
Agrarian Landscape in the Delegation of Sbiba: Evaluation of Landscape Dynamics in an Agricultural Area

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Abstract:

This study is carried out during 2013 in the delegation of Sbiba, which is located in the central west of Tunisia. This area is characterized by the arable abundance of the lands that occupies 60% of the total surface area of the delegation. The objective of this work is to reveal the importance of the agricultural sector and to present the major changes that this sector lived during more than four decades. To achieve our goals, an analytical research based on several trans-disciplinary tools, in particular, the carto-interpretation, and then a

delimitation of natural and landscape zoning was invented. Also a phytological study was conducted to prove the anthropic influence on the floristic distribution of biodiversity in the agricultural landscape of the zone. The results show that the apple tree crops are the primordial agricultural sector of the region, they occupy 42.2% of the fruit-tree crops. This region is the supply of 45% of the national production, the irrigated sector had had sudden deep changes since the 1920s. The introduction of the perimeters irrigated to the delegation of Sbiba helped evolve the occupancy rate of the grounds from 35% in 1981 to 91%. We also notice through the factorial analysis of the statements phytologic an anthropic action that threatens the durability of the floristic biodiversity of agrarian landscape in Sbiba.

Key words: agrarian landscape, apple trees orchards, landscape dynamics, anthropic action, biodiversity.

1. Introduction

The access roads to the knowledge of the landscape are multiple today, and its evolution is placed at the result of dynamic space and chronological factors of natural or anthropic origin (Pinchemel and Pinchemel, 1994). About the concerns caused by these problems of “degradation” of the mediums, the problems of the conservation of the biodiversity were essential with force these last years; this fact, new interdisciplinary tools must be implemented, in order to make it possible to reconstitute the stages of the anthropisation and, thus, to understand some aspects of the organization and functioning of the territories. Agriculture is an important potential in terms of biodiversity and provides a remarkable opportunity for the development of truly sustainable development in the governorate of Kasserine. We will be questioning in this work particularly with an agrarian and landscape typology: apple-trees orchards landscape (Ilahi et al., 2013) and the floristic biodiversity. Sharing a look at the landscape, local actors build

the sense of action that help to clarify both the meaning of human actions, to select the objects that serve as the supports of intervention and to determine the orientations to take (Droeven, 2010). Within this framework our work is directed towards the broader context of the management of the landscapes, durability and the territorial development. In a governorate that imposes itself as being the largest area of apple in Tunisia (6923 ha), and the most apples productive region in Tunisia with 45% of national production (6923 ha), and the producing region of apples in Tunisia with 45% of production to the national scale (Khedhri and al., 2012), the delegation of Sbiba is presented as the first supplier of apples with 50% of the productions in the regional. The apple trees crops is a tradition related to the farmers of Kasserine, in particular the region of Sbiba, and in 2004 the productivity reached 10.4 t/ha against 5 t/ha with Kairouan and Sidi Bouzid (Selmi, 2009). These crops constitute an important potential of development and a remarkable appropriateness of a true sustainable development for this region.

2. Materials and Methods

2.1. Study Site: Delegation of Sbiba

The area of Sbiba is located in the Governorship of Kasserine, in the mid-west of Tunisia (Figure 1), covers a surface of 46253 ha (5.6% of the total surface area of the Governorship). The climate of the area semi-arid is strongly marked by the continentality; the seasonal rainfall mode is of the type APHE in which the summer remains the first dry season and the winter is the second (Chabbani, 1992), the annual average temperature of Sbiba is of 19.3°C. The useful agricultural surface is evaluated to approximately 44969 ha (97% of the total surface area of the delegation), whose fruit trees crops is the dominant culture. An old tradition of irrigation by rather rudimentary means (sources, well and derivation of wadis

water) remained until our days and supported, by 1920 the beginning of work of installation of an irrigated perimeter using water of the wadi Sbiba (Bonvallot and Hamza, 1980), the development of an intensive farming.

