NARDI FUNDULEA, ROMANIA ROMANIAN AGRICULTURAL RESEARCH, NO. 40, 2023
www.incda-fundulea.ro; doi.org/10.59665/rar4063 Print ISSN 1222-4227; Online ISSN 2067-5720

COMPARATIVE STUDY REGARDING YIELD AND ECONOMIC EFFECT OF AGRICULTURAL ACTIVITIES CARRIED OUT IN MEADOW AND HILL CONDITIONS, IN THE BRANIŞTEA AREA, GALAŢI COUNTY

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ABSTRACT

The current study carries out a technical-economic analysis of the agricultural activity that takes place in conditions of meadow lands compared to the agricultural activity that takes place in conditions of hilly lands, aspects that largely characterize the agriculture of Galaţi County. The paper highlights the technical and economic aspects that can characterize the two distinct zonal situations of agricultural production. The obtained data specify which are the most appropriate crop conditions and agricultural crops and measure these aspects in monetary units.

Keywords: meadow lands, hilly/sloping lands, agricultural yields, economic effects.

INTRODUCTION

For thousands of years, agriculture has been the activity that has provided the largest quantities of food for the world's population, and this quality of agriculture must be maintained in the future. Agriculture involves the performance of mechanized agricultural works and the establishment of crops respecting a series of good practices to avoid soil degradation and preserve their production capacity. In the context in which it is found that natural resources are increasingly limited, quantitatively and qualitatively, a series of signs of concern have appeared regarding the prospects for the development of this sector that must ensure the basic needs of human existence. For these reasons, in agricultural practice they have started to use more and more a series of working principles corresponding to the concept of "sustainable agriculture". In essence, "sustainable development represents the ability of mankind to continuously ensure the requirements of the present generation, but without compromising those of future generations" (Jensen et al., 2012).

Sustainable agriculture is a type of farming that focuses on maintaining and improving the long-term health and productivity of the land and natural resources. This includes reducing the use of synthetic fertilizers and pesticides, conserving water and soil, and using renewable energy sources. Sustainable agricultural practices can have many benefits, such as improving soil health, protecting water quality, and increasing crop yields. However, the adoption of sustainable agriculture can also have some challenges, such as the initial costs of implementing new practices and the need for training and support for farmers. Overall, the adoption of sustainable agricultural practices can have positive impacts on the environment and the long-term sustainability of the farming industry (Vanuytrecht et al., 2014).

The goal of sustainable agriculture is to develop productive and profitable agricultural systems, conserving basic resources, protecting the environment, increasing opportunities and reducing long-term risks (Gerhards et al., 1999; Balafoutis et al., 2017). These possibilities are based on the

Received 4 October 2022; accepted 19 January 2023. First Online: January, 2023. DII 2067-5720 RAR 2023-63

method of reducing imputations and the practice of competent management, which allow the optimization of agricultural practices in order to ensure sustainable levels of agricultural production with profitable economic results (McBratney et al., 2005).

Modern agriculture is a farming practice that uses advanced technology and data analysis to optimize crop production and reduce waste. This involves using sensors and other monitoring devices to collect data on factors such as soil moisture, crop health, and weather conditions, and then using this information to make informed decisions about irrigation, fertilization, and pest control. By using precision agriculture techniques, farmers can improve crop yields, reduce water and fertilizer usage, and save money (Plant et al., 2000). For example, using irrigation and other water management techniques can improve the crop water productivity of wheat by increasing the amount of water available to the plants and reducing the amount of water lost to evaporation and runoff. Proper fertilization and pest management can also improve the yield of wheat by providing the plants with the necessary nutrients and protecting them from pests and diseases. Overall, implementing effective farming practices can help increase the yield and crop water productivity of wheat, improving the efficiency and sustainability of wheat production (Gerhards and Sökefeld, 2003; Peteinatos et al., 2015).

Climate change is expected to have significant impacts on agricultural suitability and yield reduction. As the climate changes, certain regions may become more or less suitable for growing certain crops due to changes in temperature, precipitation, and other factors. For example, higher temperatures can increase the evaporation of soil moisture, leading to drought conditions that reduce crop yields. In addition, extreme weather events, such as floods and heatwaves, can damage crops and decrease yields. Overall, climate change is likely to have complex and varied impacts on agricultural suitability and yield reduction, and farmers will need to adapt their practices to these changes in order to maintain their productivity (Habtemariam et al., 2017; Abd-Elmabod et al., 2020).

