

# REMOTE SENSING MONITORING TO PRESERVE SEMI-NATURAL MOUNTAIN MEADOWS LANDSCAPE

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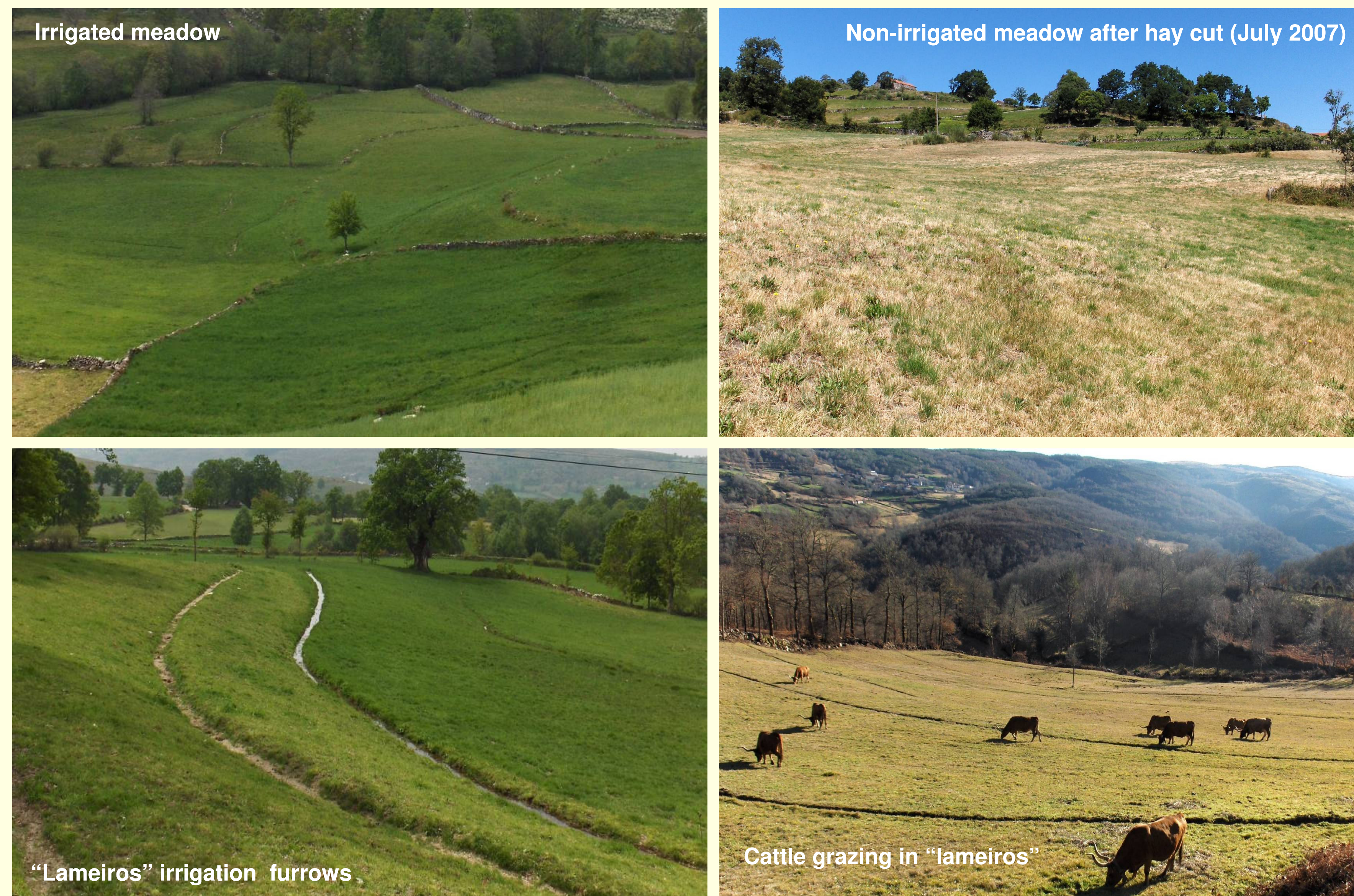


## INTRODUCTION

“Lameiros” are ancestral semi-natural meadows, essential elements of mountain landscapes and traditional agricultural systems in Northern Portugal.

Although recognized for their economical, environmental, landscaping, cultural and genetic value, the perpetuation of these “lameiros” could be at risk, at medium term, due to human desertification in the mountain regions and to the announced water scarcity.

