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Socioeconomic interest and valorization of medicinal plants from the Rissani oasis (SE of Morocco)

[Interés socioeconómico y valorización de plantas medicinales del oasis de Rissani (SE de Marruecos)]

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Abstract

The survival and sustenance of man depends largely on plants which generate directly 87% of its food needs and constitute a source of basic health care in developing countries. Based on socio-economic surveys and field observations led in the Rissani oasis (SE of Morocco), we have identified 109 species belonging to 45 botanical families and 102 genera. The distribution in families is: *Lamiaceae* (15.2%), *Asteraceae* (11.5%), *Fabaceae* (8.46 %), *Poaceae* (8.12%) and *Apiaceae* (6.75%). The species used in traditional medicine correspond to 57.8%, for food 10.1% and for other uses 28.4%. Of these species, 10.1% are cultivated, naturalized, introduced and/or weeds. Byproducts of 46.8% of these species are imported from other regions of Morocco and locally marketed. Many medicinal species from this area are not recognized by the inhabitants, and their sensitization towards the use and conservation of local plant diversity is needed.

Keywords: Rissani oasis, flora, socio-economy, medicinal use.

Resumen

La supervivencia y sustentabilidad de la humanidad depende en gran medida de las plantas. Estas satisfacen directamente el 87% de sus necesidades alimenticias y constituyen, en países en desarrollo, una fuente para el cuidado de salud. Basados en estudios y observaciones de campo realizadas en el oasis de Rissani (SE de Marruecos), hemos identificado las 109 especies de plantas más utilizadas que pertenecen a 45 familias y 102 géneros. La distribución por familia es: *Lamiaceae* (15.2%), *Asteraceae* (11.5%), *Fabaceae* (8.46%), *Proaceae* (8.12%) y *Apiaceae* (6.75%). Las especies utilizadas en medicina tradicional corresponden al 57.8%, en alimentación 28.5% y para usos múltiples 28.4%. De estas especies el 10.1% son cultivadas, naturalizadas, introducidas y/o corresponden a malezas. Subproductos del 46.8% de estas especies son importados de otras regiones de Marrueco para su comercialización. Muchas de las especies medicinales no son reconocidas por los habitantes del oasis y es necesario sensibilizarlos en relación a su utilización y conservación.

Palabras Clave: Oasis de Rissani, flora, economía social, usos en medicina.

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INTRODUCTION

Medicinal plants were used by many civilizations (Chinese, Egyptian, Babylonian, Greek, Roman, etc.) for their therapeutic, cosmetic, dietary, pharmaceutical, food and industrial properties (Lahsissene *et al.*, 2009).

Indeed, plants are a basic element for the man survival, and they generate directly 87% of its food needs, in addition to latex and wood (Rejdali, 1996). They constitute also a source of medical care in developing countries because of lack of a modern medical system (in Mehdioui & Kahouadji, 2007).

Morocco, a producing country of medicinal and aromatic plants (PAM), has a potential medicinal flora very rich and diversified, with a very pronounced endemism. But this heritage is still unknown and under-exploited (Kassel, 2001), and treatment with medicinal plants, among the therapeutic methods, presents an interest in parallel to the modern medicine. Several plants are used in medicine or food (Soulimani *et al.*, 1997, 2001; Ennabili *et al.*, 2000, 2006; Boustia *et al.*, 2001, 2008; Daoudi *et al.*, 2008; El Meskaoui *et al.*, 2008; Greche *et al.*, 2009).

Economically, the PAM byproducts (essential oils and extracts) have a high value - c. 35.6 billion MAD in 1992 - (in Kassel, 2001). However, it is very difficult to identify the Moroccan domestic PAM-production because of lack of reliable national and/or regional statistics, and irregular production mainly from natural areas. Available estimates from the "Administration des Eaux et Forêts", which manages the exploitation of forest areas with almost all spontaneous PAM, highlight a major national commercial activity due to PAM. Rosemary exploitation provides for example c. 4.05 million MAD, and more than half of world production of essential oils is provided by developing countries (Ministere de L'Agriculture, 2005).

Morocco exports entirely its domestic PAM-production. PAM export to the USA and the EU equals c. 250 million MAD, and essential oils export yield c. 165 million MAD. The PAM export in 2002

was 39,849 ton, valued at 547 million DH, and this export tonnage and value have increased 56% and 43% in the same order compared with 2000 (Ministere de L'Agriculture, 2005).

Despite the socioeconomic importance of PAM in Morocco, many areas such as the High Atlas, the Rif Mountains and the Saharan provinces are under-explored (Rejdali, 1996; Ennabili *et al.*, 2000, 2006). In this work, a socioeconomic survey was conducted nearby the population of the Rissani oasis (Province of Er Rachidia) in order to contribute to medicine valorization of plant resources and their integration into the local economy.

METHODS

Study area

The area of Rissani (Region of Meknes-Tafilalt, S of Morocco) is bounded by Merzouga, Jorf-Alnif, Erfoud and Taouz respectively on the East, West, North and South (Figure 1).

The city of Rissani lies on the banks of Ghri and Ziz wadis (31°17'18.8556"N - 4°16'30.9174"W). The study area corresponds to three rural communes and municipalities, including 13 Mechiakhats -Territorial Subdivisions- and 133 Ksours -agglomerations of rural dwellings- (Personal Communication, 2009).

This area belongs to the subdesertic biogeographical-realm, cognizing a critical situation due to the scarcity of water resources (annual rainfall low than 150 mm), salinization and soil erosion, silting of cultivated areas, illiteracy, poverty and migration of the population (Monographie Regionale de l'Environnement, 2001; Renevot, 2009). In this context the main activities are based on the date palm and underlying cultures -cereals, fodder and cash crops- (Anonymous 2002).

