

THE ROLE OF THE FLORA IN AGRICULTURAL SYSTEM DEVELOPMENT IN MOUNTAIN AREAS - CASE STUDY: TAFRAOUTE IDA OUZDOUTE, MOROCCO

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Abstract. The open areas in the Western Moroccan Anti Atlas Mountains constitute a diversified natural potential. However, this wealth is doomed to disappearance under the growing impact of natural and anthropogenic hazards - an example being the changes introduced on the agricultural production system. Hence, the importance of having a look at these territories in terms of participative sustainable development is great. This paper provides the first elements of a work-in-progress research, which aims at setting up a geographical information system integrating the components of geo-bio-diversity, the local know-how, the heritage, and the risks that are associated with them. It is to present the results of the study of the flora throughout the Tafraoute Ida Ouzdoute Valley (Ighrem, Taroudant). The exploration, sampling, and the semi-structured interviews are the main methodological tools adopted. The inventory and analysis of the data on the local flora confirm the diversity of plants, their importance in the development of agriculture and the enrichment of the ecosystem services of the mountains. In addition, a great need has been detected in terms of communication on the enhancement and preservation of this component of biodiversity.

Keywords: plants diversity, agricultural system, ecosystem services in mountain areas, sustainable development participatory, Tafraoute Ida Ouzdoute (Morocco).

Rezumat. Rolul florei în dezvoltarea sistemului agricol din zonele montane – studiu de caz: Tafraoute Ida Ouzdoute, Maroc. Zonele deschise din Munții Anti Atlas din vestul Marocului constituie un potențial natural diversificat. Cu toate acestea, această bogăție este sortită dispariției sub impactul tot mai mare al pericolelor naturale și antropice – un exemplu fiind modificările introduse în sistemul de producție agricolă. Prin urmare, importanța de a avea o privire asupra acestor teritorii în ceea ce privește dezvoltarea durabilă participativă este mare. Acest document oferă primele elemente ale unei cercetări în curs de desfășurare, care vizează crearea unui sistem informațional geografic care să integreze componentele geo-bio-diversității, know-how-ului local, patrimoniul și riscurile asociate acestora. Este vorba de prezentarea rezultatelor studiului florei în cazul Văii Tafraoute Ida Ouzdoute (Ighrem, Taroudant). Explorarea, eșantionarea și interviurile semistructurate sunt principalele instrumente metodologice adoptate. Inventarul și analiza datelor privind flora locală confirmă diversitatea plantelor, importanța acestora în dezvoltarea agriculturii și îmbogățirea serviciilor ecosistemice ale munților. În plus, a fost detectată o mare nevoie în ceea ce privește comunicarea privind sporirea și conservarea acestei componente a biodiversității.

Cuvinte cheie: diversitatea plantelor, sistem agricol, servicii ecosistemice în zone montane, dezvoltare durabilă participativă, Tafraoute Ida Ouzdoute (Maroc).

INTRODUCTION

The Anti Atlas Mountains of Western Morocco constitute one of the ecosystem complexes of the Globe with major scientific importance, and which require systematic research (MICHARD et al., 2008). The Ighrem Region in Taroudant, Morocco (9°23'W, 30°25'N, elevation 115 m) is a good example of this complexity (Fig. 1).

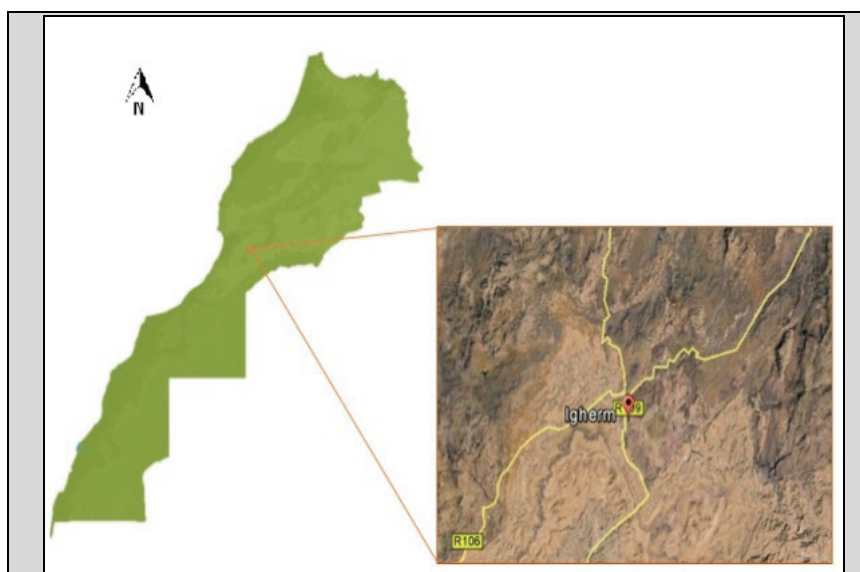


Figure 1. Location of the study area (original).

