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Economic performance of small ruminant production in a protected area: a case study from Tell Ar-Rumman, a Mediterranean ecosystem in Jordan

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Abstract

This paper discusses the qualitative impact of a grazing/herding management program on the profitability of Small Ruminant (SR) herds near the protected area of the Royal Botanic Garden (RBG) in Tell Ar-Rumman, Jordan. As the ultimate goal of establishing a protected area is to rehabilitate and enhance vegetation cover in a sustainable manner, a unique program was set up to meet the needs of local herders and enable the RBG to pursue its biodiversity conservation goals. Financial data pertaining to five local herders were recorded using the accrual accounting system and analyzed for the years 2009 and 2010. Significant changes occurred in the productivity and profitability of the SR herds, with the herders' net incomes increasing by 6% to 159% as a result of direct and indirect support provided by the RBG in 2010. The grazing/herding management program is not only improving the income of participating pastoralists, but is also contributing to the growth and conservation of vegetation and wildlife in Tell Ar-Rumman.

Keywords: Economic performance; Small ruminant; Grazing-herding management

Report

Background

Small Ruminant livestock (SR) refers to sheep and goats. In 2010, the Al-Balqa Governorate in Jordan hosted 7.8% of Jordan's total population of SR (DOS, 2011), primarily produced under traditional systems characterized by inadequate feed and water supply, poor veterinarian services and weak management practices (Alassaf, 2012).

The SR population in Jordan dropped from 7.1 million in 2008 to 5.9 million head in 2009 (DOS, 2011), due to limited grazing options and low rainfall. Livestock owners generally have few resources to invest in technologies and other advanced equipment that would maximize herd productivity. So there was a need to record and analyze herd management decisions in order to find ways to raise profitability. A rise in profitability would be a clear indicator of success. The tangible benefits are regular cash

income, meat, milk and manure, and the intangible benefit is the role of SR as insurance in case of emergency (Kosgey et al., 2008).

Economic performance has an important impact on the decision to continue farming in marginal areas (Alassaf et al., 2012; Hadjigeorgiou, and Zervas, 2009). In general, livestock owners in Tell Ar-Rumman (Jordan) are small herders and have adopted a low level of production technology. They have suffered from successive weak production seasons, causing a fragile economic status. But there is always room for improving herd economic efficiency and productivity. An economic and financial analysis can assist herders in making profitable decisions, especially in a context of agricultural sustainability in a protected area (Thomson and Nardone, 1999).

Grazing and herding practices have a great impact on the vegetation and biodiversity of protected areas. It has been found that plant cover in ungrazed plots was 20% greater than in grazed plots (Louhaich et al., 2009). However, the absence of grazing may not necessarily improve the variety of plant species available for livestock utilization, as rangeland genetic erosion can be an attribute of traditional production systems (Thornton et al., 1999).

A protected area, called the Royal Botanic Garden (RBG), was set up in Tell Ar-Rumman with the specific goal of enhancing the quantity and diversity of native vegetation cover. Local pastoralists initially voiced their opposition to the RBG, because a fence was erected around an area they had traditionally used for grazing, and they expected that their livelihood would be endangered.

However, the RBG initiated a collaborative grazing and land management program based on a participatory approach with members of the local community. This study tracks the economic results of the first group of farmers who cooperated with the RBG in this program, with particular attention to qualitative changes in herd management attributed to RBG recommendations, and reflected in the herders' revenue and production costs. An efficiently managed grazing system has been established on land in the protected area, with no negative impact on the herders' income.

Since pastoralism constitutes a deep cultural tradition in Jordan, simply removing animals from the range was never considered to be the right solution. It is well-documented in other parts of the world that removing grazing from a landscape which has traditionally been grazed often has a *negative* impact on species diversity (Al-Tabini et al., 2012; Louhaichi et al., 2009; Thornton et al., 1999). Therefore, after initial biomass studies and grazing trials, the RBG introduced a managed grazing system that allows local herds to graze on RBG land at certain times of the year and under specific conditions.

In 2008, the RBG conducted a rapid assessment of how local herders were managing their herds and the current herd status. It was found that the herds suffered from poor feeding management and weak veterinarian services, which resulted in low productivity. Low productivity was forcing herders to intensify grazing, in order to reduce the high costs of feed, and this was detrimental to the RBG's efforts to rehabilitate vegetation cover and restore biodiversity.

Through close cooperation and consulting between the RBG and the pastoralists, the latter have not only seen improvements in herd health, herd management, and increased profits, but have also adopted a conservation mindset and are now actively protecting the RBG site, having recognized the importance and benefits of conserving biodiversity. At the same time, plant surveys on RBG land, where managed grazing is

being allowed, have revealed a significant change in plant species composition, with an increase from 436 species in 2006 to 580 species in 2010 (RBG, 2011).