The empirical knowledge in herbal medicine was transmitted orally from generation to another and enriched thanks to the strategic location of the study area -between North Africa, the Sahara and the Sahel- and historical events -interaction of the Amazigh, Jewish, Saharan and Arab-Muslim civilizations- (El Rhaffari & Zaid, 2002).

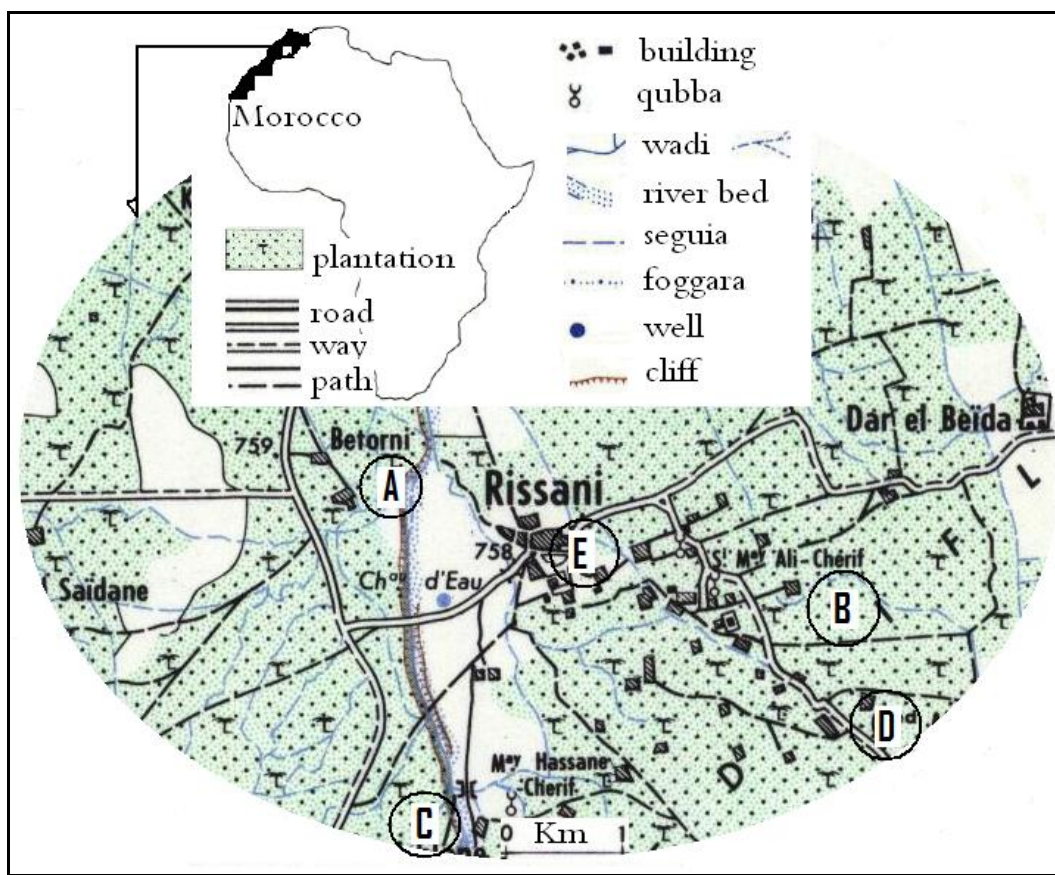


Figure 1. Study area location. A, Mly Abdellah Dqaq. B, Abbar el mekhzen, Kasbate sidi Melouk and Zawiya Mly Ali Cherif. C, Kasbate Wighlane and Tabouâssamt. D, Bni Mimoune chorfa, Ouelad Aicha, Ammar and Lmati. E, Ihyatene and Kasbate Mly Moustaine. Modified source: "Direction de la Conservation foncière et des Travaux topographiques, Division de la carte, Rabat, 1970".

Inquiry form

To gather information relating to plants use in the study area, multiple entry inquiry-forms have been randomly filled out with the local population during the June-October 2009 period. Samples of plants used locally were harvested on land and/or requested from herbalists.

Plants identification

The plants collected on land are identified using Ozenda (2004), Quezel & Santa (1962 & 1963) and consulting databases [Base de données des plantes d'Afrique & <http://fr.wikipedia.org>]. The un-sampled plants and used by the local population were identified by combining other works relevant to the study area (Bertrand, 1991; Bellakhdar, 1997; Hseini *et al.*, 2007; Tahraoui *et al.*, 2007).

RESULTS AND DISCUSSION

Locations

According to plants-use importance, the localities visited are recorded in Table 1.

Interviewees

The interviewees are represented mainly by herbalists and/or traditional healers (41.6%), users - including traders and shepherds- (40.4%), and fellahs - farm workers- (18.2%). They are mostly illiterates (especially women and older men), and school and university graduates.

Flora

The analysis of 367 inquiry forms or "location-interviewee-plant" combinations, filled out in 14 stations, shows that 109 species are used in traditional medicine and food by the population of the

Rissani area. All recognized species belong to 46 botanical families and 102 genera (Table 2). 24.8% of families are represented by one species each (Figure 2). 10.1% of these species are cultivated,

naturalized, introduced and/or weeds in comparison with the national native flora, and 46.8% are imported from other regions of Morocco and marketed locally.

Table 1. Importance of plants use by location visited in the Rissani area. *Frequency (%)*: frequency of plants use, corresponding to "location-interviewee-plant" combination rate.