This entire territory is mainly formed of landforms and valleys which make life difficult for its inhabitants (AL-AZKI 2003; 2006, 2008; 2010-2011a; b). This geography imposes a special agricultural system. The zones of exploitation are landscaped in the form of levels where the trees, shrubs and herbaceous plants are grown successively on plots which are very fragmented (Fig. 2).

The management of water resources has undergone a great change. The traditional ancestral system based on the distribution of in shares has been changed with a modern system in terms of integration of new techniques of collection and irrigation. This change accompanied the dynamic of development recorded in many communities of the Ighrem (BERCU, 2015).

Study area. The geography of this territory is characterized by the abundance of landforms and valleys, which makes life difficult and imposes a special agricultural system. The trees, the other plants and the market gardening succeed one another in holdings that are generally very fragmented and distributed in floors (Fig. 2); the management of the water resource has changed from a traditional system ancestral database on the distribution of shared water rights, to a modern system with the integration of new techniques of collection and irrigation (BERCU et al., 2015).



Figure 2. Agriculture on levels at Targa, Tafraoute Ida Ouzdoute Valley (original photo).

However, its mountain ecosystems are facing extinction by natural hazards (drought, erosion, etc.) and anthropological impacts (human migration and neglect of the territory, excessive exploitation of natural resources). The present study of the Tafraoute Valley aims at presenting the results of the efforts undertaken to enhance and preserve the floristic richness as a major component of the biodiversity of the valley. In the different stages of this study, an interest was given to the involvement of the local population in order to ensure a sustainable development participation (PARRIS & KATES, 2003). This development is necessarily linked to the maintenance of mountain agricultural system, which requires a rigorous and responsible management of natural resources, as well of ecosystem goods and services derived from it. (Fig. 3).

In fact, this study first proposes to establish an inventory of the main plant species of the valley and to determine their uses depending on the local traditions and practices. Then, it aims at checking to what extent the development projects put in place in the valley have contributed to the preservation of the flora (TANCOIGNE et al, 2014; GRÊT-REGAMEY et al., 2015).

Conceptual Framework. The mountain ecosystems of Ighrem are threats to destruction under the effect of natural (drought, erosion, etc.) and anthropogenic risks (migration of men, excessive exploitation of natural resources). The present study in Tafraoute Ida Ouzdoute aims at presenting the results of the efforts undertaken to enhance and preserve the floristic richness (KÖRNER et al., 2011). The ecosystem services, biodiversity and sustainable development are the concepts that govern this work (Fig. 3).

Ecosystem is the foundation upon which human beings survive and their community civilization develops (O'FARRELL et al., 2007). One of these key components is the biodiversity, which was defined as all species of microorganisms, plants and animals, as well as ecosystems where they live and interact (KAENNEL, 1998; ***. COM, 2001; ***. UNEP, 2010).