To prevent this situation is being developed a monitoring program of these semi-natural meadows by remote sensing, in order to better know and understand their dynamics in traditional agriculture and in mountain landscape at the North of Portugal. The success of the referred “lameiros” dynamics monitoring program is, however, conditioned by the spatial resolution adequacy, considering the characteristic small dimension of the “lameiros” and the necessary availability of satellite historical data to study the evolution of these semi-natural meadows in the mountain landscape in the last decades, including in periods of water scarcity. This study is focused on these two issues, in order to evaluate the most appropriated spatial resolution sensor.



## MATERIAL AND METHODS

Study site	- Salto, Montalegre (Portugal)
Study period	- July-December
Sensors used	- Spectroradiometer - Satellite sensors: Landsat 5, Landsat 7, SPOT 2, SPOT 4 and SPOT 5
Spatial resolution tested	- 10m – SPOT5 satellite images - 20m – SPOT4 and SPOT2 satellite images - 30m – Landsat5 and Landsat7 satellite images
Experimental design	- Two agricultural fields with different water regime: Irrigated meadow (IM) vs Non-Irrigated Meadow (NIM) - Each field was split in 3 plots: IM1, IM2, IM3 and NIM1, NIM2, NIM3
Treatments	- Spectroradiometer: . measurements points established, in each plot, according to field conditions; . 10 reflectance files were saved for each point; . 7 campaigns of reflectance measurements were carried out in sunny days from the period July-September of 2007, between 11-13h. - Satellite data: . 11 satellite images, from the period 1991-2006, were used: - 2 from SPOT 2 - 1 from SPOT4 - 3 from SPOT 5 - 3 from Landsat5 - 2 from Landsat7
Vegetation index used	- Normalized difference Vegetation Index was used to set the monitoring program, since is a sensitive indicator of the amount and conditions of the vegetation

Table - Comparison of mean (n=3) NDVI values, obtained by different satellite sensors and spectroradiometer (Sp), in irrigated (IM) and non irrigated meadows (NIM).

Month		Sensors										
		Sp	SPOT(10m)		Sp	SPOT20m		Sp	Landsat5			
Jul	IM				0,82	0,84	0,76				0,83	0,71
	NIM				0,64	0,61	0,56				0,59	0,50
	Sig				0,000	0,000	0,000				0,001	0,004
Aug	IM	0,65	0,68	0,63	0,65	0,61						
	NIM	0,27	0,37	0,45	0,27	0,38						
	Sig	0,003	0,015	0,001	0,003	0,001						
Sep	IM	0,70	0,72					0,71	0,77			
	NIM	0,49	0,49					0,48	0,43			
	Sig	0,001	0,000					0,008	0,000			
Oct	IM							0,77	0,69	0,77	0,73	
	NIM							0,60	0,66	0,59	0,64	
	Sig							0,046	0,173	0,008	0,021	
Nov	IM									0,44	0,59	
	NIM									0,50	0,65	
	Sig									0,542	0,180	
Dec	IM	0,43	0,62	0,65				0,66	0,42			
	NIM	0,43	0,63	0,60				0,64	0,41			
	sig	0,928	0,818	0,313				0,748	0,942			

Sig - Significance (F Test) of two-way ANOVA; n.s. – non-significant at P≤0.005 level

## CONCLUSIONS

The results revealed very interesting perspectives for the use of SPOT and Landsat sensors on the “lameiros” dynamics monitoring, particularly for the July-September period. However, the study was not conclusive about the potentialities of both sensors to distinguish between irrigated and non-irrigated meadows all year around.

The adequacy of 30m resolution Landsat images to monitor “lameiros” opens good perspectives in terms of historic coverage. Also, the use of the Landsat thermal band might be useful for evapotranspiration mapping, in order to support the water management on these seminatural mountain meadows.

## RESULTS AND DISCUSSION

Between July and September all the satellite sensors used were able to distinguish irrigated from non-irrigated meadows. The results of the October-December period did not distinguish meadows with different water regime, which reflects the generalized water availability, resulting from precipitation, over both study fields.

When compared with the results at field level, both SPOT and Landsat images showed a very interesting behaviour for the monitoring of the studied “lameiros”, as reflected by the correlation values. The results for November and December were less consistent than those from the other months, probably reflecting the unfavourable illumination conditions during this period, which affect the NDVI measurements.

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