International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-14 Issue-8, July 2025

Landscape Temporal Evolution in a Transhumance Route in Greece

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Abstract*: Transhumance is a traditional pastoral practice recorded in Greece since ancient times. This extensive form of livestock farming was practiced by the three ethnic groups primarily engaged with transhumance in Greece: the Vlachs, the Koupatsaraioi, and the Sarakatsanaioi. Although the Sarakatsanaioi continue to engage with transhumance, in recent decades they have stopped moving their flocks on foot, and nowadays livestock are transported by trucks. Through our semi-structured interviews, we conducted research and recorded nineteen routes, nine of which ended at Mount Vermio. This study aims to analyze the impact of transhumance and how the shift in the method of moving flocks from winter to summer pastures affected the evolution of vegetation. The methodology we used was to map land uses within a three-kilometre-diameter impact zone in areas where overnight stops of herders with their herds had previously occurred. The research results showed that the abandonment of this traditional method of animal movement led to a densification of vegetation, specifically, an increase in the area covered by shrublands and forests, and a simultaneous decrease in grasslands. Moreover, due to lignite mining in the Mount Vermio area, the areas mapped as other uses increased. This vegetation evolution was recorded not only in the upland areas where the flocks passed through, but also in the lowland areas, which are most affected by human activity. Finally, another factor that impacted the change in the landscape was the abandonment of crops.

***Keywords*: Transhumance, Greece, Campsites, Grassland Reduction.**

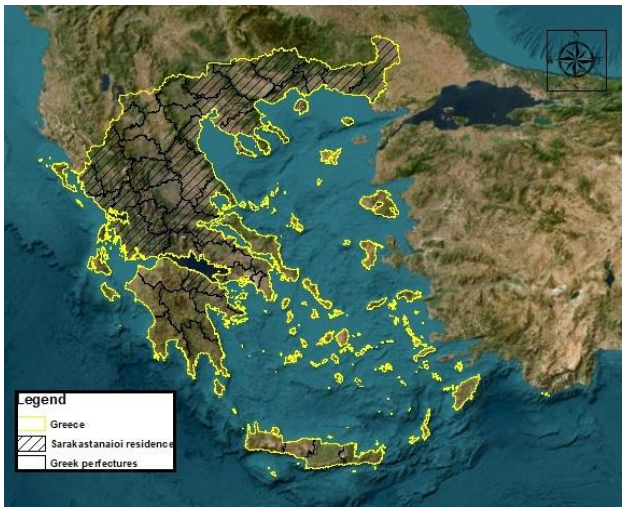
Abbreviations:
OU: Other Uses
AC: Agricultural Crops
S: Settlements
G: Grasslands
SH: Shrublands
SF: Sparse Forests
F: Forests

I. INTRODUCTION

In Greece, most of the livestock farmers engaged in transhumant livestock farming belong to three ethnic groups [1]: the *Sarakatsanaioi*, the *Vlachs*, and the *Koupatsaraioi*. The *Sarakatsanaioi* were a pastoral nomadic society. The homeland of the *Sarakatsanaioi* was the mountain range of central and southern Pindus and Roumeli (Sterea Ellada), with the centre being the Agrafa region. Their dispersion to the rest of mainland Greece occurred during the Ottoman period, primarily in the 18th century [2] (Figure 1).

After the agricultural reform of 1922 [2], transhumant livestock farming began to decline, and this trend became more noticeable after World War II [3]. In 1960, transhumant goats and sheep numbered more than 2 million [4]. From 1965 to 1984, transhumant sheep herds decreased by 27.5%, while the herds of permanent livestock increased by 15.6% [5]. Today, according to the Greek Organization for Payments and Control of Community Aid for Orientation and Guarantee [6], there are approximately one million transhumant animals.

Transhumant livestock farming is one of the factors that positively influences landscape heterogeneity, as the presence of an extensive network of migratory routes, functioning as ecological corridors [7] —is responsible for maintaining the functions and services provided by these ecosystems [8]. Despite its numerous contributions, the movement of sheep and goats in Greece has shown a downward trend over the last 30 years, and the *Sarakatsanaioi* have stopped moving their animals on foot [9].