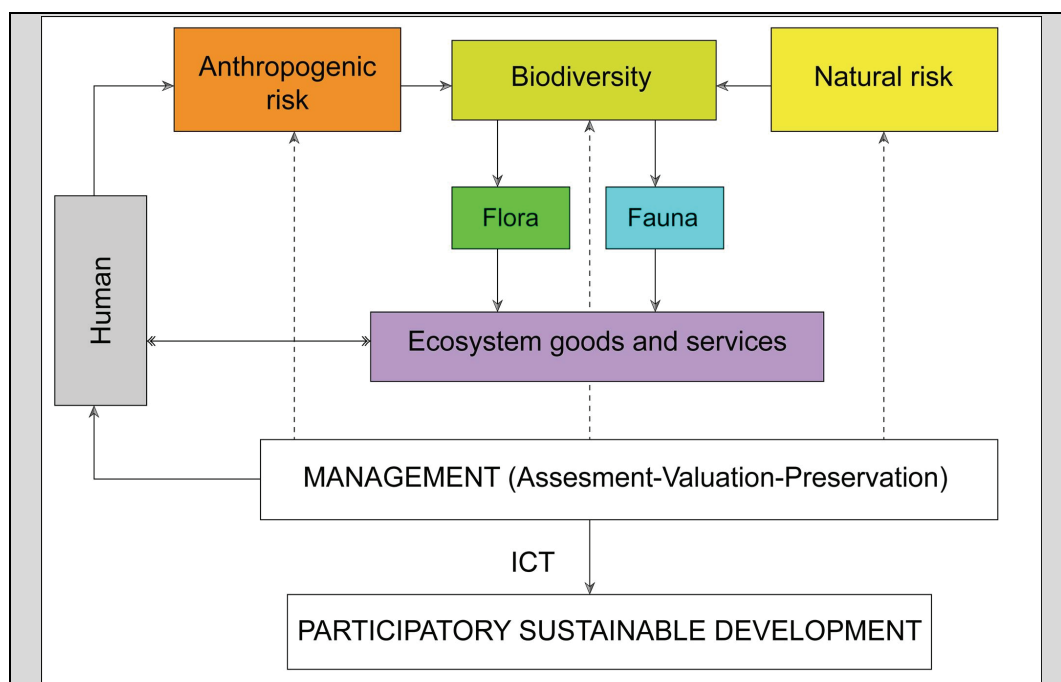


Figure 3. Research model (original).

The products and services provided to the ecosystem service function furnish the necessary environmental conditions and process in order to meet the requirements of human beings (COSTANZA et al., 1997; HUANG et al., 2010). Therefore, the maintenance and protection of ecosystem service function is essential for achieving harmony and balance between human community and ecosystem (HUANG et al., 2011a; b). So, a sustainable development participation seems necessary to maintain life in these isolated rural areas. As it was defined by the report of 2001, sustainable development implicitly requires the participation of the local population to ensure the sustainability of resources and the continuity of human life.

This paper presents the first elements of an ongoing research project that aims to develop a geographic information system incorporating elements of geo-bio-diversity, local expertise, as well as the risks associated with them in the territorial development (GRAY, 2011).

MATERIALS AND METHODS

The approach undertaken to develop this study was a multidisciplinary one. Through exploration and sampling, 34 local plants were collected. This work was complemented by semi-structured maintenance. Thus, with 30 record maintenance guides, an ethno-botanical survey of land was used to determine the local use of these plants. In parallel, regular monitoring of the plant nursery was used to evaluate the two local species production capacity. The two main criteria to undertake this evaluation were: the number of plants (seedlings) who survive and the number of plants who die of the total number cultivated.

The farm where the works were carried out, with an area of 600 m² and a fenced area of 4,000 m², has been an agricultural project in partnership with the Government Programme "National Initiative for Human Development" in 2010.

The methods of prospecting and sampling were supplemented with interviews. Thus, with 30 record maintenance guides, an ethno-botanical survey of land was used to determine the local use of these plants. This sample represented 15.87% of the population of the locality. These people were selected on the basis of 1) their knowledge of the medicinal plants of the forest, and 2) their experiences with traditional uses of plants.

RESULTS AND DISCUSSION

The inventory of the flora from plantations. The work done in the Tafraoute Ida Ouzdoute Valley allowed the collecting of the main species of local flora. 28 species were identified belonging to 24 families (Table 1; Fig. 4) (PRODAN & BUIA, 1966; MORARIU & TODOR, 1972; BENABID & BELLAKHDAR, 1987; DRĂGULESCU, 1995; BENABID, 2000; 2002; FĂGĂRAȘ, 2005; CHIFU et al., 2006; BENABID & MELHAOUI, 2011; AXINI, 2012).

Table 1. The systematic analysis of the plant species identified in the Tafraoute N'Ida Ouzdoute Valley.

