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**Environmental Services, Externalities  
and Agriculture:  
The Case of Mountain Tourism in Morocco**

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**Abstract**

*This study uses hedonic pricing techniques to estimate the value of agricultural amenities in Morocco's High Atlas Mountains. The analysis is limited to positive externalities related to land use, providing indicators to better inform policy decisions effecting rural and agricultural development. Advantages linked to landscape planning and its contribution to sustaining the tourism activity are documented. Amenities specific to mountain agriculture have a positive influence on the tourist accommodation rental market and particularly on farmhouses. These advantages include joint products linked to the farmhouses bordering cultivated areas, the scenery value of annual crops, the shade and attractiveness provided by walnut trees and the presence of domestic animals.*

**Keywords:** *agricultural landscape values, hedonic valuation, Morocco, rural development,*

**1. Introduction and objectives**

The role agriculture plays in maintaining and shaping the natural landscape in mountainous regions of the industrial countries has received a great deal of attention in recent years. In contrast, these environmental and agricultural links have received much less policy and research attention in the developing countries and transition economies of the world. The purpose of this paper is to analyze the

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environmental services provided by the agricultural sector in the Western part of the High Atlas Mountains in Morocco. In particular, the tourism related impacts from agriculture are examined. The High Atlas Mountains is a widely recognized tourist site with a good climate, topographical contrasts and wide diversity of flora and fauna. The region has unique and important cultural heritage attributes with a range of economic activities.

Agriculture has long played an important role in shaping and contributing to the landscape in Morocco. Agriculture produces foods and other commodities, and helps to attract visitors, thus promoting the tourist industry. Agriculture's environmental contributions are linked to how it shapes and maintains landscape. Farm households offer a cultural experience for tourists, providing insights into their rural world and local way of life, as well as offering home-stays, accommodation, catering, local food products, information about production practices, and transport services including portage with animals to visit regional sites.

While many of these agricultural roles are private goods with market prices, others are externalities and are not internalized into the prices of goods. The purpose of this paper is to estimate the positive externalities of agriculture on mountain tourism in Morocco. The study concentrates on the positive externalities linked to shaping the natural landscape. The aim is to isolate the amenities directly related to agriculture which have positive influences on tourism, and to then estimate their monetary value. The study uses an hedonic price model to examine: the relationship between how tourism and overnight stays at farmhouses; and agricultural amenities and how those amenities influence prices of tourist accommodation in the rural environment.

## 2. Analytical framework: hedonic pricing method

The basic principle of the hedonic pricing method rests on estimating a price differential among goods of the same type, but which have different intrinsic, environmental and societal characteristics or attributes to generate implicit marginal prices associated to each attribute. These empirical applications became more and more popular in the 1970s, after they were formalised in Rosen's works (1974), and dealt both with consumer goods (Anderson and Cordell, 1988; More *et al.* 1988; Miyata & Abe 1994; Des Rosiers *et al.*, 1996; Le Goffe 1996; Palmquist *et al.*, 1997; Gravel *et al.*, 1997) and goods for the purpose of production; (Clark and Huhn 1989; Palmquist 1989; Garrod and Willis 1991; Smith and Huang 1993; Lansford and Jones 1995; Roos 1996; Tyrvaenen 1997; Ready *et al.*, 1997).

The applications of the hedonic pricing method have dealt with several types of agricultural amenities (agricultural landscape, recreation in the countryside, and others). Studies often cited include evaluations of the impact of the amenities provided by horse breeding on the real estate and work markets in the United States (Ready *et al.* 1997), estimating the amenities linked to agriculture and forestry and their influence on rural sites in France (Le Goffe and Delache 1997) and evaluating the impact of animal husbandry on lands which have not been previously used for the breeding of pigs on the real estate market (Palmquist *et al.* 1997). To the author's knowledge, this method of study has not yet been applied to agriculture with relation to the environment in Morocco.

Based on the general model of the differentiated products' market, the hedonic pricing method has the advantage of being applied to a real market rather than a hypothetical one (as in the contingent valuation method). For example, in the case of a real estate market, the aim is to understand the relationship between the price of a property and its locational attributes, its intrinsic quality and the quality of its environment. The model uses ( $U$ ) as the utility function of each household depending on the consumption, aggregated by vector  $x$ , and characteristics of their property represented respectively by the vectors of its location ( $L=L_1, \dots, L_j$ ), its intrinsic characteristics ( $H=H_1, \dots, H_n$ ) and its environmental surroundings ( $E=E_1, \dots, E_m$ ). Hence the expression of the household's utility function being written as  $U=U(X,L,H,E)$ .

In the choice of property, we assume that each household maximises their utility function under budgetary constraints:

$$\begin{aligned} \text{Max } U &= U(X, L, H, E) \\ \text{Sous contrainte: } P_x X + P_h(L, H, E) &= R \end{aligned}$$

Where  $P_x$  is the price vector for consumer goods,  $P_h$  the property price, a function of the different characteristics and  $R$  the household's revenue.

The solution to this problem is given by the first order conditions, which verify:

$$\lambda = \frac{P_{x_i}}{\frac{\partial U}{\partial X_i}}$$

$$\frac{\partial P_h}{\partial L_j} = \frac{1}{\lambda} \cdot \frac{\partial U}{\partial L_j}$$

$$\frac{\partial P_h}{\partial H_n} = \frac{1}{\lambda} \cdot \frac{\partial U}{\partial H_n}$$

$$\frac{\partial P_h}{\partial E_m} = \frac{1}{\lambda} \cdot \frac{\partial U}{\partial E_m}$$

$$R = P_{x_i} X + P_h(L, H, E)$$

These optimal conditions stipulate that, given an equilibrium market with households that maximise their utility, the marginal implicit price of any attribute, observed at a certain level, is equal to the marginal willingness to pay. These implicit price functions cannot be considered to be inverse demand functions for environmental attributes, as they depend entirely on the household's characteristics and on the nature of the supply function (Freeman, 1979). For the main part, empirical applications are limited to the calculations of the implicit price functions without going as far as building the demand function which would require data on the supply elasticity and the household's socioeconomic characteristics.

