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Agricultural Landscape Externalities, Agro-tourism and Rural Poverty Reduction in Morocco

Agricultural and Development Economics Division (ESA)
Food and Agriculture Organization
of the United Nations

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1. INTRODUCTION AND OBJECTIVES OF STUDY

The present study is focused on the Environmental Services of Agriculture with the objective to identify and quantify economically their contribution to rural poverty reduction in Morocco[1]. One of its major implications is to provide a different and a fresh understanding of the environmental role of agriculture, particularly those pertaining to landscape externalities of high positive potential that could be used as a pedestal for sustainable development. A better understanding of the beneficial linkages between market agricultural production and its positive landscape externalities would undoubtedly help in creating a favourable environment for a territorial dynamic that would lead to greater economic diversification, and thereby contribute to poverty reduction in rural areas.

Two major considerations are retained to evaluate economic benefits associated with agricultural landscape externalities. On one hand, a scenic agricultural landscape with many environmental amenities is provided as an input on behalf of rural tourism in Morocco and essential factor of his prosperity. Furthermore, the rural tourism sector is considered as an important internalization form of agricultural landscape externalities. On the other hand, the economic benefits are evaluated in relation to income, employment, investment and welfare of local population and their contribution on rural poverty reduction.

In accordance with these considerations, the specific objectives of the present study are:

- To identify the main landscape externalities generated by the farming practices specific to the agro-ecosystem of Morocco's Western High Atlas region ;

- To analyse the currently internalization forms of the main agricultural landscape externalities generated by identifying the markets concerned and the various categories of beneficiaries;

- To evaluate, for each internalization form identified, the economic benefits and contribution to rural poverty reduction;

- To propose the appropriated policy mechanisms to enhance positive environmental services from agriculture and promote local market solutions for compensating farmers.

The report is organised on two main parts. First part presents the methodological approach on which the study is based, particularly delimitation of observation fields, definition of data collection procedures, choice of empirical analysis methods to be applied to agricultural landscape externalities and selection of indicators to measure impacts on food security and poverty reduction. The second part presents the results and consists of three main sections: the first concerns the inventory of emission sources of externality in relation to the main features

[1] The present study is part of the second phase of the FAO-ROA project: Socio-economic Analysis and Political Implications of the Roles of Agriculture.

of the externalities inventoried; the second reviews existing internalization forms and their secondary effects on local economies and the third section presents the evaluation results of the impacts on rural poverty reduction.

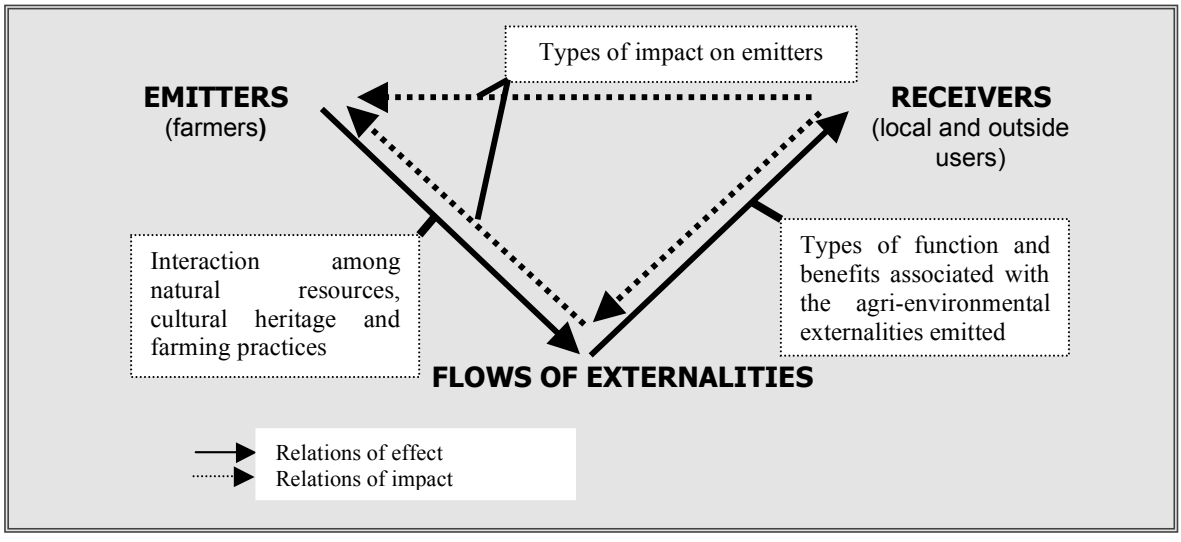
2. METHODOLOGICAL APPROACH

2.1. Concepts and theoretical framework

In the Moroccan context, the agricultural landscape is still considered as a non-market output and subsequently not recorded by the country's statistical department (Allali, 2003). It is also viewed as an unintentional environmental service jointly generated by farming practices without specific supplementary costs. Likewise, the farmers who provide these environmental externalities are not directly remunerated by the potential beneficiaries, who are usually rural residents or visitors. This reveals that the concept of environmental services in the sense of economy of services (intentionality, specific cost and direct remuneration), as defined by various authors (Hill, 1997; Delaunay and Gadrey, 1987; Gadrey, 1996 and 2000; Aznar, 2004), is inappropriate to be used in the Moroccan context.