Township	Location	Frequency (%)
<i>My Ali Cherif</i>		54,36
	Rissani	33,14
	Kasbate sidi Melouk	9,6
	Ihyatene	5,23
	Kasbat My Moustaine	4,07
	Zaouite Mly Ali cherif	2,32
<i>Sfalat</i>		27.31
	Lmati	7,55
	Ammar	6,68
	Kasbat Ouighlane	5,81
	My Abdellah Dkak	4,07
	Tabouassamt	3,2
<i>Bni Mhamed Sijilmassa</i>		18,30
	Bni mimoune charfa	7,55
	Elfida	6,4
	Ouelad Aicha	3,48
	Abbar mekhzen	0,87

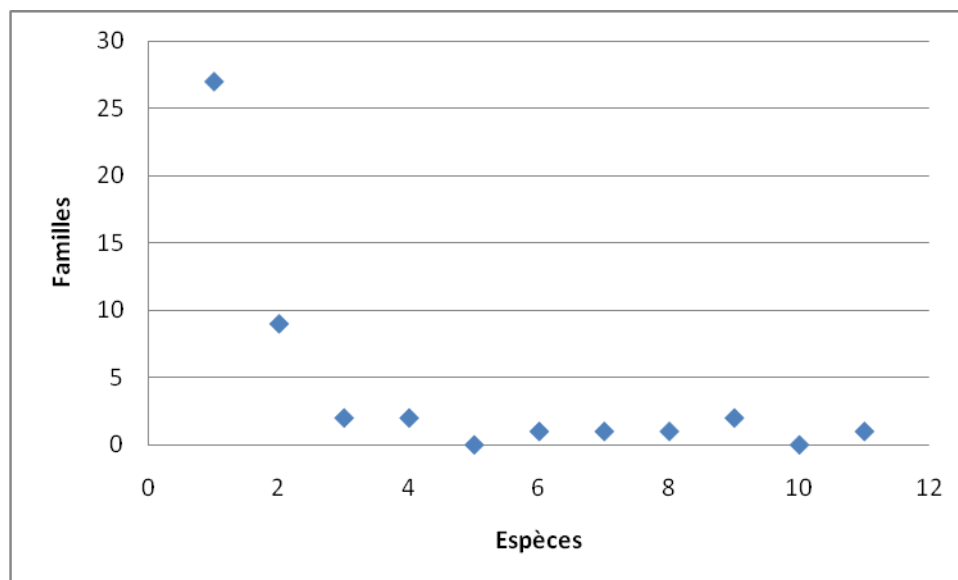


Figure 2. Diversity of botanical families identified in the study area.

Lamiaceae, *Asteraceae*, *Fabaceae*, *Poaceae* and *Apiaceae* are the most used and represent c. 10% of botanical families and 40.3% of identified species (Table 2). The rate of species with medicinal properties reached 57.8%, while those with alimentary properties constitute 10.1%, vs. 55% reported by

Ennabili *et al.* (2006) under another socio-economic and climatic context of the northern Morocco. 28.4% of the identified species have a multiple uses -food, traditional medicine, pastoralism, firewood, etc.- (Table 2).

Table 2: Importance of plant use by identified taxon in the Rissani area. *A*, alimentary use. *AP*, aboveground part. *B*, bulb. *C*, cosmetic use. *F*, flower. *Fb*, bark fruit. *Fl*, floral bud. *Fr*, fruit. *Fv*, fruit vinegar. *G*, gum. *L*, leaf. *M*, medicinal use. *Ot*, other uses. *P*, whole plant. *R*, root. *Rh*, rhizome. *S*, seed. *St*, stem. *T*, toxic property. *Tr*, trunk. *W*, wood.

Taxon	Vernacular name(s)	Exploited part(s)	Utilization(s)	Frequency (%)
<i>Lamiaceae</i>				15.21
<i>Rosmarinus officinalis</i> L.	azir	L	<i>M</i> : intestinal pain, flu, rheumatism, cattle constipation, large intestine, hemorrhoids, wounds, skin cancer, dehydration, painful menstruation.	3.05
<i>Origanum</i> spp.	zaâtar	L	<i>M</i> : stomach pain, intestinal pain, colic, toothache and gums pain, appetizer, large intestine.	2.03
<i>Satureja montana</i> L.	zokni	L	<i>M</i> : headaches due to sunburns, vomiting in newborns, fever, large intestine, stomach.	2.03

