

RESEARCH ARTICLE

(Open Access)

Mixed crop-livestock farming in AL-Prespa: recent trends and future challenges and remedies

DORINA GRAZHDANI*

Agricultural University of Tirana, Faculty of Economy and Agribusiness, Kamëz, Tirana, Albania

Abstract

One alternative approach to diversify agricultural production is to integrate cropping with livestock production at the farm scale. Cropping, when possible, tends to become more important than animal production because, in general, it can feed more people per area unit in terms of calories and protein. In such systems, the role of wasteland grazing as a source of energy for agriculture through animals for traction and dung is often taken over by the use of resources from fossil reserves. This changing role of animals in the sustainability of agriculture is addressed in this paper to assess options and constraints for crop and animal production in crop-livestock farming system in Albanian part of Prespa Park (AL-Prespa). The paper summarizes the current state of mixed crop-livestock farming and assesses the factors affecting sustainability of crop-livestock farming, such as seasonal forage availability or suboptimal pasture utilization due to overgrazing, and emphasizes that Prespa area agriculture is essentially characterized by mixed farm operations in which crops and animals play an important part. This paper also assess future challenges, determine new opportunities, and present some remedies for sustainable intensification of crop-livestock systems, considers how the application of practices in sustainable crop-livestock farming may contribute to promoting sustainable land use and improving environment conservation, natural resource management, livelihoods of crop-livestock producers, and product quality. The taken results are encouraging.

Keywords: crop-livestock farming, sustainability, animal production, alpine meadows, tree lopping

1. Introduction

Over the last 50 years, increasing labor costs, production subsidies and a global marketplace have all contributed to farms becoming more and more specialized. The widespread availability of cheap agro-chemicals meant that traditional forms of farming could be dropped in favor of more intensive farming, resulting in higher yields and cheaper food. On the other hands, the literature [1, 2, 3, 4, 7, 8, 9, 10] provides ample evidence that well managed integrated crop-livestock systems can provide overall positive effects on soil functioning, profitability, and natural resource use.

Small-scale mixed crop-livestock farming is the backbone of agricultural economies throughout the developing world.

There are some advantages of mixed system: Diversification in the use of production resources; reduced risk; use of farm labor more completely to ensure high farm productivity, income and access to goods and services; enable integration of components which through their interactions and complementation provides to high efficiency of resource use; increase economic output; development of sustainable ecological systems that have reduced dependence on external inputs, recycling and no pollution, and are

consistent with environmental protection, and development of stable households. One of the real advantages of mixed farming is in environmental sustainability. A mixed farming system best allows us to control the flow of nutrients within our farming system and minimize our impact on the environment in the process.

Mixed farming also benefits the environment through reduced reliance on agri-chemicals. Purely arable farms tend to rely solely on artificial inputs (fertilizers, pesticides, growth regulators and herbicides) to maintain the continuous cycle of growing and harvesting crops, and purely livestock farms tend to have big problems disposing of all their slurry on a limited area of land without damaging the environment, as well as having to buy in a large proportion of their animal feed from all over the world.

The AL-Prespa practices mixed crop-livestock farming and keeps combination of livestock species integrated with wide range crops grown mainly for household consumption. Almost all of the households hold one or two cows mainly for milk, ten to fifteen chickens and a few sheep and goats. Each family owns approximately 1.4 ha, but the productivity is low due to unfertile soils. The use of pesticides and

fertilizers is considered very low, which indicates the area's potential for organic farming.

Considering the above, the main purpose of this study was to provide a synopsis of the recent issues facing, to identify the future challenges, and to suggest ways for sustainable development of mixed crop - livestock farming in AL-Prespa.

In this paper firstly, the main characteristics of case study AL-Prespa are reported. Some factors and directions for the agricultural and livestock sustainability are also investigated. Then, the livestock breeding and animal feed resources and management in study area are documented. Affordability in the area of AL-Prespa is also evaluated. Finally, the main current challenges the area's agriculture and livestock breeding faces concerning agricultural production and livestock population and productivity are presented.