### 3. Descriptive analysis of the results of the survey

Farmhouse accommodations or "staying in local people's homes" represents the most common form of accommodation in mountain tourism, but it is also unaccounted for by the rural tourism development office, which does not list it as part of the local tourism infrastructure. This informal segment of the tourist accommodation market has not been subject to any inventory and there has been no effort made to structure or organise it. The sample survey for this study 107 farmhouses that provide accommodation all located in the north face of the Western High Atlas Mountains. The two criteria for choosing farmhouses were: (1) accommodation and (2) agricultural activity. For their importance in terms of tourism and for methodological considerations, in our sample two valleys were included, Aït Mizane and Imnane.

The largest proportion of the surveyed farmhouses (75%) is situated in the Aït Mizane valley, and the remainder in the valley of Imnane (25%). The higher figure for the Aït Mizane valley is explained by the importance of its tourism activity; one of the main hiking paths (trails) to the summit of the

Toubkal Mountain runs across it. In both valleys, villages and farms have been selected to obtain a representative sample of the diversity in the existing land use (agricultural land, forests, trails, water courses, house construction, and built-up areas), the main production activities (agriculture, breeding, tourism) and the tourism activity in relation to infrastructures and other existing services.

### *Profile of farmhouse owners*

The owners' profile is drawn up on the basis of their main socioeconomic characteristics: age, level of education, household size and main activity (Annex Table 1). The owners' average age is 41 years. Of the whole sample, owners aged between 30 and 50 represent more than half (57%), with older and aged owners being in the minority, representing respectively 23% and 20% of the total. There is, however, a marked difference in the age structure between the two valleys: in the Imnane valley, where nearly two thirds of the owners are more than 40, whereas in the Aït Mizane valley more than half are below 40.

One of the important socioeconomic characteristics of these high mountain populations is illiteracy: more than half (57%). The proportion of owners attending university is just 3%. The relatively high percentage of people with a professional qualification in the Aït Mizane valley comes from the fact that this valley benefited from the training in becoming mountain guides offered by Tabannt-Bouguemaz training centre.

The size of the household constitutes another issue linked to the already very limited production opportunities. Of the whole sample, the average household has 5 persons. However, in the Imnane valley, large families are widespread, 33 % of households have over 6 dependants.

### *Characteristics of agriculture and animal husbandry*

The main characteristic of farms in high and humid mountainous regions is the extremely small size of cultivated land, situated mainly on terraces. The 107 farms surveyed cultivate a total area of 23 hectares; that is to say nearly a fifth of a 0.2 hectare per farm (Annex Table 2). In addition to the difficult mountainous relief, the farmland has shallow soils, is easily eroded, and is situated on very steep slopes. A dense hydrographic network, fed by springs and watercourses, provides irrigation on virtually the whole of the cultivated surface in both valleys. The use of external inputs is rare, limited to small amounts of manure fertilizers.

The cropping system is centred around irrigated mixed farming, on these small parcels of land built on terraces with fruit tree cultivation. In both valleys, the areas reserved for cereals and vegetable farming represents the dominant part of the cultivated land. Tree cultivation is present everywhere and plays an important role in maintaining and shaping the landscape, helps to prevent further soil erosion and contributes to local biodiversity. Tree plantations are largely dominated by apple, cherry and walnut trees and are found on the slope sides along the main watercourses of both valleys.

The presence of forests and rangelands give the area a pastoral perspective. Livestock breeding remains important and constitutes a regular source of income. The main livestock are small ruminants, with the a marked presence of horses and mules. The sample households own 1015 goats, 304 sheep, 107 cows and 61 horses or mules (an average of 9 goats, 3 sheep, 1 cow and below 1 horse or mule per farm). As far as tourism is concerned, the livestock breeding plays an important role, providing not only meats, milk and other dairy products (small ruminants and sheep) but also transport and portage facilities to tourists. Wool production which represents the main input for local hand made crafts and other artisanal products (Annex Table 3).

### *Intrinsic characteristics of farmhouses*

In the absence of strict regulations for rural constructions (building permits), new farmhouse development tend to be more "modern" constructions, gradually replacing the typical traditional architecture. Imported materials such as reinforced concrete are gaining ground over local materials (earth and stones). This transformations of the rural landscape is likely to have a negative impact on the attractiveness and sustainability of mountain tourism.

In order to characterise the intrinsic attributes of farmhouses, indicators that have a direct influence on the conditions of the tourists' stay are measured. In particular, the number of beds, presence and quality of toilets and showers, presence of drinking water and electricity, and suitable furniture. In

farmhouse accommodations, the number of beds are not counted, rather, how many people can be put up as groups in bedrooms or on terraces in the open air.

Of the whole sample studied, each farmhouse can accommodate an average of 21 persons, in small groups of 5 to 7 persons (Annex Table 4). However, this figure increases when the owner opens up all the rooms of the farmhouse to the tourists or has very big terraces: 25% of farmhouses can accommodate over 25 individuals. In 45% of the farmhouses, the part reserved for tourist accommodation is actually integrated to the rest of the family home. These adjoining quarters combined with the architecture of the house, as a whole, constitute a decisive criterion in the tourists' choice of accommodation. Only 44% of farmhouses have preserved the typical mountain house architecture. On the others, many extensions have been built, and alterations have taken place using reinforced concrete and bricks.

With regard to inspecting the farmhouses for the quality of the accommodation they offer, we found that the vast majority (97%) have toilets, but they are in poor condition in 12% of cases, whereas they are not well maintained in 70% of cases and only in satisfactory working order for 18% of them. In 70% of the farmhouses surveyed, showers exist but this proportion goes down in the Imnane valley : 37% of the total. The condition of the showers is good in 19% of cases, average 63% and below average 18%. Well-furnished farmhouses represent only a privileged 18% of the sample; it is otherwise traditional (71%) or non-existent (11%). Conversely, the vast majority of farmhouses have electricity (75%) and constant drinking water (85%). However, there is a big difference between the two valleys. While electricity and drinking water are extremely common in the Aït Mizane valley , 86% and 99% of the total, in the Imnane valley, these proportions only correspond to 45% of the farmhouses.

