

Peyman Azar et. al

Investigation and Analysis of Economic Value from the Production of Medicinal Plants in Comparison With the Income from the Production of Forage Plants

Investigation and Analysis of Economic Value from the Production of Medicinal Plants in Comparison With the Income from the Production of Forage Plants

(A case Study: Larijan Rangelands, Amol City)

Peyman Azar

Ph.D Student of Department of Natural Resources, Nour branch, Islamic Azad University, Nour, Iran.

(Corresponding author)

Tell: 09113927699

Email: Peymanazarr67@yahoo.com

Dr.Mohammad Mahdavi

Professor of Department of Natural Resources, Nour branch, Islamic Azad University, Nour, Iran.

Tell: 09113111210

Email: khosro.mahdavi@gmail.com

Dr.HassanGhelichnia

Associate Professor of Forest and Rangeland Research, Mazandaran Agricultural and Natural Resources Research Center, Agricultural Research, Education and Extension Organization, Sari, Iran

Tell: 09113272115

Email: ms_ghelichh@yahoo.com

Investigation and Analysis of Economic Value from the Production of Medicinal Plants in Comparison With the Income from the Production of Forage Plants

(A case Study: Larijan Rangelands, Amol City)

Abstract:

In the rangelands, in addition to plants that are involved in forage production, there are other valuable species that are important from the pharmaceutical and industrial point of view, and if scientifically recognized, cultivated, developed and properly exploited. They can play an important role in public health, employment and non-oil exports, so that with economic valuation, their true value can be realized to some extent, and more than before the destruction and improper use of these lands. Natural as the native habitat of these plants. The aim of this study is to investigate and analyze the economic value of medicinal plants in comparison with the income of forage plants in Larijan rangelands. For this purpose, in three plant types in the region, in the form of homogeneous transects, plots were established and the production of medicinal plants and forage were studied. The results showed that on average per hectare of rangelands in the region if forage is produced about 1249496 Tomans per hectare per year and if these rangelands are allocated to the production of medicinal plants about 691472 Tomans per hectare in the year will bring income for the rangers of the region. Paying attention to these numbers shows that if it is possible to develop and expand the cultivation of medicinal plants in the region, the economic benefit will bring about 5.4 times more economically for ranchers and ranchers.

Keywords: Larijan, Rangeland Ecosystem, Fodder Production, Medicinal Plant Production, Economic Interest

Tob Regul Sci.™ 2022;8(1): 3911-3926

DOI: doi.org/10.18001/TRS.8.1.296

Introduction

It is not possible to deny the importance of natural resources and the vital role they play in the development. Estimates show that rangeland, agricultural lands, commercial forests, and permanent glaciers cover about 47, 10, 28, and 25% of Earth's surface, respectively (Azarnivand and Chahoki, 2014). Rangeland ecosystems are among the largest ecosystems in Iran but, unfortunately, most of this kind of ecosystem is used as grazing land and overgrazing on rangelands has often changed the quality and quantity of their plant cover and has also increased the desertification phenomenon (Karami et al., 2018). Rangelands are among the most important sources providing fodder to increase animal products and the major part the feed required by light livestock in Iran is produced on these natural land areas. In addition to playing an effective role in the production of animal products, rangelands have other benefits. They produce medicinal and industrial plants, provide recreational spaces, protect the environment, soil and wildlife, and conserve water (Mesdaghi, 2008). Economically speaking, the values of rangelands are not limited to fodder production but also include other products. Calculations have indicated that each hectare of rangeland has the annual value of about \$ 232 with fodder production accounting for about 24.5% and environmental values (such as conservation of soil and water resources, large-scale removal of greenhouse gases from the atmosphere, waste disposal, pollination, biological control, etc.) for 75.5% of the total value (Mesdaghi, 1979). In addition to fodder plants, there are other

