Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.4, No.14, 2013

Economic Development and Biodiversity Gain with Local Community Cooperation

Dr. Ismaiel Abuamoud[1*], Dr. Raed Al-Tabini[2], Eng. Khalid Al-Khalidi[3], Mustafa Al-Shudiefat[3]
Economic Development & Tourism Economics Specialist, Queen Rania Institute of Tourism & Heritage, The Hashemite University, P.O. Box 150459, Zarqa 13115, Jordan
1. Researcher, RBG and Academic Director, SIT, School for International Training, Amman, Jordan
2. The Royal Botanic Garden, P.O. Box 99, Amman 11910, Jordan,
Email of correspondent author: ismaiel005@yahoo.com

Abstract
Environmental degradation due to overgrazing and the inconsistent assignment of property rights to herding populations has severely affected global rangeland productivity. A political barrier exists to rehabilitating these rangelands, as environmental protection schemes are often cast as "anti-jobs." These problems are continually felt in Jordan, one of the most water-scarce countries in the world. This study aims to provide a case study in contrast with the perception that there is, necessarily, a "land vs. jobs" trade-off. The study focuses on the efforts of the Royal Botanical Garden (RBG) to improve the profitability of 5 herding families in Tell Ar-Rumman, Jordan. The RBG implemented numerous programs, including veterinary care, training, and at-cost high-grade pharmaceutical sales. They also supplemented feed, created managed grazing protocols, and introduced profitability accounting measures. Analyses of the five herders' incomes pre- and post-intervention indicate significant net gains. Improvements on herder's net income of 89%-400% were observed.
Keywords: Jordan, Rangeland, Economic Development, Sustainable Development

Acknowledgment
I would like to express my sincere appreciation to all those who provided us the possibility to complete this study, specially the RBG staff for providing necessary information regarding the study. Special thanks I give to Haden Quinlan, whose contribution in stimulating suggestions and improvement of this work.

1. Introduction

Unsustainable resource use at both the local and global scale for the purpose of community economic development, especially in developing countries, has led to a decline in environmental resources quality (Dietza & Adger, 2003). In particular, excessive grazing pressure and sporadic periods of drought have interacted to cause the loss of desirable returning grasses and shrubs in most of areas in Jordan. Plant and grass loss leads to increased soil erosion and reducesthe availability of grazing resources. In part, this degradation has been facilitated by improper resource-management schemes and insulated from change by the perception that environmental regulatory practices will inherently pose trade-offs for local community livelihoods. This paper will first contextualize rangeland degradation within Jordan from an environmental and a policy perspective. It will then contend that, contrary to popular expectations, rangeland management and the promotion of sustainable livelihoods are complementary goals. It will conclude with recommendations for changes to the Jordanian program and limitations of the present analysis.

Jordan, a small Middle Eastern country, is one of the most-water scarce places in the world. Eighty percent of the country is considered *badia*, an administrative denomination which implies an either arid or semi-arid climate, most of which receives less than 200 mm/year of rainfall. The *badia*is divided into two areas based on average annual rainfall, steppe and desert, with the former receiving between 100-200mm and the latter less than 100mm (Hashemite Fund for Development of Jordan Badia, YEAR; Al-Tabinim 2008; Al-Tabini et al., 2012).Areas which receive more than 200mm/year of rainfall are generally used for agriculture, but sheep and goats often graze close to cultivated land, and are sometimes allowed to graze on stubble and immature barley (which will not mature due to water shortages) for a premium. However, these areaswith relatively "high" rainfall – often referred to as marginal areas – make up less than 9% of Jordan's total land area (Al Dala'een, 2012), and less than 6% are used for grazing (Al Jaloudy, 2003).

Despite the relative advantages of these areas compared to the more arid *badia,* marginal areas are still prone to degradation. For one, they have high silt content, between 30 and 60%, making them subject to wind and water erosion. They are also characterized by low levels of organic matter, specifically nitrogen and phosphorus, risking low soil fertility (Khresat et al., 1998), due to pH levels above 8, "lead[ing] to alkaline reaction[s]…resulting in low availability of certain nutrients like phosphorus and micronutrients" (Rawajfih et al., 2005). This is compounded by sporadic and occasional heavy showers, which "because surface run-off and soil erosions that decrease the amount of water stored in the soil" (Khresat et al., 2004). Consequently, careful

management of grazing is critical to maintaining soil health, especially because up to 70% of Jordan's land area is used solely for grazing purposes (Milne et al., 2007).

Despite the potential productive value of rangeland, Jordan's land has become severely degraded. In 1991, the Food and Agricultural Organization of the United Nations estimated that Jordan's *badia* only provided 10% of its potential forage cover (FAO 1991), a trend that has worsened over time. While analyses have suggested that forage cover in Jordan's rangelands could provide up 40% of livestock feed requirements, supplemental feed accounted for 90% of animal feed in the 1990s (Al-Eisa, 1998) and 95% today (Al-Tabini, 2011a). If current use patterns continue, Jordan's ecosystem is predicted to become more vulnerable to erosion over time, compounding and entrenching an existing problem (Al-Adamat et al., 2007). Predictive modeling suggests that "overgrazing, leading to degradation of rangelands, [is] the single most important issue facing Jordan in terms of soil organic carbon stocks" (GEF, 2005),a "key control of soil fertility" (Jobbagy& Jackson, 2000).

The present study focuses on a Mediterranean ecosystem used for grazing in the Tell Ar-Rumman area of Jordan, which falls into the marginal area category (6% of the country that receives on average more than 200mm of rainfall annually). Since a large fraction of Jordan's landmass is significantly at risk for degradation, pilot projects for land rehabilitation in Tell Ar-Rumman may offer important insights for the *badia* region of Jordan. The more water-abundant Tell Ar-Rumman offers a staging ground with minimal transition costs and, as such, is more flexible for experimentation that may lead to policies from which all of Jordan may benefit.

1.2. Land Tenure and Environmental Tradeoffs

While wind and water erosion are biological processes accelerated by the natural arid climate, overgrazing (and, to some extent, unsustainable agricultural encroachments into former rangelands) is largely symptomatic of the confusing, fragmented land-tenure system in Jordan. An understanding of land tenure in Jordan is critical to understanding how overgrazing is being facilitated at an institutional level. Agricultural Law 20 of 1973, implemented in order to better facilitate government-level environmental policies, declares all rangelands to be government owned (Juneidi& Abu-Zanat, 1993). In practice, however, tribal claims to rangeland have often resulted in the granting of property rights to tribes, who have then sold their land to third parties (Al-Oun, 2009), a process that has contributed to the encroachment of agriculture on marginal lands and pressured grazers to move to inferior rangelands. The reduction of net range area is putting excess pressure on still-available rangeland, increasing overgrazing pressures, and further degrading the soil, an effect which has been recently been observed in India (Mahanta& Das, 2012).

However, the majority of available lands in Jordan are too arid to support agriculture without extensive irrigation and, as such, remain in public hands. This situation is in keeping with traditional theoretical work suggesting that resources with low productivity, little competition, few alternative uses, or unpredictable returns will inevitably result as commons (Van den Brink et al., 1995).Moreover, lands that are privately owned but used exclusively for grazing are often *de facto* communal, due to variable precipitation and fluctuation in available forage for grazing. As Blench (1996) writes, "if you do not allow someone to graze 'your' area this year, in another year your herds may have access blocked elsewhere" (p. X).