Methods

Tell Ar-Rumman, like most areas in Jordan, suffers from excessive grazing pressure which, combined with drought, leads to the loss of desirable returning grasses and shrubs. The loss of plants and grasses causes increased soil erosion and reduced availability of grazing resources.

The present study was conducted at the RBG located 30 km northwest of Amman, Jordan, near the village of Tell Ar-Rumman (32°10'57" N, 35°49'38"E), on 2 km^2 of land donated by the Ministry of Agriculture for the establishment of the RBG, a new botanical garden and protected area. The RBG is intended to be a center for public education, scientific research, and biodiversity conservation.

Data were gathered in 2009 and 2010 from five herders who used to illegally graze their herds on the site. The RBG conducted training courses in 2009 aimed at introducing skills and practices in SR management, including herd management, veterinarian training on common disease diagnosis and treatment, and herd record keeping. The RBG provided additional veterinarian services: a vaccination program, training for a veterinarian extension worker, and a veterinarian clinic. The RBG also supplied supplementary feed, to compensate the loss of rangeland, to cover the daily feed requirements of the herds, especially in mating and late pregnancy periods.

The RBG staff trained the herders on how to record herd production data using structured records. The herders recorded their production data and related costs on a daily basis under the supervision of the RBG staff. Herd production data were collected and analyzed for each herd separately, and showed the productivity and net revenue per head. The collected data included the following:

- Production features and revenue: herd size and types (sheep, goat), lambs, milk production and prices, sales and prices of livestock production (lambs, sheep, and milk).
- Production costs: the expenses included feed cost, transportation, medical services, water, and labor.

The accounting system was designed to obtain reasonable accuracy for the net income (revenue) over a given period of time. It was assumed that 2009 was the second productive year for each herd. The net revenue calculated in this study included the opportunity costs of herders, in the case of family-based herding. Later the data were recorded and analyzed using MS Excel.

Results and discussion

Economic performance of SR production

Small Ruminants are raised for different reasons. Some people in Jordan are motivated to raise SR for additional income, while others depend on SR as a main source of income, for domestic food, and as simple investments they are familiar with.

Herd sizes depend on the purpose for raising the livestock. Small herds are mainly meat producing, as well as fiber and milk producing. More importantly they are considered as an in-hand cash source.

Table 1 represents the herd size, total net revenues and per head revenues for 2009 and 2010. The percentage of change was calculated to determine changes in herd size and revenues, and thus to represent improvements, if any, in performance due to RBG recommendations on herd management. The results showed a fluctuation in herd size between −3% and 3%, except in the case of Herder 4 who owns a goat herd. In the latter case, a 14% increase was seen in 2010, as goats are known for high twinning rates.

Changes in herd sizes were inconsistent with changes in revenue from 2009 to 2010. The herders who had either sheep or goats (but not both) generated higher revenues in comparison to those who owned both. This indicates that specialization in one type of SR might improve herd management and make it easier to meet expected revenue goals.

In detail, Table 1 shows that Herder 2's goat herd had the highest change in revenue (70%), in spite of having a negative change (−2%) in herd size for the two years 2009 and 2010. This change in revenue may be attributed to improved herd and grazing management practices and a consequent increase in lambs and milk per unit of production. It is important to emphasize that the changes in revenue are not attributed to changes in prices or market availability. The product prices and market outlets for these herders was the same in 2009 and 2010.

On other hand, the change in revenue for Herder 3 was the least (−3%), while Herder 5 had an exceptional reduction in revenue (−55%). Both of their herds were mixed, consisting of both sheep and goats.

The herders who paid most attention to the RBG's recommendations derived greater benefits than those who did not fully implement the recommendations.

Factors affecting economic performance of SR production

Production costs In general, there are two types of costs associated with producing an agricultural product: variable and fixed costs. Variable costs vary according to the size of the herd, whereas fixed costs occur regardless of the level of output. Examples of

Table 1 Herd size and revenue in 2009 and 2010

Herder name	Animal type	Herd size			Revenue				
		2009 head	2010 head	% of change	2009 JD®	2010 JD®	Per head (2009) JD	Per head (2010) JD	% of change
Herder 1	Sheep	250	243	−3	20,290.80	33,547	81.16	138.05	60
Herder 2	Goat	58	57	−2	2,541.63	3,626.80	43.82	63.63	70
Herder 3	Sheep	129	133	3	12,423.28**	12,093.40**	58.87	56.25	−3
Herder 3	Goat	82	82	0					
Herder 4	Goat	125	146	14	3,445.79**	6,213.47**	27.56	42.55	55
Herder 5	Sheep	35	34	−3	886.56	489.26	10.19	6.52	−55
Herder 5	Goat	52	41	−3					

® JD: Local currency, Jordanian Dinar.
**Revenue for sheep and goats.
Source: Income statements of 2009 and 2010.

variable costs include feed, medicine, labor, and supplies. Fixed costs include depreciation on the herd and buildings, land, equipment, and rents. In this group of herders, fixed costs represented a very low portion out of the total costs. The herding style is traditional, where concrete buildings, vehicles and equipment are in limited use, and the herders do not have to pay rent for the land they graze on. The traditional style of herding involves mainly variable costs.

