

SOCIETY FOR ECOLOGICAL RESTORATION INTERNATIONAL

Cork Oak Woodlands on the Edge

ECOLOGY, ADAPTIVE MANAGEMENT, AND RESTORATION



Edited by
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*Ecology, Adaptive Management,
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Cork Oak Woodland Conservation and Household Subsistence Economy Challenges in Northern Tunisia

PABLO CAMPOS, PAOLA OVANDO, ALI CHEBIL,
AND HAMED DALY-HASSEN

Cork oak is the most common native tree species in northwestern Tunisia, occurring especially throughout the Kroumerie-Mogod mountain range. Over the past half century, however, cork oak woodlands in this area have been reduced and converted into agriculture and pastureland (Chebil et al. 2009). In 2003 it was officially estimated that cork oak woodlands in Tunisia covered 90,000 hectares (CNT/DGF 2005), which represents a loss of one third from estimates made in the 1950s (Boudy 1952). One key management problem is that the Tunisian Forest Code lists livestock grazing among the usage rights that can be freely practiced by rural inhabitants but does not set periods for grazing exclusion. Unrestricted grazing, increasing demographic pressure, and lack of proper surveillance have led to degradation and natural resource destruction throughout the cork oak woodlands of the country (FAO 2001; Ben-Mansoura et al. 2001; Daly-Hassen et al. 2007).

Despite their declining area, cork oak woodlands continue to play a prominent economic role for rural households and also for the state, which is the sole legal owner of all Tunisian woodlands. Market benefits from the cork oak woodland area derive from multiple final products, including cork, mushrooms, berries, essential oils, wildlife game, and firewood collected for domestic uses (see Chapter 3). Nevertheless, rural households benefit mainly from traditional livestock rearing and subsistence crops grown in small, treeless parcels within or bordering the cork oak woodlands.

In this chapter we analyze natural resource use and the challenges for conservation in cork oak woodlands, in the context of the developing economy of Tunisia. For this purpose, cork oak woodland area includes associated shrubland (hereafter *woodland*). Our analysis focus only on total income supplied by cork oak woodland activities, although we refer also to livestock rearing and

crop activities, which are the other two activities in agroforestry (cf. Campos et al. 2008a).

Our main objective is to measure the total income accrued from the current unsustainable woodland use in a specific case study of a state-owned but communally grazed woodland, located in northern Tunisia (Iteimia), and its distribution to local households, the state, and private firms working with cork harvesting, firewood, myrtle, and other woodland products. Second, we estimate the livestock keeper's income loss if current overgrazing is reduced to a sustainable grazing regime in order to facilitate and promote the natural regeneration of cork oak and associated shrub vegetation. This analysis should be useful for householders, nongovernment organizations, and government decision makers concerned with woodland natural resource conservation and restoration management in Tunisia.

We first present the Iteimia case study, in view of current woodland management practices and the actual distribution of woodland resources. Next, we consider the criteria for valuing goods and services derived from woodland use. Third, we measure cork oak woodland total income and discuss how it is distributed to the state, private firms, and local households. Fourth, we discuss the conflicts that arise between a hypothetical woodland conservation policy and local householder's subsistence economy. Finally, our concluding remarks are framed by two perspectives: the need to improve current scientific knowledge of the environmental services provided by Tunisian woodlands and the need to enforce natural resource conservation policy, including local householders' needs and equity tradeoffs.

Case Study: Iteimia

Current Woodland Management

Campos et al. (2008a) estimated a set of economic indicators derived from the agroforestry on-site uses in the *douar* (village) of Iteimia under subsistence farming conditions. Iteimia is located in the Ain Snoussi region of northern Tunisia, a midelevational mountain area with altitude ranging from 400 to 642 meters. This region has a humid Mediterranean climate, with an average annual rainfall ranging from 1,000 to 1,500 millimeters (Oliveira et al. 2004).

The agroforestry area was farmed and managed by 110 households and 508 inhabitants. We conducted our study considering only woodland area. Cork oak area covers 444 hectares, or 72 percent of the overall agroforestry area, with an average density of 583 cork oaks per hectare (Campos et al. 2008b). Shrubland occupies 44 hectares, or 7 percent of the area. The wood-

land area thus totals 488 hectares and consists of 91 percent cork oak area and 9 percent shrubland. The most common shrub species are mastic, myrtle, and strawberry tree. Subsistence crops are cultivated in small treeless plots bordering the woodlands, making up a total of 127 hectares (21 percent of the agroforestry area).

