first proposed by Glass (1976) as a method to construct a systematic quantitative summary of evidence across empirical studies. It has been defined as having three general purposes (Bergstrom and Taylor 2006, Rosemberg and Loomis 2000): (i) combining results on a particular topic, (ii) regress and test hypotheses between predicted and explanatory variables and, (iii) use the results as a transfer function, allowing adjustments of different benefits provided by the ecosystem. In the field of environmental economics, in particular, MA represents the practice of using a collection of formal and informal statistical methods to synthesize the results found in a well-defined class of empirical studies (Smith and Pattanayak 2002).

In the 1990s, for the field of environmental valuation, meta-analysis has started to play an important role in environmental economic research. Several studies have focused on environmental issues, on the basis of single or multiple valuation techniques. The reason of the importance given to this analytical instrument can be linked to the increase in the available number of heterogeneous environmental valuation studies; the seemingly large differences in valuation outcomes as a result of the use of different research designs and, in view of the high costs of carrying out environmental valuation studies and the increasing demand for transferable valuation results (Woodward and Wui 2001).

Meta-analysis of ecosystems

In order to develop a preliminary valuation of the Azerbajan ecosystem interested by the project, and investigate how different variables influence the values of different ecosystem services, we used the estimates from a recent study by Scandizzo and Cufari (2015), a meta-analysis based on 110 studies randomly selected for three different kinds of ecosystems: grasslands, wetlands and forests. Grasslands comprise mainly savannahs and rangelands. The wetland category refers to every kind of wetland ecosystem, including mangroves areas and predominant in Asian countries, and Forests reflect either specific studies made on forests, or the value estimates for forests included in studies on a main ecosystem/biome. The total number of studies selected is 110, but almost every study evaluates several ecosystem services with different valuation methods, so that the number of observations may be more than 110 when different ecosystem services values and valuation methods are used as covariates. Also, in several studies, more than one ecosystem has been evaluated, because an area can include two or more different types of ecosystems. These practices reflect the fact that different methodologies of evaluation are used for different services, according to the distinction between direct and indirect use and non-use value (Costanza 2006, Barbier 2006, Faber et al 2006).

In the meta-analysis, our main variable of interest, as a dependent covariate, is the economic value of the observed ecosystem, while the explanatory variables, following other meta-regression studies (Brander et al 2005, Woodward and Wui, 2001, Brower et al 1999), are grouped into categories corresponding to: (i) the evaluation method, that is the methodology applied to assign an economic value to the ecosystem; (ii) the ecosystem services, according to the services provided to the area/community and evaluated into the study, (iii) the geographic area, i.e. the area where the study was made and, (iv) other explanatory variables, such as GDP per capita, the size of the area considered into the study and the population density. Two sets of data are used to capture the impact of climate change in the area object of study: the monthly average temperature changes (measured in °C) in the area of study from 1990 to 2009, taken from World Bank Climate Database, and the Monthly average rainfall (measured in mm) for the study area for the same range of time, taken from the same source. These data have been transformed in annual means and variances for the corresponding variables of temperature and rainfall changes. The studies selected cover a period of publication of 32 years, from 1980 to 2012. The year variable included into the dataset was converted into a yearly index, by taking the difference between the publication year and 1980. Economic values are estimated in US$ per hectares per year. All values, including GDPs, have been converted in constant 2005 prices taking into account the yearly inflation rate for every country.

TABLE 9: Descriptive statistics by ecosystem type (2005 US$/ha)

	FOREST	WETLAND	GRASSLAND	TOTAL
Mean	817.0237	1272.48	698.1188	940.0937
Median	126.6623	463.9378	45.38186	181.1486
Maximum	6858.386	10209.92	6559.159	10209.92
Minimum	2.044972	8.479397	1.357268	1.357268
Std. Dev.	1804.051	1852.803	1615.74	1743.898
Observations	44	55	27	110

Source: Authors' computation

TABLE 10: Descriptive statistics by geographic area (2005 US$ per ha)

	EU	NAM	CAM	LAM	AFR	ASI	OCE
Mean	510.8118	1256.894	813.6544	1196.319	263.994	1709.064	855.8954
Median	355.82	191.3133	488.0441	66.70345	40.95031	306.0101	1030.938
Maximum	1273.384	6858.386	3230.122	6559.159	2670.365	10209.92	2209.301
Minimum	13.23036	6.066973	16.89497	10.92701	1.357268	8.479397	180.4702
Std. Dev.	502.189	2182.269	951.9917	2398.138	583.6956	2594.185	660.1195
Observations	9	14	12	7	32	27	10