Table 2 presents the percentages of variable cost items out of the total production costs in 2010. The main purpose of this calculation was to compare the relative costs, to reflect different management decisions and their impact on reducing the production cost and thus increasing the net revenue.

The records show that feed and labor accounted for the highest share of the total costs. The feed cost was 51% to 86%, while labor was 11% to 44%. Understanding this contribution to the cost shares gives insights on how herders could better manage costs to improve their profitability. Herders can control feed costs by maximizing the use of pasture, producing their own harvested feeds, buying and storing feed in bulk, and minimizing feed wastage. Even though the cost of veterinarian medications is very low, it accounted for 0% to 3% of the total variable cost, and had a tangible impact on improving herd productivity.

Lamb sales, breeding and mortality rates A short lambing season is a result of successful herd management. On the other hand, the number of lambs born per ewe is certainly an economically important attribute in an SR enterprise. Profitability is largely determined by the number of lambs sold per ewe, as selling lambs is the main return from SR farming. Therefore, a great deal of effort should be devoted to taking care of animal health before, during, and after birth. Knowledge of when and how lamb mortality occurs can be helpful in minimizing the mortality rate. The percentages of sales, breeding, and death losses from the total number of lambs give quantitative measures for herd management. For this group of herders, lambs were either sold, died or were replaced into the herd, as the herders decided.

The high animal mortality rate for some herders indicated poor herd management, specifically with respect to veterinarian services. In 2009, the RBG staff conducted trainings on different veterinarian topics, which helped control the mortality rate in almost all the herds. Herder 3, however, had the highest mortality rates due to a mismanagement decision to purchase sick lambs and kids. It is important to know when and

Table 2 Percentage of variable cost items out of total costs recorded in 2010

Item	Herder 1 sheep	Herder 2 goat	Herder 3 sheep	Herder 3 goat	Herder 4 goat	Herder 5 sheep	Herder 5 goat
Feed	86%	62%	79%	61%	62%	51%	53%
Labor	11%	34%	18%	36%	33%	42%	44%
Transportation	0%	0%	0%	0%	0%	0%	0%
Water	1%	0%	1%	0%	2%	3%	1%
Maintenance	0%	1%	1%	0%	0%	1%	1%
Medications	1%	3%	1%	1%	2%	2%	0%

Source: Calculated from 2010 records.

how lamb and kid mortality occurs, in order to avoid such losses in the future. This information should be included in the herd's records to handle future losses.

Table 3 shows the lambing rate in 2009 and 2010, and indicates an improvement for most of the herds. In general, the lambing rate was higher in 2010, except for Herders 3 and 5. Herder 3 had a slight decrease from 67% to 62%, while Herder 5 reduced the size of his goat herd from 52 head to 41 head in 2010, which negatively affected the lambing rate for the year.

Lambs and milk sales are the primary source of income for small herds in Jordan, with minor contributions from the sale of manure and wool. Milk productivity depends on a number of factors such as the nutrition and health of the milking flock. Herders need to give more attention to these factors to ensure a productive and constant milking season with high quality milk, and to gain increased revenues.

As demonstrated in Table 3, lamb sales counted for 26% to 73% of the total sales. These figures explore how the revenue from selling lambs could cover the variable costs of production, especially feed costs, leaving the revenue from milk as net revenue for the herders.

Variable costs as a percentage of revenue A high level of SR sales does not necessarily lead to high revenue. There is a need to examine the costs associated with these sales. This examination is helpful in determining how the sales could cover the variable costs used in production.

Table 4 shows that sales accounted for a 32% recovery of the variable costs out of total sales for Herder 1, indicating that Herder 1 had the most efficient herd management of all the herders. At the opposite end of the scale, Herder 5 used 93% of his total sales to cover variable costs of sheep production, and 86% of goat sales to cover variable costs. In other words, a major share of his sales revenue was used to recover variable costs, which decreased the herd's profitability.