2. Material and Methods

2.1. Description of study area

The study was conducted in AL-Prespa. This Park, containing the two inter-linked lakes (Macro and Micro Prespa) and their surroundings, is the first transboundary protected area in the Balkans, preserving fragile ecosystems and tending to the wellbeing of its inhabitants. Natural beauty, rich biodiversity, flora and fauna with rare and endemic species and various rare biotopes characterize its environment. It is also rich in historical and cultural values, which include prehistoric settlements, monuments and artworks from the Ancient and Byzantine period, as well as wealth of local traditions, practices, architecture and art forms.

Traditionally, the population of the region has predominantly engaged in agriculture (68%) and other farming activities such as livestock breeding, forest raising and fishing. A great number of state-owned industries have been closed down in the last decade and the ensuing fragmentation of the land into the ownership title of the rural households produced a negative impact on the development of the agricultural sector. However, not withstanding this negative phenomenon, a growing trend of small and medium sized agribusinesses is being recorded lately.

2.2. Sampling data collection, and statistical analysis

Both formal and informal surveys were conducted from October 2011 to September 2012. Secondary data from published and institutional documents were reviewed to generate baseline

information on agricultural and livestock production, marketing and institutional supports. A focused group discussion with group of farmers and key informants interview with farmers, extension workers and traders were held in respective agro-ecologies of the study area to gather detailed information on agricultural farming and livestock husbandry practices. Formal household survey was conducted using structured questionnaire administered to a total of 265 household heads randomly drawn from villages.

The household survey data were analyzed using SPSS statistical package [11].

3. Results and Discussions

3.1. Agricultural farming in AL-Prespa

Cultivated land generally spreads over sloppy terrains. For a variety of reasons, such as heights above sea level, lack of financial resources, population migration, etc., about 22% of land, is not utilized. Limited area and very fragmented agricultural land, like other regions of the country, is typical for Prespa basin region too. Each family of this community owns approximately 1.3 ha of arable land, which is fragmented in 4 -7 small plots, that creates too many problems for an effective management. There is not any initiative for land consolidation or cooperative, which creates the conditions for technology improvement and real marketing contracts. Only 25 % of the agricultural land is flat, deep and, to a certain extent, fertile. This land is lying either aside Prespa lake or among hills. The majority of arable land is shallow, stiff, less fertile and situated in slopes.

Climatic conditions, in the area, are favorable for the growth of different crops, vegetables, forager plants and some fruit trees. Because lacks of irrigation, the main crops cultivated are that, ripen up to mid summer, before the long drought starts. The wheat, maize, alfalfa, dry beans and some other vegetables for self-consumption, are the main crops that are cultivated.

According the data of the Statistic Section of the Regional Directorate of Agriculture and Food, the total agricultural land is 1789 ha (Table 1). Due to population migration and soil low fertility, more than 300 ha of arable land are not cultivated. The crop field area is planted of 653 ha cereals, 286 ha forage crops (alfalfa mainly), 12 ha vegetables and potatoes and 26 ha beans. An area of 46 ha, cultivated with fruit trees includes more than 20 ha apples and the rest plums. Prespa Basin has favorable soil and climate conditions, as well as tradition, in vineyard and wine

production. There are 150 ha of vineyards, mainly table grapes. with grapes destined for wine and about 10 ha with

Table 1. Agricultural land use in AL-Prespa

<i>Village</i>	<i>Land total (ha)</i>	<i>Cereals</i>	<i>Forage</i>	<i>Fruit tree</i>	<i>Wine yard</i>	<i>Vegetable</i>	<i>Others</i>
Pusteci	271	120	20	4	26	8	93
Shulini	144	60	10	4			65
Lajthiza	75	43	10	4	3		15
Zaroshka	123	48	28	7	9	1	30
Cerje	182	10	20	4			148
Gorica e Vogël	96	28	30	2.5	15	0.5	20
Gorica e Madhe	216	110	40	0.2	6		59.8
Tumineci	195	109	40	0.5	20	5.5	20
Gollomboci	104	30	26	15	2	1.5	29.5
Buzliqeni	53	25	17	2	3	2	4
Shueci	100	20	10	1	65	4	0
Rakicka	230	50	30	2	1	10	137
Total	1789	653	286	46.2	150	32.5	621.3
%		37	16	3	8	2	35