<i>Mentha pulegium</i> L.	f'liyou	L	M: diarrhea, cough, flu, breast cancer.	1.69
<i>Mentha suaveolens</i> Ehrh.	l'marṣiṭa, timarṣat	L	M: dizziness, headache due to cold, cold, injury, breast cancer.	1.36
<i>Lavandula angustifolia</i> Miller	l'khezama	AP	M: rheumatism, excessive secretion of urine, painful menstruation. C: hair loss.	1.01
<i>Marrubium vulgare</i> L.	m'riwta	L	M: diabetes, head cooling, otitis.	1.01
<i>Mentha spicata</i> L.	liqama, naânaâ	AP	A: flavor tea.	1.01
<i>Salvia officinalis</i> L.	salmiya	L	M: bladder stones, diabetes. A: flavor tea.	1.01
<i>Ajuga iva</i> (L.) Schreb.	chantgoura	L	M: cooling, rheumatism.	0.67
<i>Lavandula dentata</i> L.	jaâda	AP	M: cooling.	0.34
<i>Asteraceae</i>				11.50
<i>Artemisia herba-alba</i> Asso	chiḥ	L	M: injury, intestinal worms and pain, diabetes, rheumatism, cattle constipation.	5.10
<i>Cotula cinerea</i> Delile	l'garṭoufa	L	M: cooling, intestinal pain. Ot: pastoralism.	1.36
<i>Carthamus tinctorius</i> L.	zaâfour, l'âasfour	F, S	M: anemia, cooling.	1.01
<i>Warionia saharae</i> Benth. & Coss.	afssas	L	M: headache (cold), knees rheumatism.	1.01
<i>Anacyclus pyrethrum</i> (L.) Link	âoud igandṣ, âaqer qarḥa, âoud lqarḥ	AP	M: leprosy, cooling.	0.67
<i>Chamaemelum nobile</i> (L.) All.	l babounj	AP	M: nervous irritation, calming. C: hair loss.	0.67
<i>Dittrichia viscosa</i> (L.) Greuter	magraman	AP	M: intestinal pain, stomach pain, diabetes.	0.67
<i>Launaea arborescens</i> (Batt.) Murb.	oum l'beina	AP	M: otitis, boils. Ot: pastoralism.	0.67
<i>Artemisia arborescens</i> L.	chiba	AP	A: flavor tea.	0.34
<i>Fabaceae</i>				8.46
<i>Medicago sativa</i> L.	l'faṣṣa	AP	M: bladder cooling. C: hair loss. Ot: pastoralism.	2.72
<i>Trigonella foenum-graecum</i> L.	ḥalba	S	M: diabetes, stomach aches, appetizer.	2.37
<i>Vicia faba</i> L.	l'foul	AP, Fr	A: food.	1.36
<i>Glycine max</i> (L.) Merr.	ṣoja	Fr, S	M: appetizer.	0.67
<i>Glycyrrhiza foetida</i> Desf.	âraq ṣouṣ	St	M: regulation of blood pressure.	0.34
<i>Lens culinaris</i> Medik.	l'âdass	S	M: hemorrhage. A: food.	0.34
<i>Lupinus albus</i> L.	tirm's, g'nawa	foul S	M: diabetes.	0.34
<i>Pisum sativum</i> L.	jalbana	Fr	A: food.	0.34
<i>Poaceae</i>				8.12
<i>Hordeum</i> spp.	ch'âir	AP, S	M: kidney failure. A: food. Ot: pastoralism.	2.03
<i>Triticum aestivum</i> L.	gam'ḥ	AP, S	M: stomach aches. A: food. Ot: pastoralism.	2.03
<i>Cynodon dactylon</i> (L.) Pers.	n'jem	AP	Ot: pastoralism, firewood.	1.36
<i>Zea mays</i> L.	l'k'bal	AP	M: nephrolithiasis, cooling. A: food. Ot: pastoralism.	1.36

<i>Sorghum bicolor</i> (L.) Moench	illan	S	M: sprain, fracture, lactation. A: food.	0.67
<i>Arundo donax</i> L.	l'q'sab	R	C: hair loss.	0.34
<i>Phalaris paradoxa</i> L.	zwan	S	M: diabetes.	0.34
<i>Apiaceae</i>				6.75
<i>Daucus carota</i> L.	khizzo	AP, R, S	M: bladder cooling, cooling, diabetes. Ot: pastoralism.	1.36
<i>Pimpinella anisum</i> L.	h'bat h'lawa	S	M: stomach pain, immunological problems. A: food.	1.36
<i>Coriandrum sativum</i> L.	qasbour	AP, S	M: cooling. A: food additive.	1.01
<i>Petroselinum crispum</i> (Mill.) A.W.Hill	l'mâadnous	AP, S	M: bladder cooling. A: food.	1.01
<i>Ammodaucus leucotrichus</i> Coss. & Durieu	kamounte ben sofa, kammoun sofi	L	M: dehydration, cooling, excessive secretion of urine.	0.67
<i>Ammi visnaga</i> (L.) Lam.	t'rillan, z'riâat bechnikha	AP, S	M: leprosy. Ot: toothpicks.	0.34
<i>Carum carvi</i> L.	l'qarwiya	S	M: stomach pain, bloating.	0.34
<i>Foeniculum vulgare</i> Mill.	l'besbas	S	M: bloating, diarrhea in children. A: food additive.	0.34
<i>Magydaris panacifolia</i> (Vahl) Lange	f'rifra	S	M: anemia.	0.34
<i>Zygophyllaceae</i>				4.75
<i>Peganum harmala</i> L.	h'armel	S	M: antirheumatic, fumigation against fever. C: hair loss. T. Ot: against evil eye.	2.72
<i>Tetraena gaetula</i> (Emb. & Maire) Beier & Thulin	l'âagaya	AP	M: stomach pain, fever, large intestine, care of head buttons. C: facial treatment (buttons). Ot: pastoralism.	2.03
<i>Arecaceae</i>				3.72
<i>Phoenix dactylifera</i> L.	tt'mer	L, F, Fr, Tr	M: breast cancer, painful menstruation, infertility in women, lactation, rheumatism. A: food, jam. Ot: pastoralism, firewood, construction.	3.72
<i>Tamaricaceae</i>				3.39
<i>Tamarix aphylla</i> (L.) H.Karst.	l'âadba, d'laya, tak aout	S, W	M: stomach aches, large intestine. C: hair loss. Ot: doors, windows and plows manufacturing, tanning, firewood.	3.05
<i>Tamarix gallica</i> L.	l'fersigue	AP	Ot: pastoralism, firewood.	0.34
<i>Chenopodiaceae</i>				3.38
<i>Salsola tetrandra</i> Forssk.	ch'teb, l'ghessal	AP	Ot: pastoralism, firewood, hygiene products.	1.69
<i>Chenopodium ambrosioides</i> L.	l'm'khinza	AP	M: fever, migraine.	1.01
<i>Fredolia aretioides</i> (Coss. & Moq. ex Bunge) Ulbr.	ş'llaâ'	P	M: induce vomiting in case of poisoning cases (Toukal).	0.34
<i>Suaeda vermiculata</i> Forssk. ex J.F.Gmel.	sowid	AP	Ot: pastoralism, firewood.	0.34