[Fig.1: Sarakatsanaioi residence in Greece]

This study aims to examine the changes that have occurred due to the abandonment of transhumant livestock farming in areas where herders used to make overnight stops (campsites) during the transition from lowland pastures to the mountains.

II. MATERIALS AND METHODS

To analyze the impact of mobile livestock farming on the landscape, 31 interviews were conducted with *Sarakatsanaioi* transhumant farmers to record the routes they used during their movement from Thessaly to Northern Greece. Nineteen routes were recorded, of which nine ended at Mt Vermio. Of these, the main route was from the

Manuscript received on 13 May 2025 | First Revised Manuscript received on 18 May 2025 | Second Revised Manuscript received on 17 June 2025 | Manuscript Accepted on 15 July 2025 | Manuscript published on 30 July 2025.
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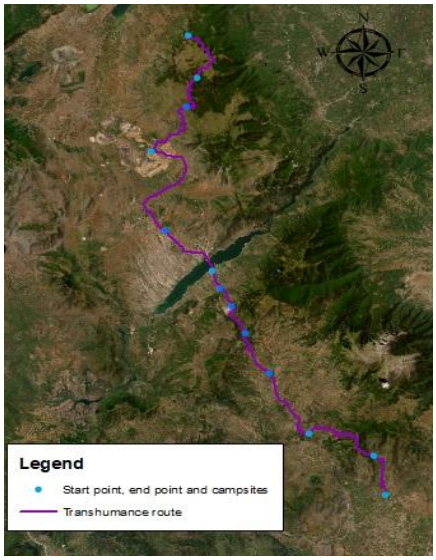
village of Rodia in Larissa to "Tseligato Katrantza" on Mt Vermio. During this route, they made eleven overnight stops (Figure 2).

For the temporal evolution study of the land uses in the study areas, orthophotomaps from 1945, provided by the company "Hellenic Cadastre", and satellite images from the ArcGIS Basemap (2018-2019) were selected. The Geographic Information Systems (GIS) software, specifically ArcGIS, was chosen for the spatial analysis. Regarding the analysis, a 3 km diameter circle was applied to the areas where they made their overnight stops, in which the evolution of land uses was recorded over time.

The classification categories concerned were: grasslands (G), shrublands (SH), sparse forests (SF), forests (F), settlements (S), cultivated land (AC), and other uses (OU) (including photovoltaic parks, livestock/industrial/lignite mining facilities, and lakes).



[Fig.2: Sarakatsaioi Transhumance Route with Starting and End Point, and Overnight Campsites]

III. RESULTS

In the "Ano Argyropouli" campsite, the largest percentage of the area was occupied by shrublands. 84% of the area remained unchanged, 6% showed densification, and 10% showed reversal of vegetation evolution (Table I).

Table-I: Double Flow Table of Land Use Changes (ha) in "Ano Argyropouli" Campsite

1945/2018	OU	AC	G	SH	1*
OU	0,00	0,00	0,00	0,00	0,00
AC	0,00	4,65	0,00	0,43	0,43
G	0,00	34,63	5,00	36,86	71,48
S	1,91	24,06	12,47	586,80	38,44
2*	1,91	58,69	12,47	37,29	
1*: Reversal of vegetation evolution, 2*: Set of changes					

At the "Ntava" campsite, the largest percentage was occupied by shrublands and forests. 39% of the area remained unchanged, 33% showed densification, and 27% showed reversal of vegetation evolution (Table II).

At the "Chani Chatzigogou" campsite, the largest percentage was occupied by cultivated land. 65% of the area remained unchanged, 17% showed densification, and 18% showed reversal of vegetation evolution (Table III).

At the "Palati tou Vasilia" campsite, in both periods, the largest percentage was occupied by shrublands and forests. 59% of the area remained unchanged, 34% showed densification, and 7% showed reversal of vegetation evolution (Table IV).

At the "Lavanitsa" campsite, the largest percentage was occupied by other uses and grasslands. 21% of the area remained unchanged, 52% showed densification, and 27% showed reversal of vegetation evolution (Table V).

At the "Servia" campsite, the largest percentage was occupied by the corps. 68% of the area remained unchanged, 17% showed densification, and 15% showed reversal of vegetation evolution (Table VI).

At the "Petrana" campsite, the largest percentage was occupied by the cultivated land. 63% of the area remained unchanged, 32% showed densification, and 55% showed reversal of vegetation evolution (Table VII).