As result of lack of irrigation, the low fertility of the soil, low quality seeds and samplings, non-satisfactory level of agricultural services offered, obstacles in dissemination of agricultural information to the farmers and their associations, the realized agricultural yields are low. Thus, the average yield of wheat is 1.8 t/ha, in maize 1.5 t/ha, in vegetables 13 t/ha, in potatoes 16 t/ha, in forage crops 19.3 t/ha, in fruit trees 9 kg/tree and in grapes 5.9 t/ha and 2.3 t/ha forage plants.

3.2. Livestock breeding in the AL-Prespa

Livestock is very important for all the community of Prespa Basin, where an extensive way rearing animals is very common. Depending on terrain characteristics and availability of meadows/pastures of the different villages, households keep 1-2 dairy

cows and normally a small flock of sheep and/or goats. They provide fresh milk, homemade dairy products and meat for the family round the year. Rearing of calves, sheep and goats destined to livestock market are not common because the far distance from markets and lack of slotter houses, cooling and processing facilities.

In AL-Prespa, the breeding systems for the small ruminants are still traditional: exploitation of the summer and winter meadows, low grazing in the considerable area of non-cultivated agricultural land, tree lopping and a relatively limited use of concentration and dry feed. In table 2 is give a detailed situation of livestock for every village and in the total.

Table 2. Livestock population and livestock units according to the various villages

<i>Village/Commune</i>	<i>Cows</i>	<i>Sheep</i>	<i>Goats</i>	<i>Horse</i>	<i>Pigs</i>	<i>Poultry</i>	<i>Bee</i>	<i>LSU*</i>	<i>LSU/HH**</i>
Pusteci	700	800	450	320	50	700	30	1210	4.77
Zaroshka	190	390	80	20	300	20	-	381.7	4.56
Lajthiza	120	35	320	50	20	200	20	216.3	3.84
Gorica e Madhe	400	570	420	98	30	500	100	641	5.32
Gollomboçi	200	10	280	60	-	100	-	290.5	4.48
Kallamasi	500	600	250	120	40	800	200	757	4.69
Gorica e Vogël	210	400	150	70	20	450	200	366.5	6.88
Cerje	50	200	20	100		100	-	183	2.04
Shulini	320	250	790	160	40	500	20	615.5	4.99
Commune Pusteci	2690	3255	2760	998	500	3370	570	4661	4.63
Buzliqeni	70	500	150	40	300	340	-	305.2	7.24
Shueci	40	550	400	30	100	260	20	227.5	3.20
Rakicka	70	600	800	40	100	280	20	315	6.59
Commune Progëri	180	1650	1350	110	500	880	40	847.7	5.26
Total	2870	4905	4110	1018	1000	4723	610	5484	4.7

*LSU = Livestock Unit: Cows, Horse = 1; Pig = 0.35; Sheep = 0.15; Goat = 0.1; Chicken = 0.01; ** HH = household

The livestock has been summarized according LSU (international standardized systematic) and distributed accordingly HH, while it can be seen that those villages with a unit factor/HH smaller 5 are breeding and growing animals mainly for their own needs (self sustaining agriculture) and not for commercial purposes. Those above 5, such as Gorica e vogël, Gorica e madhe, Buzliqeni and Racicka have a higher economical potential and would be able to sell their products. A more intensive livestock breeding and growing activity is ongoing in the area of Micro Prespa Lake with an average of 5.26 LSU/HH.