<i>Brassicaceae</i>				3.04
<i>Brassica rapa</i> L.	left	AP, R	A: food.	1.36
<i>Lepidium sativum</i> L.	ḥab r'chad	S	M: stomach aches, anemia, facilitate deliverance, cooling.	1.01
<i>Anastatica hierochuntica</i> L.	k'micha	AP	M: excessive secretion of urine.	0.34
<i>Eruca vesicaria</i> (L.) Cav.	l'ḥarra	S	M: sprain.	0.34
<i>Malvaceae</i>				3.04
<i>Malva neglecta</i> Wallr.	l'khebbiza	AP	A: food. Ot: pastoralism.	2.37
<i>Abelmoschus esculentus</i> (L.) Moench	meloukhiya	AP, Fr	A: food.	0.67
<i>Ranunculaceae</i>				2.37
<i>Nigella sativa</i> L.	l'ḥbba souda, sanouj	S	M: stomach pain, immunological problems, rheumatism, diabetes, large intestine.	1.36
<i>Delphinium staphisagria</i> L.	ḥ'bate rass	S	C: hair loss.	0.67
<i>Ranunculus bullatus</i> L.	ouden l'ḥ'louf	AP	M: cooling.	0.34
<i>Rutaceae</i>				2.03
<i>Haplophyllum tuberculatum</i> (Forssk.) A. Juss.	l'fijel	AP, S	M: leprosy, lactation, cooling. Ot: fumigation.	1.36
<i>Citrus ×aurantium</i> L.	limoun	Fb, Fr	M: appetizer. A: food.	0.34
<i>Citrus limon</i> (L.) Burm.f.	l'ḥameḍ	Fr	M: fever, angina. A: additive.	0.34
<i>Caryophyllaceae</i>				2.02
<i>Spergularia rubra</i> (L.) J.Presl & C.Presl	b'ṣaṭ l'moulouk	AP	M: diabetes.	0.34
<i>Corrigiola telephiifolia</i> Pourr.	âoud sarghina	St	M: headache. Ot: wellness, fumigation.	0.34
<i>Dianthus sylvestris</i> Wulfen	nwar	Fl	C: hair loss.	0.34
<i>Herniaria hirsuta</i> L.	h'rast l'ḥjar	AP	M: nephrolithiasis.	0.34
<i>Spergularia media</i> (L.) C.Presl ex Griseb.	boughlam	St	M: sexual weakness, cooling, female sterility.	0.34
<i>Vaccaria hispanica</i> (Mill.) Rauschert	tighichet	St	Ot: fumigation.	0.34
<i>Punicaceae</i>				1.69
<i>Punica granatum</i> L.	roman	Fb, Fr	M: Allergy eyes, stomachache, large intestine. C: hair care. A: food.	1.69
<i>Alliaceae</i>				1.68
<i>Allium cepa</i> L.	l'bṣal	AP, B	M: blood pressure, skin cancer, leprosy. A: food.	1.01
<i>Allium sativum</i> L.	touma	B	M: cough, cooling, breast cancer. A: spice.	0.67
<i>Linaceae</i>				1.36
<i>Linum usitatissimum</i> L.	z'riâ't l'k'tane	S	M: stomach pain, stimulation of lactation. A: additive.	1.36
<i>Myrtaceae</i>				1.35
<i>Myrtus communis</i> L.	riḥan	L	M: large intestine. C: hair loss.	1.01

<i>Pimenta dioica</i> (L.) Merr.	nwiwra	S	A: spices.	0.34
<i>Cucurbitaceae</i>				1.01
<i>Citrullus colocynthis</i> (L.) Schrad.	l'h'daj	Fr	M: cooling, hemorrhoids. Ot: clothing conservation.	1.01
<i>Cupressaceae</i>				1.01
<i>Tetralinis articulata</i> (Vahl) Mast.	l'âarâar	AP	M: intestinal pain, stomachache, appetizer, cattle constipation. Ot: fumigation, tanning.	1.01
<i>Leguminosae</i>				1.01
<i>Senna alexandrina</i> Mill.	sana	L	M: constipation, intestinal pain and .gas.	0.67
<i>Ceratonis siliqua</i> L.	l'kharoub	Fr	M: stomachache.	0.34
<i>Lythraceae</i>				1.01
<i>Lawsonia inermis</i> L.	l'hana	L	M: large intestine. C: hair loss.	1.01
<i>Mimosaceae</i>				1.01
<i>Acacia nilotica</i> (L.) Willd. ex Delile	tal'h	Fr, G	M: blood pressure, bladder stones, skin cancer, diabetes.	1.01
<i>Oleaceae</i>				1.01
<i>Olea europaea</i> L.	zitoun	Fr, L	M: oral inflammation in children and cattle. A: food, oil. Ot: pastoralism.	1.01
<i>Rosaceae</i>				1.01
<i>Rosa canina</i> L.	lward	F	C: hair loss.	0.67
<i>Pyrus communis</i> L.	bouâwide	Fr	A: food.	0.34
<i>Anacardiaceae</i>				0.67
<i>Pistacia atlantica</i> L.	l'qwawch	S	M: stimulation of lactation.	0.67
<i>Capparaceae</i>				0.67
<i>Capparis spinosa</i> L.	l'k'bar, tilaloute	Fr	M: diabetes, rheumatism, stomach aches.	0.67
<i>Euphorbiaceae</i>				0.67
<i>Euphorbia falcata</i> L.	h'yat noufous	AP	M: Sexual weakness, rheumatism.	0.34
<i>Ricinus communis</i> L.	l'kharwaâ	S	C: hair loss.	0.34
<i>Iridaceae</i>				0.67
<i>Crocus sativus</i> L.	zaâfran l'hour	F	M: skin cancer. A: additive.	0.34
<i>Iris pseudacorus</i> L.	âoud el âanbar	St	C: hair loss.	0.34
<i>Myristicaceae</i>				0.67
<i>Myristica fragrans</i> Houtt.	l'gouza, gouza teb	Fr	M: cooling. A: spices.	0.67
<i>Verbenaceae</i>				0.67
<i>Aloysia citriodora</i> Palau cultivée	lwiza	L	M: calming. A: flavor tea.	0.67
<i>Aloaceae</i>				0.34
<i>Aloe succotrina</i> Lam.	siber	AP	M: breast cancer.	0.34
<i>Annonaceae</i>				0.34
<i>Xylopia aethiopica</i> (Dunal) A.Rich. ?	b'zar	S	A: spices.	0.34
<i>Apocynaceae</i>				0.34
<i>Nerium oleander</i> L.	defla	AP	M: skin cancer.	0.34