valuable species in rangelands that are pharmaceutically and industrially important and, if suitable actions are taken for their correct development and utilization, can play an important role in public health, job creation and non-oil exports (Jangjoo et al., 2007). Diversity of bioclimates in various parts of the county has allowed a considerable number of diverse species of medicinal plants and plants with essential oils to adapt themselves to the ecological stresses in the environment over the years and enjoy broad adaptation (Mozaffarian, 2012). Various species of medicinal plants are being identified worldwide each of which can have various applications. Therefore, any species of medicinal plants is considered a multi-purpose commodity in economy, especially in rangelands. Economic valuation can make it somewhat possible to understand the actual value of medicinal plants in rangelands and to prevent the ever increasing degradation and indiscriminate utilization of these natural lands as their native habitat. This research conducted a feasibility study for economic justification of medicinal plants compared to fodder plants so that effective steps can be taken to protect the valuable species of medicinal plants while making optimal utilization of them in rangelands by planting, developing and correctly utilizing them with an emphasis on job creation for rangeland owners. Many studies have been carried out in various areas of the world to determine the economic value of the byproducts of rangelands compared to that of fodder production in them. Some of them are mentioned here. In their study of the economic values of medicinal plants in Sinkchal and Viserrangelands in Aradan County as an opportunity for empowering rangeland utilizers, Karami et al. (2018) estimated that the economic values of these two rangeland areas were IRR 3,467,240,000 and IRR 2,943,616,000, respectively. They also concluded that these very large figures indicated the importance of better protection of natural resources and added that attention to sustainable multiple use of rangelands could create an opportunity for empowerment of the local communities and rangeland utilizers. Ghanbari (2019) studied production of fodder, truffle mushrooms and foxtail lilies (*Eremurus*) in rangelands of West Azerbaijan Province. They reported that the mean income from production of truffle mushrooms and foxtail lilies in the studied region for all the annual harvests was IRR 838,053, whereas the economic profit of producing fodder was IRR 15 million for each household per year. They concluded that, considering the byproducts of producing truffle mushrooms and foxtail lilies in the region, their production increased job opportunities and also could play an effective role in improving the economic situation of the rangeland utilizers. Mythili and Shylajan (2003) studied the role of minor forest and rangeland products in the income and economy of the utilizers in some regions in India and concluded that the financial resources obtained from these minor products decreased the dependence of the local communities to the forests and rangelands, the level of this dependence on the social status and the legal conditions for harvesting the minor products differed and lack of sustainable management of forests and land use change in forested areas were only due to insufficient knowledge of the products and services that forests and rangelands provided on local, regional and global scales. Morjandino et al. (2004) evaluated the income resulting from rangeland plants and stated that the mean economic rent of the studied

Investigation and Analysis of Economic Value from the Production of Medicinal Plants in Comparison With the Income from the Production of Forage Plants

rangelands varied from \$73 to \$ 117/ hectare / year. These differences were caused by soil fertility, method of utilization, etc. O'Connell et al. (2006) studied the economic value of the rangelands in Western Australia and stated that the economic rent of the rangelands in this part of Australia was about \$77/hectare/year. Webster and Sanderson (2009) reported that the economic value of rangeland-derived products in New Zealand was \$10.2 million per year and the products obtained from the rangelands directly influenced the income of rangeland utilizers and contributed about \$5.2 million to the GDP of this country (constituting an important part of the economy of this country). Timmermann and Smith (2019) studied the effects of harvesting commercial medicinal plants on changes in the livelihood situation of utilizers in Himalayan highlands in Nepal and reported that the byproducts of interest (medicinal plants) in forests and rangelands could play a considerable role in the economic status and livelihood of the local utilizers (accounting for about 58% of their annual income) through finding a consumer market and establishing an economic safety network(Khosravi and Mehrabi, 2005, Mirdeylami et al., 2010, Atri et al.,2011, Zakeri et al., 2014, Mostafa'i, 2015, Raoufi-Rad et al., 2016).

Research method

Considering the objectives of the study, the following steps were included in it:

1.The rangeland areas of interest were selected.The study region is located in along the Alborz mountain range with longitude 52°26' E and latitude35°49'N in Larijan District, 100 km southwest of Amol County, Mazandaran Province. This region, which has an area of about 3400 ha, is considered a mountainous rangeland area serving as a summer resort for the nomads and constituting a part of the Lar Watershed with an altitude range of 2360-2950 m.