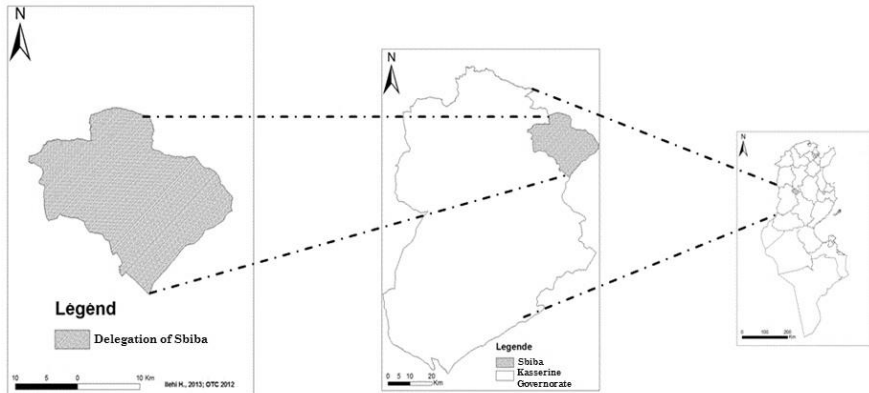


Fig.1. Geographical Localisation of the delegation of Sbiba

2.2. Methods

2.2.1. Cartographic agricultural data processing

From the map of occupation of the ground of the delegation of Sbiba, the abundant data by the Ministry of Agriculture (M.A) and the localization of the sites by GPS, we carried out some cards sets of themes by using a software SIG (ARC MAP version 9.3) on the scale 1/200 000.

- Map of Sbiba water resources realized by the software ARC Map v 9.3 starting from the data of M.A and CRDA Kasserine.
- map of the farmings realized with the help of software SIG (Arc Map v 9.3) starting from the map of occupation of the ground of the Governorship of Kasserine by the extension “Analysis tools” and the extension “clip”.
- Map of source of the irrigated perimeters in the delegation of Sbiba.
- Map of development of the irrigated sector: introduction of the irrigated perimeters,

- Map of localization of the orchards of fruit trees in the delegation of Sbiba. This map was carried out by the surveys of the points on ground by using GPS and the abundant data by the M.A.
- Map of the distribution of the fruit trees crops in the irrigated perimeter of Sbiba. This map is carried out by the superposition of the two cards: map of the fruit trees orchards and the map of the irrigated perimeters.
- Map of distribution of the apple orchards in the irrigated perimeters of the delegation of Sbiba (1/200 000). Realized by the superposition of the apple trees orchards map and the map of irrigated perimeter.

2.2.2. Method by phytological statement

Our objective is to characterize the distribution of the flora and the vegetation in response to different organization schemes landscape, themselves dictated by distinct degrees of artificiality of the landscape. For that, the flora, or more precisely the floristic list, is retained as element to evaluate the vegetable biodiversity.

We take into account two considerations: The existence of local nuances in the current flora of the zone of the study, illustrating distinct degrees of artificiality of the landscape, on the level of floristic diversity and distribution of the species according to their intrinsic characteristics.

The analysis thus takes into account the descriptive characteristics of the flora, namely the biodiversity index (specific wealth, floristic diversity) and the relative data with the auto-ecology of the species, in particular their preference of habitat and their strategies of dispersion of seeds. Thus, we may seek to formalize, with regard to the relative frequency of each species, a trend with the regression, the maintenance or the expansion, according to its own mechanisms of dispersion, colonization or extinction.

- Calculation of index of diversity of Shannon

The index of diversity of Shannon, for the total flora, is equal to the relative abundance of each species and is a statistical estimate of the probability of finding this species if one draws with the fate one from the individuals found in the statement observed. If we call “pi” this probability, the index of Shannon is an amount of information H:

$$H = - \sum (pi \log pi)$$

With $P_i = n_i / \sum n_j$

n_i : the full number of individuals for species I and $\sum n_j$ is the total staff complement (individuals of all the species)

3. Results

3.1. Hydrological landscape of the delegation of Sbiba

The data base of the map of the water resources of the delegation of Sbiba shows that: An abundance of the underground and surface resources marked especially by the presence of an important hydrographic network. This network is a set of 71 wadis, the delegation presents two principal Wadis:

- “Wadi HTAB” that also passes through the delegation of Jedelienne, it’s 24.8 km of length crossing the delegation of Sbiba
- “Wadi SBIBA” that is the most important affluent of the northern branch of Wadi ZEROUD and that has a 13.5 km length. It is noticed that “Wadi SBIBA” itself consists of two principal watercourses: Wadi BRIG (4.8 km) and the Wadi KHAROUBA (5.5 km) whose basins slopes are located in southern edge of the basin of the HTAB.