Openaccess to common resources has long been identified as the cause of degradation and exploitation (Hardin, 1968), and has been documented in numerous countries and ecosystems as diverse as the United States (Libecap, 1981), India (Jodha, 1995) and Mongolia (Wietz et al., 2006). The dilemma itself is a simple reformulation of the prisoner's dilemma:

> If the contender maintains his/her herd, there will be more grass left for the challenger who can feed his/her herd without purchasing additional and expensive fodder. If the contender maximizes his/her herd size, it is still better for the challenger to do the same, as (s)he is not sure that when (s)he accesses the…pasture, it will be in good grazing condition (Wietz et al., 2006).

Moreover, when there is open access, "no individual bears the full cost of resource degradation," but each individual receives the full profit of herd maximization. Consequently, "the result is 'free riding' and over exploitation" (Adhikari, 2001). While this traditional logic has recently been challenged (Livingstone, 1991; Turner,1993;Adhikari, 2001;Crepin&Lindahl, 2009), such critiques often clarify the hypothesis rather than reject it, and many clarifications focus on the importance of potentially successful communal management regimes. They point out that sustainable and equitable communal rangeland management systems have historically been the norm, and have seen successes recently in several countries, such as Nepal (Andersen, 2011) and Ethiopia (Degefa, 2010), with evidence that suggests these programs can be extended with ease to the Middle East (Chatty, 1998).

Consequently, the "tragedy of the commons" has arisen not as a result of common property, but as a result of insufficient incentives for reciprocity and protection of that property. Communal regulatory systems have broken down over time, as a result of diverse factors such as state interference and usurpation of common lands without adequate compensation, improved transportation, and population pressures (Dasgupta, 2002). In the absence of these regulatory factors, the communal property problem in Jordan has become an open-access one.

The traditional resource-management system in the Middle East, known as *hima*, established protected areas to be used as drought reserves. The *hima* system simultaneously shielded herders from the full impact of climate shocks and allowed for herd rotation on available land resources. It managed grazing sites, limiting the number and types of ruminants or restricting access based on climactic variations (Kilani et al., 2007). However, the same factors breaking down communal management systems throughout Asia and Africa have affected the Middle East as well, and better transportation, changes in land tenure, and a state-centric management approach to land decisions have all accelerated the erosion of the *hima* system (Bourn, 2003). Jordan has not been exempt from these changes, leading to the aforementioned fragmented system of land ownership and regulation. Evidently, this problem has manifested itself in land degradation and insufficient motivation for conservation.

Another criticism stems from the inherent irrationality of the 'tragedy' in that, while each herder may maximize his short-run returns, long-run returns will inevitably suffer as a result of increased environmental degradation; in this light, continued exploitation of the land is viewed as an irrational behavior (Lipton, 1997;Rahman, 2003). However, this irrationality can be considered rational given external conditions which require an emphasis on short-run thinking, given that a long-run profit motive would encourage reduced animal stocking rates to rehabilitate degraded rangeland (Torell et al., 1991)Namely, "(1)increases in population as mortality falls but fertility declines lag and (2) declines in common property resources" (Jodha, 1986; 1991). Both conditions are present in Jordan, albeit with fertility rate fluctuations (Ministry of Municipal, Rural and Environment Affairs,1991; USAID, 2012). More importantly, considerations of rational behavior must take into account accurate opportunity costs of reducing work for herders often working below the poverty level. One explanation of herd expansion explains,

To farmers living at the subsistence level, less of anything often translated into the difference between survival and starvation. Pastoral nomads faced a similar situation. They also needed more cash for new taxes and to buy supplies they had once gotten through barter. Traditional means of rising…cash…declined, but cash requirements increased. As farmers shifted to cash crops, they produced less fodder and grain, so prices rose rapidly. To adapt to changing economic conditions, nomads had to expand their economies, which, of course, meant increased herd size (Speece, 1997).

This analysis reveals a common theme of environmental conservation dialogue: environmental protection necessitates a reduction of income for affected parties.

The "environment vs. jobs" trade-off is heavily debated in the academic literature. However, much of this analysis is macroeconomic (Bezdek et al., 2008) or industry-level analysis which focuses on heavy-polluting industries (Morgenstern et al., 2000; Greenstone et al., 2012), while few articles discuss this tradeoff in the context of rangeland management. While some studies provide economic analysis that demonstrates that decreasing available range invariably hurts local livelihoods (Mahanta& Das, 2012), other studies appear to assume that environmental protection schemes will necessitate an impairment of livelihoods without substantive theoretical explanation (Lise et al., 2006).

This paper attempts to repudiate the notion that environmental protection and local livelihood promotion in rangeland management systems are inimical. Conclusions which show that these two goals can be complementary may have far-reaching consequences, as the "jobs vs. environment" debate has shown to be a significant roadblock in conservation efforts internationally, for example in forest preservation in the United States (Lewis et al., 2002). More importantly, cross-national studies have demonstrated that one's position on the "jobs vs. environment" tradeoff is a significant indicator of one's political attitudes towards environmental conservation (Korfiatis et al., 2004), giving the present analysis potential macro political implications, particularly for Jordan, given that both environmental preservation and the development of rural communities are important elements of Jordan's national strategy (Ministry of Environment, 2006).

2. Scope of Intervention

This paper focuses on a case study from the Community-Based Rangeland Rehabilitation Project (CBRR), a program of the Royal Botanical Garden (RBG), in Jordan. The program is modeled after the community participatory projects which have seen successes in the aforementioned countries and, as far as the authors of this paper are aware, is the only project of this nature in Jordan. In 2005, over 180 hectares of land at Tell Ar-Rumman, 25km to the north of the capital Amman, were donated from the government to establish the RBG. One of the RBG's goals is to be a center for public education, scientific research, and conservation efforts in Jordan (RBG, 2011). One of its important missions in this domain is to educate local/regional herders about proper range management.

Consequently, the CBRR was established in 2007 in order to facilitate this educational process. The CBRR is driven by two main themes: to assist in the development of sustainable livelihoods for local communities while rehabilitating overgrazed and degraded soil. As was suggested earlier, often these goals are considered contradictory. As such, the herding community was initially resistant to the efforts of the CBRR, considering it a

top-down approach to range management similar to programs that have been unsuccessful in Bedouin communities in Syria (Chatty, 1998). The community initially ignored the fencing around the protected site and would actually cut the RBG'S fence in order to continue grazing unhindered (Khalidi et al., 2012).

However, the CBRR offered numerous programs to the herding community in the form of direct subsidies (supplemental feed allotments) and indirect subsidies (rangeland management training, profitability analysis, veterinary care and training), in exchange for the participation of the community in protecting the Tell Ar-Rumman site. Grazing on the site is not strictly prohibited, but is allowed to an extent which continues to supplement the diet of ruminants with healthy and diverse forage while simultaneously allowing forage to develop without threat of overgrazing. Moreover, the CBRR acts as a middleman between the community and government agencies, which often ignore the opinions of local communities in favor of 'ivory tower' approaches to effective land management. Meetings are held with administrative officials from, for example, the Ministries of Agriculture and Environment, and are then held with community leaders and family heads to help determine suitable management practices for both parties. The CBRR is motivated to give the community a voice, in particular because participatory community-management systems have been proven effective tools in combating degradation throughout the world.

On this note, the CBRR intends to provide a case study demonstrating that livelihood development and environmental protection are complementary aims. The present paper attempts to highlight this fact, while simultaneously contributing to the rich extant literature on community-based programs for rangeland management. A full analysis of both the environmental benefits of the CBRR and the impact on local livelihoods is beyond the scope of this paper. However, preliminary reports from both the CBRR and its parent project, the RBG, will act as cursory evidence to the environmental benefits of the program. Subsequently, the paper will focus on a profitability analysis of the program taken from a sample size of five herders. Economic metrics will be applied and discussed, and the paper will finish with recommendations for future profitability.