Thus, the adopted analytical model is focused on the theory of externalities, particularly on the concept of production externalities. In our study-case, three major characteristics of agricultural landscape externalities are important to exanimate: the emitters, the outflowing externalities and receivers. The emitters are the farmers who unintentionally generate positive landscape externalities through the use of natural and environmental resources in their productive combination. The outflowing externalities are overall the rural landscapes and amenities generated by the interaction among natural resources, cultural heritage and farming practices. The receivers are both the local residents and visitors who potentially benefit from the flows of positive agri-environmental externalities emitted (see Figure 1).

Figure 1: Main poles of the triangle of agricultural landscape externalities



The application of this analytical model requires the identification of the main sources of emission, the detailing of the landscape externalities generated by farmers and their spheres of positive trade-off. Previous works on the same region indicate four main potential sources of landscape externality emission, which are thus explored by the present study (Allali, 2003 and 2004): farming practices, natural resource management, agro-biodiversity conservation and transformation of traditional farm buildings.

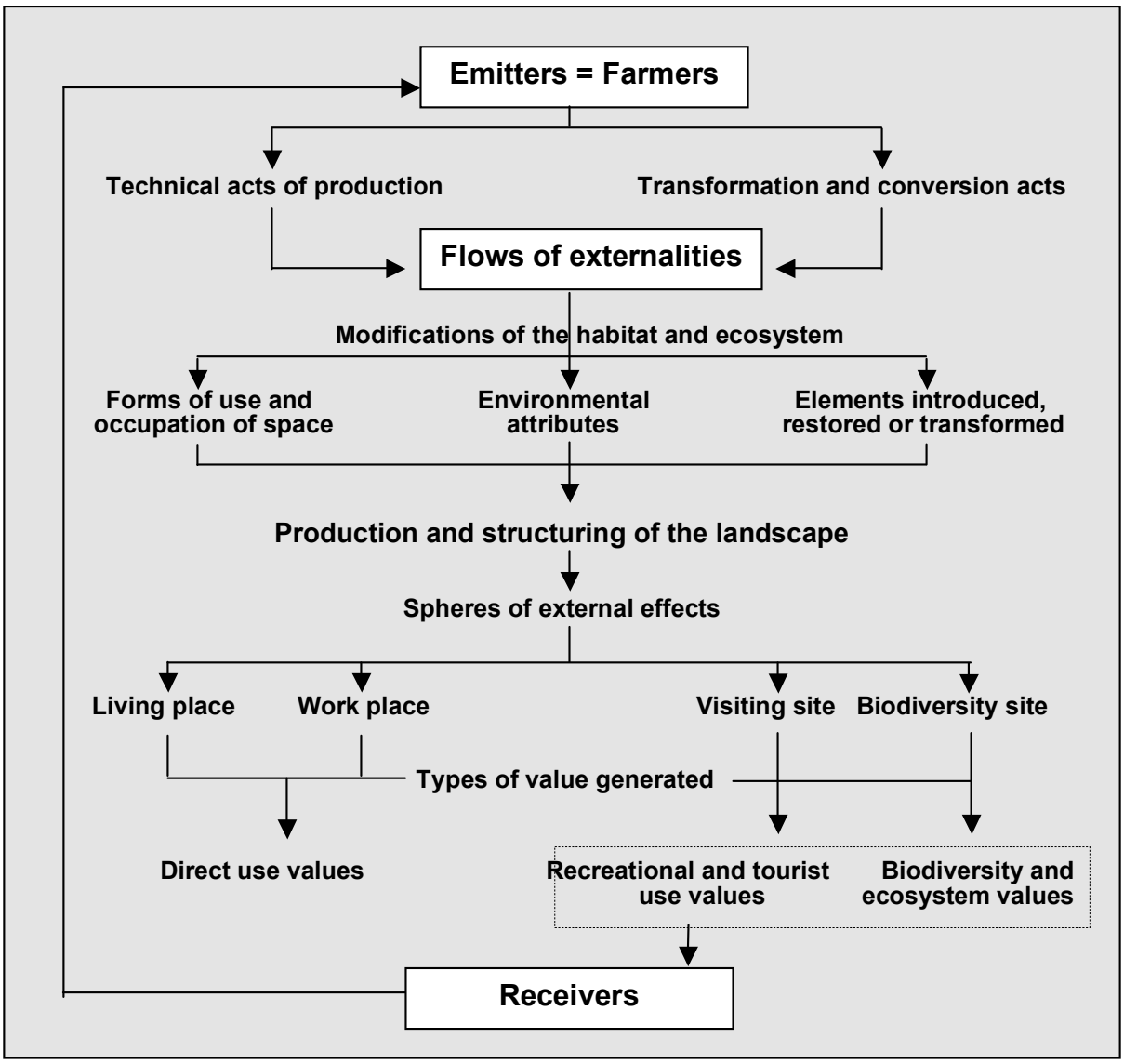
This choice has two main consequences. First, the basic supports of landscape externalities concern mainly the production space (natural patrimony, farmland and livestock buildings), the consumption space (farm residential area) and the circulation space (paths, dirt roads, boundaries, fenced-off areas). Second, the types of landscape externality considered are all spatially localized and corresponded to the flows of visible attributes of rural countryside that make it pleasing to the visual senses. Therefore, the study considers only agricultural landscape externalities that have a visual and aesthetic dimension and a positive impact on the rural landscape quality. The following three externality categories are assessed to evaluate their economic contribution on rural poverty reduction (see Figure 2):