Source: Authors' computation

TABLE 11: Descriptive statistics by evaluation method (2005 US$/ha)

	CV	MP	TC	HP	PF	NFI	RC	OPPC	BT
Mean	1082.26	1042.40	509.94	718.53	584.20	1221.66	676.72	72.11	1671.59
Median	116.76	234.86	232.99	138.66	463.94	226.56	439.42	56.04	847.24
Maximum	10209.92	6802.13	1868.36	4948.87	1396.25	6802.13	1868.36	229.04	6212.10
Minimum	1.36	6.68	8.48	27.05	27.26	14.13	27.05	7.66	72.74
Std. Dev.	2308.51	1676.57	639.35	1710.72	536.63	1823.66	663.55	73.75	2349.37

Observations	39	52	9	8	9	24	9	8	6

Source: Authors' computation

TABLE 12: Descriptive statistics by ecosystem service (2005 US$ per ha)

	FORESTRY	**WATER**	**TOURISM**	**CARBON**	**FISHERY**	**FODDER**	**OPTION VALUE**	**EXISTENCE**	**BIODIV**	**USE**	**NONUSE**
Mean	949.55	1696.23	1109.93	1262.79	1810.69	458.82	1311.98	1911.62	735.37	977.81	1020.73
Median	177.43	495.04	195.87	186.75	1129.54	72.74	96.73	96.73	167.04	186.75	167.04
Maximum	6802.13	10209.92	10209.92	6559.16	10209.92	1926.52	6212.10	10209.92	6559.16	10209.92	10209.92
Minimum	7.66	9.93	1.36	9.93	16.07	20.52	10.93	13.23	4.18	1.36	4.18
Std. Dev.	1516.34	2383.41	2121.74	1887.50	2260.74	824.49	2739.82	3492.57	1641.50	1775.80	2303.56
Observations	49	33	49	19	36	5	5	13	29	105	39

Source: Authors' computation

Considering all the studies (Tables 9-12), the average economic value is around 940 US dollars per hectare, with the maximum and the minimum value found respectively for a US and a Mexican mangrove site. The median value, however, is much lower than the average and shifted toward the minimum, at about 160 US dollars per ha. Contingent valuation studies are widely represented among the studies, together with the market price method to evaluate the services. These correspond to the predominance of ecosystem services evaluated in tourism and recreational, forestry and biodiversity. Many studies, in fact, calculate the willingness to pay for tourism and recreational activities, aiming, at the same time, at assigning values to biodiversity

conservation. Another frequent practice, especially for forest evaluation, is to evaluate forestry resources with the market price value methodology (Shackleton et al 2002, Godoy et al 1993, Campbell et al 1997).

Table 13: OLS Regression (White heteroskedasticity-consistent standard errors & covariance)
Dependent variable: log(value)

Variable	Coefficient	t-Statistic
C	4.415613	1.100942
YEAR	-0.008185	-0.332181
GRASSLAND	0.886925	1.559620
WETLAND	1.049406	1.995955**
FOREST	0.882169	2.229226**
LOG(SIZE)	0.022074	0.383232
CV	-0.267369	-0.576850
HP	-2.323155	-3.551478**
TC	-0.348560	-0.681721
RC	-0.033143	-0.078607
PF	0.900575	1.661665
MP	0.037777	0.110552
OPPC	-1.838683	-3.116486**
NFI	0.743899	1.727142*
BT	-0.386497	-0.654778
FORESTRY	0.376534	0.944249
FISHERY	0.912306	2.433650**
TOURISM	0.407318	1.347237
WATER	1.140772	3.427433**
CARBON	1.225927	2.345614**
FODDER	0.192937	0.250530
OV	0.338849	0.435172
LOG(GDP_05)	0.202765	0.842129
LOG(POPDENS)	0.002356	0.013133

LOG(RURAL)	-0.003491	-0.007559
NAM	-4.139748	-2.489434**
CAM	-3.882353	-2.373607**
LAM	-4.249316	-2.240182**
EU	-3.140386	-2.332099**
AFR	-4.916812	-2.630827**
ASI	-3.354465	-2.045577**
OCE	-2.643170	-1.724923*
LOG(AVTEM)	0.133863	0.457265
LOG(VARTEM)	-0.185449	-1.320066
LOG(AVRAIN)	0.688088	1.341825
LOG(VARRAIN)	-0.285619	-1.285453
NONUSE	0.084372	0.196343
R-squared	0.566507	
Adjusted R-squared	0.349760	
S.E. of regression	1.657046	