#### *Characteristics of the services provided by farmhouses*

In addition to offering accommodation and information to tourists, farmhouse owners and their families provide many other services, including catering meals, selling fresh agricultural produce, transporting packs and tourists and guiding services. The survey data shows that 83% provide meals to tourists and 18% sell fresh agricultural produce (Annex Table 5). Furthermore, a distinct number of farmhouse owners and members of their families go on hiking excursions with the tourists as cooks (18%), guides (36%), mule-drivers (36%) or training instructors (9%). Tourists also have opportunities to discover the local ethnological heritage, mainly through traditional work tools, local agricultural techniques, and related aspects of local culture.

#### *Income from agricultural and tourism activities*

The level of to agricultural is small. For the sample, the average income corresponded to 9000 DH (1 DH = 0.1 Euro) per household per year, but with important variations both within and between the two valleys (Annex Table 6). It averages at about 10 000 DH in the Aït Mizane valley and 5000 in the Imnane valley. On the whole, nearly half the households (47%) do not earn more than 5000 DH per annum and 66% do not reach 10,000 DH level. These figures, while showing that it is difficult to obtain sufficient income from agricultural activity alone, bear witness to the fact that tourism activities play an important role.

The average income obtained from tourism remains higher than the one gained from agriculture. It is above 40,000 DH per annum in 11% of cases and 20,000 DH per annum in 36% of cases. These levels show the importance played by tourism in reducing poverty and unemployment, especially in this mountainous region known for its high population density and its vulnerability in terms of food security issues.

#### *The relationship between agriculture and mountain tourism activity*

The analysis of the relationship between mountain tourism and agriculture is evaluated in terms of the synergy between the two activities. The relationships examined are from the point of view of financial

sources for investments, changes in the use of agricultural land, involvement of the family as a workforce in both sectors of activity, and the intended destination of the agricultural production in relation to providing food and selling fresh produce to the tourists.

Analysing financial sources for investments such as extending the houses and altering them to cater for the needs of tourists show that households rely on the income they make from their agricultural activity (Annex Table 7). In nearly half of the cases, (49%), the investment made in building tourist accommodation is sustained by the revenue drawn from the agricultural activity. The rest of the financial sources come from the salaries born of the tourism trade (guides, mule-drivers, and cooks), private loans, and contributions from family members working abroad.

The available data, between 1996 and 2002 periods, show that important changes have taken place in the use of agricultural land (Annex Table 8). In order to improve the aesthetic value of the agricultural landscape in both valleys, the farmers have a tendency to substitute cereals with fruit tree plantations. While the agricultural land use data indicates that cereals occupied 53% and 79% of the utilised agricultural area in the Ait Mizane and Imnane valleys respectively, in our sample, these proportions do not go over 19% and 21% of the utilised agricultural area. On the other hand, the tree plantations, which used to occupy between 45% to 60% of the utilised agricultural area (1996), are now occupying up to 80% of the utilised agricultural area. These changes suggest farmers are becoming aware of the economic interest from better integrating agriculture and tourism.

For the majority of farmhouse owners, the most positive outcome of the complementary relationship between agriculture and tourism is the employment of their family members. While agricultural activities provide the local population with days of work all year round, they provide significantly less activity than tourism does during the high season. The data from our survey shows that 82% of farmhouse owners rely on their family for labour, 8% use permanent workers and 6% use seasonal workers (Annex Tables 9a and 9b). On average, two family members other than the owner are involved in tourism activities. The reciprocal nature of their involvement in both sectors of activity (in contact with tourists and agriculture at the same time) constitutes the best opportunity for the local population to become aware of the close relationship between a sustainable tourism and the quality of the environment.

The final characteristic part of the relationship between tourism and agriculture is local agricultural produce for tourist consumption. After analysing the intended use of the farmhouses agricultural production, our survey compares a series of food products provided for tourists as fresh produce or as meals (Annex Tables 10a and 10b). These products are divided as follows among the surveyed farmhouses: predominantly fruit (apples, cherries, walnuts) and vegetables for 30% to 40% of the production, less importantly cereals (16%), milk and other dairy products (16%), meats (12%) and eggs (11%) and a small percentage of the honey (3%) and olive oil (1%) produced. Obviously, all of these products already have good market values.

#### **4. Applying the hedonic model to farmhouse stays**

To estimate the hedonic price function three steps are followed: (i) Hypothesis regarding the uniqueness and size of the market; (ii) specifying the price function; and (iii) choosing the functional form for the hedonic model.

##### *Hypothesis regarding the uniqueness and size of the market*

The farmhouse rental market in the two valleys situated in the Western High Atlas Mountains verifies the basic hypotheses of the application of the hedonic prices method; the uniqueness and market equilibrium. Staying at a farmhouse stays represents a relatively homogenous part of the accommodation sector compared with hostels and related hotel facilities. Their size (in the case of the



farmhouses dotted about the two main valleys of the Toubkal National Park) and their way of functioning (no advanced booking and flexible offers) provide visitors with freedom of choice and the possibility to change plans without incurring significant costs. Furthermore, rental prices are not fixed or subject to any kind of regulation and can therefore be negotiated between owners and visitors. During the high season when farmhouses are at capacity, the prices are considered as the highest equilibrium prices.

### *The variables and attributes*

The choice of explicative variables, we had a double objective. First, to account for all of the key criteria used by visitors in their choice of accommodation, as they are reported in the study on tourist demand conducted in the same area (Houmaid and Allali, 2000). Secondly, to specify the representative variables of the agricultural landscape, avoiding their correlation to other variables concerning environmental attributes. The above considerations being taken into account, the hedonic price function is specified as follows:

$$P_i = P (L_i, H_i, E_i, A_i)$$

Where  $P_i$  is the farmhouse rental price (i), and  $L_i$ ,  $H_i$ ,  $E_i$  and  $A_i$  corresponding respectively to the vectors of its intrinsic location, environmental, and agricultural attributes.