- ***Landscape,*** covering the agricultural contribution to landscape upkeep, landscape structuring and rural sightseeing (recreation, sports and relaxation);

- ***Natural patrimony,*** covering solely the positive effects of farming practices on the basic natural resources (soil conservation and water management) in a context of ecological fragility;

- ***Biodiversity,*** covering the contribution of farming practices to the conservation in situ of local genetic diversity, particularly animal resources.

Figure 2: Overview of the analytical model used for agricultural landscape externalities



2.2. Data collection procedures

The study was carried out in Morocco's Western High Atlas region, focusing on three major agro-ecological systems: the high mountains, the medium mountains and the foothills (see Map, Appendix 1). These systems were chosen out of a concern for a certain representivity of the diversity both of the natural environment and of agricultural practices used. Within each of these three agro-ecological systems, the representative zones were then selected in according to the following criteria: (i) the weight of agriculture and livestock activities, as potential sources emission of landscape externalities and (ii) the importance of rural tourism activity, as indicative of the potential and real opportunities of internalization the externalities. This typology was intended, not only, to cover all typical cases, but also to localize agricultural landscape externalities in mountain zones. Hence, four zones were chosen as representative of the variations in the Western High Atlas mountain region and their position

in the local economy (see Appendix 2). Within each of the zones considered, a simple random sampling approach was therefore adopted for the selection of farms. The sample selected was made up of 134 farms, spatially distributed according to the weight of the three agro-ecological zones and the four representative areas studied (see Appendix 3).

Field surveys were carried out in two stages. First, an initial survey focused on inventory and analysis of landscape externalities in relation to the farming practices and acts of intervention that emit them. Then a second survey was carried out, focusing mainly on existing forms of internalization and their impact on food security and poverty reduction. Two sets of interview guidelines, tested first on a limited sample of farms in December 2004, were then administered to the farmers. The first concerned the description of all the components of the conditions under which landscape externalities are generated. The second set of interview guidelines focused mainly on internalization forms of landscape externalities in terms of their positive impact on local and household economies.

2.3. Methods used for inventory and empirical analysis of externalities

The farm-level work was carried out through identification and analysis of agricultural landscape externalities. This inventory, based on observation and questioning of the farmer, allowed the collection of information on two major aspects of the conditions of landscape externality generation. The first was a delimitation of the farm's production and consumption spaces and identification of the support-goods modified in relation to their uses and degrees of modification. The second was a description of externalities through examination of the following points: (i) the relationship between cause (farming practices and processing activities) and positive external effect, (ii) the nature of the involvement of farming practices and processing activities in generating the external positive effect, (iii) the existence of indicators to support and measure the relationship and involvement, and (iv) the spatial dimension of the external positive effect generated. The inventory and survey exercise coincided with the growing season of the main crops, which facilitated appreciation of visible elements of the agricultural landscapes.

Following collation of the inventory data, a list of priority landscape externalities was established. Three main criteria were combined to draw up this list: (i) the consistency of the collected data with the definition of the three poles characteristic of the externality, (ii) the relative size of the external effects generated within the area (physical presence and spatial and temporal dimensions of the effect) and (iii) the possibility of evaluating their impact on household economies in monetary terms. After the externalities had been inventoried, ranked and prioritized, it was then possible to identify the spheres of positive trade-offs more precisely, together with their required spheres of evaluation (see Table C in annexe).