From the data of the M.A., these water resources (underground and surface) are exploited with the

help of 1175 wells of surface, and 151 drillings. We notice also the presence of many of hill lakes (16 hill lakes).

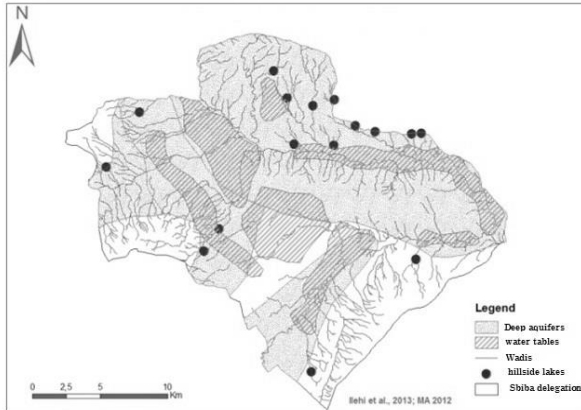


Fig.2. Map of Sbiba's water resources and Wadis

3.2. Agricultural landscape of Sbiba: Rainfall agriculture and irrigated agriculture

The analysis of the data base of the map of the sources of the irrigated perimeters in Sbiba shows that 3349 ha are private irrigated perimeters and 2421 ha are irrigated public perimeters.

The same data base enables us to know the irrigation facilities in these perimeters, we note that 755 ha of the surfaces are irrigated by drillings, 1157 surface wells are equipped to irrigate 2314 ha, and 280 ha are irrigated by derivation of wadis water.

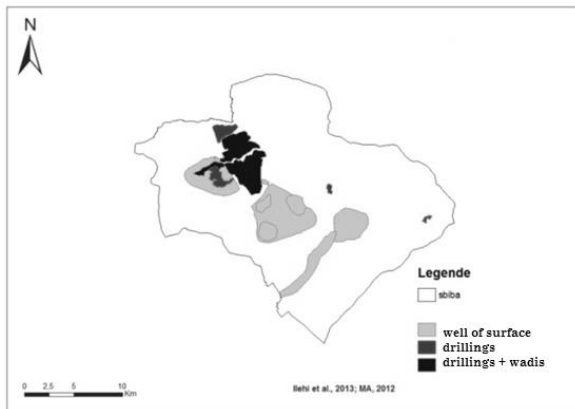


Fig.3. Map of the sources of the irrigated perimeter in Sbiba

The data base of the map of farming in the delegation of Sbiba shows that fruit trees crops (orchards of fruit bearing arboriculture and olive-growing) remain the principal farming in the area, they occupy a surface of 10194 ha is 22.12% of the agricultural lands, followed by the truck farming that occupies a surface of 828 ha is 17.7% of the agricultural lands.

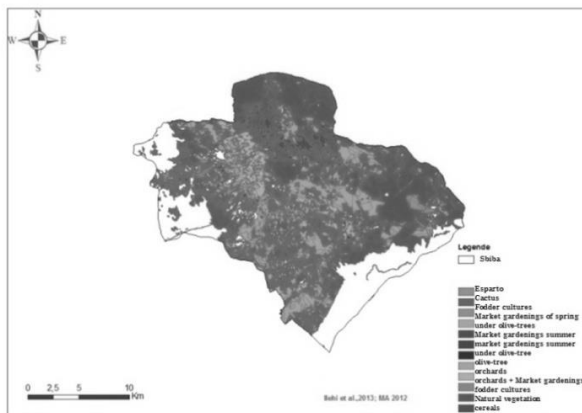


Fig.4. Map of distribution of farming in Sbiba

3.3. Apple orchards landscape

3.3.1. Sbiba between rain and irrigated arboricolous sector

The base of the data of the map of the arboricolous sector to the delegation of Sbiba shows that arboriculture (orchards of fruit-bearing arboriculture and oleiculture) remains the principal farming in the area, it occupies a surface of 10194 ha is 22.12% of the agricultural lands with Sbiba.

The data base of the map shows that:

- The rainfall arboricolous sector occupies a surface of 7800 ha.
- vegetable crops under olive-tree occupy 351 ha,
- the fodder crops under olive-tree occupy 6776 ha,
- the surface occupied by orchards in guide with market gardening and/or fodder is of 325 ha.
- The arboricolous sector in irrigated is presented mainly by the apple tree orchards.