### *Intrinsic attributes*

The main intrinsic attributes taken into account are: the maximum number of people who can be accommodated, whether or not the tourist accommodation is adjoining the family home, how typical or traditional the architecture is, and the indicators which measure the quality and standard of accommodation; namely the presence and quality of toilets and showers, the availability of drinking water, electricity and the availability and quality of the furniture.

To minimise the number of variables linked to the intrinsic attributes of the farmhouses, the indicators measuring the standard of accommodation have been incorporated into a single variable named: "farmhouses" (modern conveniences). A scoring system ranks each farmhouse: one for the presence of a particular attribute and zero for the absence of it. In the same way, we have used 2, 1 and 0 to stand for the following quality standards: Good (2), average (1), below average (0). On the basis of the score obtained, the farmhouse is classified either in class one (score  $\leq 3$ ), class two (score between 4 and 6) or class three (score  $\geq 7$ ). This classification can be compared to the star system used for hotels, or the ear of corn system used for country cottages (gites).

According to our classification, the farmhouses are divided as follows: 51% in class three, 38% in class 2 and 11% in class one. The majority of farmhouses in class 3 are situated in the valley of Hershey where tourism is important.

### *Locational Attributes*

The second set of criteria tourists use to choose their type of accommodation is linked to geographical location. Among the important aims of the tourist in their choice of where to stay include attributes like how relaxing the site is, what sort of outdoor activities, and the possibility for nature discovery. One study carried out in the same area in 2002, shows that out of 400 tourists of different nationalities, 18% come to meet the local people, 29% come to view the scenery, 49% for the hiking experience, and 4% for mountain sports (skiing, rock climbing, etc.) (Houmaid and Allali 2002). Given these motivations, it becomes clear that being close to villages ("douars"), mountains, hiking trails or beauty spots are the decisive factors in choosing farmhouse location.

Taking into account these considerations, the selected attributes of the chosen location are mainly concerned with the farmhouse's geographical situation in terms of altitude, distance from the centre of the closest "douar" (village) and of Imlil (starting point of the hiking paths), distance from the summit of Toubkal, and the proximity of the pedestrian and equestrian paths. As far as other attributes linked to the natural scenery are concerned, they will be taken into account under the environmental component.

Concerning altitude, 40% of farmhouses are situated below 1800 meters, 52% between 1800 and 2000 and 8% above 2000 meters. As for the distance from Imlil, which is the starting point of the hiking paths, 66% of farmhouses are situated less than 2,5 kms away from it, 10% are between 2.5 and

7 kms away and 24% are more than 7 kms away. The farmhouses that are the furthest away from Imlil (7%), are over 13 kms away. As far as being in the vicinity of pedestrian paths, 90% of farmhouses are very close, but only 49% of them are close to equestrian trails.

#### *Environmental attributes*

In the absence of quantitative data on the environmental quality of the two valleys, such as air quality, diversity of the fauna and flora, etc., the selected environmental attributes are primarily concerned with the natural use of the land rather than agricultural use (mountains, forests, watercourses, lakes, water falls, panoramas.). The choice of environmental attributes is directed by how attractive they are to tourists. The available data suggests that tourists are attracted to the mountainous scenery (37%), the rural countryside (24%), the agricultural landscape and the forests (16%), traditional architecture (14%) and the panoramas (9%) (Houmaid and Allali 2002).

To take into account the environmental attributes, each farmhouse is described by three sets of distances, which are likely to affect the quality of the environment. The first is the distance from the closest forest, the second, the distance from recreational sites around (streams, lakes and water falls, and the third is the distance from the summit of Toubkal Mountain. On average, each farmhouse is at about 1.3 kms from the closest forest and no further away than 5 kms. The majority of farmhouses (65%) border on forests or are less than one km away. Only 7% of farmhouses are over 4 kms away from a forest. As far as recreational sites are concerned, we have selected Ifni lake for its attractiveness to tourists. In 66% of cases, the lake is no further than 15 kms from the farmhouse. The distance from the summit of the Toubkal Mountain is on average 11 kms, with a minimum of 5 kms and a maximum of 24 kms. More than two thirds of farmhouses (70%) surveyed are situated less than 10 kms away from the mountain top, and the majority (92%) are less than 18 kms away.

#### *Landscape attributes of agricultural origin*

In our choice of attributes of agricultural origin, we have tried to reconcile the external impacts linked to agriculture's role in shaping the natural landscape (landscape dimension), with its contribution in sustaining the activity of mountain tourism. Due to the spatial aspect of these dimensions, which goes beyond the framework of farmhouses, we have also chosen to include the specific situations of each village as measuring indicators of their effects.

The attributes which represent the landscape dimension are linked to: the farmhouse settings and the cultivated area; the greenery from agricultural origin in the spring and summer; the proportion of irrigated terraces belonging to the farmhouse in relation to the rest of the village; the shade and added beauty brought to the local landscape through fruit tree plantations (particularly by walnuts); and the number of trees planted. The choice of walnut trees is justified by its landscaping qualities due to its great size and wide foliage. To these attributes, the presence of farm animals such as small ruminant goats is added. For the second dimension, we have selected two attributes: the availability of food from local agricultural production, and transport facilities using mules.

Of the whole sample, the average irrigated area is about 0.20 ha. The farmhouses without agricultural land represent 23% of the total, and about 7.5% have over an hectare. In 45% of cases, the area cultivated on terraces was near to the farmhouse. The average number of fruit trees is about 190 per farmhouse. However, in 22% of cases, fruit tree plantations are absent, whereas they are important in 28% of cases ranging from 200 to a maximum of 2,060 trees. The walnut and apple trees represent the most common types of planted trees. The main intended use remains self-consumption and catering for tourists. In 40% of cases, farmhouses provide tourists with meals made of the cereals and vegetables grown on the farm.