Source: Scandizzo and Cufari (2015)
Statistical significance: *>10%, **>5%, ***>1%

The coefficients of the scalar covariates measure the percentage change (elasticity) in the dependent variable, for a one percentage change in the value of the independent variables, while the coefficients of the dummy variables indicate how much the value of the category indicated confers a premium or a penalty with respect to the constant of the regression. In this respect wetland ecosystems appear to command a robust value premium, while the African ecosystems tend to have consistent lower values than similar ecosystems in other countries. Water ecosystem services, as well as carbon sequestration and fishery production, also appear to confer a positive and significant value premium to the ecosystems. Value is also positively related to population density. The same result holds for the GDP variable.

Preliminary Value Assessment of the Project Area

In order to develop a preliminary valuation of the ecotypes of the project area, we consider its classification according to the two criteria of the ecological regions and IPCC climate type (Table 11). Using The equation from the meta-analysis in Table 13, and the relevant statistics for the variables included, we obtain the estimates in Table 15. These estimates suggest a varying pattern of ecosystem values across the ecological zone, with the lowest values for the temperate desert area. The total values, however, are considerable and amount to a grand total of 147 million US$. These values, however, are subject to considerable local variations, especially as the consequence of the combined change of temperature and rainfall (Table 16). These can be seen as across space as well as climate change induced variations.

Table 14. Ecological regions (ha) and IPCC climate types (ha) for Ismayilli and Shamakhi rayons.

	Ecological Region (HA)			IPCC Climate Type		
Rayon	Temperate Continental Forest	Temperate Desert	Temperate Mountain	Warm Temperate Dry	Cool Temperate Dry	Cool Temperate Moist
Ismayilli	158,834	17,033	31,391	121,051	67,213	20,141
Shamakhi	100,755	25,822	8,203	79,340	52,892	3,306
Totals	259,589	42,855	39,594	200,391	120,106	23,447

Source:
UNDP Strategic Plan Environment and Sustainable Development Primary Outcome: *Mobilizing environmental financing*

Table 15. Ecotype Valuation for the ecological regions of the Ismayilli and Shamakhi rayons.

	Temperate Continental Forest	Temperate Desert	Temperate Mountain	Temperate Continental Forest	Temperate Desert	Temperate Mountain	Total
	Values per Ha (US$)			Total Values (US$)			
Rayon							
Ismayilli	429.5	354.4	427.8	68,214,738	7,276,816	13,430,152	88,921,706
Shamakhi	429.0	318.8	426.5	43,225,062	11,042,460	3,498,447	57,765,969
Total	430.0	335.4	428.1	111,615,282	18,348,299	16,948,947	146,912,528

Table 16. Value per ha as a function of temperature and rainfall variation

		Coeff. of Variation of Rainfall		
Average Temperature	0.9	1.0	1.3	1.5
		US $ per Ha		
5	519	494	431	409
10	426	401	345	318
15	302	302	250	250