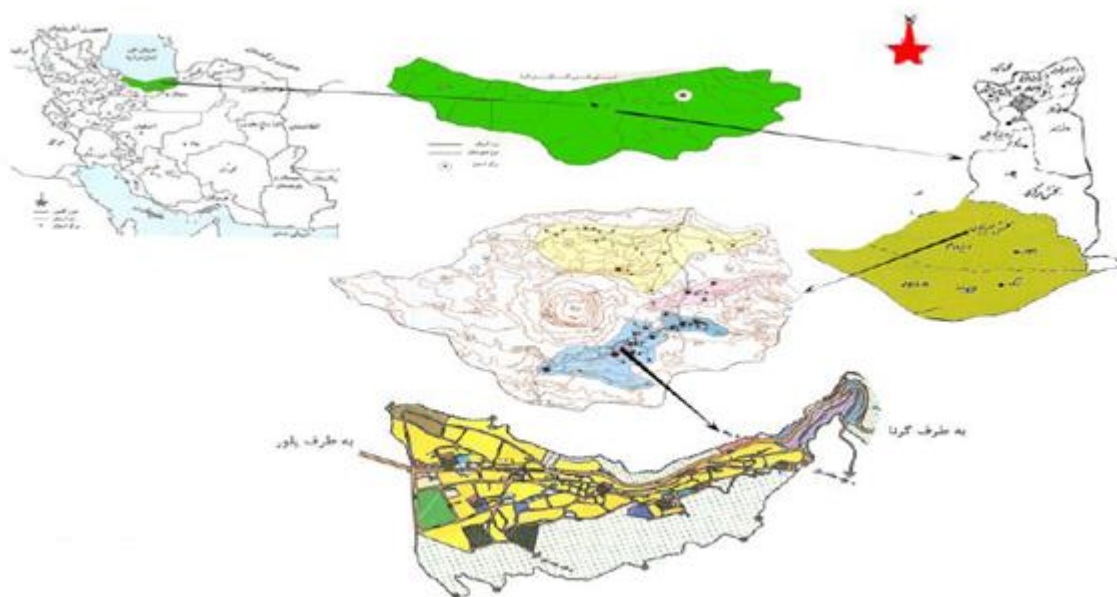


Figure 1: The study region located in Mazandaran Province, Iran



Figure 2: A view of the plots and transects selected for studying percent vegetation cover and plant production in the study region

2. The crown cover percentage and the number of bases in each plot were determined. After measuring the structural indices of the vegetation, production (the number of organs/the utilized product) for each species of the medicinal plants and of the species producing byproducts in the plots was measured. Finally, rangeland condition in the study region for each habitat was determined using the modified four –factor method. Rangeland condition and trend for each habitat was specified by giving scores to the signs of regression in vegetation and soil employing the rangeland trend scale for the studied year (Arzani et al., 2008, Sharifi et al., 2013).

3. The economic indicators were estimated. In addition to calculating the economic indicators related to utilizing the produced fodder and keeping livestock (animal products) in the study region, the economic indicators associated with medicinal plants were also calculated for the following purposes:

3.1. The sale prices of medicinal plants and their byproducts and also of the produced fodder and animal products were estimated. The produced rangeland fodder is economically a heterogeneous product (i.e. its price is determined based on its species, class of palatability and nutritional value) exchanged in an organized market (Heshmatol Vaezin et al., 2010; Raoufi-Rad et al., 2016; Lalman, 2000). Therefore, the replacement cost method (the price of barley for the equivalent weight of fodder) was used to estimate its price. Considering the comparison of the characteristics of barley and the fodder (its species, class of palatability and nutritional value), the quantity of fodder produced in the habitats located in the study region was multiplied on average by 0.7 of the TDN for barley on average to obtain the TDN for the fodder (Eskandari et al., 2008).

3.2. The household annual net income and economic profit were calculated. The net income from 100 head of cattle, sheep, etc. and the mean annual net profit from livestock (and hence the annual net profit of the utilizer) were calculated using the following Relations:

$$T_{ppi} = f(S_i, X_{si}, X_{bi}, Li) \quad (\text{Relation 1})$$

Here, the total production of the stockman (animal products and produced livestock) is a function of the total number of livestock the stockman has, the amount of available rangeland fodder, the workforce, and the amount of barley of fodder the stockman obtains from outside the rangeland (Rastegar et al., 2013; Kopahi, 2006; Amirnezad, 2007; Jalilian, 2010).