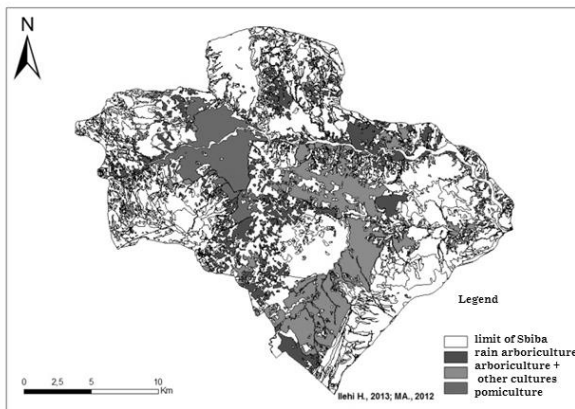


Fig.5. Map of the arboricolous sector in the delegation of Sbiba

The analysis of the data base of the map of orchards in the delegation of Sbiba shows the following results:

- 90% of the arboricolous orchards in the area are apple trees orchards,

- 82.6% of the apple trees orchards are orchards led in monoculture,
- a predominance of the varieties of the Golden Delicious and Richared Delicious that account for 71% of the cultivated autumnal varieties,
- 7.3% of the apple trees orchards are intercropped: Apple trees associated with other crops (fruit trees, vegetable crops, fodder crops).

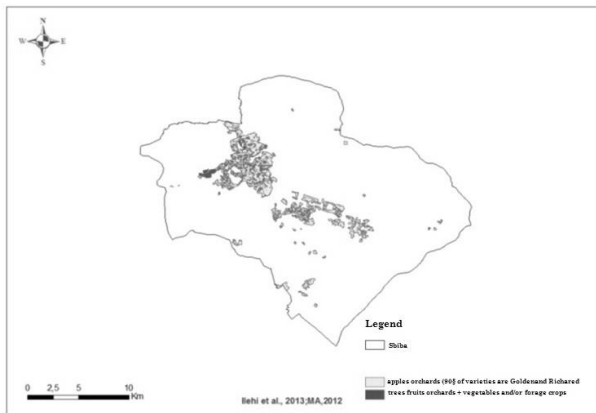


Fig.6. Localisation of the orchards with an arboricol vocation in Sbiba

The apple-tree orchard occupies a surface of 2536.6 ha (90% of the orchards superficies). The map of distribution of the apple trees orchards shows that apple trees occupy 43.9% of the irrigated perimeters.

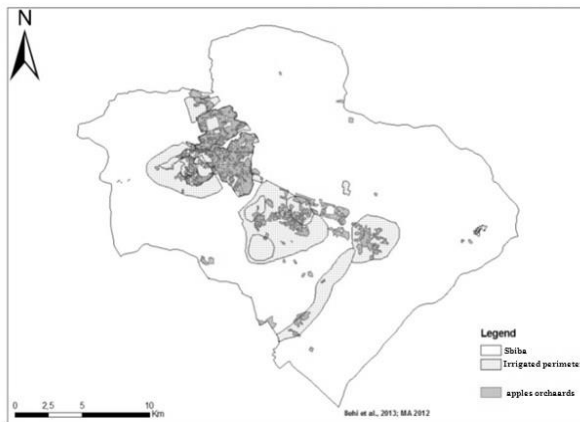


Fig.7. Map of distribution of the apple-trees orchards in the irrigated perimeters of Sbiba

3.4. Landscape dynamics of the agricultural sector of Sbiba

3.4.1. Mutation of the occupation of agricultural land

From the data base of the crop’s map of Sbiba’s area, we use statistics of the surfaces of the various agricultural speculations (table 1), and with the help of the data of the Ministry of Agriculture, that reveal the changes of the occupation of the ground in the delegation of Sbiba between 1981 and 2011.