Source: Author's computations

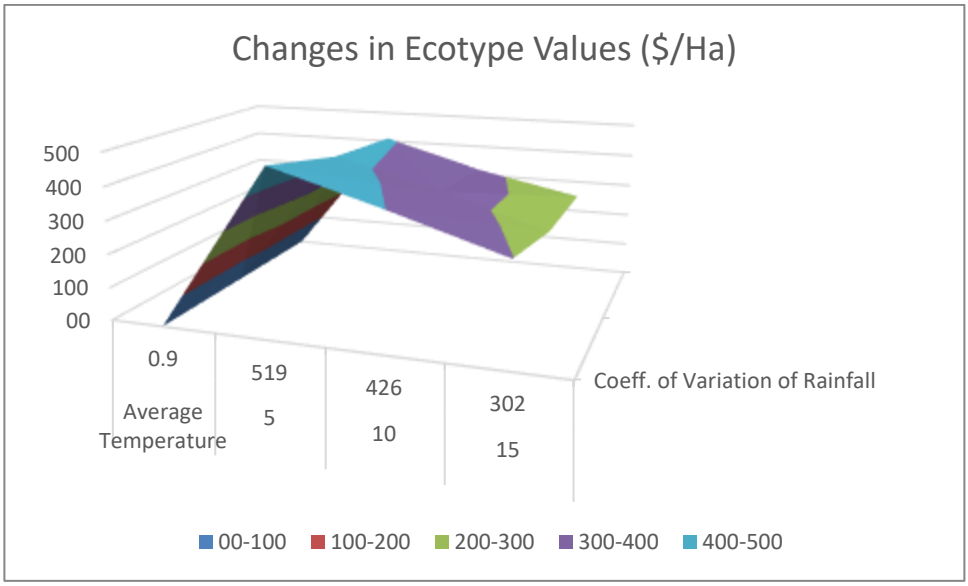

Fig. 1

10. Next Step: A Contingent Valuation Study

While the meta-analysis yields a preliminary valuation of the ecotypes in the project area, a useful second step to complete such an assessment is constituted by a contingent valuation (CV) study. This will consist in analyzing the "stated preferences" of eligible stakeholders (mainly tourists and local population) for the consumption of ecological services and for the conservation of cultural and natural heritage. It is proposed to apply a first CV study to a small test sample in this

phase. A PES program will then be recommended on the basis, inter alia, of the information provided by the test case and a representative sample will be used prior to the launch of the PES program. The analysis will be developed by applying questionnaires designed to gather relevant information for policies to finance preservation and endogenous economic development, with focus on measures of specific components of the total economic value for ecosystem services, especially the contribution for non-use value. The main objective of the survey and the subsequent analysis will be to ascertain the interviewees' opinions and sensitivity with respect to the main environmental problems. This will provide qualitative as well as quantitative indications for policies and financing sources on cultural and economic issues in the context of planning and managing a PES system, as it will allow a complete and reliable measure of total economic value of ecosystem services.

Willingness to pay, as well as willingness to accept measures are elicited in the context of the Contingent Valuation Methodology (CVM), a procedure widely used in the context of valuation of goods with no market prices, such as many environmental goods. In this context the value assigned refers to non-use value or nonmarket use value or both (Venkatachalam 2004).

A typical CVM survey in environmental studies starts with the familiarization of the interviewee with a project proposal on the environmental good or resource. The project proposal aims to identify an improvement of the environment and a method to finance it. On this basis, the interviewee is requested to answer questions about the willingness to pay (WTP) or, in the case of PES possible sellers, the willingness to accept (WTA) payments for the improvement.

The WTP/A questions can be structured in several ways and may be organized according to open-ended patterns, bidding games, payment cards and dichotomous choices. The open-ended pattern consists in simple questions on the maximum willingness to pay of the interviewee for the project to be valued. This method is not used often, because of the difficulty for the interviewees to answer the question, resulting in many missing WTP/A values. In the bidding game approach, instead, interviewees are asked if they are willing to pay (or to accept) a certain amount and then, if the answer is yes (or not) to increase (decrease) the amount until the answer is negative (positive), with the last answer interpreted as WTP/A. The criticism to this approach is that there might be a starting point and a final WTP/A bias, and a non-reliable answer from interviewees who are impatient to finish the interview. The payment card method consists in listing possible values of WTP/A on a card and showing them to the interviewee, who should choose the payments that correspond to her willingness to pay. The dichotomous choice method (or referendum format), consists in a question about voting yes or not for a public program on environmental good.

Table 17 shows the major advantages and disadvantages of the elicitation formats:

Table 17 . Pros and Cons of Different Methods of WTP /A Elicitation

	OPEN ENDED	**PAYMENT CARD**	**BIDDING GAME**	**REFERENDUM**
Advantages	Quick and easy to administer and analyse;	Use of payment cards may facilitate respondent's valuation process	Bidding process is likely to capture maximum WTP and /or minimum WTA;	Realistic – individuals typically make decisions faced with fixed price; but not useful for WTA
	Avoids 'anchoring' effects - respondents influenced by suggested starting value;		Simple nature of choice (yes or no);	Less incentive to lie
	Straightforward calculation of willingness to pay		Requires smaller sample	
Disadvantages	Makes strategic bias, more likely (free riding etc.);	Can be subject to biases associated with ranges used on the card;	Starting bid is in likely range of expected payment – responds quickly to please interviewer;	Framing or Anchoring effect arising from the probability of accepting the bid level due to ignorance about true valuation;
	Might lead to understatement of	Some respondents will choose	Starting bid far away – respondent gets tired of bidding	Danger that the respondents exposure to the first offer would influence

	WTP due to lack of knowledge of costs	first or last in a sequence	and respond randomly;	them to accept the follow-up offer;
				May need to make assumptions on statistical distribution of WTP to estimate the WTP function

While WTA studies may be used to elicit anticipated values on the part of possible providers, most empirical measurements suggest that WTAs may considerably overstate the value placed on the asset by the stakeholders. As a consequence, WTPs are considered more reliable as a basis for the estimation of values of natural assets, even in the case where the questions are asked out of possible providers of the ecological services valued. In general, however, the following methodological considerations based on the literature, apply both to WTP and WTA.