3.3. The expected value of the rangelands (i.e. the current total of the annual net profit per unit area, also called the economic rent, multiplied by the number of hectares under the production of a given product) determines the expected value of the rangelands (Faustmann, 1995). To calculate the value of each hectare of the studied rangeland producing medicinal plants and byproducts or producing and storing fodder, the economic rent was divided by the actual discount rate in the following Relation (Heshmatol Vaezin et al., 2010):

$$REV = \frac{ER}{r} \text{ (Relation 2)}$$

Results

In general, the following three plant types can be observed in the rangelands that form the summer resort in the study region:

1. *Astragalus gossypinus*-*Thymus pubescens*
2. *Bromus tomentellus*- *Astragalus gossypinus*-*Festuca ovina*
3. *Onobrychis cornuta*- *Bromus tomentellus* – *Thymus pubescens*

Table 1: Information on topographic features and soil for plant types constituting the vegetation

Names of plant types	Altitude range (m)	Dominant slope (%)	Dominant orientation	Land unit	Percentage of crown cover	Percentage of rocks and pebbles	Percentage of litter	Percentage of bare land
<i>Astragalus gossypinus</i> - <i>Thymus pubescens</i>	2400-2700	50	South East	high mountains	64/2	12/8	10/8	12/2
<i>Bromus tomentellus</i> - <i>Astragalus gossypinus</i> - <i>Festuca ovina</i>	2600-2800	45	South West	high mountains	65	10/4	9/6	15

Onobrychiscornuta					high				
- Bromus tomentellus- Thymus pubescens	2500-2800	40	East	mountains	68/3	10/9	8/7	12/10	

As shown in Table 1, the studied rangelands are located in the 2400-2800 m altitude range. The plant type

Onobrychiscornuta- Bromus tomentellus- Thymus pubescens forms most of the percentage of crown cover, and the plant types Astragalus gossypinus- Thymus pubescens and Onobrychiscornuta- Bromus tomentellus- Thymus pubescens are found on the steepest and least steep slopes, respectively. The results of the four-factor method indicated that all three plant types are in good condition and the tendency of the rangelands was towards the positive. They suggest that somewhat effective measures have been taken to optimally use the rangelands in the study region.

4. The expected value of each hectare of the rangeland in the study region was calculated (assuming that the medicinal plants were utilized). The results indicate that the estimated economic rent resulting from utilization of the medicinal plants in the studied rangelands for the plant type Astragalus gossypinus-Thymus pubescens for each harvest period would be about IRR 39,455,830/hectare. The expected value of utilizing the medicinal plants in the study region considering the discount rate of 5.4% in the last month of summer in 2020 was IRR 7317040/hectare (Table 2).

Table 2: The expected value of utilizing the medicinal plant in the study region in the plant type Astragalus gossypinus-Thymus pubescens

Name of medicinal plant	Economic rent)IRR/hectare/year(expected value)IRR/hectare(marketing margin coefficient (%)
Achillea aucheri	-	-	16
Achillea millefolium	205992	38146	8
Falacaria vulgaris	93630	17339	-
Galium verum	168536	32210	6
Malva sylvestris	75625	14004	-
Nepeta crassifolia	56178	10430	7

Name of medicinal plant	Economic rent)IRR/hectare/year(expected value)IRR/hectare(marketing margin coefficient (%)
Papaver bracteatum	224712	41613	11
Salvia hypoleuca	430698	79759	-
Stachys lavandufolia	599232	110969	30
Taraxacum syriacum	262164	48549	15
Teucrium polium	32210	5779	-
Thymus pubescens	1161012	215002	57
Tragopogon graminifolius	149808	27742	3
Verbascum agrimonifolia	486786	90162	12
total	3945583	731704	

As shown in Table 2, the highest economic rent and expected (economic) value in the plant type *Astragalus gossypinus*-*Thymus pubescens* were those of *Thymus pubescens* and *Stachys lavandufolia* and the lowest those of *Teucrium polium*.

The results indicate that the estimated economic rent resulting from utilization of the medicinal plants in the studied rangelands in the plant type *Bromus tomentellus* -*Astragalus gossypinus*-*Festuca ovina* in one harvest period was about IRR 44511860/hectare/year. The expected value per hectare of the rangelands for this plant type in the study region would be about IRR 7316990/hectare if the medicinal plants were utilized and the discount rate in the last month of summer in 2020 was 5.4% (Table 3).

Table 3: The expected value of utilizing the medicinal plant in the study region in the plant type *Bromus tomentellus* -*Astragalus gossypinus*- *Festuca ovina*

Name of medicinal plant	Economic rent (IRR/hectare/year)	expected value (IRR/hectare)	marketing margin coefficient(%)
<i>Achillea aucheri</i>	593630	17339	-
<i>Achillea millefolium</i>	187260	34678	12
<i>Falacaria vulgaris</i>	56178	10403	12
<i>Galium verum</i>	93630	17339	15
<i>Malva sylvestris</i>	93630	17339	17
<i>Nepeta crassifolia</i>	74904	13871	13
<i>Papaver bracteatum</i>	243438	45081	17
<i>Salvia hypoleuca</i>	393246	72823	11
<i>Stachys lavandufolia</i>	505602	93630	10
<i>Taraxacum syriacum</i>	205986	38145	10
<i>Teucrium polium</i>	93630	17339	12
<i>Thymus pubescens</i>	1554258	287825	14
<i>Tragopogon graminifolius</i>	74904	13871	12
<i>Verbascum agrimonifolia</i>	374520	69355	16
total	4451186	731699	