Regarding the agrotechnical peculiarities of the mechanized agricultural works with reference to the meadow lands and hilly lands, here it must be stated that, a first difference is given by the climatic peculiarities that characterize these territories, and secondly, the difference is given by the shape of the relief. Regarding the shape of the relief, this difference generates a different effect of the action of the force of gravity in combination with the organizational effect of the territory, with the effect of soil works, with the mechanical, physical and chemical effect of the water from precipitation, with the mechanical effect of the wind and the effect generated by the type of agricultural plants used in these situations (Zhang et al., 2021).

In essence, in the main, on the meadow lands the concern for maintaining the fertility level of the soil and the concern for the proper management of the water in the soil to avoid degradation through salinization, excess moisture, excessive weeding, etc. prevails, and on the hilly lands the concern for maintaining the level of soil fertility and the persistent care and concern for combating soil erosion (Pintilie, 1985; Borlan et al., 1994; Onisie and Zaharia, 2002; Constantin, 2011). There are more work restrictions on the hilly lands compared to the meadow lands.

The agrotechnical peculiarities of mechanized agricultural work carried out on meadow lands depend on a variety of factors, such as the type of crops being grown, the climate and soil conditions of the region, and the availability of agricultural machinery. In general, meadow lands are well-suited for growing grasses and other forage crops, and mechanized agricultural work on these lands may include activities such as tilling, planting, fertilizing, and harvesting. The use of appropriate machinery, such as tractors and mowers, can greatly improve the efficiency and productivity of these activities, but it is important to consider the specific characteristics of the meadow lands in order to choose the right equipment and techniques (Ortiz et al., 2013; Vasiliu et al., 2016).

The agrotechnical peculiarities of mechanized agricultural work carried out on hilly terrains can present some challenges compared to work on flat or gently sloping lands. The steepness and unevenness of the terrain can make it difficult to use large machinery and can increase the risk of accidents and soil erosion. In addition, the hilly terrain may affect the availability and distribution of water, sunlight, and other resources, which can impact crop growth and yield. To address these challenges, farmers may need to use specialized machinery and techniques that are designed for hilly terrains, such as terracing and contour plowing, and may also need to take extra precautions to protect the soil and prevent accidents (Angers and Eriksen-Hamel, 2008).

As already mentioned, the same types of overlaps can be used on land with slopes of up to 14-16% as for flat land. For slopes between 16 and 25%, it is necessary to reduce the proportion of fallow crops. Above the 25% slope, it is recommended to use special protective layers whose structure depends on the erosive potential of the land. Within them, the share of very good protective crops for the soil increases a lot (Moţoc, 1975).

MATERIAL AND METHODS

The ever-increasing demand for food causes the need for efficient and sustainable exploitation of agricultural land to grow. At the same time, the share of hilly areas is very significant in the total balance of the agricultural land fund, and the knowledge of some technical and economic aspects of agriculture practiced on meadow lands, compared to hilly lands, is of a nature to guide farmers in the agricultural activity they carry out.

The technological measures applied to an agricultural crop have in mind the principle of obtaining the maximum yield, under the conditions of a certain economic efficiency and respecting the ecological criteria for the protection of the agricultural environment with all its components, soil-plant-water-cultivator.

The aim of the current study is to carry out a technical-economic analysis of the agricultural activity that takes place in meadow land conditions compared to the agricultural activity that takes place in hilly land conditions, aspects that largely characterize the agriculture of Galaţi County. The paper aims to highlight the technical and economic aspects that can characterize the two distinct zonal situations of agricultural production. In this sense, a case study was carried out at "SC Agro Pavelad SRL" from Braniştea commune, Galaţi County. The study focused on the identification in production conditions of the agricultural yields achieved by the company, over a period of three years, for a series of crops located on meadow lands and on hilly lands and aimed at establishing the economic efficiency of these crops, so that the data results to be as suggestive as possible. The crop structure of the farm (wheat, barley, rapeseed, sunflower, corn, soy and alfalfa), applied culture technologies, productions obtained in meadow and hill conditions, applied capitalization prices and finally the indicators were taken into account achieved economic results (revenues, expenses and profit). The obtained data highlights the most appropriate crop conditions and agricultural crops and will measure these aspects in monetary units.

The paper highlights the technical and economic aspects that can characterize the distinct zonal situations of agricultural production, which may vary on a number of factors, including the type of crops being grown, the climate and soil conditions of the region, and the availability of labor and other resources.