Bishop and Heberlein first introduced the single bounded dichotomous choice approach in 1979, to answer to the typical problems raised by open-ended questions. This approach is based on a a range of predetermined bids from which a single bid is assigned to each interviewee as the maximum WTP amount for the particular good. The answer of the interviewee, who is asked whether she accepts the value assigned, can be yes or no, as in a take it or leave it approach (Bishop and Herberlein, 1979; Mitchel and Carson, 1989; Haneman, 1994).The major advantage of this procedure is that it facilitates the completion of the valuation approach from the respondents, minimizing the risk of strategic bias in the WTP answer (Hanemann 1994; Carson et al., 1996). Disadvantages however arise from the fact that one can derive from this method only the maximum and not the actual willingness to pay; furthermore there is the possibility of starting point bias (Alberini, 1995; Boyle et al., 1996; Ready et al., 1996; Carson et al., 1996).

Hanemann (1984, 1985), has introduced a modified version of the single bounded approach, called the double bounded approach, simply adding a follow-up question to the first question with the first bid. A one more bid to the first question is added as a second question and the amount of the second bid depends on the answer to the first question, with the second bid higher or lower than the first bid depending on whether the answer to the fist question is yes or no.

This methodology was first applied by Carson and Steinberg (1990) followed by Hanemann et al. (1991) and has been proven as statistically more efficient than the single bounded approach

(Hanneman 1991; Kanninen, 1993; Alberini, 1995). In particular, Hanemann et al. (1991), have derived asymptotical gain in efficiency with the double-bounded model, by describing the Maximum likelihood estimation of this model and comparing it with the maximum likelihood estimation of the single-bounded methodThis approach also poses some problems, however, such as starting point bias and yea-saying problems (Ready et al., 1996).

Several studies (Carson et al., 1996), suggest that in general the dichotomous choice technique provides higher values for the WTP elicited than open-ended questions. The basic reason is that the dichotomous choice method minimizes the occurrence of strategic bias, the yea-saying effect and in general the tendency of respondents to provide a lower value of WTP when facing a difficult open-ended question (Brown et al., 1996). This has determined a shift in recent years in contingent valuation studies from openended elicitation to dichotomous choice formats, also because this technique has been recommended by the NOOA panel in the contingent valuation guidelines (NOOA, 1993). However, the econometric analysis required by this technique is more complicated than the open-ended analysis and modeling. (Hanemann and Kanninen, 1999).

In the context of PES planning, a number of studies evaluate the willingness to pay for its development and all the environmental goods involved , which have non-market values and need to be evaluated through contingent valuation scheme.

This methodology, for example,was used by Loewen and Kulshreshta (1995), together with the travel cost method to evaluate the recreation value of Prince Alberta National Park. They found that interviewees spent an average of 30$ to visit the park, with the travel cost method showing a consumer surplus of 24$, contingent valuation a surplus of around 13$ per person per day with a final estimate of total recreation value of the park of around 16 million $ per year.

A dichotomous choice framework was used to evaluate the willingness to pay for the Changdeok Place (Kim et al., 2004), employing both linear and logarithm logit model. The bid was fixed at 10, as a result of a pre-test and the final WTP value was estimated around 6$ per person, with the final aggregate value of around 2 million dollars.

Revenues for coral reef conservation were proposed by the study made in the Philippines (Arin and Kramer, 2002), which evaluated, through contingent valuation, the WTP for a marine sanctuary as source of finance for marine reserves and rentability for local resources. The average WTP was estimated at around 5$, with a total value of around 1 million dollars for the island.

In South Africa, Dumadisile et al, (2005), made a study on a natural reserve areas for the recreation activity and showed that the WTP of the visitors where between 8$ and 16$. The study was assessed with the referendum format framework and a total of 120 questionnaires were made.