Table 3 shows that the highest economic rent and expected (economic) value in the plant type *Bromus tomentellus* -*Astragalus gossypinus*- *Festuca ovina* were those of *Thymus pubescens* and *Achillea aucheri* and the lowest those of *Falacaria vulgaris*. The results related to the estimated economic rent resulting from utilization of the medicinal plants in the studied rangelands in the plant type *Onobrychis cornuta*- *Bromus tomentellus*-*Thymus pubescens* in one harvest period was about IRR 30938040/hectare. The estimated expected value of each hectare of the rangelands in the study region was IRR 6110130/ hectare if the medicinal plants were utilized and the discount rate in the last month of 2020 was 5.4% (Table 4).

Table 4: The expected value of utilizing the medicinal plant in the study region in the plant type *Onobrychis cornuta*- *Bromus tomentellus*-*Thymus pubescens*

Analyses the	Medicinal plant	Economic rent	expected value	marketing margin coefficient	related to
)IRR/hectare/year)IRR/hectare((%)	
		IRR 6110130			
	<i>Achillea aucheri</i>	299616	55484	-	
	<i>Achillea millefolium</i>	149808	27742	12	
	<i>Falacaria vulgaris</i>	-	-	12	
	<i>Galium verum</i>	112356	20807	15	
	<i>Malva sylvestris</i>	-	-	17	
	<i>Nepeta crassifolia</i>	341082	63136	13	
	<i>Papaver bracteatum</i>	205986	38145	17	
	<i>Salvia hypoleuca</i>	-	-	11	
	<i>Stachys lavandufolia</i>	561780	104033	10	
	<i>Taraxacum syriacum</i>	280890	52017	10	
	<i>Teucrium polium</i>	-	-	12	
	<i>Thymus pubescens</i>	1067382	197663	14	
	<i>Tragopogon graminifolius</i>	56178	10403	12	
	<i>Verbascum agrimonifolia</i>	224712	41613	16	
	total	3093804	611013		

information in the above table demonstrate that the highest economic rent and expected (economic) value were those of the plant species *Thymus pubescens* and *Stachys lavandulifolia* and the lowest those of the plant species *Tragopogon graminifolius*.

5. The expected value of each hectare of the rangelands in the study region was estimated assuming that the fodder plants were utilized. Study of the results indicated that the economic rent resulting from utilizing the fodder produced in the rangelands of the study region in one harvest period in the plant type *Astragalus gossypinus*-*Thymus pubescens* was IRR 7623590/hectare/year, and the estimated expected value of each hectare of the rangelands in the study region resulting from fodder production was IRR 1411770/hectare assuming that the discount rate in the last month of summer in 2020 was 5.4%. In addition, the estimated economic rent resulting from utilization of the produced fodder in the rangelands of the study region for the plant type *Bromus tomentellus*-*Astragalus gossypinus*-*Festuca ovina* in one harvest period was IRR 6583880/hectare/year, and the expected value of each hectare of the rangelands in the study region resulting from fodder production would be IRR 1219230/hectare assuming that the discount rate in the last month of summer in 2020 was 5.4%. The economic rent resulting from fodder production in the rangelands of the study region for the plant type *Onobrychis cornuta*-*Bromus tomentellus*-*Thymus pubescens* in one harvest period was IRR 6771020/hectare and the estimated expected value of each hectare of the rangelands in the study region resulting from fodder production would IRR 1253890/ hectare assuming the discount rate was 5.4% in the last month of summer in 2020 (Table 5).

Table 5: The expected value resulting from fodder production in the rangelands of the study region

Plant type	Economic rent IRR/hectare/year(Expected value)IRR /hectare(
<i>Astragalus gossypinus</i> - <i>Thymus pubescens</i>	762359	141177
<i>Bromus tomentellus</i> - <i>Astragalus gossypinus</i> - <i>Festuca ovina</i>	658388	121923
<i>Onobrychis cornuta</i> - <i>Bromus tomentellus</i> - <i>Thymus pubescens</i>	677102	125389

Table 5 shows that, if the rangelands are used for producing fodder, the highest economic rent and expected value would be those of the plant type *Astragalus gossypinus*-*Thymus pubescens* and the lowest those of the plant type *Bromus tomentellus*-*Astragalus gossypinus*- *Festuca ovina*.