Table1. Evolution of the surfaces of the irrigated and rainfall crops

	Type of occupation	1981		2011	
		Superficies (ha)	%	Superficies (ha)	%
Irrigated perimeters	Cultivation of cereals	164	49.4	981	17
	Arboriculture	81	24.4	2742	47.52
	Truck farming	65	19.6	1677	29.06
	Fodder	22	6.6	370	6.4
	Various Cultures	332	100%	5770	100%
Rainfed Agriculture	Cultivation of cereals	380	13.3	28517	65.3
	Oleicole	8	0.2	6776	15.5
	Arboriculture + Cultivation of cereals	57	2.0	676	1.5

	Cactus	197	6.9	123	0.2
	Rangs and forests	2202	77.4	7515	17.2
	Various crops	2844	100%	43607	100%

The data analysis in table 1 shows the following results:

In 1981 regularly cultivated surfaces extend, apart from the perimeter irrigated on all the zone of Piedmont. The useful agricultural surface can be evaluated to approximately 1000 ha of which 332 ha are irrigated perimeters. During the Eighties, the cultivation of cereals is the most practiced culture, it covers 601 ha on the whole is 61.6% of the acreage.

In the irrigated perimeter it occupies a good part of the useful agricultural lands, 49.4% of the total surface area of the perimeter. Apart from the irrigated perimeter, the cultivation of cereals occupies most of the cultivated grounds. Arboriculture (apple trees and almond trees) remains a very limited activity, one notices also a weak presence of the culture of olive-tree.

The truck farming (production of peppers and tomatoes) was an activity under development. In 2011 we noticed the development of the various agricultural speculations, the surfaces of the various cultures recorded a remarkable increase during the three last decades.

The useful agricultural surface occupies 46,066 ha, the surfaces arable occupy 38 214 ha. Although the cultivation of cereals yielded the occupation of the ground in the perimeter irrigated to other culture, it recorded an increase in surface to reach 981 ha in irrigated, and the rain cultivation of cereals remains the principal culture by occupying 28 517 ha is 65.3% of the total surface area of the rainfall crops.

Arboriculture underwent a very significant development to occupy 2742 ha of the irrigated grounds i.e. 47.52% of the irrigated perimeter, arboriculture especially cultivation of olive trees records an increase in surface of 8 ha at 1981 to 676 ha at 2011. The vegetable farming practiced in irrigated occupies 1677 ha is 29.06% of the irrigated surfaces.

3.4.2. Development of Sbiba's irrigated sector

The base of the data of the map of the introduction in the irrigated perimeters proves that the first perimeters completely installed were in the 1960s: Perimeter of Sbiba-Right Bank and perimeter of Sbiba-Left bank of a total surface area of 1878 ha, installed in 1963, After a period that exceeded the twenty years, the installation of a new perimeter takes place:

- The perimeter of Sbiba 18: installed in 1996, surface equalizes with 265 ha,
- The installation of the perimeter of Sbiba 16-15 during the year 1997 to increase the irrigated agricultural surface of 81 ha.

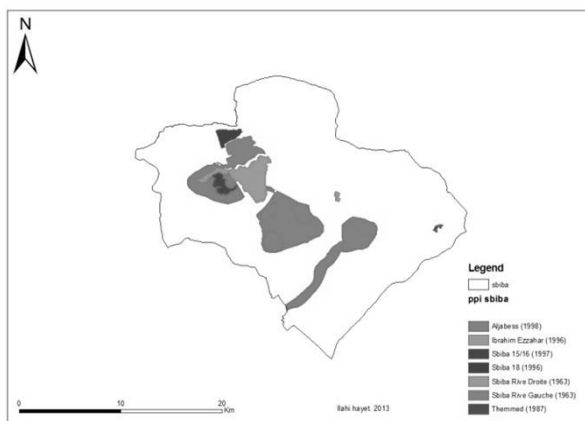


Fig.8. Map of development of the irrigated sector: introduction of the irrigated perimeters

3.5 Interrelationship between floristic biodiversity and anthropic action in an agricultural space

The graph visualizes projections in the factorial design F1 X F2 of tax with the plant species associated with the ecological groups presenting the study's site.

From this graph we can draw the following table:

Table 2: Coordinates of the ecological Groups in the factorial design:

	F1	F2
Aquatic	-0,051	-0,544
lean grassland	-0,051	-0,022
Weeds	-0,051	0,046
ruderal wastelands	0,182	0,000
Crops	0,308	0,000

The table shows that:

- only the species cultivated, of the waste ruderal lands and the adventitious ones for the factorial design F1 X F2 present a positive index what testifies the anthropic action on the medium,
- The species of thin meadow present a negative index. What shows us that the medium of study has a pastoral aspect but with non-significant presence.
- The watery species present also a negative index: that shows the weak distribution of the aquatic environments in the zone of study.