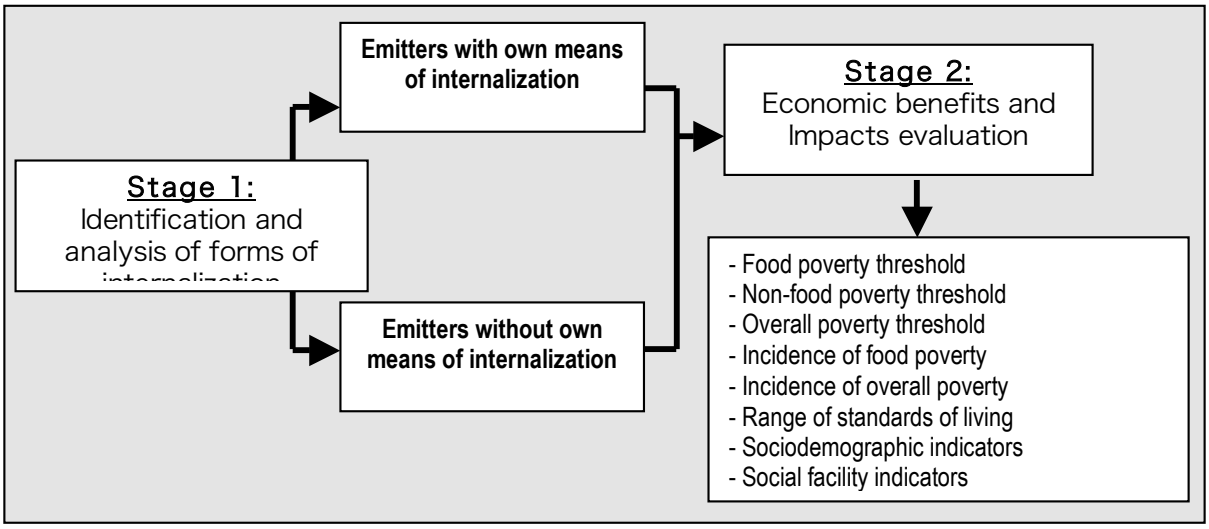
2.4. Methods used to evaluate impact on household economies

Evaluation of the contribution of agricultural landscape externalities to rural poverty reduction took place in two complementary stages (see Figure 3). The first consisted of the establishment of linkages between each of the three categories of externality considered and

the spheres of positive trade-offs identified, a procedure that required systematic identification of all the existing forms of internalization found on each of the farms studied. Each form thus identified was then analysed in terms of its direct effects on job creation, income generation, investment stimulation and introduction of farms into the market. Two distinct types of farmer-emitter were distinguished, based on the output of this first stage: (i) emitters of agricultural landscape externalities without their own means of internalization and (ii) emitters of agricultural landscape externalities with their own means of internalization. The latter can in turn be divided into three groups according to the volume and nature of their supply of tourist services.

The second stage of evaluation concerned the contribution of the various agricultural landscape externalities to rural poverty reduction. This evaluation focused exclusively on the emitters and was concerned mainly with identifying the level of poverty in its various forms for each of the representative areas studied and each of the identified groups of emitters (with or without internalization).

Figure 3: Evaluation of landscape externalities and impact indicators used



Monetary poverty was the concept adopted to establish the poverty level of the households considered and was determined through the standard of living, defined in terms of the effective consumption of the household per adult-equivalent. Three poverty thresholds were thus used: first, the food poverty threshold, corresponding to the minimum expenditure needed for an individual or household to obtain a basket of food items that meets both nutritional norms for a balanced diet and the consumption habits of the rural population in question; second, the non-food poverty threshold, corresponding to the minimum expenditure needed to obtain the non-food goods and public services essential to a household; and, third, the overall poverty threshold, corresponding to the sum of the food and non-food poverty thresholds.

With regard to the average poverty thresholds established for rural areas in Morocco (Directorate of Statistics, 1999) and updated for 2005, the incidence of poverty, the

contribution to poverty and the depth of poverty are then determined for each of the groups of emitters and each of the representative areas studied:

- The incidence of poverty corresponds to the proportion of poor households, in other words those below the food and overall poverty thresholds;

- The contribution to poverty corresponds to the proportion of poor households in the area, distinguishing four situations depending on distance from the overall poverty threshold (range of standards of living): (i) the non-poor, covering households whose total consumption is over 150 percent of the poverty threshold considered; (ii) the vulnerable, covering households whose consumption is between 100 and 150 percent of the poverty threshold; (iii) the poor, covering households whose consumption is between 75 and 100 percent of the poverty threshold; and (iv) the extremely poor, covering households whose consumption is less than 75 percent of the poverty threshold;

- The consumption deficit ratio is used to define the depth of poverty, taking account of both the proportion of poor households in the total sample and the difference between the average consumption of poor households and the poverty threshold.