RESULTS AND DISCUSSION

The commercial company "Agro Pavelad SRL" is located in Braniștea commune, Galați County and was established in 2017, having as its main field of activity "large culture". The company exploits approx. 150 ha, of which 135 ha is leased and 15 ha in the property. Crop irrigation was applied only in the meadow area. The soils in the Braniștea area, Galaţi County belong to several soil categories. In the meadow area, the Alluviosol type soils from the Protisols class predominate, and in the hilly area, the typical Preluvisol from the Luvisols class predominates.

In the period 2018-2021, "SC Agro Pavelad SRL" from Braniştea practiced a diversified and almost similar crop structure for the areas it agriculturally exploits, Table 1.

Table 1. Crop structure practiced at the agricultural farm "SC Agro Pavelad SRL" from Braniştea, during 2018-2021

Agricultural culture	Cultivated areas on land located in the meadow area (ha)				Cultivated areas on land located in the hill area (ha)			
	2018-2019	2019-2020	2020-2021	Average	2018-2019	2019-2020	2020-2021	Average
Wheat	27	30	25	27	10	15	10	11
Barley	5	4	5	5	3	1	4	3
Rape	15	10	15	14	10	4	4	6
Sunflower	15	15	30	20	15	10	10	12
Maize	22	30	15	22	5	15	16	12
Soy	14	9	8	10	6	4	5	5
Alfalfa	2	2	2	2	1	1	1	1
Total	100	100	100	100	50	50	50	50

The work technologies applied to agricultural crops located on meadow lands and to crops located on hilly lands in the period 2018-2021, do not show great differences in terms of the application of agricultural technology elements. The main difference is the possibility of applying irrigation on meadow lands, a fact that also brings increases in production and the fact that performing soil works on sloping lands is conditioned to a large extent by the application of some work solutions aimed at avoiding soil erosion. At the same time, the agricultural productions were sufficiently supported by the choice and use of quality genetic material, with the highest productivity indices, respectively the seed adapted for the pedoclimatic conditions of the cultivation area, Table 2.

Table 2. Cultivated varieties and hybrids at "SC Agro Pavelad SRL" Braniştea, during 2018-2021

Agricultural culture	Cultivated varieties/hybrids in the meadow and hilly area		
	2018-2019	2019-2020	2020-2021
Wheat	Glosa	Glosa	Glosa
Barley	Tunika	Tunika	Tunika
Rape	PT307	PT303	PT303
Sunflower	P64L25	P64L29	P64L25
Maize	P9911	P9757	P0023
Soy	P18A02	P18A02	P18A02
Alfalfa	Roxana	Roxana	Roxana

The climatic conditions developed during the period 2018-2021 were varied in terms of precipitation and temperatures, Table 3. It can be observed that, compared to the multi-annual one, the 2018-2019 agricultural year presented a total precipitation deficit of 148.8 mm and an average annual temperature higher by 1.3°C, and the 2019-2020 agricultural year was even more unfavorable, with a precipitation deficit of 249.1 mm and an average annual temperature higher by 2.6°C . Only the 2020-2021 agricultural year presented a better situation, with precipitation being 239.3 mm higher than the multi-year average and the multi-year average temperature higher by 1.6°C.