<i>Aristolochiaceae</i>				0.34
<i>Aristolochia longa</i> Desf.	ber'z'tem	St	M: skin cancer, hemorrhoids.	0.34
<i>Berberidaceae</i>				0.34
<i>Berberis hispanica</i> Boiss. & Reut.	irghis	St	M: diabetes.	0.34
<i>Cyperaceae</i>				0.34
<i>Cyperus esculentus</i> L.	ttara	Fr	C: hair loss.	0.34
<i>Gentianaceae</i>				0.34
<i>Centaurium spicatum</i> (L.) Fritsch	g'sat l'hiya	AP	M: diabetes, cooling.	0.34
<i>Juglandaceae</i>				0.34
<i>Juglans regia</i> L.	l'm'swak	St	M: large intestine, injury. C: whiten teeth.	0.34
<i>Juncaceae</i>				0.34
<i>Juncus maritimus</i> Lam.	zriâ't semmar	S	M: bladder cooling, excessive secretion of urine.	0.34
<i>Lauraceae</i>				0.34
<i>Persea americana</i> Mill.	avocat	Fr	C: hair care. A: food.	0.34
<i>Moraceae</i>				0.34
<i>Ficus carica</i> L.	karmouss	Fr	A: food.	0.34
<i>Papaveraceae</i>				0.34
<i>Rupicapnos africana</i> subsp. <i>gaetula</i> (Maire) Maire	belaâmane	F	M: renal insufficiency.	0.34
<i>Rhamnaceae</i>				0.34
<i>Ziziphus lotus</i> (L.) Lam.	Sedra, n'begue	Fr, L	M: stomach pain, kidney stones.	0.34
<i>Vitaceae</i>				0.34
<i>Vitis vinifera</i> L.	Laâ'neb	Fr, Fv	M: large intestine, anemia. A: food.	0.34
<i>Zingiberaceae</i>				0.34
<i>Zingiber officinale</i> Roscoe	s'canj'bir	Rh	M: cough, rheumatism. A: spices.	0.34

Exploitation

According to our results, the local population satisfies its needs in medicinal plants through herbalists which import almost all plant material from national markets (Fez, Marrakech, Casablanca), and export to these markets plant material of the following species: *Peganum harmala*, *Artemisia herba-alba*, *Rosmarinus officinalis* and *Carum carvi*. Other species (*Rosmarinus officinalis*, *Artemisia herba-alba*, *Teatraena gaetula* and *Pistacia atlantica*) are sought by herbalists in the province (Rich, Gourrama, Midelt).

The aerial part of the plant -AP- is most exploited (36.7) and followed by seed -S- (18.3%), against

15.6%, 11.9% and 8.3% respectively for leaf -L-, fruit -Fr- and stem -St-. The whole plant -P- and the flower -F- are represented by a rate of 3.66% each, and 1.83% is the rate of the underground part use -R, Rh- (Table 2). The important representation of the aerial part would be due to its easy harvest and wealth photosynthetic metabolites (El Rhaffari & Zaid, 2002). But the interviewees have difficulties identifying the plant parts used mainly when plant material is imported and/or sold in the souks -local markets- or by herbalists in the Rissani city.

The identified plants are used in traditional medicine to treat diseases and dysfunctions of 11 systems, and the majority (37.9%) is used to treat

the endocrine-system problems, vs. the digestive-apparatus problems found by El Rhaffari & Zaid (2002) and Mehdioui & Kahouadji (2007). The endocrine system is followed by the dermatological (26.6%), gastro-intestinal (24.8%), urino-genital (17.4%), articulatory-skeletal (11%), immune and nervous systems (8.3% each), circulatory (6.4%) and oto-rhino-laryngeal (2.8%) ones. The lowest rates of diseases treated are observed in cases of dehydration and ophthalmic system with 1.83% and 0.91% respectively (Table 3).

These plants are used in various forms of preparation: a single plant, herbal blend or mixture of plants and minerals or animal products (honey, eggs, milk, fat, wool). These recipes are administered by

different ways: external application, oral administration, fumigation, etc.