The agroforestry area belongs to the state, but local inhabitants have specific use rights. The state is represented by the Forest Administration Service of the Ain Snoussi region, which is engaged in natural resource management operations (except for grazing resource use), from which it gets commercial benefits, mainly from cork (which is also entirely owned by the state) and firewood outputs. The Forest Administration profits also, but to a lesser extent, from selling licenses (through the auction system established by the Tunisian government in the area) for wild boar hunting and from selling the right to collect mushrooms and myrtle to private firms, which hire local workers to gather those products (see Site Profile 14.1).

The household subsistence economy in the agroforestry area generates diverse uses of natural resources, especially the freely accessed grazing resources and the collection of woodland goods, such as acorns (see Color Plate 7b), firewood from cork oaks (legally restricted to dead wood lying on the forest floor), and shrub biomass, used for fodder, firewood, charcoal, and shelter (see Chapter 3). Local householders also benefit from seasonal woodland jobs—mainly for men—and the cultivation of subsistence crops. Women and children play a major role in rearing livestock and tending crops. Livestock herds consist of local races and cross-breeds of cattle, as well as goats, sheep, mules, and horses.

The Forest Administration aims to generate woodland capital income (net benefit) to the government and, simultaneously, to develop local householders' subsistence economy while respecting the Tunisian Forest Code regarding forest resource usage rights and restrictions. This allows attempted livestock production improvement through introduction of exotic breeds of hybrid meat and milk cows. Concurrently, the local people use natural resources with the aim of maximizing their household income, given their labor capacity and knowing that alternative job opportunities in the area are scarce. Labor market regulation is weak, and most operations, except cork stripping, occasional sanitary felling of trees, and private firm operations, are performed by household members (self-employed labor).

Private Economic Benefits and Costs Valuation Criteria

We follow the conventional system of national accounts for measuring woodland benefits and costs (Eurostat 2000). Accordingly, Iteimia woodland

TABLE 14.1.

Total benefits from state cork oak woodlands, Iteimia, Tunisia, 2002.

Class	Quantity/ha	Price ^a (€/unit)	Value ^a (€/ha) ^b
1. Cork (kg)	207.800	0.390	81.5
1.1 Summer cork	113.800	0.650	74.0
1.2 Winter cork	94.000	0.080	7.5
2. Firewood (kg)	867.300	0.010	8.9
2.1 Cork oak firewood	397.000	0.014	5.4
2.2 Shrub firewood	470.300	0.008	3.5
3. Charcoal (kg)	49.400	0.260	12.8
4. Grazing rent (forage units)	651.700	0.070	44.4
5. Other woodland goods	21.902	0.360	7.8
5.1 Acorns (collected) (kg)	20.400	0.060	1.3
5.2 Myrtle (t)	0.100	27.450	3.5
5.3 Mushrooms (kg)	1.400	2.050	2.8
5.4 Hunting rent (license)	0.002	97.60	0.2
6. Subsidies net of taxes			-2.5
Total benefits (1 + 2 + 3 + 4 + 5 + 6)			152.9

^aExchange rate in 2002: 1.34 Tunisian dinar = €1.^b"ha" indicates woodland hectare, including cork oak woodlands and associated shrubland.

benefits are determined by market exchange values (i.e., price time quantity), except for free access grazing resources, whose rental rates were estimated subjectively (Table 14.1). Total costs considered were labor costs (employees and self-employed labor cost), intermediate consumption (raw materials and services), and machinery depreciation. All except self-employed labor costs are also derived directly from known market values (Table 14.2). We also measure householders' total livestock income as the *market accounting residual value* from livestock benefits minus intermediate costs (for details see Campos et al. 2008b).

For woodlands we also assume a subjectively estimated grazing *forage unit* (FU) price and then estimate the grazing rent as the quantity of extracted FUs times assumed price (€/FU). (An FU is the energy equivalent of 1 kilogram of barley.) Consequently, if we assign a positive grazing rent, then it conditions the joint livestock *self-employed labor income*, but the householders' total income derived from livestock husbandry does not change because the hypothetical open-access grazing rent is entirely appropriated by livestock keepers.