Discussion and conclusion

Rangeland vegetation provides many services, and each of these services may have much greater value than that of fodder production, which is prominent due to the relationship fodder has with the life of communities ([Kamaljit, 2006](#)). The increasing problems resulting from degradation and indiscriminate use of natural resources, especially in rangeland ecosystems, have forced the managers and decision makers of these natural areas to be diligent in making macro- and national-level plans for the conservation and sustainable development of these God given gifts. For this purpose, special attention has been paid to the issues facing ecological economics in various ecosystems, especially in rangeland ecosystems. As a complementary income source and also a source for providing food materials, the byproducts play a prominent role in daily life welfare of the local people in various regions (Thadani, 2001). Given the increasing trend in human population on the one hand and the inability of the animal husbandry sector to create sufficient employment on the other hand, it is very important to pay attention to the byproducts in rangelands in the world, especially for small landowners or those who are not landowners. The Improving the economic conditions of these groups of people in local communities accelerates realization of sustainable development (Shahabi, 2003).

Studies have revealed that production of the three plant types in the rangelands of the study region amounts to 199.7 kg/hectare on average. The results indicated that the related economic rent in the rangelands of the study region was IRR 38,301,910/hectare/year on average, and the mean expected economic value resulting from it was IRR 6914720/hectare.

A quick look at the expected value of fodder and medicinal plants in this research shows that the value of the produced medicinal plants is about five times more than that of fodder plants on average indicating the potential capability of the region for production of medicinal plants, the necessity of paying attention to this issue in rangelands that have this potential, and the advisability of the change in land use from grazing land to areas for production of medicinal plants. Although a little more quantity of fodder are produced in the study region than medicinal plants, but the high economic value of medicinal plants allows to achieve greater economic income by planting them instead of producing fodder. Several researchers worldwide have conducted research in this relation. Heshmatol Vaezin et al. (2010) estimated the mean economic rent resulting from the rangelands in Maku city was IRR 279,300/hectare/year. Zakeri et al. (2014) estimated that the royalty for fodder crops was IRR 541,500/hectare/year and IRR 8,000,000/hectare/year for licorice. Mostafani (2017) reported that the most profitable land use at equal costs was production of medicinal plants followed by husbandry and beekeeping. He introduced utilization of medicinal

Investigation and Analysis of Economic Value from the Production of Medicinal Plants in Comparison With the Income from the Production of Forage Plants

plants and beekeeping among the potential land uses in the study region that had the potential to offset the economic and ecological damages inflicted by animal husbandry and to serve as complementary, supplementary and even alternative economic and ecological solutions. Raoufi-Rad et al. (2016) estimated that the net income of each rural household from harvesting fodder was IRR 106 million/year (765 of the annual income of the household), and the net income of each household from harvesting two types of tragacanth was IRR 11,781,000 million (8.47% of the annual household income). Their results concerning these two activities created 120 and 68 jobs in the region, respectively. They added that utilization of tragacanth was a profitable economic activity that, together with other rangeland products such as fodder, played an important role in the local and regional economy and, in addition to creating jobs each year, reduced degradation of rangelands and their conversion into rainfed agricultural lands. Karami et al. (2018) estimated the economic values of medicinal plants in Sinkchal and Vise rangelands in Aradan County to be IRR 3467240000 and IRR 2943616000, respectively. They stated that these large figures better expressed the importance of protecting the natural resources, and added that attention to sustainable use of the multipurpose capabilities of the rangelands could create an opportunity for empowerment of local communities and rangeland utilizers. Ghanbari (2019) studied production of fodder, truffle mushrooms and foxtail lilies (*Eremurus*) in rangelands of West Azerbaijan Province. They reported that the mean income from production of truffle mushrooms and foxtail lilies in the studied region for all the annual harvests was IRR 838,053, whereas the economic profit of producing fodder was IRR 15 million for each household per year. They concluded that, considering the byproducts of producing truffle mushrooms and foxtail lilies in the region, their production increased job opportunities and also could play an effective role in improving the economic situation of the rangeland utilizers. Webster and Sanderson (2009) reported that the economic value of rangeland-derived products in New Zealand was \$10.2 million per year and the products obtained from the rangelands directly influenced the income of rangeland utilizers and contributed about \$5.2 million to the GDP of this country (constituting an important part of the economy of this country). Bishnu et al. (2016) stated that attention to medicinal plants as a byproduct in the study region during a two-year period increased the income of the stakeholders in the local communities by 10% and decreased the number of low-income groups in the region by 15%. Timmermann and Smith (2019) stated that the byproducts of interest (medicinal plants) in rangelands and forests located in the Himalayan highlands in Nepal could play a considerable role in improving the economic status and livelihood of the local utilizers (accounting for about 58% of their annual income) through finding a consumer market and establishing an economic safety network. The results of this section of the research are in agreement with those of the researchers mentioned above who stated that production of medicinal plants had greater economic value compared to production of fodder crops in some rangelands and/or attention to production of medicinal plants along with fodder plants in the traditional animal husbandry systems was an effective step in improving the economic conditions of utilizers of rangelands. These