At the "Drepano" campsite, the largest percentage of the area was occupied by cultivated land. 69% of the area remained unchanged, 7% showed densification, and 24% showed reversal of vegetation evolution (Table VIII).

At the "Charavgi" campsite, in both periods, the largest percentage was occupied by other uses and grasslands. 15% of the area remained unchanged, 21% showed densification, and 64% showed reversal of vegetation evolution (Table IX).

At the "Tseligkato Gkiona" campsite, in both periods, the largest percentage was occupied by grasslands. 77% of the area remained unchanged, 19% showed densification, and 4% showed reversal of vegetation evolution (Table X).

At the "Ano Seli" campsite, in both periods, the largest percentage was occupied by grasslands and forests. 35% of the area remained unchanged, 57% showed densification, and 8% showed reversal of vegetation evolution (Table XI).

Table II: Double Flow Table of Land Use Changes (ha) in "Ntava" Campsite

1945/2018	OU	AC	G	SH	SF	F	1*
OU	0,00	0	0	0	0	0	0
AC	27,26	84,63	3,54	0,25	1,57	22,81	55,43
G	0	17,14	1,17	1,18	1,96	11,71	31,99
SH	7,91	81,44	0	79,68	35,98	107,26	232,59
SF	12,74	5,52	5,72	0	0,00	47,53	71,51
F	24,94	10,47	0,11	0	1,4	112,87	36,92
2*	72,85	114,56	9,37	1,43	40,91	189,31	
1*: Reversal of vegetation evolution, 2*: Set of changes							

Table III: Double Flow Table of Land Use Changes (ha) in "Chani Chatzigogou" Campsite

1945/2018	OU	AC	G	SH	SF	F	1*
OU	4,23	16,06	0,00	0	0,00	54,84	70,90
AC	0,11	453,81	0,00	0,21	1,61	10,24	12,17
G	0,00	125,22	0,00	2,70	5,96	31,80	165,69
SH	0,00	0,00	0,00	0,00	0,00	0,00	0,00
SF	0,00	0,00	0,00	0,00	0,00	0,00	0,00
F	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2*	0,11	141,28	0,00	2,91	7,57	96,88	
1*: Reversal of vegetation evolution, 2*: Set of changes							

Table IV: Double Flow Table of Land Use Changes (ha) in "Palati tou Vasilia" Campsite

1945/2018	OU	AC	G	SH	SF	F	1*
OU	2,42	22,86	0,00	4,28	0,00	8,99	36,13
AC	1,32	49,09	7,50	1,04	0,19	4,89	13,62
G	2,72	11,86	0,00	4,77	2,19	32,77	54,31
SH	4,75	3,14	7,48	189,74	18,04	131,79	165,19
SF	2,29	0,00	0,00	0,74	0,00	1,76	4,79
F	0,00	4,07	0,33	7,72	0,00	178,06	12,12
2*	11,08	41,94	15,31	18,55	20,42	180,20	
1*: Reversal of vegetation evolution, 2*: Set of changes							

Table- V: Double Flow Table of Land Use Changes (ha) in "Lavanitsa" Campsite

1945/2018	OU	AC	G	SH	SF	F	1*
OU	0,00	8,03	2,44	0,01	0,00	0,34	10,82
AC	147,41	43,78	62,97	2,99	31,97	0,24	245,57
G	19,96	18,33	22,28	78,32	45,20	29,71	191,52
SH	0,80	1,62	1,65	65,00	30,93	74,70	109,70
SF	0,00	0,00	0,00	0,00	0,00	0,00	0,00
F	0,00	2,29	0,20	0,00	0,00	0,00	2,48
2*	168,17	30,27	67,25	81,32	108,10	104,99	
1*: Reversal of vegetation evolution, 2*: Set of changes							

Table- VI: Double Flow Table of Land Use Changes (ha) in "Servia" Campsite

1945/2018	OU	AC	G	SH	SF	F	1*
OU	73,66	30,35	0,47	2,96	0,00	1,55	35,33
AC	79,20	382,18	0,00	3,24	1,69	15,65	99,77
G	0,10	0,16	5,23	9,82	0,51	19,34	29,94
SH	17,51	5,86	0,00	12,94	6,14	27,45	56,96
SF	0,00	0,00	0,00	0,00	0,00	0,00	0,00
F	1,69	0,00	0,25	2,18	0,00	6,67	4,12
2*	98,49	36,37	0,73	18,20	8,34	63,99	
1*: Reversal of vegetation evolution, 2*: Set of changes							