Table 3. Climatic data developed in the period 2018-2021

Climatic elements		Monthly value during the agricultural year												Annual value
		IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	
Precipitation (mm)	***Multiannual**(**	***45.9***	***37.1***	***34.2***	***39.5***	***27.4***	***24.6***	***31.4***	***38.7***	***46.5***	***68.5***	***51.4***	***41.4***	***486.6***
		2018				**2019**								
	Monthly amount	26.4	3	46.3	53.8	33.8	10.6	8.8	50.6	35.2	47.2	9	13.1	337.8
	Deviations	-19.5	-34.1	12.1	14.3	6.4	-14	-22.6	11.9	-11.3	-21.3	-42.4	-28.3	-148.8
		2019				**2020**								
	Monthly amount	30	26.3	6.9	9.5	5.5	21.4	3.1	4.8	39.7	58.9	29.1	2.3	237.5
	Deviations	-15.9	-10.8	-27.3	-30	-21.9	-3.2	-28.3	-33.9	-6.8	-9.6	-22.3	-39.1	-249.1
		2020				**2021**								
	Monthly amount	32.7	30	27.8	79.6	49.8	11.2	30.2	38.4	54.4	285.2	77.3	9.3	725.9
	Deviations	-13.2	-7.1	-6.4	40.1	22.4	-13.4	-1.2	-0.3	7.9	216.7	25.9	-32.1	239.3
Temperature (°C)	***Multiannual**(**	***17.3***	***11.5***	***5.2***	***0.1***	***-1.2***	***0.2***	***4.9***	***11.1***	***17.2***	***21***	***23.1***	***22.5***	***11.1***
		2018				**2019**								
	Monthly average	19	14.1	4.3	-0.3	-1.1	2.8	8.7	10.8	17.7	24	23.5	24.6	12.3
	Deviations	1.7	2.6	-0.9	-0.4	0.1	2.6	3.8	-0.3	0.5	3	0.4	2.1	1.3
		2019				**2020**								
	Monthly average	19.3	13.1	9.8	4.3	1.5	5.4	9.2	12.3	16.5	22.3	24.9	25	13.6
	Deviations	2	1.6	4.6	4.2	2.7	5.2	4.3	1.2	-0.7	1.3	1.8	2.5	2.6
		2020				**2021**								
	Monthly average	21.1	15.6	5.9	4.2	2.1	2	4.9	9.8	17.1	20.4	25.1	23.8	12.7
	Deviations	3.8	4.1	0.7	4.1	3.3	1.8	0	-1.3	-0.1	-0.6	2	1.3	1.6

*) The multi-year average is calculated for the period 1980-2010 according to WHO recommendations.

The economic results of the agricultural activity are influenced by the prices for the exploitation of agricultural products, prices that vary quite a lot over time, Table 4. The valorization prices show a significant fluctuation, being influenced in particular by the demand existing at a given moment on the global market.

Table 4. Agricultural product recovery prices (euro/kg)

Specification	2018	2019	2020
Wheat	0.1377	0.1338	0.1617
Barley	0.1144	0.1112	0.1516
Rape	0.3283	0.4530	0.5659
Sunflower	0.2668	0.2944	0.4446
Maize	0.1144	0.1647	0.2021
Soy	0.2923	0.2965	0.5052
Alfalfa	0.1864	0.1956	0.2223

The results obtained regarding the technical and economic effect of practicing agriculture on meadow lands and on hilly lands are presented in Tables 5 and 6.

Table 5. Production results obtained for different agricultural crops, by “SC Agro Pavelad SRL” Braniştea, in the period 2018-2021, in meadow and hill conditions

Agricultural culture	Products obtained on land located in the meadow area (kg/ha)				Products obtained on land located in the hilly area (kg/ha)				Differences (meadow-hill)	
	2018-2019	2019-2020	2020-2021	Average	2018-2019	2019-2020	2020-2021	Average	kg/ha	%
Wheat	3900	3500	7500	*4966*	2950	500	5800	*3083*	+1883	+61
	DL 5% = 92.72 kg/ha; DL 1% = 145.01 kg/ha; DL 0.1% = 235.75 kg/ha									
Barley	2450	2100	3400	*2650*	1200	300	2550	*1350*	+1300	+96
	DL 5% = 62.62 kg/ha; DL 1% = 97.94 kg/ha; DL 0.1% = 159.23 kg/ha									
Rape	2800	2600	3900	*3100*	1900	500	3200	*1866*	+1234	+66
	DL 5% = 31.06 kg/ha; DL 1% = 48.58 kg/ha; DL 0.1% = 78.98 kg/ha									
Sunflower	2350	2200	3200	*2583*	2100	300	2800	*1733*	+850	+49
	DL 5% = 16.23 kg/ha; DL 1% = 25.39 kg/ha; DL 0.1% = 41.27 kg/ha									
Maize	6500	5300	9700	*7166*	5600	500	7500	*4533*	+2633	+58
	DL 5% = 36.33 kg/ha; DL 1% = 56.82 kg/ha; DL 0.1% = 92.38 kg/ha									
Soy	2500	2300	3200	*2666*	1200	250	2500	*1316*	+1350	+102
	DL 5% = 24.40 kg/ha; DL 1% = 38.16 kg/ha; DL 0.1% = 62.04 kg/ha									
Alfalfa	4500	3400	5000	*4300*	3800	800	4500	*3033*	+1267	+41
	DL 5% = 25.26 kg/ha; DL 1% = 39.51 kg/ha; DL 0.1% = 64.23 kg/ha									

In the period 2018-2021, the agricultural production obtained in the meadow area was higher by 1883 kg/ha (+61%) for wheat and by 1300 kg/ha (+96%) for barley. Also, in rapeseed, the production obtained in the meadow was higher than that obtained on hilly lands as follows: in rapeseed with 1234 kg/ha (+66%), in sunflower with 850 kg/ha (+49%), in corn with 2633 kg/ha (+58%), in soybean with 1350 kg/ha (+102%) and in alfalfa with 1267 kg/ha (+41%).