2.1. Environmental Rehabilitation

Preliminary evidence suggests that the CBRR and RBG projects have been demonstrably successful in rehabilitating the Tell Ar-Rumman site. Initial projects focused on site protection, enhancing natural vegetation regret, and water surface hydrology management. Three years after the RBG's initiation, the diversity of plant species had increased by nearly 150% and plant species have shown "remarkable growth" (Al-Ayyash et al., 2013).

These results were re-confirmed after the introduction of the CBRR. In the three years following the CBRR's initiation, from 2008 to 2010, biomass estimates were taken using the transect technique (Bonham, 1989). The site was divided into 11 sectors, with three study points that were identified randomly (albeit with attention to distributing points evenly across each sector).Quadrates were positioned along each 30-m transect at 10-m intervals, totaling 270 quadrates. The biomass was dried and weighed, and also estimated visually (Al-Tabini et al., 2011b).

The results were striking. Overall biomass in the entire site doubled, and in some sectors more than doubled. For instance, the biomass cover improved by 700% in sector 7, measured in tons/total area and by 500% in sector 9 (Al-Tabini et al., 2013). After carrying capacity was measured, using methods outlined by Holochek et al. (2003), the stocking rate for the entire site (calculated as 100% of food intake for 30 days) was estimated at around 1,400 sheep in 2010, nearly triple the 500 sheep estimated in 2008 (Al-Tabini et al., 2013).

Moreover, a "diverse and abundant bird community and rodent burrows have been noted" (Al-Tabini et al., 2011a). The culmination of these reports indicates that the CBRR and RBG have been successful in, at the least, establishing a foundation for rehabilitation in the site with marked results.

These findings, however, are preliminary as the relatively short observation period of 5 years was marred by heavy rains in 2010 and 2011 which obscured the direct impact of the CBRR. Further analysis during drought, normal, and wet conditions will be necessary to fully grasp the impact of the CBRR. However, for the present analysis, we chose to accept these results for operational easebecause the preliminary findings suggest that rehabilitation is in fact occurring, and because we have no reason to doubt that programs like managed grazing, revegetation projects and the elimination of early-grazing benefit the degraded soil (CBRR, 2012 yearly report).

3. Herd Profitability

Sheep and goat husbandry[1] has a long history in Jordan. The arid climate, however, makes sheep husbandry difficult. Drought and the high cost of raising livestock put pressure on herders' profitability. Lower profitability has, in turn, resulted in out-region migration in search of low-cost grazing.

Herders in Jordan lack awareness regarding best management practices for their herds, such as record keeping practices for the herd, proper feeding regimens, and animal health issues. Livestock productivity for both milk

[1] Hereafter referred to as sheep husbandry.

and red meat in rural areas in developing countries is below international standards due to the traditional farming system (Alam, 2009;Stein et al., 2010).

Empowering small herders, consequently, will efficiently support economic development objectives, mainly in developing countries. Therefore, educating small-scale herders in rangeland management techniques, simple financial analysis techniques, animal health protocols, and providing them with supplemental grazing and animal feed subsidies will improve herders' economic returns on their herds and improve chances of business success. This process supports their families and the local economy on the one hand and allows them to preserve natural resources on the other (WFP, 2000).

Net profit for livestock production is a function of several factors. An almost endless number of production practices and management decisions, as well as many external forces such as forage prices, livestock prices, labor cost, transportation and other macroeconomic variables, such as interest and inflation rates, affect herd profitability (David et al., 1993). Specialists at the CBRR know which factors a herder may need to improve on to make the best use of his herd. For example, most livestock herders do not analyze their individual herd profit, but rather depend on a measure of the amount of cash on hand by the end of the year to determine the net revenue for their business. This process frequently leads to incorrect management decisions, as the profit contribution of various factors is unknown (Hughes, 2006).

Accurate identification of the factors that determine herd profitability allows herdsmen to focus their management efforts on those areas that can improve profitability. Simple economic and financial analyses can assist them in making profitable decisions. Through this project, the CBRR has tried supply the missing pieces that herders in Jordan need in order to improve their profitability by working closely through specialists with a group of herders near the protected area to increase their knowledge and return per head.

3.1. Herd Structure

Within Jordan, the herd size and structure depends on the willingness of the farmers to maintain a herd size commensurate with their resources and the size of their family. Family size may have an impact on herd size due to the dependence of small-scale herders on the family's labor. This affects the process of replacement in the herd, and some herders follow the pattern of replacement through the election of the best from the entire herd, while others buy from other herds or utilize both methods. Ewes are the basic unit of production in the herd.

Revenue from livestock in Jordan primarily comes from the sales of lambs for meat, milk production, and breeding animals. Additional revenue is obtained through the sale of culled mature animals and by-products, e.g. wool and manure.

Herders assume that male lambs must reach a certain age or weight before they are sold and, consequently, expected prices determine the age at which they sell the lambs. In this study, it has been found that lamb prices rise gradually the longer the herder keeps them before they are sold. Herders generally sell their lambs at the age of 6 months or older to generate higher revenue per head. Female lambs are usually kept or sold for breeding and, in some cases, are sold for meat.

The productive life of ewes may extend for more than five years in some cases; farmers may cull a ewe in the case of illness, inability to produce or not producing as expected (Wolfova, Wolf, & Milerski, 2009). Costs per ewe or per herd are calculated for feeding, transportation, health care, labor, breeding and purchasing of breeding animals. All remaining costs, such as depreciation and maintenance expenses, are included as fixed costs per animal or per herd.

Some livestock herders prefer to have sheep and goats in the same herd, as we find in our sample, and some depend on one type of animal. Livestock owners in Jordan primarily depend on imported fodder to feed livestock. Due to drought and scarcity of vegetation, they need to purchase feed throughout most of the year, but may cutback the amount allocated per head in spring time and during the harvest season for wheat and barley in northern and central Jordan.

4. Data

Five herding families were analyzed for this study. Despite the relatively small sample, there were several considerations appropriate to the studies that justify the use of this localized sample. First, the families in question had a historical claim to the land put under protection by the RBG and used by the CBRR. Consequently, adjudications of program suitability with the local community were made more accurate by involving the members of the community who would potentially have the greatest objections to limitations on their land. Second, the CBRR program started with just five families, and has since expanded to nearly 40. We opted to evaluate the initial 5member families so that our data would be more precise and less subject to annual fluctuation. Finally, there is a saying in the herding communities of Jordan analogous to the American expression "seeing believes." Rather than try to persuade the entire community of the benefits of the CBRR, program administrators worked first with willing participants in order to provide empirical results to the surrounding community. The expansion of the CBRR project to 38 families by 2012 is testament to the benefits

of this approach.
Data used in the analysis were collected by RBG researchers in 2009 and 2010 through direct contact with the herders. Specialists at the RBG visited the herders on a regular basis in order to gather data and provide herders with advice to improve their herds. Herders were questioned on the number of sheep and goats per herd, number and price of lambs sold, milk production volume and price per kg. Regarding expenses, data included feed, transportation, medical services and labor costs. Balance sheets, income statements, and livestock summary tables were built to compare herders' performance between 2009 and 2010. The five herders in this study owned a total of 736 head, and the size of the protected area managed by the RBG was about 1,800 dunums (180 hectares). Depending on grazing capacity, areas of the site were opened for grazing from September until early November every year, providing fresh fodder whichrepresented between 4% and 34% of the animals' annual feed requirements (RBG, 2011).
The protected area allows the thousands of plant species that grow naturally in Jordan to flourish. Common palatable forage species grown in the area include *Poabulbosa*L., *Hordium* spp., *Avenasterilis* L., *Erodiumgruinum* (L.), *Salsolavermiculata* L., and *Ephedra aphylla.*