Interpretation of the axis F1:

- Positive coordinates: cultivated vegetable communities (*Malus pumila*, *Olea europea*, *Prunus persica*) and uncultivated waste landsrudérales (*draba muralis* L. etc), favourable with the presence of the action human.
- Negative coordinates: adventitious species in positive interaction with meadow species. What shows a human action as well as a pasture action. The adventitious ones are also in negative interaction with the cultures and the ruderal wastelands are due to the absence of the cultivation method of weeding in agricultural spaces (apple-trees, olive-trees and peach-trees orchards).

Interpretation of the axis F2:

- Positive coordinates: Formation vegetable adventitious, a nature influenced by the human practices; (in negative

correlation with crops: in our case apple-trees, olive and peach trees),

- Negative coordinates: meadow and watery formations which mark the pastoral vocation of the zone, and the weak presence of the aquatic environments.

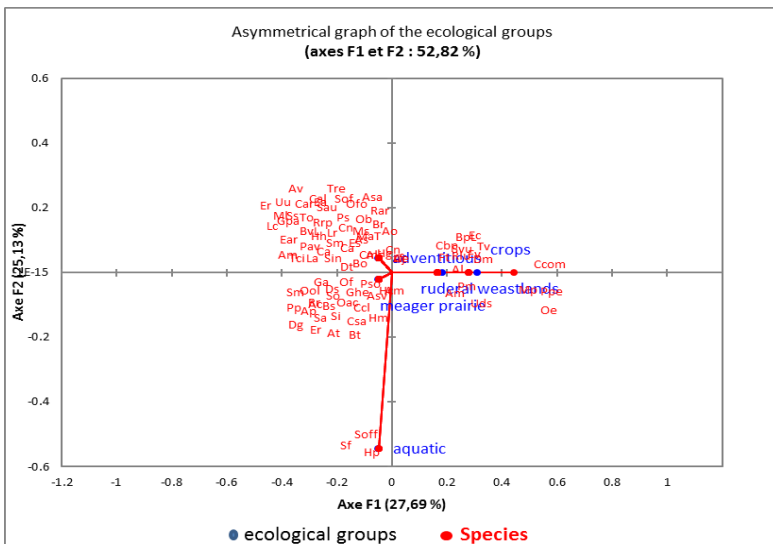


Fig. 9 Factorial design showing the interaction of the species according to their ecological groups in the site of study

4. Discussion

This study enabled us to analyze and interpret the various stages of development of the agricultural sector to the region of Sbiba, this sector was with paramount importance since the 1920s, that made it possible for this region to position itself as being first producing apples with the national scale. In spite of the efforts employed to modernize the agricultural sector, the durability of this medium remains threatened by several factors, and since the vegetation is distributed in answer, first of all, in the conditions of the medium in keeping with the ecological requirements of the plant species the human

activities and their evolution comes in the second place, sometimes in a determining way.

The results of the phytologic analysis shows that in the study site are found floristic species conducive with the human activity, these species are accompanied with adventitious presence and it is especially due to the absence of the weeding practice. This nature remains closely related to the nature of the anthropic activity, what threatens the durability of the agrarian mediums.

Conclusion

The present study makes it possible to confront spatial analysis thanks to the use of software SIG and the data agricultural. The unit identifies landscape characteristics of the delegation of Sbiba. Thus a large territory landscape was identified: the agricultural landscape in irrigated and it is especially the apple trees orchards. The characterization of this territory shows the following essential facts:

Sbiba's agricultural space depends increasingly on the water component (it is a non-renewable source), the floristic biodiversity is closely dependent on the presence of human being and these cultural activities. What enables us to conclude that this biodiversity remains always threatened and this landscape can be durable only when the political landscape that preserves the agricultural area and the species is placed thereon.

The valorisation and the insertion of a territory in development projects durable require, first of all, recognition of the processes of change and evolution of this kind of space. This implies taking into account of its economic, social and space values by suitable territorial governance.

Although, to reflect on the landscape allows the farmers to consolidate agricultural systems as well as possible developing the local and effective natural resources on the

economic plan, this can be a means of improving promotion of their products of quality. Lastly, the landscape constitutes a means of communicating on the role of the farming within the social groups (Guillaumin A, 2008).

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