steps can be taken in the study region of the present research also by allocating a part of the rangelands with high production potential for medicinal plants compared to fodder plants on a wide scale and in an organized way to improve the current conditions. Studies also show that at present this is taking place on a limited scale and unsystematically by some of the utilizers in the study region.

References

1. Amirnezad, Hamid, Determining the Total Economic Value of the Forests in Northern Iran with an Emphasis on Environmental-Ecological Valuation (Case Study: the Forests in Nowshahr), PhD Thesis in Agricultural Economics, College of Agriculture, Tarbiat Modares University, 2005, 136 pp.
2. Arzani, Hossein; Azarnivand, Hossein; Mehrabi, Ali Akbar; Nikkhah, Ali; Fazel Dehkordi, Laila, the Minimum Area of Ppasture Required by Ranchers in Semnan Province, the Journal Research and Construction in Natural Resources, 2007, volume 20, No. 1, pp. 107-113.
3. Arzani, M., 1997, Guidelines for the National Plan for the Evaluation of Iran's Different Climatic Ranges, Jangal Va Mata (Forests and Pastures) Publications, 1997, 75 pp.
4. Atri, M., Savadkouhi, F., Akbarzadeh, M., 2011, Introduction of Medicinal Plants in the Summer Resort Rangelands of the Gadook Region, Mazandaran Province, the publication Understanding Medicinal Plants and Their Application, volume 1, No. 3, pp 9-14.
5. Economic Study of Anghuzeh Species Harvest in Tabas Region, Khosravi, H., Mehrabi A., 2005, the Journal Natural Resources of Iran, volume 58, No. 4, pp. 933-944.
6. Eskandari, N. Mahdavi, F., Alizadeh, A., Rangeland Policies in Iran, Pune Publications, 190 pp.
7. Faustmann, M. 1995. "On the determination of the value which forest land and immature stands possess for forestry". Journal of Forest Economics, 1(1):7-44p.
8. Ghanbari, S., 2019, Valuation of Economic Production Functions of the Rangelands in West Azerbaijan Province, the First International Conference and the Fourth National Conference on Protecting the Natural resources and the Environment, University of Mohaghegh Ardabili, Ardabil, Iran.
9. Heshmatol-Vaezin, M., Ghanbari, S., Tavali, A., 2010, Evaluation of the Income from the Production of Fodder and Byproduct of *Eremurus olgae* in the Pastures of Khazengah Area of Mako City, the Pasture and Watershed Scientific Research Publication, 63(2): 183-195.
10. Hossein Arzani, Mehdi Abedi, Rangeland Assessment, Measuring Vegetation (Volume 2), University of Tehran Printing and Publishing Institute, 2015, 306 pp.
11. Hossein Arzani, Sayeda Khadija Mahdavi , Ali Nikkhah, Hossein Azar Nivand, Determining the Size of Livestock Unit and Daily Requirement of Sheep of Dalaq Breed in Aq Qala Pastures, 2006, volume 13 (3): 236-247 pp.