The Prespa habitants use to grow-up those kinds of domestic animals that can better adapt to the environmental conditions in the area. Among them the most important are goats. During centuries there has been consolidated a very interesting goat, with a robust constitution, able to cover kilometers in slope rocks every day in search of fodder. Its weight is 35-40 kg, annual milk production, 100-120 l and reproduction, 120 %. Its fodder base is the oak's leaf. "Prespa black goat" represents a genetically pure material. There are no interventions aiming to improve the race. The import of some cultivated breeds as Alpine goat, Ile de France etc. has already started and some families are carrying out the breeding in the Prespa region.

The sheep arrangement continues to be still one of the main livestock activities. Until the year 1960 the common type "reckë", small body and rough wool dominated the region. A distinctive characteristic of Prespa's sheep was their black color, sign of a very resistant type. In the '60-ies of last century began the crossbreed of the region sheep with races half-rough wool, like Cigaja and Rude and was done a severe selection of the sheep with black wool because of the very poor industrial value. From 1991, when race improvement stopped to be applied, there is a predomination of sheep with half-rough wool, but there are also any with black wool, sign of the presence of the ancient genetic material. Its weight is 25-30 kg, annual milk production, 50-70 l and reproduction, 120 %.

The people of Prespa area have also arranged and cows. The cows are used for milk, meat and work. The cow type "Busha" of the region represents an animal grey in color, color which became deeper on neck and on head, very resistant and adopted to the climate of the region, similar to cow living in the mountain areas of Korça and to that of Prespa area in Greece [6]. The annual production is: milk, 1000 l and

meat, 100 kg. During these last 30-40 years there have been efforts to crossbreed it with Jersey, Oberental and others, but couldn't assimilate the cow of the region.

The main current problems the area's livestock breeding faces are as follows: Forage production, one of the main sources of livestock fodder, is not sufficient to meet the needs for livestock food even in the summer time because of the lack of irrigation water; bad experience acquired in communist times with joined community herds; high transportation costs for the distribution of the milk from the mountainous areas to the villages; livestock keeping at a small scale (8 – 10 sheep and goats, and 1 cow on the average) is not seen as profitable enough to justify the increased cost of paying a shepherd, organizing milking etc.; livestock-related work is mostly done by old people and women.

Concerning the possible future perspectives, it is estimated that the total number of sheep and goats in the research area will decrease, the total number of cows may increase or remain stable, and some farmers will enlarge their stockbreeding size and specialize their farm, increasing the number of cows and sheep rather than the number of goats.

3.3. *Animal food resources and management*

There are two factors by which livestock impact the condition of forests inside AL-Prespa: Grazing of animals (goats, sheep, and cattle) inside the forest land, and lopping of fodder (sprouts, branches and leaves) for livestock. These two practices and illegal wood cutting carried out by the local population for subsistence economy, but also for income generation (selling of firewood to communities outside AL-Prespa), have led to a severe degradation of most of the forest areas. More than 50% of the forests cannot be called forests anymore.

3.3.1. *Grazing in forestlands*

Grazing capacity of wooded lands, namely high and coppice forests as well as scrublands is generally estimated to about 1.3 SEU/ha [5]. On the contrary, the grazing capacity of pasture and meadows officially accepted is 3.66 SEU/ha.

The actual grazing capacity under the present degraded state of shrub forests and pastures, however, is estimated to be much less, about 0.9 SEU/ha. In future, some 1,000 ha of the grazed forest land bordering Greece may fall into the core protection zone of the national park, and should therefore be

excluded from the available rangeland, resulting in a livestock charge of 1.6 SEU/ha [5].

From this estimation, it is clear that the present grazing pressure is probably still too high for the generally degraded vegetation resources. A continuation of the trend of decreasing livestock numbers and/or improvement of the grazing schemes and thus the state of the pastures will be necessary to resolve this situation.