Between the two culture areas studied, the biggest production differences are in barley (96%) and soybean (202%), followed by rapeseed (66%) and wheat (61%).

Table 6. Economic results obtained with different agricultural crops, by “SC Agro Pavelad SRL”, in the period 2018-2021, in meadow and hill conditions

-income-

Agricultural culture	Incomes obtained on land located in the meadow area (euro/ha)				Incomes obtained on land located in the hilly area (euro/ha)				Differences (meadow-hill)	
	2018-2019	2019-2020	2020-2021	Average	2018-2019	2019-2020	2020-2021	Average	euro/ha	%
Wheat	537.03	468.3	1212.75	*739.36*	406.22	66.9	937.86	*470.33*	269.03	+57
Barley	280.28	233.52	515.44	*343.08*	137.28	33.36	386.58	*185.74*	157.34	+85
Rape	919.24	1177.8	2207.01	*1434.68*	623.77	226.5	1810.88	*887.05*	547.63	+62
Sunflowers	626.98	647.68	1422.72	*899.13*	560.28	88.32	1244.88	*631.16*	267.97	+42
Maize	743.6	872.91	1960.37	*1192.29*	640.64	82.35	1515.75	*746.25*	446.04	+60
Soy	730.75	681.95	1616.64	*1009.78*	350.76	74.125	1263	*562.63*	447.15	+79
Alfalfa	838.8	665.04	1111.5	*871.78*	708.32	156.48	1000.35	*621.72*	250.06	+40

-costs-

Agricultural culture	Costs made on land located in the meadow area (euro/ha)				Costs made on land located in the hilly area (euro/ha)				Differences (meadow-hill)	
	2018-2019	2019-2020	2020-2021	Average	2018-2019	2019-2020	2020-2021	Average	euro/ha	%
Wheat	175.57	163.69	198.86	*179.37*	175.57	20.59	198.86	*131.67*	+47.70	+36
Barley	105.89	96.77	173.80	*125.49*	88.95	22.65	173.80	*95.13*	+30.36	+31
Rape	209.88	197.67	364.79	*257.44*	180.02	50.45	364.79	*198.42*	+59.03	+29
Sunflowers	198.44	185.31	271.82	*218.52*	198.44	20.59	271.82	*163.62*	+54.91	+33
Maize	209.67	216.20	212.20	*212.69*	209.67	24.71	212.20	*148.86*	+63.83	+42
Soy	188.49	222.37	337.50	*249.45*	188.49	20.59	337.50	*182.19*	+67.26	+36
Alfalfa	95.30	156.48	204.12	*151.97*	95.30	30.89	204.12	*110.10*	+41.87	+38

It can be observed that, regarding the income obtained for each crop, taking into account the existing production differences, greater in favor of the crops located on meadow lands, it is clear that the incomes for these products are also higher, as follows: with 269.03 euro/ha (+57%) for wheat, with 157.34 euro/ha (+85%) for barley, with 547.63 euro/ha (62%) for rape, with 267.97 euro/ha (+42%) for sunflower, with 446.04 euro/ha (+60%) for corn, with 447.15 euro/ha (+79%) for soybeans and with 250.06 euro/ha (+40%) for alfalfa.

The analysis of the expenses made for each crop separately shows that this indicator is higher for crops located in the meadow compared to those located on hilly land, as follows: higher by 47.70 euro/ha (+36%) for wheat, by 30.36 euro/ha (+31%) for barley, with 59.03 euro/ha (+29%) for rapeseed, with 54.91 euro/ha (+33%) for sunflower, with 63.83 euro/ha (+42%) for corn, with 67.26 euro/ha (+36%) for soybeans and with 41.87 euro/ha (+38%) for alfalfa.

The results obtained regarding the economic effect of practicing agriculture on meadow lands and on hilly lands are presented in Figures 1, 2 and 3. The graphic representation of the annual profit obtained by crops is presented in Figure 1 and 2, and the graphic representation of the average crop profit and the total crop structure, for the period 2018-2021, is presented in Figure 3.