5. Method

The primary and secondary data provided by the RBG were used to derive the cost-benefit model in this study. The enterprise budget concept was used, organized according to livestock type (sheep / goat). The analysis assumes a cash accounting system (transactions are recorded when cash changes hands).
The sales price for lambs and cull sheep used in the income statements was computed by dividing the total income generated from each item by the number of animals sold. The average market price for sheep and goats in 2010, $282, was used for depreciation purposes. Money values are presented in Jordanian dinars (JD), which has a fixed exchange rate with the US dollar at 1JD=$1.41.
This analysis aimed to help herders to monitor their cost and return per head and decide which type of livestock to invest in. The income statements and cash flow sheets were developed by adjusting the annual cash expenditures and receipts collected by the RBG staff. Livestock income (sheep and goats) was generated from the sale of primary products such as meat and hides, and from secondary products such as milk, wool and lambs (Greenfield, 2010).Since the herders in this study did not pay expenses on taxes, land, or buildings, these items were not included in the fixed cost category.
While both the 2009 and 2010 data were analyzed using the same method, they were analyzed separately and then compared to find the improvement in the herders' net income and per head productivity pre- and post-intervention.

6. Comparative Results

The five herders reported owning a total of 736 animals (of which 410 were sheep and 326 goats) valued at 147,200 JD or US $207,616. Figure 1 shows the change in herd size between 2009 and 2010. The overall change in the total number of animals is only 1%. As shown in Figure 1, however, some herders lost or gained more than others. Despite the fact that the total number of animals declined between 2009 and 2010, total milk production for the five herds increased by 38% in 2010 compared to 2009.

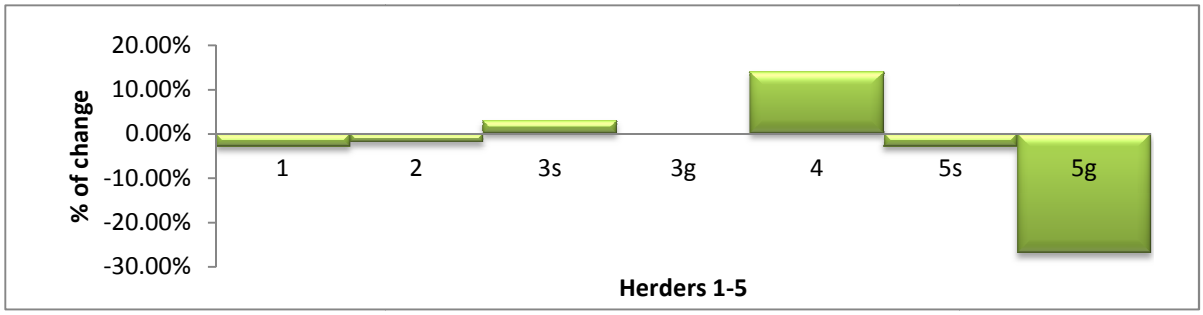

Figure 9. Percentage of change in herd size2009-2010, s=sheep, g = goat

The contribution to profit listed in the herders' financial statements shows great variation between the herders studied (Table4).

6.1. Costs

The costs of raising sheep or goats include labor, fuel, machinery and equipment depreciation, etc. The revenue includes lamb and goat kids' sales, milk and culling sales. The cost of each head and the total cost per herd were computed. There are two types of costs associated with producing an agricultural product: variable costs and fixed costs. Variable costs vary according to the size of the herd, whereas fixed costs occur regardless of the level of output (Hirpa & Abebe, 2006). Examples of variable costs include feed, medicine, labor and supplies.

Fixed costs include depreciation on herd animals and buildings, equipment and rent. Herders can improve their net revenue by minimizing their variable cost through maximizing the use of pasture if possible, producing their own harvested feeds, buying and storing feed in bulk when it is available in low prices, and minimizing feed wastage. Also, they can maximize income by selling at higher prices after improving the quality of their products and adding value to their products. The sale price for sheep's milk is about $1per/liter and $0.60/liter for goat's milk. The milk is priced in line with market prices and the pricing of major competitors in the region.

Table 21. Ratio of variable cost items to total variable costs, 2010

Item /	*1*	*2-S*	*2-G*	*3-S*	*3-G*	*4-G*	*5-G*
Feed	0.	0.7	0.61	0.51	0.53	0.62	0.62
Labor	0.	0.1	0.36	0.42	0.44	0.34	0.33
Transportati	0.	0.0	0.000	0.00	0.004	0.00	0.00
Water	0.	0.0	0.002	0.03	0.006	0.001	0.02
Maintenance	0.	0.0	0.000	0.006	0.006	0.005	0.00
Medications	0.	0.0	0.014	0.017	0.004	0.025	0.01

To understand the variation among the five herders in terms of net revenue, additional analyses were conducted.Figure2 shows the contribution of each item in the variable cost list as a percent of the total variable cost. Feed was the largest share, accounting for 51% to 86% of total the variable cost, followed by labor expenses in 2009 and 2010. However, low feed costs do not always mean higher revenues and, in our case, it was found that Herder 1 paid the highest feed cost, but also generated the highest income among the five herders.

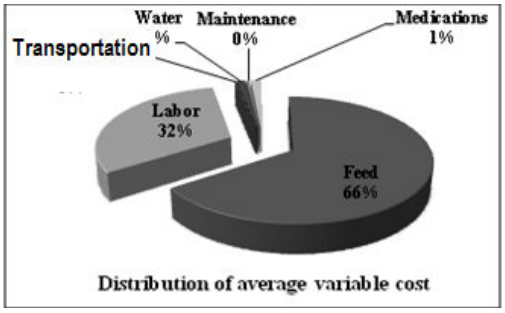

Figure 10.Variable cost usage

6.2. Ratio of Variable Costs to Sales Revenue

Table 22.Variable cost to sales

1-s	*Sheep*	*33%*
2-s	Sheep	43%
2-g	Goat	62%
3-s	Sheep	43%
3-g	Goat	67%
4-g	Goat	53%
5-g	Goat	47%

A ratio analysis of variable costs to total sales revenues important in order to understand what portion of total revenue was used to cover variable costs. Table 2 shows the ratio of variable cost to sales revenue for each herder and herd, expressed as percentages of 33%to 67%. High variable costs reduce the Contribution Margin(CM), namely the difference between sales revenue and variable costs before deduction of fixed costs or, in other words, the amount of sales dollars available to cover fixed costs after all variable costs have been paid. The Contribution Margin Ratio (CMR), seen in Table 3, is the percentage of sales revenue, after deducting variable costs that is available to cover fixed costs. CMR = $(Sales - Variable\ Cost)/Sales * 100$. This ratio helps to find the Break-Even Point (BEP), i.e.$(Total\ Fixed\ Cost)/CMR$, and shows the minimum sales that each herder has to generate to cover both variable and fixed costs. Table 3 indicates that Herder 2g and Herder 3s and 3g did not reach the break-even point, meaning that they were operating at a loss.

[1] S= Sheep, G= Goats

Table 23. sales revenue, variable cost, contribution margin/ratio, fixed cost, and break-even point for the five herders.