Only 33.9% of plants exploited in the Rissani area are locally produced (spontaneous and/or cultivated), and 24.8% of them are used in herbal medicine systems, vs. 90% reported by Mehdioui & Kahouadji (2007).

We noted that *Artemisia herba-alba*, an introduced plant in the study area by flooding during wet years, has a great therapeutic value. It is used by the local population in several recipes preparation namely those for the treatment of diabetes, digestive apparatus, internal and external infections by micro-organisms, cancer and rheumatism.

Table 3. Importance of diseases treated by herbal medicine in the Rissani area.

Systems classification / Spheres	Diseases / Malfunctions	Frequency (%)
1. Endocrine System	Lack of appetite	37.94
	Lack of breast milk	
	Sexual weakness	
	Diabetes	
	Breast cancer	
	Stunting	
2. Dermatological System	Hemorrhoids	26.6
	Injuries	
	Leprosy	
	Boils	
	Head buttons	
	Facial buttons	
	Skin cancer	
3. Digestive Apparatus	Hair loss	24.77
	Constipation	
	Large intestine	
	Colic	
	Stomach aches	
	Bloating	
	Intestinal pain	
	Intoxication	
4. Urino-genital system	Vomiting and gastro-esophageal reflux	17.43
	Bladder lithiasis,	
	Bladder cooling	
	Excessive secretion of urine	
	Sterility	

	Renal insufficiency	
	Painful menstruation	
	Hemorrhage	
	Deliverance difficulty	
5. Articulatorty-skeletal system	Sprain	11.01
	Rheumatism	
	Fracture	
6. Immune system	Cough	8.25
	Flu	
	Intestinal worms	
	Angina	
	Diarrhea	
7. Nervous system	Nervous irritation	8.25
	Migraines	
	Headaches	
	Fever	
	Dizziness	
8. Circulatory System	Anemia	6.42
	Hypertension	
9. Oto-rhino-laryngeal Sphere	Buccal inflammation	2.75
	toothache and gums pain	
	Otitis	
10. Other	Dehydration	1.83
11. Ophthalmic System	Eyes allergy	0.91

Phoenix dactylifera has an obviously importance: resource value in food and farming, its therapeutic property -treatment of cancer, pains, infertility and lactation-, palm leaves and branches used respectively as firewood and in roof houses of Ksours.

The local interest of *Tamaricaceae* (*Tamarix gallica*) was highlighted by Ennabili *et al.* (1996) in NW of Morocco (firewood supply) and is also observed in the Rissani area. We also noted the therapeutic benefits of *T. aphylla*, entering the preparation of several recipes namely those for digestive treatment and hair care. The people interviewed also underlined the *T. aphylla*, used in basketry (doors and windows for rural housing), livestock (plows) and the tannery.

Apart from *Peganum harmala* (Table 2) which is toxic according to interviewees, the toxicity of other species has been reported by Ennabili *et al.* (2000), Eddouks *et al.* (2002) and/or Bnouham *et al.* (2006), including *Aristolochia longa*, *Iris pseudacorus*, *Nerium oleander*, *Citrullus colocynthis*, *Ricinus communis*, *Ceratonia siliqua* and *Tetraena gaetula*. Although they are toxic, these plants are used locally

by people in traditional medicine, and administered by various ways due to information lack.

Marketing

The unit price of plants and/or plant by-product varies according to the local "supply/demand" (Table 3).

The study area has about 310,650 feet of date palm (Personal Communication, 2009), and according to surveys conducted, the area produced more than thirty varieties of dates. Bouslikhene and Bouf'gousse varieties represent more 50% of the total production. The unit price of dates depends on the quantity produced and the nutritional value, and varies between 100 and 150 MAD/kg for the Mejhoul variety. Incomings due to date's production vary depending on the variety and range between 200 and 400 MAD/year/date palm.

These dates are sold locally in the Rissani souks, and mostly exported to the national markets (Fez, Meknes, Nador) and international ones, appreciating Mejhoul and Bouf'gousse varieties (Renevot *et al.*,

2009). The average annual consumption of dates in production areas is 15 kg/inhabitant, vs. 3 kg/inhabitant in Morocco. The Tafilalet area represents 28% of national production (Renevot *et al.*, 2009).

According to our results, wheat and barley production in the study area is estimated at 10 quintals/ha, due to soil depletion. Olive culture encounters difficulties related particularly to soil salinity, and farmers have c. 2-50 olive trees each [3,000 olive feet in 2005 in the area (Personal Communication, 2009)]. The olives production is intended for home consumption (olive and cooking oil).

The price of some PAM imported from other regions of Morocco and exploited in the study area ranges from 8 MAD/kg for *Artemisia herba-alba* to 225 ± 35.4 MAD/kg for *Carthamus tinctorius*, vs. 1 and 6.5 ± 0.70 MAD/kg for *Daucus sativa* and *Vicia faba*, respectively.

Therefore, the local population resorts to herbal medicine, and some medicinal plants have an economic value more important than other alimentary species cultivated in the study area (Table 4). Development of culture and valorization of certain medicinal plants -requiring less water and soil quality- would be established to improve people's incomes and promote new jobs creation. In this way, a local valuation study of *Carthamus tinctorius* culture could be led, seen the adaptation to arid climate, socioeconomic importance and therapeutic properties (Tables 2 and 4) of this species.

CONCLUSION

Many of plant species identified in the study area are used in traditional medicine, and with varying rates, these plants have also alimentary virtues and/or exploited in breeding and production of firewood. The aerial part of the plant is the most used, followed by

seed, leaf, fruit, stem, the whole plant, flower and the underground part one.