3. RESULTS

The main results of the study are presented in five complementary sections. First, the generation conditions of agricultural landscape externalities are considered, presenting the results of the inventory of sources of emission, differences in these sources depending on area, and the factors influencing them. The constituent elements of the various agricultural landscape externalities identified are then considered, with their major landscape attributes and their functions, values and spheres of trade-offs. This leads to an examination of the various forms of internalization recorded on the farms studied and an evaluation of their various economic contributions to the economy of the households considered. Last comes a review of the results of the evaluation of the potential impact of agricultural landscape externalities on rural poverty reduction, once the externalities have been internalized by rural tourism.

3.1. Principles emission sources of agricultural landscape externalities

In 134 farms studied, 13 main emission sources of landscape externality were identified on the basis of an assessment of the physical, visual and location-specific elements of the landscape they emit. In other words, only emission sources potentially capable of generating landscape externalities that in turn meet criteria for the three poles of an externality were taken into account. These emission sources of externality are linked mainly to technical acts of production, operations to modify the constructed elements of the farm and practices to conserve local natural resources (see Table 1).

Table 1: Main emission sources of agricultural landscape externalities

Emission sources of agricultural landscape externality	Cases recorded	Percentage of total	Percentage of sample
Stone's Clearing and land reclamation	75	10	56
Water rehabilitation of dry land	62	8	46
Terracing and terraced plots	84	11	63
Fruit trees plantations on slopes	98	12	73
Construction of stone edges around plots	72	9	54
Planting of ornamental trees around houses	29	4	22
Growing of flowers and gardening around houses	49	6	37
Creation and upkeep of earth irrigation channels	73	9	55
Creation and upkeep of dirt road around the farm	65	8	48
Rehabilitation of dirt road outside the farm	19	2	14
Conservation of the typical architecture of houses	85	11	63
Renovation and landscape Integration of farm buildings	15	2	11
Mule local breeds conservation	63	8	47
Total	**789**	**100**	-

In terms of the number of cases recorded, technical acts of production are those most involved in generating landscape externalities, particularly the clearing of stones and the placing of uncultivated land under cultivation (10 percent), the irrigation of farmland (9 percent), the terracing of plots (11 percent), the planting of fruit trees on slopes (8 percent), the construction of edges around plots (9 percent) and the creation and upkeep of earth irrigation channels (9 percent). The most common activities in the category of operations to modify the farm's constructed elements are the growing of flowers around the home (6 percent), conservation of the typical architecture of the home (11 percent), the extension and integration of livestock buildings into the landscape (2 percent), the creation and upkeep of tracks around the farm (8 percent) and the rehabilitation of tracks outside the farm (2 percent). The only action observed in the category of the conservation of local resources was the rearing of local-breed mules (8 percent).

Examination of the nature of the modified production-factors and the acts of intervention involved shows that the sources of emission belong much more to the *production space* (77 percent) than the *consumption and circulation spaces* (13 and 10 percent respectively) (see Table 2), inasmuch as the "emission-factors" most involved in generating landscape externalities are of agricultural use. These factors are natural resources, particularly soil and water (69 percent), natural patrimony, particularly local animal genetic resources (8 percent), farm buildings (13 percent) and circulation spaces (10 percent). This result not only confirms the forefront position of agricultural spaces as important landscape externality emission-factors, but also shows the considerable part played by the residential context and the circulation spaces in terms of the diversification of landscape attributes in rural areas, thus indicating the important position of the farm as the place of agricultural landscape externality emission.

Table 2: Classification of main emission sources of agricultural landscape externalities (as a percentage)

Types of space concerned	Emission sources of landscape externalities	Modified habitat and ecosystem	Acts of intervention	% of total
Production	Stone's clearing and land reclamation	Soil	Rehabilitation	**69**
	Water rehabilitation of dry land	Soil & water	Irrigation	
	Terracing and terraced plots	Soil & water	Rehabilitation	
	Fruit trees plantations on slopes	Soil	Planting	
	Construction of stone edges around plots	Soil	Upkeep	
	Planting of ornamental trees around houses	Soil	Planting	
	Growing of flowers and gardening around houses	Soil	Planting	
	Creation and upkeep of earth irrigation channels	Soil & water	Rehabilitation Upkeep	
	In situ conservation of local-breed mules	Local genetic resources	Animal husbandry	**8**
Circulation	Creation and upkeep of dirt road around farms	Soil	Rehabilitation	**10**
	Rehabilitation of dirt road outside farms		Upkeep	
Consumption	Conservation of the typical architecture of houses	Residential context	Renovation	**13**
	Landscape integration of farm's buildings		Extension	

