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Abstract. Despite their ecological, economic and social importance, Mediterranean grasslands continue to receive limited scientific, political and media attention. Grasslands are typically viewed as underutilized space, able to be transformed into more "valuable" land by placing it under cultivation, transforming it into forest land and/or privatizing it. This paper synthesizes a number of pertinent issues in relation to social and economic systems on grasslands within the southern Mediterranean region. One effective avenue for drawing more attention to the need for preserving grasslands is to emphasize the economic aspects and benefits of grasslands, relative to the costs of degradation and the cost of inaction. This paper defines marketable and non-marketable goods that are not clearly defined in the literature of sustainable grassland management. When goods are clearly defined payment for environmental services is feasible. Providing an enabling environment for community-based land use and decision-making may foster an acceptance of schemes for community-based payment for ecosystem services on grasslands. There is a need for policies which provide security in property rights, risk reducing strategies, and that take into account both technical and socioeconomic constraints to ensure adequate incentives for participation in grassland management. This is important as mismanagement and climate change have led to further degradation. Land tenure practices and improper policies can also act as indirect drivers of grassland degradation. When farmers and herders lose control or long-term security over the land they use, the incentives for maintain environmentally sustainable practices are lost.

Keywords. Mediterranean grasslands – Community-based land management – Payment for environmental services – Marketable goods.

Des avantages et services inconnus pour soutenir la réforme politique des prairies

Résumé. *Malgré leur importance écologique, économique et sociale, les prairies méditerranéennes continuent de recevoir une attention scientifique, politique et médiatique limitée. Les prairies sont généralement considérées comme des espaces sous-utilisés, capables de se transformer en terres "précieuses" comme les forêts et/ou soumises à la propriété privée. Cette étude fait la synthèse d'un certain nombre de questions pertinentes liées aux systèmes sociaux et économiques sur les prairies dans la région du sud de la Méditerranée. Un moyen efficace pour attirer davantage l'attention sur la nécessité de préserver les prairies est de souligner les aspects et les avantages économiques de ces prairies, par rapport aux coûts de la dégradation et au coût de ne rien faire. Cet article détermine les biens commercialisables qui ne sont pas clairement définis dans la littérature sur la gestion durable des prairies. Uniquement si les biens et les services sont clairement définis, le paiement de ces services environnementaux sera faisable. Fournir un environnement propice pour l'utilisation des terres communautaires et la prise de décision liée aux prairies peut favoriser l'acceptation des systèmes de paiement à base communautaire pour les services de cet écosystème. Il y a un besoin de politiques qui assurent la sécurité des droits de propriété, les stratégies de réduction des risques, et qui tiennent compte des contraintes techniques et socio-économiques pour constituer des incitations adéquates pour la participation à la gestion des prairies. Ceci est important car la mauvaise gestion et le changement climatique ont conduit à une dégradation avancée. Une gestion du foncier et des politiques inappropriées peuvent également agir en tant que facteurs clés indirects qui contribuent à la dégradation des prairies. Lorsque les agriculteurs et les éleveurs perdent le contrôle ou la sécurité de longue durée liés aux terres qu'ils utilisent, les incitations à maintenir des pratiques de gestion environnementale durable sont également perdues.*

Mots-clés. *Prairies méditerranéennes – Gestion communautaire des terres – Paiement pour les services environnementaux – Biens commerciaux.*

I – Introduction

Worldwide, there is estimated to be 50 to 200 million pastoralists, who secure a living through the benefits provided by a range of ecosystem services and public goods which are produced by grasslands (IFAD and FAO, 2014). While this paper discusses grasslands in the Mediterranean region, much of the literature often refers to grasslands as rangelands, as well as parts of the Mediterranean region as MENA (Middle East and North Africa). Literature citations which are relevant to grasslands in the Mediterranean are used, however reference to rangelands and MENA are largely left unchanged in order to maintain citation integrity and inclusivity. Within the MENA region, grasslands are home to ecosystems which have historically played a vital role in the evolution of human societies (Jouven *et al.,* 2010); with the nature of uncertainty and an intermingling of environmental, social and political concerns shaping the makeup of rural society. Not surprisingly, unsustainable management of grassland resources, influenced and exacerbated by climate change (recurrent drought), is leading to concerns over degradation; thereby diminishing potential agro ecological, environmental, social and economic roles in maintaining both community identity and a vibrant rural society. To be sure, in regions which exhibit significant geo-political sensitivity, arid grasslands are prone to the enactment of regulatory mechanisms, targeted at shaping the makeup of rural society, and with limited attention accorded to the potential benefits and impacts from a leveraging of social, cultural, aesthetic and economic values. This is particularly true for much of the MENA where the pan-Arabism movement of the 1950's and 1960's, exacerbated by recent strife within the region ("Arabic Spring") is leading to increased vigilance on border areas. One aspect of regional political economy in this regard was, and continues to be, a felt need for national policies aimed at incentivizing the settlement of communities on large swathes of grasslands as a vehicle for monitoring movements and developments on border areas (Chatty, 2006).