About a third of the species used correspond to spontaneous and/or cultivated plants in the study area. The most spontaneous species are exploited in breeding and as firewood. Moreover, many of these plants have a medicinal property proved by their regular use.

The interviewees are mainly illiterate in women and old men, or school and university graduates, and represented mostly by herbalists and/or traditional healers, followed by trader, shepherds, fellah (farmers and farm workers).

The endocrine system is the most concerned by the local use of plants in traditional medicine, and accompanied by dermatological system, digestive apparatus, urino-genital system, articulatory-skeletal system, immune system, nervous system, oto-rhino-laryngeal sphere, dehydration and ophthalmic system.

Medicinal plants especially *Artemisia herba-alba* and *Carthamus tinctorius* have an economic interest when compared to the alimentary species cultivated in the study area (e.g. *Daucus sativa* and *Vicia faba*). Agricultural production in the area suffers from critical situations due primarily to scarcity of water resources and the infestation of some varieties of date palm, which constitutes the mainstay of the oasis cultures.

The introduction of other plants farming like olive tree in the study area is limited among others by the soil type, and local valorization of plants with socio-economic interest including the medicinal and aromatic plants could be recommended. Furthermore, the local population must participate in conservation and valorization of biodiversity and, therefore, contribute to local sustainable development.

Table 4. Unit price (MAD/kg) of plants sold in the Rissani area. Mean $\pm$ standard deviation (sample size). AP, aboveground part. B, bulb. Fr, fruit. L, leaf. P, whole plant. R, root. S, seed. St, stem.

Species	Plant part	Sale	Purchase
<i>Carthamus tinctorius</i>	S	225.00 $\pm$ 35.35 (2)	110.00 $\pm$ 14.14 (2)
<i>Euphorbia falcata</i>	AP	135.00 $\pm$ 21.21 (2)	.
<i>Phoenix dactylifera</i>	Fr	125.00 $\pm$ 35.35 (2)	.
<i>Chamaemelum nobile</i>	AP	90.00 $\pm$ 14.14 (2)	70.00 $\pm$ 14.14 (2)
<i>Aloysia citriodora</i>	L	80.00 $\pm$ 0.00 (1)	60.00 $\pm$ 14.14 (2)
<i>Corrigiola telephiifolia</i>	St	70.00 $\pm$ 0.00 (2)	65.00 $\pm$ 0.00 (1)
<i>Ranunculus bullatus</i>	AP	65.00 $\pm$ 7.07 (2)	50.00 $\pm$ 0.00 (1)
<i>Ammodaucus leucotrichus</i>	L	50.00 $\pm$ 0.00 (1)	40.00 $\pm$ 0.00 (2)
<i>Senna alexandrina</i>	L	42,50 $\pm$ 3.53 (2)	32.50 $\pm$ 3.53 (2)
<i>Eruca vesicaria</i>	S	40.00 $\pm$ 0.00 (1)	35.00 $\pm$ 7.07 (2)
<i>Warionia saharae</i>	L	37,50 $\pm$ 3.53 (2)	27.50 $\pm$ 3.53 (2)
<i>Lavandula dentata</i>	AP	35.00 $\pm$ 7.07 (2)	25.00 $\pm$ 7,07 (2)
<i>Petroselinum crispum</i>	S	35.00 $\pm$ 0.00 (1)	30.00 $\pm$ 0.00 (1)
<i>Origanum spp.</i>	L	35.00 $\pm$ 0.00 (1)	30.00 $\pm$ 0.00 (2)
<i>Nigella sativa</i>	S	30.00 $\pm$ 0.00 (1)	25.00 $\pm$ 0.00 (2)
<i>Cotula cinerea</i>	L	30.00 $\pm$ 0.00 (1)	25.00 $\pm$ 0.00 (1)
<i>Mentha suaveolens</i>	L	24.00 $\pm$ 0.00 (1)	10.00 $\pm$ 0.00 (2)
<i>Capparis spinosa</i>	Fr	20.00 $\pm$ 0.00 (1)	11.25 $\pm$ 1.76 (2)
<i>Fredolia aretioides</i>	P	17,50 $\pm$ 3.53 (2)	10.00 $\pm$ 0.00 (1)
<i>Tetraclinis articulata</i>	AP	15.00 $\pm$ 0.00 (1)	9.00 $\pm$ 0.00 (2)
<i>Dittrichia viscosa</i>	AP	13.00 $\pm$ 0.00 (1)	10.00 $\pm$ 0.00 (1)
<i>Centaurium spicatum</i>	AP	10.00 $\pm$ 0.00 (1)	8.00 $\pm$ 0.00 (2)
<i>Rosmarinus officinalis</i>	L	10.00 $\pm$ 0.00 (1)	7.00 $\pm$ 0.00 (2)
<i>Artemisia herba-alba</i>	L	8.00 $\pm$ 0.00 (1)	5.00 $\pm$ 0.00 (2)
<i>Vicia faba</i>	Fr	6,50 $\pm$ 0.70 (2)	.
<i>Allium cepa</i>	B	4.00 $\pm$ 0.00 (2)	.
<i>Olea europaea</i>	Fr	3.50 $\pm$ 2.12 (2)	.
<i>Triticum aestivum</i>	S	3 $\pm$ 0.5 (2)	.
<i>Hordeum spp.</i>	S	2.20 $\pm$ 0.00 (2)	.
<i>Brassica rapa</i>	R	2.00 $\pm$ 0.00 (2)	.
<i>Medicago sativa</i>	AP	1.00 $\pm$ 0.00 (4)	.
<i>Daucus carota</i>	R	1.00 $\pm$ 0.00 (3)	.

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