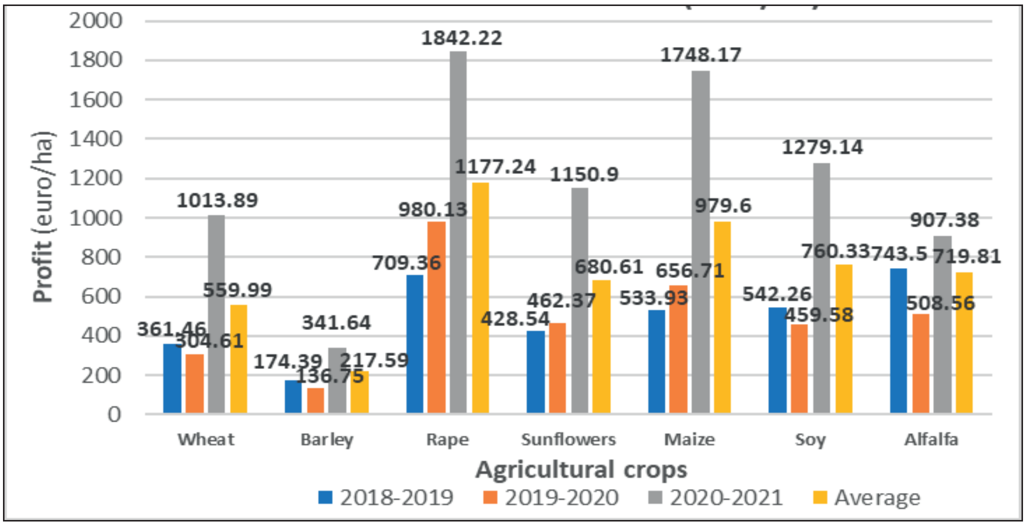

Figure 1. Graphic representation of the profit obtained in the meadow area

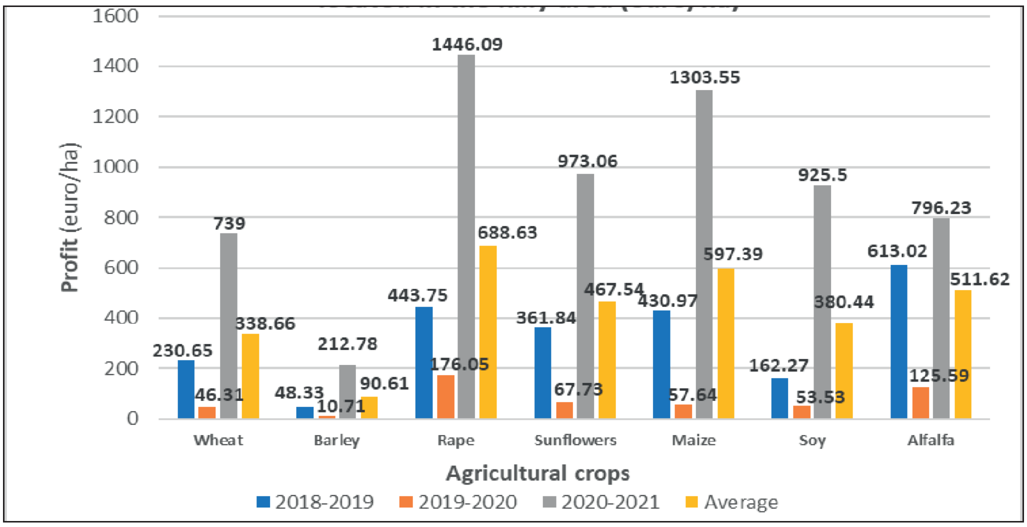

Figure 2. Graphic representation of the profit obtained in the hilly area

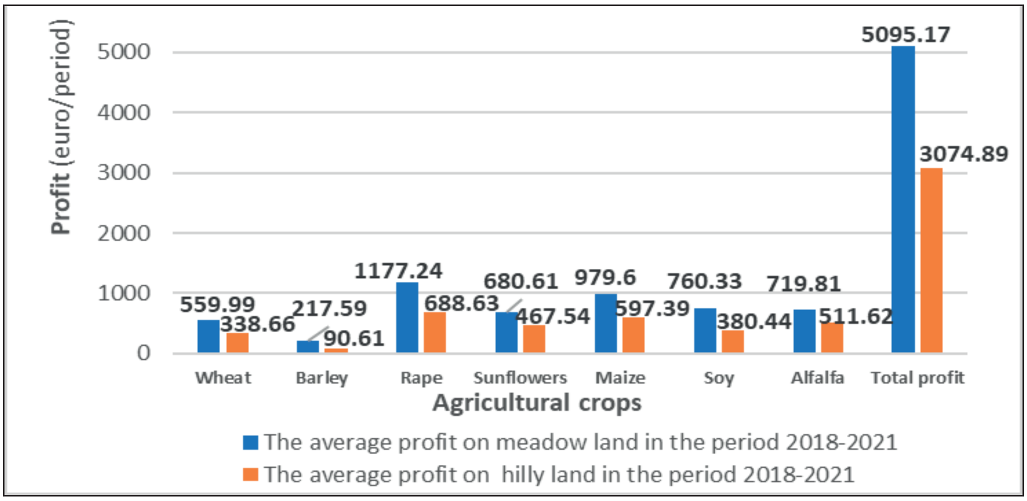

Figure 3. Graphic presentation of the average crop profit and the total crop structure, in the period 2018-2021

Regarding the profit made for each crop separately, it can be observed that the highest values are found for crops located in the meadow compared to those located on hilly lands. By comparison, the most profitable crops are barley (138%), soybeans (98%) and rapeseed (70%). Also, it is observed that from the point of view of economic efficiency, wheat is surpassed in terms of profitability by most of the other crops.

It can be concluded that the agriculture practiced on the meadow lands is more profitable than the agricultural activity carried out on the sloping lands. For the situation at “SC Agro Pavelad SRL” Braniştea and for the crop structure presented, it can be estimated that the profitability of one ha of meadow land is 65% higher compared to 1 ha of hilly land.

CONCLUSIONS

The study carried out regarding the behavior and economic efficiency of some agricultural crops in meadow and hill conditions leads to the following conclusions:

- by comparing the value of the profit recorded for the plants grown on meadow lands and on hilly lands, it turns out that, in the meadow, barley crops do better and bring a higher profit (138% higher profit compared to barley grown on sloping lands), in soybeans (98% higher profit) and in rapeseed (70% higher profit).

- on the lands located in the meadow, the highest profit is obtained from rapeseed (1177.24 euro/ha), corn (979.60 euro/ha) and soybeans (760.33 euro/ha), and on the slopes it is recommended to use crops that can be exploited better and shows a higher profit: rapeseed (688.63 euro/ha), corn (597.39 euro/ha) and alfalfa (511.62 euro/ha).

- agriculture practiced on meadow lands is more profitable than agricultural activity carried out on sloping lands. For the situation at “SC Agro Pavelad SRL” Braniştea and for the crop structure presented, it can be estimated that the profitability of one ha of meadow land is 65% higher compared to 1 ha of hilly land.