#### *Explaining the rental price of farmhouses*

Unlike the market of classified and non-classified country cottages (gites) where prices are theoretically set to 30 DH per person per night, farmhouse rentals are not subject to any regulatory controls. The prices are negotiated either directly between the owner and the tourists or indirectly

through travel agencies or mountain guides. Rental prices are subject to seasonal changes. The high season goes from April to September, with the highest number of visits from June to August. The low season is spread over the rest of the year, from October to March where the number of visits reaches only 15% of the yearly total.

The rental prices of the farmhouses surveyed is for the high and low seasons of 2002 (Annex Table 11). Of the whole sample, the average rental price during the high season is 37 DH per person per night, but this figure varies by valley. In Aït Mizane ,39 DH per person per night, and 31 DH in Imnane. During the low season, it costs an average of 28 DH per person per night or some 31% less than during the high season.

Fluctuations in rental prices from one farmhouse to another are important, especially during the high season. The minimum and maximum prices registered are 20 and 80 DH per person per night respectively. In 51% of the cases, the rental price is below 30 DH per person per night, with an average of 24 DH. On the other hand, in 15 % of farmhouses, the price is higher than 50 DH. Overall, the majority of farmhouses (76%) have rental prices that remain below 50 DH per person per night during the high season.

Considering that the average stay among tourists in this area is estimated to 7 nights during the high season (Houmaid and Allali 2000), we have used the weekly rental price as the variable to be explained in the hedonic pricing model. Furthermore, the absence of data on the clientele of farmhouses limits our analysis to the hedonic price function and to the implicit prices of the attributes without being able to progress to the building of their demand functions.

#### *Results of the econometric estimates of the hedonic model*

In the econometric estimate of the hedonic model, all the pertinent explanatory variables, influencing farmhouse rental prices are tested. Their descriptive statistics are reported in Table 1.

**Table 1 Descriptive statistics of the main variables tested in the hedonic models**

Variables	Minimum	Maximum	Average	Standard Deviation
High season rental price (DH/night)	20.00	80.00	36.87	16.87
High season rental price (DH/week)	140.00	560.00	258.08	118.11
Logarithm of the weekly rental price	4.94	6.33	5.46	0.43
Accommodation capacity (n. of persons)	3.00	50.00	20.84	9.53
Standard of farmhouse facilities (classes)	1.00	3.00	2.41	0.67
Tourist accommodation & owner's home settings (1=adjoin, 0=separate)	0.00	1.00	0.55	0.49
Type of architecture (1=typical, 0=modern)	0.00	1.00	0.56	0.49
Altitude (height in meters)	1200.00	2250.00	1868.93	196.98
Distance from the village centre (Km)	0.00	15.25	3.77	4.37
Distance from the closest hiking paths (less than 1Km=1, more than 1Km=0)	0.00	1.00	0.89	0.30
Distance from the closest forest (in Km)	0.01	5.00	1.33	1.28
Proximity to lake Ifni (1=close 0=far)	0.00	1.00	0.66	0.4747
Distance from the summit of the Toubkal Mountain (in Km)	5.00	24.00	10.78	4.70
Farmhouse bordering with agricultural fields (common border=1 none=0)	0.00	1.00	0.42	0.49
Crops on irrigated terraces: greenery of agricultural origin (% of the farmhouse's SAU/ SAU of the village)	0.00	16.01	1.26	2.64
Fruit trees (shade of agricultural origin) (number of walnut trees per farmhouse)	0.00	300.00	31.58	45.98
Husbandry of small ruminants (number per farmhouse)	0.00	130.00	12.56	26.58
Husbandry of horses and mules (number per farmhouse)	0.00	5.00	0.57	0.82
Catering with local agricultural products (1=yes, 0=no)	0.00	1.00	0.36	0.48

Source: Author's calculation based on author's 2003 surveys.

Regardless of which variables are considered, the identification of the appropriate functional form constitutes the decisive step in estimating the hedonic model. Several functional forms were tested and compared (linear, semi-log, log-log). On the basis of the statistical significance of the coefficients and the suitability of their indicators, as well as the power of the parameters R and F, the best econometric results are obtained using the semi-logarithmic form.

Using the coefficients of the estimated model, the implicit marginal price of each attribute is generated. The estimated coefficients and the implicit marginal price of each attributes are presented in Table 2.

**Table 2 Coefficients of the semi-logarithmic hedonic model and implicit marginal prices of attributes**

Explicative variables	Semi-log model		Implicit Marginal Price			Standard deviation
	Coefficients	T-student	Average	Minimum	Maximum	
Constant	5.804	19.319	-	-	-	-
Standard of farmhouse accommodation	0.175	3.483	45.165	24.50	98.00	20.669
Independent farmhouse	-0.087	-1.478	-22.453	-48.72	-12.18	10.275
Typical architecture	0.147	2.351	37.938	20.58	82.32	17.362
Altitude	-0.001	-3.812	-0.158	-0.34	-0.09	0.072
Forest	0.082	3.102	21.163	11.48	45.92	9.685
Farmhouse bordering agricultural fields	0.146	2.396	37.680	20.44	81.76	17.244
Irrigated terrace cultivation	0.033	2.338	8.517	4.62	18.48	3.897
Fruit trees - Walnut	0.001	1.891	0.310	0.17	0.67	0.142
Small ruminants	0.003	2.250	0.748	0.41	1.62	0.342
Horses and Mules	0.106	2.077	27.357	14.84	59.36	12.519
R <sup>2</sup> = 0,64    R <sup>2</sup> adjusted= 0,58    F= 15,53						

Source: Author's calculation based on author's 2003 surveys.