Table VII: Double Flow Table of Land Use Changes (ha) in "Petrana" Campsite

1945/2018	OU	AC	G	SH	F	1*
OU	25,63	4,77	0,00	0,00	0,00	4,77
AC	17,66	293,75	25,65	9,05	22,77	75,12
G	0,72	11,06	128,32	0,00	0,15	11,93
SH	2,65	0,00	1,81	0,00	162,82	167,28
F	0,00	0,00	0,00	0,00	0,00	0,00
2*	21,03	15,83	27,45	9,05	185,75	
1*: Reversal of vegetation evolution, 2*: Set of changes						

Table VIII: Double Flow Table of Land Use Changes (ha) in "Dreapano" Campsite

1945/2018	OU	AC	G	F	1*
OU	37,45	0,00	2,07	0,78	2,84
AC	113,77	279,55	10,16	3,26	127,19
G	28,55	25,74	162,01	35,68	89,97
F	0,91	1,04	0,00	5,83	1,95
2*	143,23	26,78	12,22	39,71	
1*: Reversal of vegetation evolution, 2*: Set of changes					

Table- IX: Double Flow Table of Land Use Changes (ha) in "Charavgi" Campsite

1945/2018	OU	AC	G	F	1*
OU	89,46	0,00	0,00	0,57	0,57
AC	181,75	16,03	0,00	30,69	212,44
G	253,37	15,88	0,00	119,04	388,28
F	0,00	0,00	0,00	0,00	0,00
2*	435,11	15,88	0,00	150,30	
1*: Reversal of vegetation evolution, 2*: Set of changes					

Table- X: Double Flow Table of Land Use Changes (ha) in "Tseligkato Gkiona" Campsite

1945/2018	G	SH	SF	F	1*
G	531,38	49,56	22,35	8,83	80,74
SH	25,94	0,00	0,00	48,77	74,71
SF	2,15	0,00	0,34	4,78	6,93
F	0,30	0,00	0,16	12,25	0,46
2*	28,38	49,56	22,51	62,39	
1*: Reversal of vegetation evolution, 2*: Set of changes					

Table- XI: Double Flow Table of Land Use Changes (ha) in "Ano Seli" Campsite

1945/2018	OU	G	SF	F	1*
OU	6,84	0,00	0,00	0,52	0,52
G	9,08	132,11	38,11	175,25	222,44
SF	0,12	10,21	17,35	191,87	202,20
F	0,00	1,19	36,70	85,38	37,89
2*	9,20	11,40	74,81	367,64	
1*: Reversal of vegetation evolution, 2*: Set of changes					

IV. DISCUSSION

Through this research, we found that the abandonment of animal movement on foot resulted in a change in land use, and particularly the densification of vegetation, which also aligns with the results of the National Report of Greece on the Environment [10]. Similar results were also shown by research conducted on transhumance. In the first four overnight stops located in the Larissa area, there is an increase in sparse forests and forests [11]. In the last four overnight stops, which are in Mount Vermio, there is an increase in shrublands, forests, and other uses [12]. On the other hand, however, we see that human activity can be a factor that inhibits the evolution of vegetation succession.

V. CONCLUSIONS

The decline of transhumance in Greece, particularly the abandonment of the traditional practice of moving animals on foot by the Sarakatsanioi herders, has led to the closure of landscapes through which the flocks once passed. Given these results, further research is needed to determine whether ecosystem services have declined in these areas.

ACKNOWLEDGMENT

D.K. Author would like to thank the cultural associations of *Sarakatsanaioi* for their assistance in facilitating interviews with the livestock farmers.

DECLARATION STATEMENT

I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been funded by any organizations or agencies. This independence ensures that the research is conducted with objectivity and without any external influence.
- **Ethical Approval and Consent to Participate:** The content of this article does not necessitate ethical approval or consent to participate with supporting documentation.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Author's Contributions:** The authorship of this article is contributed solely.

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