Assuming a positive grazing rent, we assign an FU price of €0.07/FU for grazing resources, which is nearly equivalent to 50 percent of the barley FU price at the farm gate (Table 14.1). This implies a household livestock self-employed wage rate of €0.22 per worked hour, assuming the later FU

TABLE 14.2.
Iteimia woodland total cost, 2002.

Class	Quantity/ha	Price ^a (€/unit)	Value ^a (€/ha) ^b
1. Raw materials and services			10.2
1.1 Summer cork			3.4
1.2 Winter cork			0.7
1.3 Firewood			3.1
1.4 Charcoal			2.7
1.5 Other woodland goods			0.3
2. Labor cost (h) ^c	134.2	0.31	41.3
2.1 Employee labor cost (h)	66.2	0.37	24.7
<i>Summer cork</i>	45.3	0.37	16.9
<i>Winter cork</i>	2.4	0.37	0.9
<i>Firewood</i>	10.2	0.37	3.8
<i>Other woodland goods</i>	8.4	0.37	3.1
2.2 Self-employed labor cost (h)	68.0	0.25	16.6
<i>Firewood</i>	54.3	0.11	5.7
<i>Charcoal</i>	6.5	1.56	10.2
<i>Other woodland goods</i>	7.2	0.10	0.7
3. Machinery depreciation			0.5
4. Total cost (1 + 2 + 3)			52.1
4.1 Summer cork			20.4
4.2 Winter cork			1.7
4.3 Firewood			13.0
4.4 Charcoal			12.9
4.5 Other woodland goods			4.1

^aExchange rate in 2002: 1.34 Tunisian dinar = €1.

^b"ha" indicates woodland hectare.

^c"h" indicates working hours.

price gives a household livestock self-employed wage rate equal to only 60 percent of the average woodland worker wage rate. If no monetary value is assigned to woodland grazing resources, then the livestock self-employed wage rate increases to 82 percent. The latter result is an objective figure and reveals that assumed woodland grazing rent might have been reduced under current conditions of chronic overgrazing, as usually occurs in open access livestock overgrazing regimes (Campbell and Luckert 2001).

Woodland Income

As in Chapter 13, our indicators here are based on an average year, 2002. Annual cork yields are considered in terms of the latest outcomes from a complete stripping rotation cycle of twelve years. However, we recognize that future cork stripping will gradually decline, given the natural regeneration

problems that cork oak woodlands in Iteimia and elsewhere are currently facing (see Chapter 10). We estimated total income accrued from open cork oak woodlands natural resource use as the difference between a reduced number of benefits and costs (Campos et al. 2008a). But given that our analysis does not integrate income changes caused by the gradual decline in cork yields and by losses in soil fertility due to excessive grazing or cropping, the estimated woodland total income is probably overvalued. We measured single and total benefit values offered by the current woodland use (Table 14.1). Note that summer cork stripping and grazing rent contributed 47 percent and 29 percent of woodland total benefits, respectively. The remaining woodland uses yielded 24 percent of woodland benefits, of which 5 percent corresponds to a range of products collected by private firms. Woodland uses did not benefit from government subsidies, and taxes on products were low.

Total cost is shown, including individual inputs and tasks (Table 14.2). Raw material and service expenditures are only 20 percent, and machinery depreciation has a negligible value of 1 percent of total cost. By contrast, labor (employees and self-employed) accounts for 79 percent of the woodland total cost. Total woodland income is shown in Table 14.3, distributed among households, the landowner, and private firms working in the area.

Woodland total income consists of 29 percent labor income and 71 percent capital income (Table 14.3). The capital income is shared by the state

TABLE 14.3.
Woodland labor, capital, and total income at Iteimia, 2002.

Class	Labor income (€/ha) ^b	Capital income (€/ha) ^b	Total income (€/ha) ^b
1. Cork	17.8	57.0	74.8
1.1 Summer cork	16.9	51.2	68.1
1.2 Winter cork	0.9	5.8	6.7
2. Firewood	9.5	-4.1	5.4
3. Charcoal	10.2	0.0	10.2
4. Grazing rent		44.4	44.4
5. Other woodland goods	3.8	3.6	7.4
6. Total income (1 + 2 + 3 + 4 + 5)	41.5	100.8	142.2
6.1 Woodland owner		52.8	52.8
6.2 Private firms		3.6	3.6
6.3 Households	41.5	44.4	85.8
<i>Grazing rent</i>		44.4	44.4
<i>Self-employed labor cost</i>	16.6		16.6
<i>Employee labor cost</i>	24.7		24.7

^aExchange rate in 2002: 1.34 Tunisian dinar = €1.