For a variety of reasons therefore, grasslands continue to face immense pressure for landscape change, but are generally of low priority when discussed in the context of conservation (Veldman *et al*., 2015). Often misclassified and identified as potential areas for reforestation (ibid), many have been targeted for forest expansion (Fig. 1), which is particularly true for areas within the 'European' Mediterranean. The existence of both grassy biomes and desert grasslands is clearly visible for the MENA region, where limited potential for agro-silvopastoral exists. Within this region, increasing population pressure, urbanization and elevated food consumption, above its production capacity, is leading to costly and unsustainable production systems (El Kharraz *et al.,* 2012). As a result, there are concerns regarding environmental degradation. A natural inclination, therefore, is to seek out avenues for reducing the pressure on grasslands through restrictions on mobility or free access on grasslands (Nori *et al*., 2009). Given that mobility of herds within the region is a traditional strategy for dealing with drought and uncertainty, addressing rangeland degradation through regulatory measures for restricting access is not clear cut and complicated because of a number of thorny issues (Nori *et al*., 2009).

Linkages between access to pastures, grassland degradation and conflicts are complex. There is evidence to suggest that severe grassland degradation is a trigger for conflicts locally, which can potentially spill over into broader conflicts at a national or regional level (Meier *et al*., 2007). Some have therefore argued that grassland degradation can be both a cause and a consequence of such conflicts and can be preventable with sound land management practices (Suliman, 2011; Bedunah and Angerer, 2012). In light of these issues, an integrated analysis of grassland systems is complex and requires a multidisciplinary approach to fully understand synergies and trade-offs between competing public, private, social, economic, cultural and environmental interests.

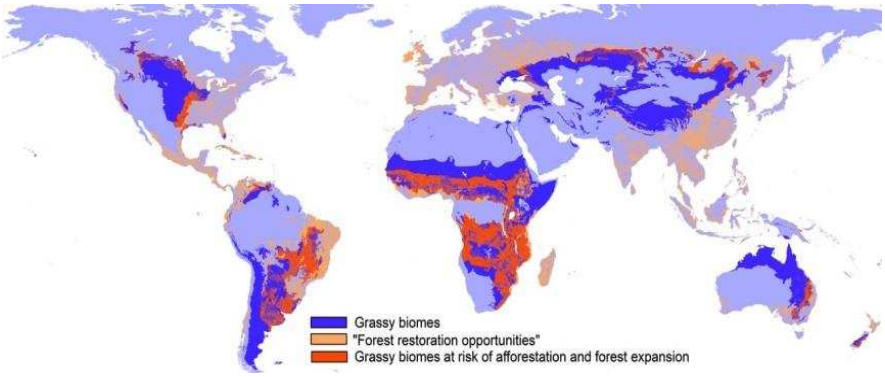

Fig. 1. Forest restoration opportunities targeted in grassy biomes (Veldman et *al.*, 2015)

Recent research suggests that under the right environment, grazing management can potentially sequester 148 Tg CO_2 yr^{-1} and legume sowing/cultivation could sequester 203 Tg CO_2 yr^{-1} with a 28% offset in N_2O emissions (Henderson *et al.*, 2015). Achieving tangible outcomes in this area however requires a more detailed understanding of social systems within rangelands. This is particularly important in terms of understanding the value of 'place' and tradition, as well as in terms of concerns related to political economy in areas where vast expanses of barren land render surveillance of sensitive border areas difficult. Ascribing economic values to ecosystem services of rangelands has the potential to provide incentives for better rangeland management, reduce externalities, improve national GDPs (Mirzabaev *et al.*, 2016), and mitigate conflict. Yet, social systems are just as crucial as ecological and environmental systems (Cousins, 1999), but are often not accorded the same attention in policy discourse as economic and environmental systems and particularly in relation to uncovering avenues for mitigating degradation.