Herder	*SALES**	*VC**	*CM**	*CMR**	*FC**	*BEP**
1/S	50,225	16,582	33,643	67%	8,150	$12,167
2/S	22,078	9,570	12,507	57%	3,872.00	$6,835
2/G	6,513*	4,063	2,450	38%	2,938.67	$7,812*
3/S	4,382*	3,193	1,189	27%	1,270.00	$4,682*
3/G	4,536*	3,025	1,511	33%	1,920.00	$5,765*
4/G	9,497	5,061	4,437	47%	2,330.00	$4,988
5/G	12,398	5,865	6,533	53%	3,733.33	$7,085

*VC=Variable cost, CM=Contribution margin, CMR=Contribution margin ratio, FC=Fixed costs, BEP= Break-even point

An additional analysis was conducted to compare cost-revenue per head among the five herders. Tables4 and 5 gives the most detailed picture of the average cost and net revenue per head for 2010 compared to 2009. The cost and net revenue per headis shown for the five herders (with andwithout depreciation) for 2010and 2009. The tables show that the annual average cost and revenue per head varied among herders. Data suggest the price of feed rose in 2010 by more than 100% from the previous year, which explains the high cost per head in 2010. In addition, a significant increase occurred in the net income for all herders in 2010 compared to 2009, as seen in Figure 3.

Table24.Average cost and net revenue per head, 2010.

Herder	*Average cost/head in dollars*		*Net revenue/head in dollars*	
	Depreciation	No deDepreciation	Depreciation	No Depreciation
1/S	$144	$98	$148	$193
2/G&S	$263	$187	$83	$159
3/G&S	$355	$255	($17)	$82
4/ G	$183	$145	$52	$90
5/G	$93	$60	$27	$60

Table 25.Average cost and net revenue per head, 2009.

Herder	*Average cost/head*		*Net revenue/head*	
	Depreciation	No Depreciation	Depreciation	No Depreciation
1/S	$104	$61	$49	$102
2/G&S	$121	$85	$20	$66
3/G&S	$106	$68	($49)	($13)
4/ G	$168	$126	($20)	$18
5/G	$109	$71	($20)	$18

6.3. Net Revenue Comparison

We predicted significant gains would arise from the CBRR program, particularly if variable costs were controlled and returns from marketing were maximized (UOE, 2002). In this study, it was found that the most important factors affecting profitability of the sheep or goat enterprises were feed costs, lambing percentages, and market prices for milk and lamb/goat kids, and labor costs. Two scenarios were used to introduce the final net revenue for the five enterprises. The first scenario includes depreciation in the fixed cost, while the second scenario excludes depreciation from the fixed cost. Tables4 and 5 show the results for the two scenarios in 2009 and 2010. There is a marked increase in the average cost per head in 2010 compared with 2009: however, we observed an increase in net income per head in 2010 compared with 2009.

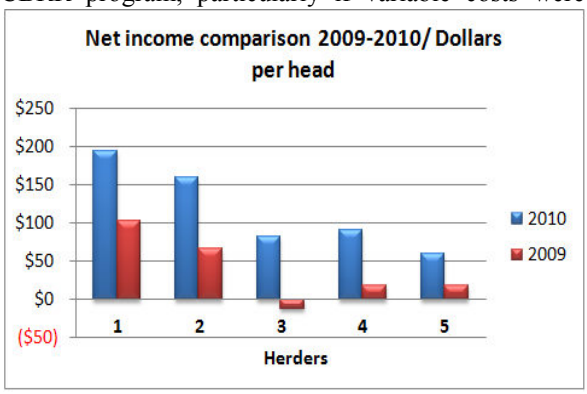

Figure 11. Net revenue comparison, 2009/2010

Our analysis suggests that indirect subsidies

(allowing animals to grazein the protected area for 40 days) allowed herders to improve net income by 5%-11%, while direct subsidies (providing animals with feed like barley and hay) contributedat 2% to 15% of total net income (Table6).

Table 26. Impact of RBG direct and indirect subsidies on herders' net revenue[1]

Herder	*Indirect Subsi*	*Direct Subsidy*	*Total Subsidy*	*Net Income*	*% ofTotal NetIncome from Indirect*	*% ofTotal Net Income from DirectSubsidy*
1-S	$1,89	$1,135	$3,0	$35,34	4%	2%
2-	$949	$1,175	$2,1	$15,80	4%	5%
3S	$570	$860	$1,4	$3,949	10%	15%
4-S	$379	$104	$484	$5,377	5%	1%
5-	$1,23	$1,018	$2,2	$8,143	11%	9%

6.4. Lambing Rate, Lamb Sales, Breeding and Mortality Rate

Table 27. Lambing Rates,2009 and 2010

Herder	*Lambing rate 2009*	*Lambing rate 2010*
1-S	79%	99.5%
2-S	66%	79%
2-G	67%	62%
3-S	47%	74%
3-G	30%	98%
4-G	96%	112%
5-G	82%	70%

While the number of lambs born per ewe is certainly an economically important attribute in sheep husbandry, profitability is largely determined by the number of lambs sold per ewe. Therefore, a great deal of effort should be put toward the care of animal health before, during, and after birth. Knowledge of when and how lamb mortality occurs can be helpful to reduce mortality rates. The percentage of sales, breeding and death loss from the total number of lambs can give us an idea of a given herder's management system. Sales prices per head obviously have a significant impact on enterprise profitability as well. Table 7 shows the lambing rate for the different herds in 2009 and 2010. The findings indicate that an improvement occurred in the lambing rate in most herds, except in the case of Herder 2 and Herder 5.

Table28.Breakdown of total lambs by sales, breeding and death, in percentages lambs

Herder	Sales	Breeding	Mortality
1-S	75%	23%	2%
2-S	96%	0%	4%
2-G	57%	27%	16%
3-S	74%	11%	15%
3-G	38%	58%	5%
4-S	58%	21%	21%
5-G	72%	23%	6%

Table 8 shows a clear variation between the five herders in terms of lambs sold, breeding and mortality rates. The high animal mortality rates seen for some herders indicate a poor management system. The overall cost of lost lambs is estimated at $3,740and this figure represents loss of $748 per herd. Further research is needed to investigate the reasons behind the high mortality rate seen for some herders. It is important to know when and how lamb mortality occurs in order to avoid such losses in the future. Moreover, recordkeeping is also a critical

[1]The indirect subsidies were computed based on the cost of feed per day per head multiplied by 40 days (grazing days for each herder). Raw 3, total of direct and indirect subsidies, according to RBG, the subsidies is given based on number of sheep. Raw 4 represents the percent of the indirect subsidies contribution on herder's income, and raw 5 shows the percent of the direct subsidies on herder's income.

issue which can result in more effective and productive livestock management.

6.5. Lambs and Milk Sales Percentages

Table 29.Percentage of milk and lamb sales out of total sales

Herder	*Lamb %*	*Milk%*
1-S	44%	21%
2-S	73%	13%
2-G	44%	24%
3-S	58%	10%
3-G	26%	21%
4-S	48%	24%
5-G	58%	5%

Lamb and milk sales are the primary sources of income from livestock in Jordan, while manure and wool are considered secondary sources of income (representing X% of total sales in our sample). Lambing percentage and sales price per head have a significant impact on enterprise profitability. The goal should be to increase the number of kids per female per year. Accelerated lambing of less than 12 months is a way to increase reproductive efficiency and reduce overhead cost. Table 9 shows the share of lamb and milk sales out of total revenue for the herds, and indicates a clear variation between the five herds. Market prices varied according to the size and quality of the animals sold and market demand. In general, herders in Jordan depend on on-farm sales, where buyers come to them to negotiate sales prices, although auction barns or brokers may also be used. While prices may be better at larger, more distant auctions, the added transportation costs and sales commission needs to be factored into the price to determine an individual herder's most profitable sales location. To generate higher revenue, herders need to decide where and when to sell their lambs or goat kids. While lamb is the primary choice for religious and cultural holidays in Jordanian cuisine, both lamb and goat sales should be timed to match these periods of increased demand.