Among the intrinsic attributes tested, three are significant for farmhouse rental prices. One is linked to the standard of accommodation of the farmhouse; one is that the tourist accommodation is independent from the family home; and one is the traditional architecture of the house. The indicators of these effects, and the implicit marginal prices, show that the better the standard of accommodation is, the higher the weekly rental price, on average 45 DH per week. The same tendency has been noted for the typical architecture of the house, but to a lesser extent, or an average of 38 DH per week. On the other hand, the lack of adjoining quarters between the tourist accommodation and the family home has a negative effect: a totally independent farmhouse is be rented for less than an adjoining one by an average of 22 DH per week.

As for location attributes, of the three variables tested the altitude factor is the only one influencing farmhouse rental prices. The higher the farmhouse, the more its rental price decreases, whereas we expected the contrary given the proximity of the summit of Toubkal Mountain. One plausible explanation for this phenomenon is the fact that the closer tourists get to the top of the mountain, the more likely they are to choose to sleep in the open or go to the Kasba Motel in Toubkal.

Out of the three environmental attributes tested, the only significant one is the forest. The closer the farmhouse is to the forest, the higher the price. The implicit marginal price is for staying close to the forest is an average of 21 DH per week. This result shows the importance of nature and forest scenery. However, this result remains incomplete, as the chosen variable does not take into account the density and nature of the trees.

Among the amenities of agricultural origin, five variables have a significant effect on the rental price, and their indicators are in keeping with intuitions. The highest implicit marginal prices are obtained by three attributes: the farmhouse bordering on the cultivated area, the presence of mules, and the proportion of terrace cultivations (relative to the village's total utilised agricultural land). The other two attributes, fruit plantations of mainly walnut trees and the presence of small ruminants have significant implicit marginal prices, but they are less important.

Compared to a farmhouse situated far away from the cultivated area, the rental price tends to increase by an average of 38 DH a week the closer the farmhouse is to the cultivated area. This is due to the qualitative effect agricultural landscapes have on the farmhouse rental market. It remains important, however, to understand why tourists are prepared to pay more for this characteristic. Are they attracted to the greenery or to the aesthetic value of terrace cultivation? The effect of the proportion of irrigated terrace cultivation of each farmhouse in relation to the total utilised agricultural land of the village constitutes a possible answer. On the one hand, the positive indicator suggests that

the larger the terrace cultivation area is, the higher the rental price tends to be. Furthermore, the scale of this increment is quite significant as it averages around 9 DH per week. This result constitutes a first quantification of the role of agriculture in the shaping of the natural landscape in mountainous areas of Morocco.

Furthermore, in the area of animal husbandry, the effects observed are equally important and significant. It seems, however, that tourists are not influenced by the presence of herds of small ruminants in the same way as they are by the presence of mules and horses. The high implicit marginal price linked to the presence of mules is explained by the tourists' dependency on mules for transport and for carrying their luggage.

Next, the proportion the implicit marginal price of each attribute represents in the average farmhouse rental price is estimated. The results we have obtained show that, on average, the amenities of vegetation and nature have positive effects on farmhouse rental prices in the range of 18%, all else equal (Table 3). The most important contribution is linked to the farmhouse bordering on the cultivated area: 14.5% of the average price. On the other hand, the attributes of animal origin make farmhouse rental prices go up by an average of 11%.

**Table 3 Implicit Marginal Prices of attributes in relation to the average farmhouse rental price**

Attributes	Implicit Marginal Price			% in Relation to Average Farmhouse Rental Price
	Minimum	Maximum	Average	
Farmhouse bordering with agricultural fields	20.44	81.76	37.68	14.50
Irrigated terrace cultivation	4.62	18.48	8.52	3.30
Fruit trees - Walnuts	0.17	0.67	0.31	0.12
Small ruminants	0.41	1.62	0.75	0.29
Horses - Mules	14.84	59.36	27.33	10.60

Source: Author's calculation based on author's 2003 surveys.

A limitation of this study is the lack data and information on of the possible negative environmental externalities associated with agricultural activities. In the author's opinion, the positive effects presented here are overestimated, since each of the two agricultural activities can also generate negative environmental impacts likely to undermine their contribution to tourism. Therefore, if the data on the quality of the environment in relation to agricultural practices had been available, farmhouse rental prices would have been indexed by the environmental parameters, which are affected negatively by agriculture and, consequently, the elaboration of an assessment of the effects would have given complete results.

## 5. Conclusions

The objective of this study is to help quantify and analyse some of the non-production roles of agriculture. The hedonic pricing method was used to evaluate some agricultural amenities in Morocco. Identifying amenities of agricultural origin and distinguishing them from the environmental attributes represents a first step towards improving the performance of impact studies in the area of agriculture.

Although this analysis is only concerned with the positive externalities of agriculture in relation to the use of land in mountainous areas, it provides valuable indicators likely to better inform policy decisions effecting rural and agricultural development. On the one hand, some advantages linked to landscape planning and its contribution to sustaining the tourism activity are documented. These advantages include joint products linked to the farmhouses bordering cultivated areas, the greenery from the annual crops, the shade and attractiveness provided by walnut trees and the presence of domestic animals.

In addition, amenities specific to mountain agriculture have a positive influence on the tourist accommodation rental market and particularly on farmhouses. Indeed, calculating the implicit marginal price of each attribute has been by far the most important contribution of the present study in analytical and quantitative terms. For the first time, we have demonstrated that agricultural amenities can explain a variation in rental prices as significant as 14.5% for farmhouses situated in mountainous regions -- positive financial externalities.

Developing the valleys and the lower slopes of the mountains through terrace cultivation, fruit tree plantations along the watercourses, construction of "seguias" (irrigation canals) and the development of a hydrologic network represent many agricultural techniques, which not only play environmental and landscaping roles but also enrich the local ethnological heritage.

The implications of this paper are many and go beyond the relationship between agriculture and the environment to also include rural tourism. The overall results suggest that the development of agriculture and tourism should not be separated in this case, and that economic and environmental sustainability is strongly subjected to the policy measures that influence negative effects and reinforce positive ones.