Impact of the RBG's direct and indirect support on herders' net profits

The RBG introduced a grazing/feeding plan for the herders, to measure the impact of managed grazing and herding on both SR profitability and the biodiversity of the RBG site. The plan was based on direct and indirect feed supplements. RBG support meant a reduction in feed cost that would improve the net revenue. The direct supplement was the provision of barley based on the daily feed requirements for mating and late

Table 3 Lambing rate in 2009 and 2010, and lamb distribution and sales in 2010

Herder	Type	Total 2009	Total 2010	Lambing rate 2009	Lambing rate 2010	Lamb distribution in 2010			Milk and lamb sales as a % of total sales	
						Sales	Breeding	Mortality	Lamb %	Milk %
Herder 1	Sheep	250	243	79%	99%	75%	23%	2%	44%	21%
Herder 2	Goat	58	57	66%	79%	96%	0%	4%	73%	13%
Herder 3	Sheep	129	133	67%	62%	57%	27%	16%	44%	24%
Herder 3	Goat	82	82	47%	74%	58%	21%	21%	48%	24%
Herder 4	Goat	125	146	30%	98%	72%	23%	6%	58%	5%
Herder 5	Sheep	35	34	96%	112%	74%	11%	8%	58%	10%
Herder 5	Goat	52	41	82%	70%	38%	58%	5%	26%	21%

Table 4 Variable costs as a percentage of revenue in 2010

Name	*Type*	Variable costs as a percentage of revenue (%)
Herder 1	Sheep	32
Herder 2	Goat	53
Herder 3	Sheep	48
Herder 3	Goat	76
Herder 4	Goat	47
Herder 5	Sheep	93
Herder 5	Goat	86

pregnancy periods, while the indirect supplement referred to periods of managed grazing inside the RBG site. These grazing periods were defined by a specific estimation of the biomass and stocking rate in the RBG site on a yearly basis. The herders were allowed to graze for a specific number of hours per day on pre-determined days, for the equivalent of 50% of the daily requirements per SR head.

The RBG grazing/herding management assisted the herders to decrease their variable costs and improve profits in 2010. Table 5 shows the impact of RBG in-kind support, in the form of direct and indirect supplements, on the revenue of the herders. The results range between 6% and 159%. Since Herder 5 did not follow RBG recommendations and ended up with very low revenue, the RBG support appears extremely high in this table. Supplementary grazing (indirect support) improved the revenue by 4% to 34%, while grazing plus supplemental feed (direct and indirect support) resulted in a 6% to 159% improvement in revenue. Some herders would have made zero net revenue, or suffered a loss, if the RBG grazing/herding management had not been offered. Moreover, without the RBG's program, such a reduction in herd revenue would have been detrimental to the RBG's vegetation recovery rate, because the herders would have cut fences to enter RBG land and graze everywhere possible in an uncontrolled manner.

Conclusion

To understand economic performance, this study analyzed the profitability of SR production for five herders at close coordination with the RBG. Profits were driven by cost control and gross production. The study suggests that traditionally measured parameters such as lambing rate, cost per head and death loss, although they do have an effect on net profit, are not enough to determine best practice management in SR flocks.

Table 5 Impact of RBG support on net income of herders

RBG support	Herder 1	Herder 2	Herder 3	Herder 4	Herder 5
Indirect: Pasture (JD®)	1,346	269	673	875	404
Direct: Barley (JD®)	805	74	833	722	610
Total JD	**2,151**	**343**	**1,506**	**1,597**	**1014**
Indirect revenue (%)	4	7	6	14	34
Direct revenue (%)	2	2	9	12	125
Overall net revenue %	**6**	**9**	**15**	**26**	**159**

®JD: Local currency, Jordanian Dinar.

Herders are strongly advised to use a profit analysis method to determine and monitor the profitability of their flocks, as well as obtain clear insights for future business and management decisions.

In addition, the study suggests that SR herders should maintain historical records allowing them to measure progress over time. Herders have to understand how to increase the productivity of each head rather than just increase the number of head per herd. The role of specialists in animal health and nutrition is very important in helping the livestock owners reach this goal.

This multi-faceted support and managed grazing program for livestock herders, using a participatory approach, has been shown to raise the income of herding families while helping to conserve and augment the vegetation cover and wildlife in Tell Ar-Rumman. Future biodiversity conservation polices and initiatives should therefore consider introducing a similar program to promote better livelihoods for herders and enhance the sustainable growth and conservation of biodiversity.

Competing interests

The authors declare that they do not have any financial competing interests (political, personal, religious, ideological, academic, intellectual, commercial or any other) with other parties for this specific research topic.

Authors' contributions

KA had made a significant contribution to the concept and design of the research theme, he participated in data collection, analysis and interpretation the results. AA had performed data analysis and participated significantly in drafting manuscript. MA: had have been involved in drafting the manuscript and in interpretation the results. RA had participated in manuscript design, coordination and revision of this manuscript. All authors read and approved the final manuscript.

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