3.3.2. Lopping of branches

Dry foliage of oak branches cut in August or September are fed at a rate up to 80% of the winter diet of goats, and to a lesser extent to sheep. About 200 kg of dry branches (a small pile) is needed per animal for which an area of 600 m² has to be cut. For the estimated number of 4,110 goats a lopping area of 246 ha should be provided annually and for the 4,905 sheep another 294 ha may be needed. These cuts can be executed every 5 years on the same area. Thus, a total oak bush area of 2,700 ha should be foreseen for

lopping, which is about 49% of the 5,500 ha of oak shrubs in the park.

In future, some leaf fodder could be provided through the scheduled clear-cutting and releasing (singling of coppices) work in the managed oak stands and later on by green pruning.

3.4. Affordability in the area of AL-Prespa

In the commune of Pusteci, have been interviewed 96 households, in the commune of Progëri 44 households regarding their monthly expenses. The investigation had been conducted in order to identify the average affordability and further potential contribution into an improved systematic related to waste, wastes water and other public service provisions. The affordability will indicate the potential contribution into an improved environmental sound systematic and protection of the existing ecosystem.

Table 3. Monthly expenses per family (in Lek) in AL-Prespa

	<i>Pusteci</i>	%	<i>Progëri</i>	%
Food	8176	47.6	6739	44.6
Accommodation	388	2.3	404	2.7
Petrol/transportation	1180	6.9	676	4.5
Water consumption	381	2.2	351	12.3
Electricity/gas consumption	1536	8.9	1323	8.8
Waste services	63	0.4	167	1.1
Education	355	2.1	318	2.1
Clothes	1608	9.4	1807	7.8
Telephone	1586	9.2	1595	10.6
Social events	345	2.0	333	2.2
Saving for future	237	1.4	567	3.8
Health and treatment	861	5.0	859	5.7
Other taxes	270	1.6	247	1.6
Others	198	1.2	347	2.3
Expenses for family	17184	100.0	15106	100.0

The average number of family in Commune Pusteci is 4.47, while in that of Progër 4.63. The average expenses per family (including savings) per months are in Commune Pusteci 17184 Lek, while in that of Progër 15106 Lek (equal to 123 and 108 Euro) (Table 3). Main expenses are costs for food, followed by telephone costs, accommodation costs (electricity, gas, and water), clothes, health and treatment and fuel. Important is that between 1.4% and 3.8% of expenses are for savings for the future. All other parameters are below 4%. Participation of households on an improved infrastructure or protection of the ecosystem would be in a range of 1.8 until 2.11 Euro per family and month. Those figures show clearly, that the current situation does not allow a crucial economical participation on investment activities, but much more,

that the situation requires none-capitalized seed capital, either provided by the government or other donor organization. Soft loans can purely be handled on a private initiated base.

3.5. Future Challenges for AL-Prespa

3.5.1. Towards an Eco-friendly and Good Agricultural Practice approach

Improved infrastructure, extension of environmentally friendly production techniques, preservation of traditional products and promotion of local production to modern markets add to the picture of prosperous Prespa.

Fertilizer and pesticide use, agricultural runoff due to flood irrigation instead of drip irrigation, and

solid waste (pesticide packaging and excess crops) are the main challenges for the development of a sustainable agricultural production system. Eutrophication from excessive use of manure and other fertilizers for agriculture is considered as one of the main threats for soil quality, with consequences for the future production of crops. Sodium, phosphorus and potassium reach the lakes through soil, surface and underground waters, with a negative impact on aquatic ecosystems and fish.

The current waste management practice is improper and increases the risk for human and lakes health. Main components are mixed household waste, construction and demolition waste, and animal manure. The current insufficient waste collection and disposal practice leads to additional accumulation of 4,100 m³ wastes per year [5]. A total of 730 Mg (equal to 4,100 m³ loose) waste are disposed either backyard or on improper disposal areas, mainly close to the shore as site investigations underlined.