- on sloping land, it is recommended to use crops depending on the size of the slope. The higher the slope, the more the area cultivated with predatory species must be reduced. It is recommended to carry out soil works and establish crops on level curves, as a measure to prevent soil erosion, and to use predominantly grass crops that are good protectors and prevent strong soil washing.

- in the case of “SC Agro Pavelad SRL” Braniştea, the use of irrigation on the meadow lands represents an important technological element that contributes to the realization of the security of agricultural productions and the increased harvest obtained offsets the application expenses. It is recommended to extend irrigation to sloping lands and apply irrigation water in accordance with the requirements to avoid soil erosion processes.

- when preparing a culture structure, it is recommended that it be more diversified in order to overcome certain negative price fluctuations that may appear in the market, to take into account the technical aspects and good agricultural practices in order to practice a sustainable agriculture and of course to take into account the profitability of crops. It is observed that, although wheat is one of the most important agricultural crops that tends to achieve better and better productions, still from the point of view of profitability, almost all other crops in the case study bring a greater economic efficiency:

➢ on meadow land: rape with 109%, corn with 75%, soy with 35%, alfalfa with 27%, sunflower with 21% higher profit than wheat;

➢ on hilly lands: rape with 103%, corn with 76%, alfalfa with 49%, sunflower with 37%, soybean with 12%, higher profit than wheat.

- practicing modern agriculture, especially in conditions of excessive adverse climatic factors, requires equipping the farm with irrigation systems, with modern machinery and the use of crops where the technological elements are 100% mechanizable.

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