The most widely represented acts of intervention by farmers that generate landscape externalities jointly with agricultural production are land improvement and irrigation operations, the gardening and planting of fruit or ornamental trees, animal husbandry and upkeep and rehabilitation work, as well as renovation and extension operations. The breadth of each of these emission sources of landscape externality depends to a large extent on the nature of the modified habitat and ecosystem and the kinds of their modification by the acts of intervention. Inasmuch as almost all the emission-factors considered are of mainly agricultural use, the breadth of the main emission sources of agricultural landscape externality will be assessed on the basis of the extent of the occupation of space by farming activities.

In view of the mountainous nature and rough terrain of the four areas considered and the resulting paucity of arable land, the breadth of all emission sources, based on soil resources, is globally small (see Table 3). This same trend is also valid for the breadth of emission sources using other resources and involving other acts of intervention. One of the main causes of the lack of breadth lies in the small size of farms in Morocco's Western High Atlas region.

Table 3: Indicators of the breadth of emission sources of agricultural landscape externalities

Emission sources of agricultural landscape externalities	Kids of resource and habitat concerned	Unit	Breadth in terms of the sample
Stone's Clearing and land reclamation	Soil	ha	**17.5**
Water rehabilitation of dry land	Soil & water	ha	**12**
Terracing and terraced plots	Soil & water	ha	**10.5**
Fruit trees plantations on slopes	Soil	tree	**4 620**
Construction of stone edges around plots	Soil	km	**1.7**
Planting of ornamental trees around houses	Soil	tree	**160**
Growing of flowers and gardening around houses	Soil	m^2	**1 660**
Creation and upkeep of earth irrigation channels	Soil & water	m	**4 470**
Creation and upkeep of dirt road around the farm	Soil	m	**5 480**
Rehabilitation of dirt road outside the farm	Soil	m	**3 600**
Conservation of the typical architecture of houses	Residential context	m^2	**14 400**
Renovation and landscape Integration of farm's buildings	Residential context	m^2	**1 760**
Mule local breeds conservation	Animals	animal	**73**

These results show that local farming practices, adopted in response to the difficult natural context in which the farmers of the Western High Atlas region have to operate, are major emission sources of agricultural landscape externality. This also means that the combination of production practices and actions of natural resource conservation in ecologically fragile zones is a typical case of positive landscape externality generation.

The distribution of emission sources in terms of the four study zones provides a clearer idea of the differences in landscape externalities according to area. On the one hand, if the total number of cases recorded per zone is considered, the strong involvement of farmers in Zone 3 in comparison with those in Zones 2 and 4, and even more with those in Zone 1, is clear (see Table 4). Thus, the landscape externality generating practices recorded in Zone 3 are 40 percent of the total, whereas they are only 23 and 22 percent respectively in Zones 2 and 4, and only 15 percent in Zone 1. On the other hand, if we consider the average number of cases recorded per farm, where the disparity in the number of farms is masked, the ranking undergoes a major change, with Zone 4 moving into last place with an average of four sources of emission per farm, while the average levels of the other zones are higher than the average for the sample (or the same in the case of Zone 1), that is, six sources of emission per farm.

Table 4: Distribution of sources of externality emission in terms of representative area studied

Emission sources of agricultural landscape externalities	Number of cases recorded per representative area				
	Zone 1	Zone 2	Zone 3	Zone 4	Total
Stone's Clearing and land reclamation	7	18	28	22	75
Water rehabilitation of dry land	9	15	23	15	62
Terracing and terraced plots	15	20	43	6	84
Fruit trees plantations on slopes	18	21	37	22	98
Construction of stone edges around plots	11	15	27	19	72
Planting of ornamental trees around houses	3	6	13	7	29
Growing of flowers and gardening around houses	3	13	22	11	49
Creation and upkeep of earth irrigation channels	12	13	33	15	73
Creation and upkeep of dirt road around the farm	10	16	23	16	65
Rehabilitation of dirt road outside the farm	0	7	12	0	19
Conservation of the typical architecture of houses	17	20	28	20	85
Renovation and landscape Integration of farm buildings	0	8	7	0	15
Mule local breeds conservation	11	10	22	20	63
Total cases recorded	**116**	**182**	**318**	**173**	**789**
Percentage of total cases recorded	**15**	**23**	**40**	**22**	**100**
Average number per farm	**6**	**7**	**7**	**4**	**6**

Overall, it appears that farms in medium and high mountain zones are more involved in generating landscape externalities and emit higher average levels than those in the foothills. Although altitude certainly appears to be a factor favourable to externality emission, it is in fact its consequences that have the greatest influence, forcing the adaptation of farming practices and natural resource management methods.