According Grazhdani [5], in the Prespa area can be assumed, that an amount of 25 kg N fertilization per ha is used. For an agriculture used area of totally 971.5 (653 Cereals, 286 Forages and 32.5 Vegetables) is a total amount of 24.3 Mg N-fertilization assumed. The amount of fertilizer with an average N-content of 17% is 142.9 Mg per year. Due to the high soil erosion factor of 31.7 Mg/ year / ha and the low absorptive capacity of the topsoil can a transmission of 50% into the lake be assumed. Approximate 70 Mg of N-containing fertilizer will be spilled or transmitted into the Lakes, which also explains the higher content of NH₄ and NO₃, which cannot be caused only by septic water discharge practices.

A total of 720 kg fungi-, insect- and herbicides per season [5] have been evaluated. Similar to fertilizer can a transmission into waters be assumed with a loss-factor of 50%. Most of the fungi-, insect- and herbicides are not "contact" pesticides, which would reduce the losses extremely.

Considering the above, usually the farmers use organic fertilizers and very little chemical ones (only for wheat). The same, they use very little the pesticides and other plant protection substances, only 2-3 treating at vineyards. This situation looks very like the organic farming; otherwise there is not yet any certified organic farm in the region of Prespa Lakes Basin.

The old, water-consuming, open-channel irrigation system results in high water, energy and labor consumption, higher production costs, erosion of the soil and washing down of the pollutants into the

lakes, with a negative impact on its water quality, fish stocks and avifauna. Replacement of the old irrigation system by the new, drop irrigation significantly reduces water consumption, with the reduction of all the negative effects that this entails: the cost, soil erosion, lakes' water quality.

The introduction of Good Agricultural Practice is a major contribution to informing farmers on when, why and what to do in order to secure the production of healthy and safe food, reduce their costs, and protect the environment. In practice, this means advice on the quantity of the fertilizers to be used according to the needs of the specific plant and the quality of the soil, based on soil analysis, and application of pesticides as a reaction to precise information on the conditions that favor certain diseases and insects. The necessary information is provided by the newly established agrochemical laboratory for soil and plant testing, and by agrometrological stations that are set up in AL-Prespa. UNDP installed recently a metrological data logger system, which allows using fertilizer and pesticides in accordance to provided data. 4 stations have been installed and are webpased.

3.5.2. *Improving pasture productivity and utilization of alpine meadows*

The most inexpensive and effective method of improving pasture productivity is the application of proper grazing management. Such a management involves: a) employment of a stocking rate equal to grazing capacity, namely grazing the pastures with the proper number of animals; b) use of animal species suitable to the type of pastures; c) grazing in the proper period (season) of the year; and d) grazing for as long as available forage exists (duration of grazing).

For decades the alpine meadows of AL-Prespa have been used by the local population as pastures during the summer months. The over-grazing of sub-alpine and alpine meadows detrimentally affected the naturally fragile alpine ecosystems that are now situated in the AL- Prespa. The practice to take up large numbers of animals attended by shepherds was exercised in an organized way during the socialist time. The system has been given up as after the political changes individual property of and care for cattle became very important, the necessary infrastructure (huts, water reservoirs) decayed and looking after the livestock became a task of elder family members who are not in the position to stay out with the animals for a longer time. The drift up from

the lowlands to the alpine meadows is still visible in the field. Advantages of grazing on alpine meadows are: Higher quality of milk (because grass is better, milk smells nicer); possibly higher productivity; less moving of livestock can lead to faster growth, more meat; healthier animals etc. The measure would contribute to protect the (biodiversity) status of the alpine meadows and at the same time reduce the grazing and lopping pressure on the forest considerably.

In the last decades, the pressure on the alpine meadows has strongly diminished. So, sub-alpine and alpine meadows have regained their original grazing potential.