The socio-economic benefits of sustainable grassland management have not been comprehensively assessed. As pastoralists are increasingly urged to manage their lands in a more sustainable manner it is not often clear what the benefits are regarding this change in management. Sustainable management derives benefits principally through ecosystem services and economic impact. To have a sustainable impact it is pertinent to work within the socio-economic framework. In this paper, we endeavor to synthesize valued and unvalued rangeland benefits and a number of pertinent issues in relation to social and economic systems on rangelands within the southern Mediterranean region.

II – Economic values

When looking at the socio-economic benefits of sustainable grassland management marketable and non-marketable goods are not often clearly defined. In building on Nábrádi (2007), we identify a range of marketable and non-marketable goods and services for discussion (Table 1) and attempt to break down the attributes of value from both economic and social perspectives. Some of these goods exhibit both economic and social attributes and are discussed in more detail within relevant sections with supportive literature. Marketable services are defined here as services that either receive compensation or replace a household cost. Non-marketable services are defined as services that are provided from grasslands that do not offset household costs and there is no willingness to pay for these services. As a result, some services can be both marketable and non-marketable, depending on the producers' offsetting of cost of the services and the willingness to pay of others. When services become marketable it is easier to manage and preserve them. While value can be attributed to use, non-use, and indirect use, use does not always represent a willingness to pay or cost offsetting and can assume economic

value where there is not any. As a result use is not used in the definition of marketable and non-marketable services. .Many of the defined services are often overlooked or deemed non-marketable, causing rangelands to be undervalued and further undermine the economic case for sustainable grassland management.

Table 1. Services provided from grasslands

Product/Name	Marketable	Non-marketable	Marketable and Non-marketable
*Forage Production	+		
*Livestock Product/Sales	+		
*Recreation	+		
Extractive Industries (mining & oil)	+		
*Energy (wood, charcoal, biofuel, solar power, wind power)	+		
*Non Forage Rangeland Products (oils, honey, syrups, sweeteners)	+		
*Medicinal Plants			+
Wildlife			+
Climate Mitigation/ Soil Carbon			+
Water Infiltration			+
Cultural value			+
Soil Fertility (legumes, organic matter)			+
Plant Biodiversity		+	
Erosion Control		+	
Water Purification		+	

*Any product that is used for household consumption and offsets costs is considered marketable

1. Marketable services

Marketable grassland services are: forage production, livestock production and sales, recreation, extractive industries such as mining and oil, and non-forage rangeland products (such as oils, honey, syrups and sweeteners among others). These services either receive compensation or replace a household cost. Some services can be both marketable and non–marketable depending on whether others are willing to pay for the service. When people are willing to pay for medicinal plants, wildlife, soil carbon for climate mitigation, soil fertility for increased production, water infiltration, and cultural values from tourism become marketable services. Sustainable grassland management enables the longevity of many of these services.

One of the principle services from grasslands is forage production, which supports livestock product and sales. The EU provides subsidies to promote the development of sustainable farming systems with an emphasis on the conservation of natural resources. In many European countries within the Northern Mediterranean basin, flock sizes are being reduced (Toro Mujica *et al*., 2015). In stark contrast, livestock production in the southern Mediterranean basin is witnessing a steady increase. It is not clear whether the increase in flock size in the south is substituting the reduction in supply to meet demand in the north and should be explored further. Regardless, reducing feed costs on both sides of the Mediterranean is an important economic issue which can be accomplished in a sustainable manner. Greater reliance on livestock grazing relative to purchased forages is an effective avenue for reducing feed costs. This is particularly the case given that winter feeding costs are the single largest expense for many livestock operations (Prevatt *et al.,* 2001). Even when grazed directly, grasslands have an implicit market value in so far as they replace the need for the purchase of feed. The ability to

maintain animal weight (or at least minimize weight loss) is equally an aspect of marketable gain, which is an environmental service provided by grasslands. This service is not charged to livestock herders in open access systems and as a result is more sustainable in closed communal and individual tenure.