A study of the restoration of ecosystem services was made in China by Zonghmin et al. (2005). With the Payment card format, the WTP estimated was around 2.5$ per person and a present value of 8 million dollars for the total value. Biodiversity conservation was estimated by Baral et al. (2008) for Annapurna park in Nepal, where they applied contingent valuation with the scheme of referendum format to the visitors and found a average willingness to pay from a logit regression of around 69$ (more than the actual 27$ of the park ticket). Scott and Hosein (2013), applied a study of contingent valuation for the conservation of biodiversity in Grand Riviere, employing the scheme of double-bounded dichotomous choice and finding a WTP of 1.35$.

One of the most important criticisms of contingent valuation studies comes from Housman (2012), who states that there are basically three kinds of problems with the application of those studies. The first is a bias in the sense of overstatement of values for willingness to pay; the second is a large difference between willingness to pay and willingness to accept and the third is the problem of embedding which encompasses the scope test (Hausman 2012). The first problem is due to the fact that the interviewees often lack market experience and respond without a real perception of the values involved. Another possible cause is the fact that the interviewees may want to please the interviewer. One solution should be to find an adjustment parameter for the willingness to pay, but it is very difficult to find such a parameter in a way that is generally acceptable. The second problem concerns the differences between WTP and WTA. The theory suggests that these two measures must be similar, but instead authors find disparities most of the time between them. (Hausman, 2012). The third problems: scope and embedding, is the most relevant challenge for CV studies. The problem is related to the scope effect (Kahneman and Knetsch 1992; Diamond and Housman 1994), where respondents to surveys must be willing to pay more for a larger effect than a subset of that effect. There are several studies that apply the scope test (Desvousges, Mathews, and Train 2012), but they do not provide sufficient information to judge an adequate variation in scope. Furthermore, several studies do not provide information for a test implemented by Diamond and Hausman (1994), called “adding-up test”, where a group of interviewees is asked the WTP for a good X, another group for the good Y and a third group for the good X + Y. The result must be that the WTP for the third group must be equal to the sum of the WTP of the first and the second groups. The author states that even if a CV study passes the adding-up test there might persist non-coherent or non-stable individual preferences (Housman 2012).

To try to best predict the WTP/A in our study and overcome some of the problems stated above, we propose to use a “double bounded” question for the preservation of local environment, in the rural household surveys. To avoid the problem of overstatement, we will formulate the question in a precise manner on a possible program on environmental and economic development and check whether the respondent is favorable or not to be involved in at least one of its component by spending a certain amount of money or, alternatively , by receiving a certain

amount of money in compensation for his involvement. A second question with a proposal of a different amount will also be asked to create the double bound. This second question will concern the way (tax, voluntary contribution, user fee, PES) that the interviewee would prefer to exercise her WTP/A.

To address the embedding problem we will ask a further question at the end of the questionnaire for each interviewee on her willingness to pay for a development program including all three issues environmental conservation, local culture and local economic development. To test for the embedding problem, we expect that the WTP for these last set of questions should be greater than the first set of questions on WTP, since the latter include just one of the three topics of the development program.

11. Potential PES schemes for the target region

Option1: Grassland protection Grant scheme

Buyer: Government of Azerbaijan (or UNDP at the pilot stage)

The PES scheme aims to improve management of private and municipality lands and increase public benefits derived from existing mountain landscapes and invest in improving ecosystems for additional public benefits. The grant scheme covers only municipalities and registered private landowners. According to this scheme, municipalities and registered landowners will apply for the grants. These grants include regular payments to landowners for a given time. Landowners take an obligation to manage their lands properly. In the application, landowners will be required to identify their intentions and commitments with respect to future management and agree on land use forms and procedures. For example, the grantee can commit to conserve and manage private forest in his/her land. Also, by applying for the grant, municipalities will openly develop their future plans with respect to future land use. For example, they can commit hat the to protect and use as forest area a certain land area. Alternatively, on behalf of the municipalities, Pasture Users' Associations may develop a participatory land management plan, according to which, land will be managed properly, and natural habitat is conserved. Local landowners will join into FUAs or PUAs and apply for grants.

Sellers: Sellers include all the registered landowners and municipalities in the selected area of the target region. They will apply for grant support and accept agreement before they will start the project. Relevant government bodies (or UNDP at the initial stage) will administer grants.