## Annex Tables

Annex Table 1 Rural accommodation owner profile in western High Atlas of Morocco

	Rherhaya		Imnane		Total	
	Number	%	Number	%	Number	%
<i>Homeowners' age:</i>						
Average age	41	---	43	---	41.5	---
- [20, 30 [	20	25	5	18.5	25	23.4
- [30, 40 [	25	31.25	5	18.5	30	28
- [40, 50 [	20	25	11	40.74	31	29
- > 50	15	18.75	6	22.22	21	19.6
<i>Educational level:</i>						
- None	13	16.25	9	33.33	22	20.5
- Koranic rudiments	26	32.5	13	48.15	39	36.5
- Elementary	32	40	3	11.11	35	32.7
- Secondary	6	7.5	2	7.41	8	7.5
- College / University degree	3	3.75	0	0	3	2.8
- Professional degree	24	30	0	0	24	22.5
<i>Household size :</i>						
- [0, 4 children]	44	55	12	44.4	56	52.3
- ] 4, 6 children]	25	31.25	6	22.2	31	29
- > 6 children	11	13.75	9	33.3	20	18.70
Average number of children per household	4.4	---	4.8	---	4.5	---
<i>Main activity :</i>						
- Agriculture	19	23.75	9	33.33	28	26.2
- Tourism	53	66.25	10	37.04	63	58.88
- Staff member	3	3.75	0	0	3	2.8
- Commerce	1	1.25	3	11.11	4	3.8
- Other	4	5	5	18.52	9	8.41

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 2 Characteristics of agriculture in the Rherhaya and Imnane valleys in western High Atlas of Morocco**

	Rherhaya			Imnane			Total sample		
	Total	%	Average	Total	%	Average	Total	%	Average
Total cultivated land (SAU) (ha)	16.65	74.46	0.208	5.72	25.57	0.21	22.37	100	0.209
Irrigated SAU (ha)	16.56	99.46	0.207	5.63	98.43	0.208	22.19	99.2	0.207
Rainfed SAU (ha)	0.09	0.54	1.12 10 <sup>-3</sup>	0.09	1.57	3.33 10 <sup>-3</sup>	0.18	0.8	1.68 10 <sup>-3</sup>
<i>Land use</i>									
Cereal land	0.45	---	0.005	0.54	---	0.02	0.98	---	0.009
Food crop land	0.333	---	0.004	0.25	---	0.009	0.58	---	0.005
<i>Number of growing stock/species</i>									
Walnut tree	1806	---	22.57	1353	---	50.11	3159	---	29.52
Apple tree	10717	---	133.96	1832	---	67.85	12549	---	117.28
Cherry tree	1930	---	24.125	496	---	18.37	2426	---	22.67
Plum tree	0	---	0	51	---	1.89	51	---	0.47
Olive tree	200	---	2.5	0	---	0	200	---	1.87

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 3 Size of livestock holdings in the Rherhaya and Imnane valleys in western High Atlas**

Livestock population	Rherhaya			Imnane			Total sample		
	Total	Av./accom.	%	Total	Av./accom.	%	Total	Av./accom.	%
<i>Goats</i>	798	9.97	35	217	8.04	44.44	1 015	9.49	37.38
=10 heads/holding	59	5.9	12.5	42	7	22.22	101	5.68	14.95
] 10 ; 20]	76	15.2	6.25	75	15	18.52	91	9.1	9.34
] 20 ; 30]	85	28.33	3.75	0	0	0	85	28.33	2.8
] 30 ; 40]	155	38.75	5	0	0	0	155	38.75	3.74
= 40 h/holding	423	70.5	7.5	100	100	3.7	523	74.71	6.54
<i>Sheep:</i>	209	2.61	22.5	95	3.52	48.14	304	2.84	28.97
< 5 h/holding	15	2.14	8.75	22	2.75	29.63	36	2.57	14.02
[5 ; 10[	24	6	5	13	6.5	7.4	37	6.17	5.6
[10 ; 20[	40	13.33	3.75	30	15	7.4	50	12.5	4.67
= 20 h/holding	130	32.5	5	30	30	3.7	180	30	4.67
<i>Cattle:</i>	66	0.83	56.25	41	1.52	85.18	107	1	63.55
< 2 h/holding	30	1	37.5	12	1	44.44	42	1	39.25
= 2 h/holding	36	2.4	18.75	29	2.63	40.74	65	2.5	24.30
<i>Horses:</i>	47	0.58	43.75	14	0.52	48.15	61	0.57	44.86
= 2 horses	35	1.09	40	14	1.08	48.15	49	1.09	42.05
= 3 horses	12	4	3.75	0	0	0	12	4	2.8

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 4 Characteristics of rural accommodation in the Rherhaya and Imnane valleys in western High Atlas**

	Rherhaya		Imnane		Total	
	Average	Ratio (%)	Average	Ratio (%)	Average	Ratio (%)
<i>Capacity:</i>	21	---	21.52	---	21.16	---
= 10 p/accommodation	8.54	13.75	8.66	11.11	8.57	13.08
] 10; 15 p/accommodation]	13.36	13.75	13.62	29.63	13.47	17.76
] 15; 20 p/accommodation]	18.14	26.25	18.6	18.52	18.23	24.3
] 20; 25 p/accommodation]	23.89	22.5	23	11.11	23.76	19.62
25; 30 p/accommodation]	29.1	12.5	29.25	14.81	29.14	13.08
> 30 p/accommodation	37.78	11.25	41.75	14.81	39	12.15
<i>Standalone accom./household</i>	---	53.75	---	59.26	---	55.14
<i>Power supply</i>	---	86.25	---	40.74	---	74.8
<i>Potable water</i>	---	98.75	---	44.44	---	85
<i>Shower facilities available:</i>	1.05	81.25	0.48	37	0.91	70.1
None	---	17.5	---	63	---	29
One shower facility/accom.	---	65	---	25.9	---	55.1
2 shower facilities/accom.	---	12.5	---	11.1	---	12.2
3 shower facilities/accom.	---	5	---	0	---	3.7
<i>Bathroom available:</i>	1.44	98.7	1.26	92.6	1.39	97.2
None	---	1.3	---	7.4	---	2.8
One bathroom/accom.	---	67.5	---	63	---	66.4
2 bathrooms/accom.	---	21.2	---	26.3	---	22.4
3 bathrooms/accom.	---	7.5	---	3.3	---	6.5
> 3 bathrooms/accom.	---	2.5	---	0	---	1.9
<i>Type of construction:</i>	---	67.5	---	22.22	---	56.07