^b"ha" indicates woodland hectares.

(52 percent), private firms (4 percent), and livestock keepers (44 percent), who appropriate the grazing rent. Householders' woodland income makes up 60 percent of total woodland income. This comes from grazing rent (52 percent), self-employed labor costs (19 percent), and employee compensation (29 percent). The state and private firms receive 37 percent and 3 percent, respectively, of total woodland income (Table 14.3).

Conflicts between Woodland Resource Conservation and Householders' Subsistence Economy

Livestock rearing is certainly the most important activity for the local population. No less than 80 percent of householders' agroforestry-based income (self-employed labor income plus grazing rent) comes from livestock rearing. This activity strongly depends on woodland for free-access grazing resources for feeding animals and, to a lesser extent, on forage crops and crop fallows.

We estimate that current grazing resource consumption is 527.8 FU per hectare of agroforestry area (Campos et al. 2008a). Likewise, it is estimated that livestock obtains 80 FU/ha from cropland (OEP 1992) and 651.7 FU/ha from woodland. This latter FU consumption rate comes from areas populated by cork oaks (642 FU/ha) and shrubland (750 FU/ha). These FU values are compared with the edible growth output of FUs in cork oak area and shrubland, which have been estimated to attain 422 FU/ha and 493 FU/ha, respectively (for further details see DGF 1995). Considering the former edible biomass annual growth figures and the distribution between cork oak areas and shrubland, we estimate that the sustainable grazing consumption totals 428.4 FU/ha of woodland. In other words, there is an overgrazing problem, which is estimated to reach an average rate of 223.3 FU per woodland hectare per year. Thus, current annual FU extraction is nearly 1.5 times the estimated edible biomass growth.

As indicated earlier, overgrazing has undoubtedly caused soil and vegetation degradation. Therefore, it seems likely that Iteimia—and similarly managed woodlands throughout northwestern Africa—will gradually lose their value as a productive natural resource. However, this situation could be corrected by enforcing livestock grazing regimes compatible with cork oak woodland tree regeneration while avoiding livestock keeper income losses.

SIMULATED COMPARISON

To analyze the potential economic effects of sustainable grazing on householders' income, we conducted a simulation, assuming that supplementary

feed could replace the quantity of FUs considered to overshoot the sustainable level of livestock grazing. For doing so, we assumed that herd size and composition remain constant.

If livestock keepers were to reduce their annual woodland grazing to a sustainable level corresponding to edible biomass growth, then cork tree recruitment and woodland pasture resources could be improved in the long term, but household income would decrease significantly. In theory the overgrazing could be offset by supplementary hay, and therefore consumption of pasture resources would decrease from the current 84 to 56 percent of livestock's total energy requirement, according to our simulation. This would imply a grazing rent loss of €15.2/ha of woodland, representing a woodland income loss of 11 percent (Figure 14.1). The average cost of supplementary hay feed in Iteimia is €0.28/FU. This raw material forage unit price is four times higher than our imputed grazing forage unit rent (€0.07/FU). As a result, the substitution of grazing resources for supplementary hay decreases household livestock income by 37 percent. The combined grazing rent and livestock self-employed labor income losses under this scenario lead to a household total income loss of 39 percent (Figure 14.1).

Certainly, this hypothetical approach to estimating the effects of grazing restrictions has several caveats because we ignore what would be the real feedback effects, in terms of herd composition, size, management intensity,