Apart from their numbers, the breadth can also give information on location-related conditions for landscape externality generation. Here again, the data concerning the breadth of sources of emission show that the levels in Zone 3 are globally higher than those in the other zones. Zones 2 and 4 have similar levels, which are far higher than those in Zone 1 (see Table 5).

Table 5: Breadth of sources of emission identified in terms of representative area studied

Emission sources of agricultural landscape externalities	Importance in terms of representative area					
	Unit	Zone 1	Zone 2	Zone 3	Zone 4	**Total**
Stone's Clearing and land reclamation	ha	2	4	9.5	2	**17.5**
Water rehabilitation of dry land	ha	2	3	6	1	**12**
Terracing and terraced plots	ha	1	6	3	0.5	**10.5**
Fruit trees plantations on slopes	tree	250	590	1 970	1 810	**4 620**
Construction of stone edges around plots	km	0.25	0.25	0.7	0.5	**1.7**
Planting of ornamental trees around houses	tree	15	28	77	40	**160**
Growing of flowers and gardening around houses	m^2	50	750	575	285	**1 660**
Creation and upkeep of earth irrigation channels	m	630	1 050	1 740	1 050	**4 470**
Creation and upkeep of dirt road around the farm	m	600	1 350	2 100	1 430	**5 480**
Rehabilitation of dirt road outside the farm	m	0	800	2 800	0	**3 600**
Conservation of the typical architecture of houses	m^2	2 480	3 950	4 270	3 700	**14 400**
Renovation and landscape Integration of farm buildings	m^2	0	530	1 230	0	**1 760**
Mule local breeds conservation	animal	11	11	29	22	**73**

The results concerning the inventory, breadth and distribution of sources of agricultural landscape externality emission show considerable variations among the four study zones, and it is now important to consider the main factors explaining the differences, especially the ranking with regard to agricultural landscape externality emission. While the importance of the support-goods and their state of modification certainly constitute a major source of variability among zones, it is equally true that other factors linked to the environment of the farm and the nature of the tools used in acts of intervention, as well as their various interactions, can also affect the emission of externalities.

3.2. Factors affecting the emission sources of landscape externalities

The influencing factors examined here are linked to the combined features of location, structure and/or functioning of farms capable of modifying the conditions for landscape externality generation. Four types of factor were identified as major sources of variability among the four study zones. These are geographical position, the environment of the farm, productive natural resources and the levels of diversification and intensification of agricultural production.

Effects of the farm's geographical position:

With regard to geographical position, the main finding is that the further the farm is from the foothills region (Zone 4) toward the medium and high mountain regions, the more favourable the conditions become for landscape externality generation (see Table 6). An altitude of between 1 000 and 1 200 metres seems to be more favourable for agricultural landscape

externality emission than altitudes of more than 1 200 metres, a fact linked mainly to the use of farmland, bearing in mind the agro-ecological demands of cultivated plant species and the status of the available natural resources.

Table 6: Geographic position of farms and levels of emission sources of externalities

Feature	Zone 1	Zone 2	Zone 3	Zone 4
Mean of emission sources per farm	**6**	**7**	**7**	**4**
Agro-ecological zone	High mountain	Medium mountain	Medium mountain	Foothills
Average altitude (in metres)	> 1 200	1 000 – 1 200	1 000 – 1 200	< 1000
Location of farm in relation to the douar *(%):*				
In the *douar*	90	44	39	39
Near the *douar*	5	26	33	46
Isolated from the *douar*	5	30	28	15
Location of farm in relation to the valley (%):				
In the valley bottom	0	11	48	10
On a slope	85	82	35	85
Near a water course	15	7	17	5
Location of farm in relation to the forest (%):				
Near the forest (less than 1 km)	70	52	59	37
Far from the forest (more than 1 km)	30	48	41	63

The influence of the farm's environment, determined through distances from the *douar* (village), the valley bottom and forests, shows that a farm distant from the *douar*, lying in a valley bottom or on valley slopes and located close to a forest is a greater emitter of agricultural landscape externalities than those in other geographical positions. This finding cannot be extended in generalized fashion to all the country's regions, but applies solely to the agro-ecosystem of the Western High Atlas region. Thus, in high mountain zones, features connected with the location of farms are one of the major factors affecting agricultural landscape externality generation.