Often missed in research aimed at mitigating rangeland degradation is the marketable and non-marketable value which medicinal plants provide. They provide value in terms of both income and cultural attachment, and in their role in providing environmental services such as water infiltration or purification. While values are typically location specific (Brown and MacLeod, 2011; Louhaichi *et al.,* 2011), we argue that the value of medicinal plants are not properly valued in terms of indigenous knowledge, with both economic (in terms of offsetting medicinal costs) and cultural values not appreciated. This is shown by a questionnaire survey conducted in Egypt which documented uses for plants which were unknown within the scientific literature prior to the study. Of the 322 native plants which were compiled, direct benefits in the form of food, medicine, and energy were documented as well as indirect (environmental) services such as biodiversity, water storage, and soil fertility (Table 4 in Bidak *et al., 2015)*. Wetlands have been disappearing globally despite the ecosystem services they provide. It is recommended to use multiple research approaches to highlight their importance, one of them is to document the uses of local plants as well as their economic importance (Turner *et al.,* 2000). Including local benefits in opportunity costs has been influential in preserving them (Barbier, 1993)

Payment for water has been implemented in many forested areas (Muñoz-Piña *et al.,* 2008), and has potential in grasslands. Reductions in grasslands in arid areas reduces water infiltration to a level that is insufficient for grass growth and can lead to a stabilized desertified state (Castellano and Vallone, 2007). In some grasslands brush management may be a way to increase water yield as well as bird habitats for species that require grasslands (Olenick *et al.,* 2004). There are many management practices that can be implemented to increase water infiltration and saving, however they need to be verified in different locations to avoid estimation errors (Havstad *et al*., 2007). While this may sound overwhelming for large programs, smaller scale user financed programs could be better targeted, more closely tailored to local conditions and needs, with better monitoring and also exhibiting a greater willingness to enforce conditionality (Wunder *et al*., 2008). Small scale projects that implement PES for water have been implemented in Latin America and South Africa (Turpie *et al*., 2008; and would be strategic for the region as many areas have water stress with growing populations (Kliot, 2005). As large research programs can be costly and time consuming to implement, community based research that allows users to document water changes with management could be immensely beneficial. Such small scale projects can build greatly needed momentum for local payment for environmental services around water in grasslands.

Grasslands in the MENA region provide natural beauty, diversity of wildlife, and recreational opportunities such as hunting, hiking, and camping, as well as economic opportunities such as, ranching and mining (Louhaichi, 2011). This is particularly the case in areas where degradation has limited the ability for sustainable livelihoods. Cultural tourism, which allows for sharing of lifestyles and experiences with tribal pastoralists such as the Bedouin community in Jordan, is a source of revenue for many pastoralist groups (Chatelard, 2006). In some MENA countries tourism represents an important income source and income diversification strategy for nomadic pastoralists. In Southern Morocco for example, it is a common strategy for poorer pastoralists to rent their dromedaries to tourism agencies accompanied by one family member employed as a tourist guide. Tourism often provides more income than traditional livestock rearing. Relatively well-off pastoralists have opened their own tourism agencies and combine touristic desert trips with herding their dromedaries on desert pastures (Werner, 2007). They also provide tourism opportunities for those imbued with feelings of attachment to nature and natural lifestyles. In seizing opportunity from this growing trend and demand, ecotourism is generally found to exist in those areas which exhibit fragility in ecological, social and cultural systems. It is an important tool for the creation of additional income for farmers, especially in protected and mountainous areas. Day hunting and season leases provide considerable amount of income to ranchers in

some locations (Olea and San Miguel-Ayanz, 2006).Yet, the management of rangeland resources which are suitable for recreational use requires contextually relevant institutions and governance mechanisms in order to promote sustainable use. For example; motorized recreation is on the rise in many rangelands. While it can provide an important revenue source it can also cause damage (White *et al.,* 2000; Wulfhorst *et al*., 2006), namely soil disturbance and vegetative destruction, which can further exacerbate erosion and degrade water quality. As a result it is pertinent that extension is fully equipped to advise how to manage motorized recreation sustainably.

2. Non-marketable services

Sustainably managed grasslands produce positive externalities, public goods and environmental services. Services are considered non-marketable when there is not a willingness to pay and costs are not offset by the service. The non-marketable services that sustainably managed grasslands can provide are: plant bio-diversity, erosion control, water purification, soil fertility, medicinal plants, wildlife, and climate mitigation from soil carbon, water infiltration, and cultural value. Sustainably managed grasslands can play a major role in providing ecosystem services such as; carbon sequestration and biodiversity enhancement but also on landscape and nature conservation, mitigation of soil erosion, water protection, cultural heritage, or wildfire prevention. However since there is often not a willingness to pay, these services are listed here as non-marketable services. The new Paris climate agreement changes the wording from permanent vegetation to long term vegetation opening up the potential for carbon sequestration from some rangeland plants. If local payment for environmental services are set up, some of these ecosystem services can become marketable. Grazing has been shown to increase soil organic carbon and nitrogen contents with light grazing compared to no grazing or heavy grazing (Ganjegunte *et al.,* 2005). Efforts to integrate grasslands into the carbon market could help eliminate/internalize this positive externality and promote sustainable grassland management. However, many of the other public goods are difficult to disaggregate and to measure in terms of cultural, intrinsic and economic value given dynamic interrelationships which can be both supporting/complementary as well as competing. Efforts that assist in generating monetary economic values for non-marketable services from grasslands should be encouraged in order to prevent degradation or inequitable use of these services.