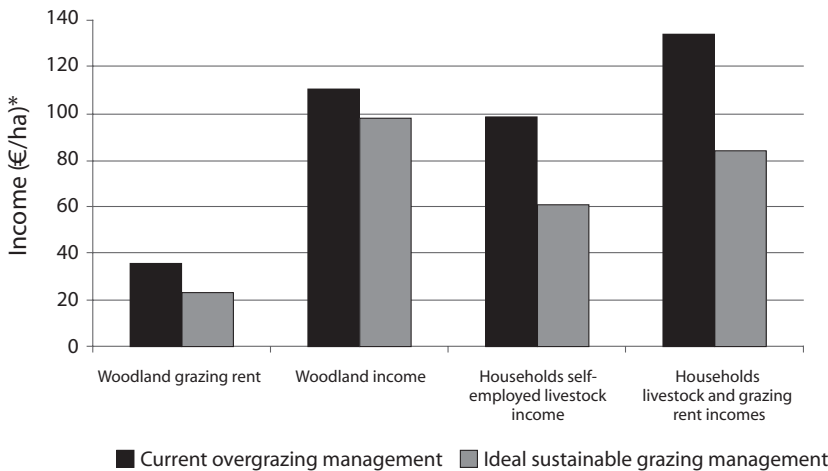


FIGURE 14.1. Householders' income with overgrazing and under ideal sustainable grazing management in Iteimia, northern Tunisia.

and land use change. This analysis should also consider alternative market opportunities (e.g., a dairy industry) to offset householders' income loss.

Conclusions

Our economic analysis indicates that households are the main beneficiaries of the goods and services generated in the woodland area, obtaining up to 60 percent of total income. This share actually is higher for agroforestry areas, when crop and livestock activities are considered, given that household income accounts for 81 percent of total income. On average, households get an annual woodland income of €480, and it increases to €948 when the agroforestry area is taken into account (Campos et al. 2008b).

Grazing and crops (forages and residues) grown in the agroforestry area are the main sources of livestock feed. As shown, comparing a hypothetically nonovergrazing woodland management scenario entailing supplementary feed with the current lack of tree regeneration management, characterized by chronic overgrazing, shows that householders' total income would decrease but that range conditions would be improved. In this regard, the quantity of available feed could be increased by creating improved grassland areas because climatic conditions are favorable in the area (1,000 mm/year of rainfall). Some parcels have been allocated to local communities for hay cropping in order to decrease overgrazing. A shift in livestock structure was also promoted by the Tunisian Forest Administration, introducing more productive cattle breeds that cannot be fed from forest grazing resources and encouraging local communities to develop new woodland activities in order to diversify and enhance their income. But to date, all attempts by the Forest Administration and local householders to manage woodland grazing in a sustainable ways have failed. Management practices for woodland areas, such as rotation of grazing parcels, surveillance, and control of illegal grazing, should be improved, with the local population involved in decision making about property rights and resource allocation, but these measures will entail changes in Tunisian government forest policy.

Householders' economic opportunities in the area are currently restricted to livestock rearing and subsistence cropping. These villagers rely on grazing resources as the mainstay of their subsistence economy, even though this leads to problems in resource conservation of woodlands and related pasture lands. The government could implement a wide array of steps to increase the income of the local population while reducing woodland degradation. Income losses from grazing restrictions should be compensated for, given the subsistence economy of most or all households. It is reasonable to base this

compensation partly on the capital income that the state currently receives from stripped cork and other miscellaneous woodland rents in Iteimia and partly on a transfer compensation mechanism from developed countries when Iteimia households suffer the economic losses of generating global environmental benefits or mitigating environmental losses. Otherwise, it is inequitable that the state, as the woodland owner, benefits from a relevant capital income (similar to a resource rent) from Iteimia woodlands while its investments in local development projects, such as roads, electricity, potable drinking water, housing, education, and health services, are grossly inadequate with respect to basic needs. The compensation scheme should also consider the public benefits of the woodland conservation services provided by local householders' livestock, such as a reduction of the risk of catastrophic woodland and shrubland fires and biodiversity losses.

This study has focused on woodland incomes derived from private goods and services controlled by the state but with the Iteimia householders being beneficiaries of certain natural resource usage rights. Therefore, total private commercial income provides an incomplete picture of the total woodland benefits (see Chapters 13 and 15). Mediterranean woodlands give refuge to exceptional levels of biodiversity, provide watershed and habitat, sequester (or release) carbon, offer historically meaningful landscapes, and are aesthetically pleasing. Neither these benefits nor the cost of losing cork oak woodlands has been taken into account in this study. Consideration of these public values in further studies is essential in order to assess the total sustainable income in Iteimia and similar woodlands.

However, even if these benefits are not considered, their existence and the evidence of gradual cork oak woodland depletion should warrant the creation of a specific program for woodland conservation, paying special attention to mitigating the income losses of livestock keepers from woodland sustainable management in Tunisia and in other Mediterranean countries. In the next chapter we apply a cost–benefit analysis to two land management scenarios in Spanish cork oak woodlands.

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