Milk revenue depends on a number of factors, such as market price, herd nutrition and flock management practices (CITATION). For example, in Greece, the share of milk in total income varies between 50% to 65%, while in Turkey it averages 24%(FAO, 1992). To obtain large quantities of high-quality milk, herders need to pay attention to the factors above, and adhere to clean equipment standards in order to achieve a higher sales price. As seen in Table 8, milk and lamb sales can account for anywhere from 47% to 86% of total sales. However, the high percentage of Herder 2's sales from sheep herding does not reflecta high revenue, so we needto look further at the costs associated with these sales. Table 8 shows that Herder 2 sold 96% of his lambsand had a 4% mortality rate, but there were no additions to his herd. It should be noted that all of the herders use some milk produced for domestic consumption as well as for sale.

7. Discussion

Jordan's arid climate and subsequent environmental variations have caused livestock to decline dramatically during the last two decades. A focus on quality, rather than quantity, with an eye towards maximizing per head productivity, may be the best strategies to reduce the effect of livestock declines in Jordanand, subsequently, manage environmental degradation. The current quantity-over-quality approach, combined with legal and geographical factors, has contributed significantly to environmental degradation in Jordan's best grazing lands. Geologically prone to environmental degradation, Jordan's semi-arid lands have been worn away by a confusing land-tenure practice which emphasizes accelerated grazing without adequate incentives for preservation. The decline of communal management systems in the region has contributed to this problem by de-emphasizing overgrazing as a potentially mitigating factor.

In part, a political barrier to rangeland policy reformation when proposed changes are perceived to affect the economic health of the communities. Often, proposals that suggest managed grazing are considered to be inimical to the healthy grazing of the herd, forcing herders to rely to a greater extent on expensive feed products. These perceptions limit the efficacy of grazing protocols and construct significant barriers to their successful implementation.

The CBRR project was designed in 2007 to encourage participatory, community-based environmental protection, with an emphasis on bolstering livelihoods in the local community. Demonstrating that these goals are complementary rather than contradictory is a major aim of the CBRR project. This analysis reviewed the CBRR's results on both fronts and tentatively concluded that these two goals may be achieved in tandem.

The majority of our findings affirm that livelihoods can be improved concomitantly with the aforementioned environmental gains. In the present analysis, we have tried to capture many of the factors that are likely to cause the variation in returns among the five herders. A comparison between the financial and economic results shows

the degree to which direct and indirect subsidies benefited small-livestock owners in the targeted area.
Herders who received subsidies witnessed improvement in net income ranging between 1% and 26%. However, subsidies are not the only factors that improved net income, as management decisions and the prices for inputs and outputs played a major role in net income variation. While, the results cannot directly provide the economic impact of pastoralism in the study area, they nevertheless show strong evidence of how livestock and land uses could best be promoted in the study area.
In this study, herder post-intervention incomes were analyzed based on actual expenses and sales. In order to gain a better understanding of the other factors impacting per-head productivity, further analysis of the herders' socio demographic characteristics is encouraged to be included in future analyses. This type of analysis helps to understand the correlation between per-head productivity and herders' characteristics, and will help the RBG to provide the herders and local community members with appropriate training. Improving the local community' income will, in turn, assist the RBG to achieve its primary goal of preserving the ecological system in the study area.
Thus, we find that several important steps must be made in order to maximize profits for local herding communities while protecting valuable rangeland resources:

7.1. Herd Quality

Results suggest that traditional small-scale livestock husbandry in Jordan has the possibility to have a high economic impact on the national economy as well as on local communities. A small improvement in per-head productivity can raise the total productivity for meat and milk. Increases might be achieved simply by maintaining the productivity of each animal rather than by increasing herd size. The role of specialists in animal health and animal nutrition in educating management regarding these issues will be very important to help livestock owners reach this goal.

7.2. Flock Records

In order to keep track of animals in the flock, each herder must maintain detailed flock records to assist in management decisions. Information should be recorded for all animals starting at birth, including birth weight, sex of lamb, type of birth (single, twin), and be kept for the entire life cycle. If a lamb dies prior to weaning, this should also be noted along with the cause of death. As high death losses may be due to disease, parasites or poor management, detailed records can be used to identify the cause and take corrective measures. Information on flock records can be stored in a variety of ways, including notebooks, and RBG staff can help to keep records with computer software such as Excel.

7.3. Marketing

The herders in this study, like most herders in Jordan, raise sheep and goats for meat and milk production. With these two products as their primary income source, farmers have to maximize their revenue from these sources using improved management systems. It may be wise to also establish an additional income source by producing high quality breeding stock animals for sale. Once a reputation for quality stock is established, breeding lambs could then be sold at any weight. The group of farmers working with RBG has a comparative advantage over other herder's due of their location, which gives them other benefits since they receive a special support from RBG. Furthermore, they live in a region where relatively high-income food consumers reside, this allow them to sell their product at preferable prices.

7.4. Further Research

It is important to acknowledge some limitations within the present study. In particular, the small sample size may be insufficient to extrapolate sufficient conclusions. Moreover, while providing insights for Mediterranean ecosystems, further analysis must be done in order to evaluate the potential applicability of the CBRR model to more arid lands in Jordan and the Middle East generally. Given this, the authors recommend further exploration of the CBRR model both in Tell Ar-Rumman with a larger sample size, and in other ecosystems less conducive to rehabilitation. For Jordan, in particular, efforts to rehabilitate decertified lands will play a critical role in regenerating valuable rangelands.

8. Conclusions

The use of various livestock management techniques is essential to achieve both economic development and biodiversity conservation goals in Jordan. This study analyzed the profitability of sheep and goat production for five herders working with the RBG in the TellAr-Rumman area of Jordan using XX analysis methods to explore whether the goals of livestock production and environmental resource management are mutually exclusive.
Profits were driven by cost control and gross production of primary and secondary products (i.e. sheep meat or offspring versus byproducts such as milk). The study suggests that traditionally measured parameters such as lambing rate, cost per head and death loss are not enough to determine best practice management decisions in sheep and goat flocks, although these factors influence overall net profit. The total cost and net revenue for each herd strongly suggestsa potential for herd size increases in sheep/goat enterprises. Herders should strongly

consider using a profit analysis to determine and monitor the profitability of their flocks. In addition, the study suggests that herders should maintain historical records allowing them to measure progress over time. Finally, the study concludes that, albeit on a localized level of analysis, environmental protection measures may be implemented effectively, and with communal support, to promote both environmental sustainability and livelihood development.

9. References

Adhikari, Bhim, "Property Rights and Natural Resources: Impact of Common Property Institutions on Community-Based Resource Management," Research Proposal for the Award of Outstanding Research on Development at the Third Annual Global Development Network Conference, Rio De Janeiro, Brazil, 2001

Alam, S. M. (2009). Role of Livestock in Economic Development. *Economic Review*, 28-30

Al-Ayyash, Saad, Al-Tabini, Raed, Al-Meshan, Odeh, Al-Oun, Salem, Abu Amoud, Ismail, Al-Adamat, Rida, Al-Oun, Mohammed, Al-Serhan, Mwafaq, and Al-Mou'it, Khaled, "Cooperative Rangeland Management Proposal," Jordan Badia Research and Development Centre, February 2013

Al-Dala'een, JawadAtef, "Causes of Public Low Knowledge of Water Cost in Jordan," *American Journal of Scientific Research,* Issue 61, p. 18-28, May 2012

Al-Eisa, A. 1998. Changes and Factors Affecting Bedouin Movement for Grazing, pp 369 -374. In. Squire and Sidahmed (eds): Drylands: Sustainable Use of Drylands into the Twenty-First Century. International Fund for Agricultural Development (IFAD) Series: Technical Reports; IFAD, Via del Serafico 107; 00142 Rome Italy

Al-Jaloudy, MahmoudAbusetta, "Country Pasture/Forage Resources Profile: Jordan," Food and Agriculture Organization of the United Nations, 2006, web

Al-Oun, Salim. Land Tenure and Tribal Identity in the Badia of Jordan: Reality and Projections. In Community-Based Optimization of the Management of Scarce Water Resources in Agriculture in West Asia and North Africa, Badia Benchmark Site - Jordan, ICARDA.