A large number of goods and services found on rangelands and grasslands are non-marketable unless small niche markets have been set up (Bohlen *et al,* 2009), which can be difficult to do.). The main challenges in setting up payment for environmental services are; low cost estimation of ecosystem service flows, difficulty in attaching flows and cost estimates in a low cost way, and the public good nature and often non-exclusiveness of these services (Kroeger and Casey, 2007). Open space is a service which rangelands provide but is seldom accorded economic value other than in formal real estate markets even though open lands provide various ecosystem services (Fausold and Lelieholm, 1999) and a range of benefits which are often difficult to quantify and rarely priced. Due to the ecological, economic and political marginality of rangelands, “higher value” more intensive land uses are impinging on rangelands around the world (Sayre *et al.,* 2013). Efforts to create low cost methods to quantify ecosystem services and assign values as well as provide excludability are needed to advance payment for environmental services further on grasslands.

Large scale cost estimates of grasslands provide an impetus to find low cost ways to measure ecosystem services and make theme excludable. In a study on the valuation of rangeland ecosystem services in China, rangelands generated a value of 149.79 million USD annually in China based on the valuation of biomass alone (Xie *et al*., 2000). Providing value to ecosystem services can strengthen economies and community resilience. There is often an economic payoff by improving rangelands and internalizing market externalities. Incentives for sustainable grassland management will promote improved practices and make them more economically

viable. There is the potential to mitigate land degradation if the correct incentives for investment and regulatory oversight allow.

3. Social

While marketable and non-marketable services are important for the valuation of rangelands, they occur in contextual social environments. Understanding and valuing the social component of rangelands is essential for sustainable management. Sustainably managed rangelands produce a myriad of social goods and provide a place for landless people to live (Sbeita, 1999). When tribal lands are divided, pastoralists face the risk of landlessness and migrate to the city in search of low-paid manual jobs (Graham, 1989). Where opportunities for settlement in peri-urban areas within the periphery of rangelands exist, maintenance of a limited number of small ruminants provide labor opportunities for the youth in terms of shepherding, but more importantly, a sense of attachment to community, identity and place.

Bedouin culture has historically played an important role in the development of the notion of a national identity in the Kingdom of Jordan (Layne, 1994), more generally within the Middle East, and continues so today despite pressures for sedentarization. Within the region, a commonly held understanding of the term 'Bedouin' (or 'Bedu') is a person or tribe who lives in the open, on rangelands, and is generally associated with a nomadic lifestyle. In antiquity, 'Bedouins and their camels lived a harmonious, symbiotic relationship with their environment' (UNESCO, 2007). Through the development of the *Hema* system – moratorium on grazing within defined areas of common tribal pastures – the Bedouins were able to maintain a balance between the needs for maintaining a system of nomadic husbandry with the environmental services provided by rangelands, such that only a slight negative influence on ecosystems existed (ibid, pp. 10). With agricultural mechanization and greater urban demand for animal sourced food products, a movement from traditional husbandry to production for market led to a shift in livestock portfolios from camels to small ruminants (predominantly sheep) in the late 1960's. Volatile conditions in the availability of feed resources given recurring drought phenomena have thereafter led to a more contemporary shift towards semi-nomadic and settled operations, which brought about deterioration of grasslands and rangelands (Leybourne et al. 1993; UNESCO, 2007). Yet, quite apart from the role of markets in influencing the decision to settle, the southern Mediterranean region exhibits a unique case study in the role that politics has played in settling nomadic (Bedouin) populations.