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 5 Main services offered by rural accommodation for tourism purposes**

Services offered	Number	Ratio (%)
Accommodation	107	100
Restaurant	89	83.17
Tourist guide	38	35.5
Mule track	38	35.5
Cook	19	18
Produce sales outlet for tourists	19	18
Leisure activity monitor	10	9

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 6 Income structure and breakdown at rural accommodations during the 2002-2003 period**

Income type (DH/year)	agricultural activities (%)	tourism activities (%)	Total (%)
- < 5000	46.63	16.82	8.41
- [5000 ; 10 000 [	19.62	17.75	9.34
- [10 000 ; 15 000 [	14	17.75	19.63
- [15 000; 20 000 [	7.47	11.22	13.08
- [20 000; 30 000 [	3.74	19.62	14.02
- [30 000; 40 000 [	4.67	5.61	14.95
- => 40 000	3.74	11.21	20.56

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 7 Main investment project financing sources in mountain tourism**

Financing source	Rherhaya		Imnane		Total	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
Agriculture	40	50	12	44.4	52	48.6
Income	2	2.5	4	14.8	6	5.6
Credit facilities	4	5	4	14.8	8	7.5
Other sources	9	11.25	5	18.5	14	13

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 8 Importance of fruit plantation introduction in detriment of annual crops**

SAU/crop ratio	Rherhaya		Imnane		Total	
	<i>1996 (WCA)</i>	<i>2002 Survey</i>	<i>1996 (WCA)</i>	<i>2002 Survey</i>	<i>1996 (WCA)</i>	<i>2002 Survey</i>
Cereal land (%)	53	19	79	21	67	20
Forests (%)	61	90	24	54	44	90
Food crop land (%)	2	2	2	4	2	4

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 9a Origin and materiality of labor used at rural accommodations**

	Rherhaya		Imnane		Total	
	Number	%	Number	%	Number	%
<i>Household labor</i>						
Number of users	59	73.75	18	66.67	77	71.96
Average number	1.5	-	1.93	-	1.62	-
Remunerated ratio	-	15.25	-	0	-	11.68
<i>Permanent labor</i>						
Number of users	25	31.25	3	11.11	28	7.5
Average number	1.6	-	2.33	-	1.68	-
Remunerated ratio	-	100	-	100	-	100
Average compensation rate (DH/d)	77.2	-	61.67	-	75.54	-
<i>Seasonal labor</i>						
Number of users	6	7.5	0	0	6	5.6
Average number	1.17	-	0	-	1.17	-
Remunerated ratio	-	100	-	0	-	100
Average compensation rate (DH/d)	45	-	-	-	45	-

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 9b Scope of household labor in tourism activities per income bracket**

Income type (DH/year)	Household labor				
	Number of users	Ratio/type (%)	Average holding/type	Labor time (weeks)	Labor time (h/season)
< 5000	14	78	2	10	900
[5000 ; 10 000 [	15	79	2	10	910
[10 000 ; 15 000 [	15	79	2	11	1 000
[15 000; 20 000 [	8	67	1	10	310
[20 000; 25 000 [	6	43	1	8	230
[25 000; 30 000 [	6	86	2	12	1 080
=> 30 000	13	72	2	12	1 060

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 10a Materiality of local produce destined to tourists. 2002-2003**

	Rherhaya		Imnane		Total	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
<i>Produce end use</i>						
Tourist restaurants	33	41.25	13	48.15	46	43
Tourist sales	14	17.5	5	18.52	19	17.75
<i>Livestock production end use</i>						
Tourist restaurants	13	16.25	7	29.93	20	18.70

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 10b Origin and materiality of agri-food products devoted to tourism customers**

<b>Produce</b>	<b>Number of Holdings</b>	<b>Ratio (%)</b>
Apples	44	41.12
Walnuts	43	40.18
Cherries	37	34.58
Vegetables	32	29.90
Grains	17	15.88
Milk	17	15.88
Butter	16	14.95
Meat	13	12.15
Eggs	12	11.21
Honey	3	28.04
Olive oil	1	0.93

Source: Author's calculation based on author's 2003 surveys.

**Annex Table 11 Rural accommodation rate descriptive statistics**

	Rherhaya		Imnane		Total sample	
	<i>Average</i>	<i>Ratio (%)</i>	<i>Average</i>	<i>Ratio (%)</i>	<i>Average</i>	<i>Ratio (%)</i>
High season rate (DH/day/person)	38.75	---	31.3	---	36.87	---
=< 30 Dh/d/p	24.05	46.3	23.05	66.7	23.73	51.4
30 to 40 Dh/d/p	39.75	25	40	22.2	39.8	24.3
40 to 50 Dh/d/p	50	11.2	50	3.7	50	9.3
50 to 60 Dh/d/p	59	6.3	0	0	59	4.7
> 60 Dh/d/p	74.44	11.2	70	7.4	73.64	10.3
Low season rate (DH/day/person)	29.31	---	24.44	---	28.08	---
=< 30 Dh/d/p	23.42	75	21.67	88.9	22.92	78.5
30 to 40 Dh/d/p	40	11.5	40	7.4	40	11.2
40 to 50 Dh/d/p	50	7.5	0	0	50	5.6
50 to 60 Dh/d/p	60	5	60	3.7	60	4.7
> 60 Dh/d/p	0	0	0		0	0

Source: Author's calculation based on author's 2003 surveys.

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