Al-Tabini, R, H Saoub, and K Al-Khalidi. 2008. Community-Based Rangeland Rehabilitation: The Tal Al-Remah Case Study. In Jordan's Arid Badia: Deepening Our Understanding, Foreword by HRH Prince El-Hassan bin Talal of Jordan, ed. Roderic WD, Mohammad IS, Smith-Gordon and Company, London.

Al-Tabini, Raed, Al Khalidi, Khalid, and Al-Shudiefat, Mustafa, "Livestock, Medicinal plants and Rangeland Viability in Jordan's Badia: Through the Lens of Traditional and Local Knowledge," *Pastoralism: Research, Policy and Practice,* 2:4, 2012

Al-Tabini, Raed, Al-Khalidi, Khalid, and Shudiefat, Mustafa, "Biomass Production and Stocking Rate for the Tell Ar-Rumman Site," Unpublished Community-Based Rangeland Rehabilitation Working Draft, July 2011 (b)

Al-Tabini, Raed, Al-Khalidi, Khalid, and Shudiefat, Mustafa, "Biomass, Biodiversity, and Soil Fertility Results: 2013", Unpublished Community-Based Rangeland Rehabilitation Working Draft, 2013

Al-Tabini, Raed, Al-Oun, Mohammed, Al-Meshan, Odeh, Al-Oun, Salem, "Community Decision Making, Ecosystem Condition, and Pastoral Livelihoods: Dynamics of the Coupled Bedouin-Livestock-Rangeland System of the Hashemite Kingdom of Jordan," Project proposal for the Royal Botanical Garden, 2011 (a)

Andersen, Kirsten, "Communal Tenure and the Governance of Common Property Resources in Asia," Food and Agriculture Organization of the United Nations, Land Tenure Working Paper 20, April 2011, web

Bahhady, F., Thomson, E., & Boulad, M. (1998). Red Meat Pproduction, Marketing and Tradein Syria. (pp. 89-100). Zaragoza -Spain: CIHEAM-IAMZ.

Bezdek, Roger, Wendling, Robert, and DiPerna, Paula, "Environmental Protection, the Economy and Jobs: National and Regional Analyses," *Journal of Environmental Management*, 86 (2008), pp. 63-79.

Blench, Robert, "The Hashemite Kingdom of Jordan National Programme for Range Rehabilitation and Development Baseline Survey of Socio-Economic and Animal Production Data," International Fund for Agricultural Development, April 1996

Bonham, Charles. 1989. Measurements for Terrestrial Vegetation. New York

Bourn, D. (2003) *Livestock Dynamics in the Arabian Peninsula: A Regional Review of National Livestock Resources and International Livestock Trade*. Environmental Research Group, Oxford.

Chatty, Dawn, "Enclosures and Exclusions: Conserving Wildlife in Pastoral Areas of the Middle East," *Anthropology Today*, Vol. 14, No. 4 (Aug., 1998), pp. 2-7

Crepin, Anne-Sophie and Lindahl, Therese, "Grazing Games: Sharing Common Property Resources with Complex Dynamics," *Environmental Resource Economics,* Jan. 2009, web

Dasgupta, Partha, "Economic Development, Environmental Degradation, and the Persistence of Deprivation in Poor Countries," adapted from the Inaugural Lecture of the World Bank's Environmentally Sustainable Development Month (2002) lecture series. November, 2002. Web.

David, A., Richardson, J., Knutson, R., Namken, J., Harris, T., Champney, W., et al. (1993). Alternative Grazing Fee Formula Impacts on Representative Public Land Ranches. *Journal of Range Management, 46* (6), 548-554.

Degefa, MastewalYami, "How Informal Institutions Strengthen Sustainable Management of Common Pool Resources in Tigray, Ethiopia," Thesis submitted to the *UniversitätfürBodenkultur Wien*, Center for Development Research, Vienna, Austria, August, 2010

Degen, A. A. (2007). Sheep and Goat Milk in Pastoral Societies. *Small Ruminant Research, 68* (1/2), 7-19.

FAO. (1992). Wool, Meat and Milk Yield from Carpet Wool Sheep Breeds in the Mediterranean. FAO.

FAO. Workshop on Pastoral Communities in the Near East: Traditional Systems in Evolution, 1-5 December 1991. Amman, Jordan, Food and Agricultural Organization (FAO)

GEF 2005, "Assessment of Soil Organic Carbon Stocks and Change at National Scale," Global Environment Facility, University of Reading and the United Nations Environment Programme, July 2005, web

Greenfield, H. J. (2010). The Secondary Products Revolution: The Past, the Present and the Future. *World Archaeology, 42* (1), 29-54.

Greenstone, Michael, List, John, and Syverson, Chad, "The Effects of Environmental Regulation on the Competitiveness of U.S. Manufacturing," September, 2012, web

Hardin, G. (1968). Tragedy of the Commons. *Science, 162*, 1243–1248.

Hashemite Fund for Development of Jordan Badia, "Jordan Badia," Hashemite Fund for Development of Jordan Badia, accessed April 15, 2013, web, http://www.badiafund.gov.jo/en/node/310

Hirpa, A., & Abebe, G. (2006). Sheep and Goat Production Handbook for Ethiopia. USAID & MoARD.

Hoffman, Irene, "Access to Land and Water in the Zamfara Reserve. A Case Study for the Management of Common Property Resources in Pastoral Areas of West Africa," *Human Ecology* , Vol. 32, No. 1 (Feb., 2004), pp. 77-105

Holocek, J., Pieper, R., and Herbel, C. 2003. Range Management: Principles and Practices. Englewood, NJ (USA).

Hughes, H. (2006). Calculating Gross Income Accurately. *Beef, 42* (12), 12-29.

IHS. (2011). *Country Intelligence: Report of Jordan.* Global Insight.

Jobbagy, Esteban, and Jackson, Robert, "The Vertical Distribution of Soil Organic Carbon and its Relation to Climate and Vegetation," *Ecological Applications,* 10(2), 2000, pp. 423-436

Jodha, N. S. (1986) Common Property Resources and Rural Poor in Dry Regions of India. Economic and Political Weekly 21: 1169–1181.

Jodha, N. S. (1991) Rural Common Property Resources: A Growing Crisis. International Institute for Environment and Development, London. (Gatekeeper Series No. S24.)

Jodha, N.S., "Common Property Resources and the Environmental Context: Role of Biophysical versus Social Stresses," *Economic and Political Weekly*, Vol. 30, No. 51 (Dec. 23, 1995), pp. 3278-3283

Jordan. Ministry of Municipal, Rural and Environment Affairs. National Environment Strategy for Jordan. Gland: IUCN–The World Conservation Union, Gland, 1991, 226 pp. (plus 16 pp front matter). Jordan Department of Libraries, Documentation and National Archives, deposit number (352/7/1991).