Unique to other areas, the MENA region has focused on settling pastoral people by physical force or economic incentives to control and integrate marginal and at times problematic populations. This movement provided conformism to aspired nation-states, republics and kingdoms of the region. Accordingly the region has never been the focus of mass international pastoral development assistance (Chatty, 2006), in supporting the view that settlement schemes have largely failed in the southern Mediterranean in terms of limiting the extent of pastoralism through forced or induced settlement within the region. Although settlement efforts have been considered successful in countries like Greece (Hadjigeorgiou, 2011). Bequest or symbolic values for lifestyle choices would appear, therefore, to weigh heavily for the Bedouin, given a continued attachment to rangelands. While official figures are difficult to obtain, anecdotal evidence would suggest that the number of Bedouins who maintain livelihoods on rangelands within the region has declined over the past half-century, yet the number of livestock (per inhabitant) grazed on rangelands may not have declined accordingly and has likely increased. Livestock number have increased in other locations in the Mediterranean while the number of pastoralists declined along with the sedentarization of pastoralists (Hadjigeorgiou, 2011). One reason why policies related to mitigating degradation of rangelands have been of limited effectiveness lies in the deficiency in respecting the role that traditional institutions play in fostering contemporary approaches to grassland management. Innovation in institutional options for common property management within the southern Mediterranean is likely to become more successful when embedded in participatory processes, rather than mandatory

and enforced options which are regulated by the state and markets. Governments will inevitably play different and varying roles regarding pastoral management. The question governments will have to address is twofold: should they play a role in managing grasslands through enforced regulations, within a region characterized by historical attachment to open space and kinship ties? Or, should they foster an environment for social values to guide environmentally sound activities (economic, recreational, aesthetic) through incentives and regulatory oversight/supervision/monitoring which are consistent with the local political economy, that include the provision of public goods and services, as well as preserving heritage, culture and national identity?

III – Discussion and conclusion

The analysis of the benefits and services of grasslands highlights a number of marketable and non-marketable goods and services of grasslands. Questions remain as to why their values continue to remain overlooked and why grassland policies seem to continuously not take them into account? Why do governments design grassland policies which exacerbate degradation in lieu of policies which leverage and utilize values found therein (Bedunah and Angerer 2012). One important reason for this dilemma lies in the cultural and economic perceptions of grasslands. This predominant perception sees grasslands as an underused space that would have to be transformed into a more "valuable" land through cultivation, transformation into forest land and/or privatizing it (IFAD and FAO, 2014). Unfortunately polices often see intensification as the only way to produce value as non-marketable services are not seen as having value. This view often does not take into consideration the cost of degradation from overuse. This perspective sees grasslands through a sedentary farmers' perspective and views all communal use as open access – in close parallel with Hardin's tragedy of the commons (Turner, 1999). It does not take into consideration the possibility of defined user groups with management rules and grazing permits. For example, the "hima" system was used in Jordan by the Bedouin that restricted and regularized the use of rangelands with accountability for sustainable land management and ownership by the local people (Haddad, 2014). Furthermore, discounting local knowledge and land use systems seems to reflect the perception of the colonialist's attitudes toward North African Dryland rangelands as "useless". For example, Morocco was divided into "useful Morocco", the areas that can be cultivated and "useless Morocco" ascribed to dry rangelands by the colonists (Planel, 2009). While having overcome this fatal policy, these attitudes continue to persist within present pastoral laws and perceptions of policy makers within the Southern Mediterranean countries. In some of these countries pastoral laws that clearly define the pastoral space as an entity do not even exist. The share of overseas direct investments into grassland-related development, governance and/or tenure activities is insignificant. The focus as a result is on controlling the movement of pastoralists. Regardless the fact that there are many existing examples of successful communal natural resource governance, there is a lack of willingness to invest and to transfer the control of natural resources management and governance to the local level (IFAD and FAO 2014). This can be difficult as local government support has been shown to be essential in reestablishing the "*hima*" system (Haddad, 2014).

The most efficient way to draw more attention to the benefits of grasslands is to emphasize the economic aspects of grasslands, to clarify the consequences of not taking grasslands benefits into account, and the costs of inaction. The latter can be achieved through calculating the costs of grassland degradation. In Uzbekistan it is estimated that the costs of land degradation have a three percent reduction of the national GDP and that most of these costs are related to shifts from grasslands to lower value lands (Mirzabaev *et al.,* 2016). If these costs of shifts from grasslands to degraded land or deserts, would be calculated for all Mediterranean countries with important grassland surfaces, it would create strong arguments for a policy change regarding grasslands. Estimations of social costs are also important but do not always receive adequate attention from all stakeholders. Often social costs and the costs of eliminating non-

marketable services can be linked to economic costs indirectly and should be included in economic calculations where possible.

The other step that should be undertaken to realize the benefits of grasslands is to promote community-based payments for ecosystem services schemes for grasslands. First steps in research to transfer lesson learned from payment for environmental services schemes of forest areas to grasslands have received little attention thus far (Dougill *et al.,* 2012) but would be helpful in order to ensure that PES efforts for grasslands are more sustainable.

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