It has been investigated how feasible it is to reactivate alpine pastures for livestock grazing from the socio-economic perspective. Infrastructure needed on alpine meadows is: Maintain and establish water ponds; overnight place for shepherd; footpath if not available, some road, and infrastructure for cheese production: drinking water; production and cool storage place for making cheese (milk factory in the villages). There is no tradition of making cheese on sub-alpine meadows. It has been suggested to repair 10, and to construct 4 water reservoirs. The standard costs for reparation of a water reservoir according to the norms book are €2,500, without 10% administrative costs, 20% VAT, and without 10% of profit. The standard costs for building a new water reservoir according to the norms book are €4,250, without 10% administrative costs, 20% VAT, and without 10% of profit. The second important measure is the construction of facilities to allow for a permanent stay on the meadows for several months together with the herds. For this reason is needed the construction of 10 shepherd huts and 20 corrals. In former times, military tents were used.

4. Conclusions

Mixed crop-livestock farming in the area, the way it is practiced, causes a series of problems to the local natural environment: Continuing high active practice of tree lopping for the assurance of winter animal fodder, mostly for goats, which causes soil erosion and compaction, the destruction of natural tree regeneration and the removal of the water-retaining vegetative ground layer; grazing in strictly protected zones; overgrazing and cultivation of the areas close to the lakeside accelerating the erosion and siltation process; local races, like Busha cattle or Prespa black goat, which are of high ecological value for the Prespa

Park, are losing their ecological value due to the existing cross-breeding system.

We suggest that integrated crop-livestock systems should be encouraged in the Prespa region, and we hypothesize such systems will be economically competitive and less environmentally harmful. Moreover, crop-livestock farming system is amenable to production of differentiated products (e.g., organic or natural labels), which can provide additional marketing opportunities beyond the conventional commodity markets that are so common with traditional grain or confinement livestock operations.

5. References

1. Abdelgali E A, Cohen S I: **Modeling Livestock Activities and Environmental Sustainability: The African Case.** *Journal of Environmental Protection* 2010., **1**: 1-9.
2. de Koeijer T. J.; Renkema J. A.; van Mensvoort J. J. M: **Environmental-Economic Analysis of Mixed Crop-Livestock Farming.** *Agricultural Systems* 1995. **48** (4): 515-530.
3. Herrero M, Thornton P K, Notenbaert A M, Wood S, Msangi S, Freeman H A, Bossio D, Dixon J, Peters M, van de Steeg J, Lynam J, Parthasarathy R. P, Macmillan S, Gerard B, McDermott J, Seré C, and Rosegrant M: **Start Investments in Sustainable Food Production: Revisiting Mixed Crop-Livestock Systems.** *Science* 2010, **327** (5967): 822-825.
4. Hilimire K: **Integrated Crop/Livestock Agriculture in the United States: A Review.** *Journal of Sustainable Agriculture* 2011, **35**(4): 376-393.
5. Grazhdani D: **Trends and Opportunities for Sustainable Development and Intergraded Management of Ecosystem in Transboundary Prespa Park Region.** PhD thesis, p.167. 2013.
6. Grunenfelder H P: Prespa cattle: Identification and possible conservation measures. Monitoring Institute for Rare Breeds and Seeds in Europe. p.9. 2006.
7. Rigby D, and Caceres D: **Organic farming and sustainability of agricultural system.** *Agricultural Systems* 2001, **68**: 21-40.
8. Ronchi B, and Nardone A: **Contribution of organic farming to increase sustainability of Mediterranean small ruminants' livestock systems.** *Livestock Production Science* 2003, **80**: 17-31.

9. Schiere J B, Ibrahim M N M, van Keulen H: **The role of livestock for sustainability in mixed farming: criteria and scenario studies under varying resource allocation.** *Agriculture, Ecosystems and Environment* 2002, **90**: 139-153.
10. Thornton P K, and Herrero M: **Integrated crop–livestock simulation models for scenario analysis and impact assessment.** *Agricultural Systems* 2001, **70** (2 -3): 581-602.
11. SPSS Version 16.0: **Software Package for Social Sciences for Window.** 2011