Juneidi, M.J. and Abu-Zanat, M., "Jordan Agricultural Sector Review: Low Rainfall Zone," Agricultural Policy Analysis Project, Phase II and USAID/Amman, August 1993

Khalidi, Khalid, Al-Shudeifat, Mustafa and Al-Tabini, Raed, "Community-Based Rangeland Rehabilitation," Royal Botanic Garden, Updated Nov. 2012, Accessed April, 2013. Web.

Khresat, S.A., Rawajfih, Z. and Mohammad, M., 1998. Land Degradation in North-Western Jordan: Causes and Processes. Journal of Arid Environments 39: 623-629.

Khresat, S.A., Rawajfih, Z., Buck, B. and Monger, H. C., "Geomorphic Features and Soil Formation of Arid Lands in Northeastern Jordan," *Archives of Agronomy and Soil Science,* December 2004, Vol. 50, pp. 607-615

Kilani, Hala, AssaadSerhal, Othman Llewlyn, "Al-Hima: A Way of Life," IUCN Regional Office for West Asia

Korfiatis, Konstantinos J., Hovardas, Tajos and Pantis, John D., "Determinants of Environmental Behavior in Societies in Transition: Evidence from Five European Countries," *Population and Environment,* Vol. 25, No. 6 (Jul., 2004), pp. 563-584

Ksiksi, T., El-Shatnawi, M., and Chouki, S. (2002). Rangelands in Jordan and Tunisia. *Rangelands,, 24* (3), 19-22.

Lewis, David J., Hunt, Gary L. and Plantinga, Andrew J., "Public Conservation Land and Employment Growth in the Northern Forest Region," *Land Economics,* Vol. 78, No. 2 (May, 2002), pp. 245-259

Libecap, Gary D., "Bureaucratic Opposition to the Assignment of Property Rights: Overgrazing on the Western Range," *The Journal of Economic History,* Vol. 41, No. 1, The Tasks of Economic History (Mar., 1981), pp. 151-158

Lipton, M. (1997) Accelerated Resource Degradation by Agriculture in Developing Countries? The Role of Population Change and Responses to It. In S. A. Vosti and T. Reardon (eds) Sustainability, Growth and Poverty Alleviation. Baltimore: Johns Hopkins University Press.

Livingstone, Ian, "Livestock Management and 'Overgrazing' among Pastoralists," *Ambio*, Vol. 20, No. 2, April

1991
Mahanta, Ratul and Das, Daisy, "Common Property Resources Degradation and Migration: A Case Study of Assam," *Journal of Human Ecology,* 38(3): 223-230 (2012)
Malik, SohailJehangir and Nazli, Hina, "Rural Poverty and Land Degradation: A Review of the Current State of Knowledge," *The Pakistan Development Review*, 37:4 (Winter 1998), pp. 1053-1070
Milne, Eleanor et al., "An Increased Understanding of Soil Organic Carbon Stocks and Changes in Non-Temperate Areas: National and Global Implications," *Agriculture, Ecosystems and Environment,* 122 (2007) 125-136
Ministry of Environment, "Environmental Policy Framework in Jordan: 2006," National Capacity Self Assessment for Global Environmental Management (NCSA), Jordan, 2006, web
Morgenstern, Richard, Pizer, William and Shih, Jhih-Shyang, "Jobs Versus the Environment: An Industry-Level Perspective," Resources for the Future Discussion Paper 99-01-REV, June, 2000, web
Office, Amman Jordan – SPNL Beirut, Lebanon, 2007
R. Al-Adamat, Z. Rawajfih, M. Easter, K. Paustian, K. Coleman, E. Milne, P. Falloon, D.S. Powlson and N.H. Batjes, Predicted Soil Organic Carbon Stocks and Changes in Jordan between 2000 and 2030 made using the GEFSOC Modelling System, Agriculture, Ecosystems & Environment, Volume 122, Issue 1, September 2007, Pages 35-45
Rahman, ABM Ziaur, "A Critique of 'The Tragedy of the Commons,'" *Journal of International Affairs*, Vol. 7, No. 2, July-December, 2003
Rawajfih, Z., Khresat, S. A., and Buck, B., "Arid Soils of the BadiaRegion of Northeastern Jordan: Potential Use for Sustainable Agriculture," *Archives of Agronomy and Soil Science*, 51(1), February 2005, pp. 25-32
RBG. (2011). *Royal Botanical Garden*. Retrieved February 2012, from http://royalbotanicgarden.org/page/overview
Seidman, K. F. (2005). *Economic Development Finance.* Sage.
Speece, Mark, "Economic Policy and Desertification in Arid and Semi-arid Developing Countries," *The Pakistan Development Review,* Vol. 36, No. 2 (Summer 1997), pp. 191-201
Stein, A. B., Fuller, T. K., Damery, D. T., Sievert, L. and Marker, L. (2010). Farm Management and Economic Analyses of Leopard Conservation in North-Central Namibia. *Animal Conservation* , 419–427.
Torell, L. Allen, Lyon, Kenneth and Godfrey, Bruce E., "Long-Run versus Short-Run Planning Horizons and the Rangeland Stocking Rate Decision," *American Journal of Agricultural Economics*, Vol. 73, No. 3 (Aug., 1991), pp. 795-807
Turner, Matthew, "Overstocking the Range: A Critical Analysis of the Environmental Science of SahelianPastoralism," *Economic Geography*, Vol. 69, No. 4, Oct., 1993
UOE. (2002). *Economics of Raising Sheep and Goats.* University Of Maryland Extension.
USAID, "The Economic Impact of Fertility Decline in Jordan," United States Agency for International Development Report No. 12-01-037, June 2012, web
Valdés, A. and Foster, W. (2005). The Role of Agriculture in Pro-Poor Growth. *The Future of Smal Farms.* Way,UK: IFPRI.
Van den Brink, R., Bromley, D. W. and Chavas, J.-P. (1995). TheEconomics of Cain and Abel: Agro-Pastoral Property Rights in the Sahel. J. Dev. Stud.31(3): 373-399.
WFP. (2000). *The Multiple Functions and Benefits of Small Farm Agriculture in the Context of Global Trade Negotiations.* London, Thousand Oaks, Delhi: The Society for International Development.
Wietz, Liese, Hess, Sebastian and Purev, Byamba, "Pastureland Degradation and Poverty among Herders in Mongolia: Data Analysis and Game Estimation," *Ecological Economics*, 58 (2006), pp. 350-364
Williams, T. (2002). Livestock Pricing Policy in Sub-Saharan Africa:Objectives,Instruments and Impact in Five Countries. *Agricultural Economics, 8* (2), 139-159.
Wolfova, M., Wolf, J. and Milerski, M. (2009). Calculating Economic Values for Growth and Functional Traits in Non-Dairy Sheep. *Journal of Animal Breeding & Genetics* , 480-491.

First author: Dr. Ismaiel N. Abuamoud graduated from New Mexico State University with a specialty of Economic Development and Tourism Economics. He has extensive experience in Jordan and Iraq as a researcher and trainer of local communities, empowering the communities, as well as poor and disadvantaged individuals, to improve productivity, equity and resource management.

Second author: Dr. Raed Al-Tabini holds a PhD in Rangeland Management and Community Development from the University of Newcastle Upon Tyne, UK. He is a former Deputy President of the Badia Research and Development Center in Jordan. Dr. Al-Tabini has managed development projects in the Middle East and North Africaon community-based rangeland rehabilitation, management of scarce water resources, and sustainable

livelihoods in agro-pastoral communities. He also collaborated in the set-up of the Badia Center for Ecological Educational. Dr. Al-Tabini is currently a researcher at the Royal Botanic Garden of Jordan, and the Academic Director of World Learning/SIT Study Abroad programs in Jordan He has published 25 academic papers and reports in international journals and at international conferences.