Type of ecosystem services provided: This scheme targets protection and management of municipality lands, which will provide clean water, reduced risk for floods, recreational use, and esthetic and existence value. Improved soil quality will contribute to restoration of vegetation cover. Touristic activities in the area will be intensified.

Option2: Establishment of a National Ecosystem Foundation

In order to improve management of private and municipality lands and increase public benefits derived from existing mountain landscapes, a National Ecosystem Foundation (NEF) may be established. NEF will be a public body that will work in the whole country, including the target region. Recreational hunters, tourists, berry and mushroom gatherers will be the direct users and buyers of the NEF sponsoredservices. Water users, and other persons willing to pay for existence and option values are counted as the indirect users. All the people that are interested in ecosystem protection or protection of species and are ready to pay can be counted as the indirect beneficiaries. Main income of the NEF will be donations of the potential buyers. Simultaneously, NEF may receive support of international and national donors.

Sellers: Sellers include all the registered landowners and municipalities of the target region. They may apply for the support of NEF or NEF will offer its support to them. Registered landowners or municipalities will sign detailed agreement on payments.

Type of ecosystem services provided: Clean water, reduced flood risk, esthetic values, existence values, option values, bequest value, recreational services will be provided to buyers. Increased touristic activities will give a stimulus to increase donations in the future.

Willingness to pay: Survey is important to assess willingness to pay of people looked over as potential buyers.

Option3: Direct government support

Buyer: Government of Azerbaijan (or UNDP at the pilot stage)

Seller: Local landowners

The buyers would like to shield or remove environmentally sensitive land from use. Planted plant species will improve resistance of land and increase quality of ecosystem services. Landowners will receive annual rental payments from the government. Contracts for land enrolled in this scheme are 10-15 years in length. The long-term goal of the activity is to reestablish valuable land cover to help improve ecosystem services and quality of environment, prevent land degradation.

Sellers: Sellers include all the registered landowners and municipalities of the target region. In order to be enrolled in the program, they will apply for government support. Their PES contracts will typically last 10-15 years.

Type of ecosystem services provided: Clean water, reduced flood risk, esthetic values, existence values, option values, bequest value, recreational services will be provided by sellers. Improved lands will provide water that mitigates the impact from debris flows and services that increase water producing ability of landscapes. PES are equivalent to money transfers.

Option4: Ecosystem subsidies

Buyer: Government of Azerbaijan (or UNDP at the pilot stage)

Seller: Local landowners

Subsidies represent money transfers across economic sectors. They lay the ground to make the most vulnerable economic sectors to compete with other sectors and to internalize external effects of private production. PES in the form of direct subsidies can be used to support farmers to change their land use patterns in ways that would enable to protect ecosystems. In most of nature conservation programs governments support farmers with subsidies to convert erodible lands into sustained agricultural ecosystems that are supported by environmentally friendly activities.

In these schemes, landowners are supported by targeted subsidies. Rather than choosing activities on the basis of perceived profits, landowners are induced to apply environmentally

friendly practices recommended by governmental agencies. For example, farmers may switch from cattle-breeding into beekeeping or apply butter-strip plowing.

Sellers: Sellers include all the registered landowners and municipalities of the target region. In order to obtain the subsidy, they will need to sign a contract with the government agency that will determine the type of the land use activity to implement.

Type of ecosystem services provided: Clean water, reduced flood risk, esthetic values, existence values, option values, bequest value, recreational services will be provided to buyers. The improved lands will provide water that mitigates the impact from debris flows and increase water producing ability of landscapes.

Option 5: Water trade

Buyer: Azersu Joint Stock Company

Seller: Local landowners

As noted before, the Girdmanchay river basin is a big potential water source at its lower fan , with the Kululu water source capable to provide 500000 people with high quality drinking water. Grasslands and forests have a rather big role in regulating this source. Recently, Azersu Company has been using this water source to supply downstream towns. A PES scheme may aim to improve management of private and municipality lands and increase quality of provisioning ecosystem services derived from existing ecosystems. Potential buyers will pay upstream farmers to improve land use management through changing traditional land use approach. Azersu may also involve downstream water users into the payments. For example, increased payments of water users may give additional means to payments for ecosystem services. Alternatively, part of the payments made by downstream water users could be used to construct sewage treatment sites in upstream residential areas.

Sellers: Sellers include all the registered landowners and municipalities of the target region. In order to be included in the program, farmers will need to make project proposals or accept the land use change scheme proposed by the buyer.

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