NO.	ORDER	FAMILY	TAXA
1.	Rosales	Rosaceae	<i>Prunus amygdalus</i> Batsch
2.		Rhamnaceae	<i>Ziziphus lotus</i> (L.) Lam.
3.	Fabales	Fabaceae	<i>Ceratonia siliqua</i> L.
4.	Apiales	Apiaceae	<i>Ferula communis</i> L.
5.	Malvales	Cistaceae	<i>Cistus villosus</i> L.
6.	Malpighiales	Euphorbiaceae	<i>Euphorbia echinus</i> Hook. f. & Coss.
7.	Sapindales	Anacardiaceae	<i>Pistacia lentiscus</i> L.
8.			<i>Schinus molle</i> L.
9.	Lamiales	Oleaceae	<i>Olea europaea</i> L.
10.		Lamiaceae	<i>Thymus leptobotrys</i> Murb.
11.			<i>Lavandula suaveolens</i> (L.) Poiteau
12.			<i>Lavandula multifida</i> L.
13.	Brassicales	Brassicaceae	<i>Moricandia suffruticosa</i> (Desf.) Coss. & Durieu
14.	Gentianales	Apocynaceae	<i>Nerium oleander</i> L.
15.	Boraginales	Boraginaceae	<i>Echium horridum</i> Batt.
16.	Solanales	Solanaceae	<i>Withania frutescens</i> (L.) Pauquy
17.	Asterales	Asteraceae	<i>Senecio</i> sp. L.
18.			<i>Cladanthus arabicus</i> (L.) Cass.
19.			<i>Centaurea</i> sp. L.
20.			<i>Launaea arborescens</i> Murb.
21.			<i>Carthamus fruticosus</i> Maire
22.	Ericales	Sapotaceae	<i>Argania spinosa</i> (L.) Skeels
23.	Caryophyllales	Cactaceae	<i>Opuntia ficus-indica</i> (L.) Mill.
24.		Polygonaceae	<i>Rumex vesicarius</i> L.
25.	Asparagales	Asphodelaceae	<i>Asphodelus tenuifolius</i> Cav.
26.		Asparagaceae	<i>Urginea maritima</i> L.
27.			<i>Asparagus stipularis</i> Forssk.
28.	Liliales	Liliaceae	<i>Asparagus albus</i> L.



Figure 4. The main trees species of Tafraoute Ida Ouzdoute Valley (original photos).

Mainly, the valley was dominated by 6 vegetable-tree species (Fig. 4; Table 2).

Shrubs and herbaceous plants identified in the valley have developed plant associations with the tree species above mentioned. 4 shrubs species and 18 herbaceous plant species were identified and determined in the valley (Fig. 5; Table 2).