12. Jalilian, N., Economic Valuation of Medicinal Plants of Shirkoh Area in Yazd City, National Conference of Medicinal Plants, University of Mazandaran, Sari, 2010.
13. JangjouBarzal Abadi, M. and M. Ghorbani, A New Approach for Economic Evaluation of the Range Management Projects in Iran, Journal of Rangeland, 2007, volume 1, No. 3, pp.292-307.
14. Kamaljit•k.2006. Multiple Land use in Tropical Savannas: Concepts and Methods for Valuation. Journal of Agricultural•1:90-95.
15. Karami, A., Ghorbani, M., Azarnivand, H., Rafiei, H., 2018, Estimation and Analysis of the Economic Values of Medicinal Plants as an Opportunity for Empowering Rangeland Utilizers (Study Region: Sinkchal and Viser Rangelands, Aradan County), International Conference of Society and the Environment, University of Tehran.
16. Kopaei, M., 2008 Principles of Agricultural Economy, University of Tehran Publications, 509 pp.
17. Lalman, D. L., Taliaferro, C. M., Epplin, F. M., Johnson, C. R., Wheeler, J. S. 2000. Review: Grazing Stockpiled Bermudagrass As An Alternative to Feeding Harvested Forage. Journal of Animal. Sciences, 79(1):1-8.
18. Manjardino, M., Pannell, D.J., Powles, S.B.2004. The Economic Value of Pasture Phases in the Integrated Management of annual ryegrass and wild radish in a western Australian farming system. Australian Journal of Experimental Agriculture, Vol 44:256-271pp
19. Mesdaghi, M., 1998, Rangeland Management in Iran, Astan-e Ghods Publications, 257 pp.
20. Mesdaghi, M., 2009, Principle and Methods of Rangeland Management (translation), University of Tehran Publications, 736 pp.
21. Mohammad Ali Zarechahoki, Hossein Azarnivand, Pasture Ecology, 2014, 345 pp.
22. Mohammad Esmail Ahangarian Abhari and Javad Nasr, Determining Livestock Unit and Daily Fodder Requirement of Zel Sheep Breed using Mazandaran pastures (case study: West Mazandaran), the Journal Natural Resources of Iran, 2004, 58(2); 448-457.
23. Mostafa'i, A., 2015, Economizing Exploitation of Pasture with Multiple-Purpose in Line with Sustainable Development, the International Conference Centered on Agriculture, the Environment and Tourism, Tabriz, Iran.
24. Motamedi, J., Arzani, H., Jafari, M., Farahpour, M., Zare Chahoki, M. A., 2019, Presentation of a Model for Estimating Long-Term Grazing Capacity in Rangelands, the Iranian Journal of Range and Desert Research, 26 (1):241-259.
25. Mozaffarian, V., Identification of the Iranian Medicinal Plants, third edition, Farhang Moaser Publications
26. O'Connell, M., Young, J., Kingwell, R.2006. The Economic Value of Saltland Pastures in a Mixed Farming System in Western Australia. Journal of Agricultural Systems, Vol 89:371-389pp.

27. Raoufi-Rad, Bagheri, M., Jafari, M., Mirtalebi, A., 2016, Estimating the Economic Value of White Gorse (*Astragalus gossypinus*) and yellow Gorse (*Astragalus verus*) Compared to the Income from Pasture Fodder in Isfahan Province, Renewable Natural Resources Research Publication volume 7, No. 4, pp. 45-57.
28. Rastegar, Sh., Darijani, A., Barani, H., Ghorbani, M., Ghorbani, J., Vahid Bardi Sheikh, A New Approach in the Economic Valuation of Pasture Fodder Production Function (Case Study: Summer Resort Rangelands in the Norud Watershed, Mazandaran Province), Pasture and Watershed Management, 66 (3): 347-357.
29. Sanderson, K., Webster, M. 2009. Economic Analysis of the Value of Pasture to the New Zealand Economy. Report to: Pasture Renewal Charitable Trust, Business and Economic Research Limited (Beryl). 42p.
30. Shahabi, S., 2004, Identification of Employment Ability in the Non-agricultural Sector of Villages (Case Study: Shahr Reza County), the Village and Development Scientific Quarterly, volume 6, No. 4, pp 21-47.
31. Sharifi Yazdi, M., Qasriani, F., Bayat, M., 2013, Determining the Most Suitable Limit of Allowed Exploitation of *Artemisia sieberi* in Dehnu-Bardsir Steppe Pastures of Kerman Province, Pasture and Watershed (Natural Resources of Iran) Publication, volume 66, No. 1, pp 121-129.
32. Zakeri, A., Tavili, A., Tolouei, S., 2014, Estimation of the Economic Value of Licorice (*Glycyrrhiza glabra*) in Comparison with the Income from Fodder of Pastures of Tazeh-Ghale, Renewable Natural Resources Research, volume 5, No. 2, pp.15-26.