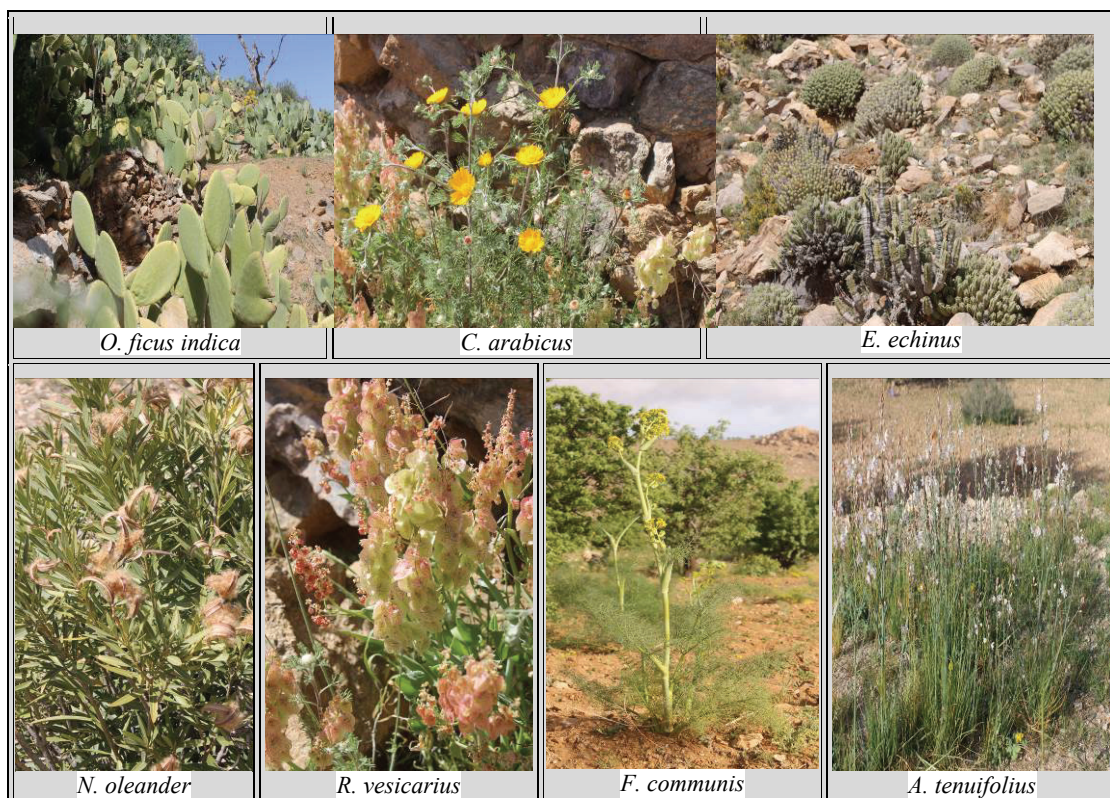


Figure 5. A sample of the floristic procession at Taфраoute n'Ida Ouzdoute Valley (original photos).

Table 2. The biological type and flora uses from the Taфраoute N'Ida Ouzdoute Valley.

NO.	SPECIES	BIO-TYPE	USES
1	<i>P. amygdalus</i>	tree	food, medical, cosmetic
2	<i>O. europaea</i>		food, medical, cosmetic
3	<i>C. siliqua</i>		food, medical, cosmetic
4	<i>P. lentiscus</i>		medical, tonic
5	<i>A. spinosa</i>		food, medical, cosmetic
6	<i>S. molle</i>		fuel and barrier in grazing
7	<i>N. oleander</i>	shrub	moderate toxic
8	<i>Z. lotus</i>		medical
9	<i>L. arborescens</i>		-
10	<i>A. albus</i>		food, after cooking
11	<i>T. leptobotrys</i>	herbaceous plant	medical, tonic
12	<i>C. villosus</i>		medical
13	<i>C. fruticosus</i>		nectariferous plant
14	<i>W. frutescens</i>		pasture plant
15	<i>M. suffruticesa</i>		medical
16	<i>E. horridum</i>		medical
17	<i>E. echinus</i>		medical, ornamental
18	<i>L. suaveolens</i>		cosmetic
	<i>L. multifida</i>		cosmetic
19	<i>A. tenuifolius</i>		medical
21	<i>U. maritima</i>		medical
22	<i>O. ficus indica</i>		food, medical
23	<i>R. vesicarius</i>		medical, cosmetic
24	<i>A. stipularis</i>		medical (vegetable powder used on the wounds)
25	<i>Senecio</i> sp.		medical
26	<i>C. arabicus</i>		medical
27	<i>Centaurea</i> sp.		-
28	<i>F. communis</i>		medical (domestic use and hives)

The flora uses of the Ida Ouzdoute Valley. The flora of Taфраoute Ida Ouzdoute Valley (Ighrem, Taroudant) is generally used for food, medicinal, aromatic or cosmetics purposes, according to interviewees in this study (Table 2). However, a laboratory work is needed to confirm or affirm these statements, and to determine the doses of use of each of the species (FISCHER, 1941; VASILCA-MOZĂCENI, 2003; HSEINI & KAHOUADJI, 2007; BENKHNIGUE et al., 2014).

The preservation of the flora in plantations. Starting from 2010, the aboriginal population has begun preservation projects of the flora in Tafraoute Ida Ouzdoute Valley. The experience of the Tigmi N'targa locality was a successful example. This experiment is unique in the eastern of Anti-Atlas Mountains (Fig. 6).

The efforts were directed to planting the local species *O. europaea* (olive trees) and *P. amygdalus* (almond trees). In a period of two years, the achieved results were 9200 seedlings of *O. europaea* located in the valley's fields. The success rate was lower for *P. amygdalus*; only 4578 seedlings survived, of which 2500 were sold, the rest were located in the valley.



Figure 6. The plant nursery at Targa, Tafraoute Ida Ouzdoute (original photo).

CONCLUSIONS

The present study has enabled us to draw up the floristic listing of a mountainous area enclave of the Anti Atlas Mountains in the Occidental Morocco. An extra work is recommended to complement the vernacular names of species and itemize their uses.

The culture of the two species *P. amygdalus* and *O. europaea* in the valley of Targa has proven its effectiveness. The new plantations have strengthened the vegetation cover. A lack was noticed with regard to the improvement of the living conditions of the seedlings to decrease the losses during the culture (34.22% for *P. amygdalus* and 8% for *O. europaea*).

It has become mandatory to raise awareness on the importance of biodiversity in the survival of these rural areas and for the integration of modern technology in agriculture.

All these efforts will not have a significant impact unless the main actor, the farmer, is at the center of every project of territorial development.

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