Effects of the features of productive natural resources

Three of the indicators selected to measure the natural resources used in agricultural production against the level of landscape externality emission appear to indicate very marked differences among the four study zones. These are the total arable land per farm, the irrigated arable land per farm and the numbers of sheep and goats (see Table 7).

Table 7: Importance of used natural resources and levels of emission sources of externalities

Feature	Zone 1	Zone 2	Zone 3	Zone 4
Mean of emission sources per farm	**6**	**7**	**7**	**4**
Number of farms	20	27	46	41
Total arable land (ha)	9.5	28	16	161
Average total arable land per farm (ha)	0.4	1	0.4	4
Average irrigated arable land per farm (ha)	0.4	0.7	0.4	1.6
Farms of less than 1 ha (%)	90	48	85	17
Number of sheep per farm	23	12	15	4
Number of goats per farm	10	5	6	3
Number of cattle per farm	1	2	2	1
Number of mules per zone	11	10	22	20

The conclusion is that the larger the area of cultivated and irrigated land, the lower the farm's emission of landscape externalities, which also means that the further the farm is from the foothills (Zone 4) toward the medium (Zones 2 and 3) and high mountains (Zone 1), where soil resources become very limited and force farmers to adopt integrated farming and conservation management practices, the greater the potential of farms for externality emission. This finding would indicate that in high-mountain zones, the relationship between farm size and landscape externality emission is not linear. The same applies to the numbers of sheep and goats, which would appear to have no positive correlation with the farm's emission of externalities.

Effects of the level's agricultural diversification and intensification

The crop intensification rate does not seem to have any clear negative correlation with the level of landscape externality emission. On the one hand, the average levels of externality emission are higher in Zones 2 and 3, where the crop intensification rates are lower. On the other hand, similar levels of emission are found in Zone 1, where the crop intensification rate is the highest (see Table 8). In other words, the effect of intensification on landscape externality emission is not always linear, but depends on various other factors, particularly the nature of the technical actions practised, the work tools used and the state of natural resources, as well as their degree of modification.

Table 8: Crop intensification rate and levels of emission sources of externalities

Feature considered	Zone 1	Zone 2	Zone 3	Zone 4
Mean of emission sources per farm	**6**	**7**	**7**	**4**
Crop intensification rate (%)	197	105	102	115
Share of cereals in cropping pattern (%)	118	69	73	84
Share of fruit tree plantations in cropping pattern (%)	75	26	22	21
Share of pulses, horticultural crops and fodder crops (%)	4	10	7	2
Share of fallow (%)	0	0	0	8

The influence of the diversification of agricultural production, established through the relative shares of different crops in the cropping pattern, indicates a positive correlation with the levels of landscape externality emission (Zones 2 and 3). Thus, crop diversification in mountain zones, particularly the layering of vegetation and the multiple levels on one plot, are attributes and amenities typical of agricultural landscapes.

As a result, the emission of agricultural landscape externalities varies according to the nature of interactions between the biophysical conditions of the area and acts of intervention on the part of farmers. The following were seen to be factors with a positive influence on landscape externality emission: features connected with the farm's location, the ways in which natural resources, particularly soil and water, are used, especially when they are combined with conservation management methods, and crop diversification in terms of land use practices. On the other hand, the structural features of farms, particularly farm size and the crop intensification rate, do not seem to have a direct, linear influence on agricultural landscape externality emission.

3.3. Kinds of agricultural landscape externalities emitted

One of the major contributions of the farm-level inventory carried out is establishment of the relationship between each emission sources identified and the landscape externalities associated (see Table 9). Thus, 41 percent of the total emission sources is associated whit cultivated fields and fruit or ornamental tree plantations (green, shade, layering of vegetation). The other relatively important proportion (23 percent) improves the context of residential life and farm buildings through integration into the landscape. The remaining sources of emission that also generate landscape externalities, although of lesser importance, concern circulation spaces and open-air recreational spaces (19 percent) (tracks, tourist trails), the upkeep and shaping of plots (9 percent) (delimitation, edging) and aspects of animal biodiversity (8 percent).

Table 9: Relationship between emission sources and kinds of externalities emitted

Source of emission	Landscape element(s) concerned	Details of externalities	Relative share (%)
Stone's clearing and land reclamation Water rehabilitation of dry land Terracing and terraced plots Fruit trees plantations on slopes	Cultivated fields Plantations	Green Shade Layers of vegetation	**41**
Construction of stone edges around plots	Stone walls	Delimitation and edging	**9**
Planting of ornamental trees around houses Growing of flowers and gardening around houses Conservation of the typical architecture of houses Renovation and landscape Integration of farm buildings	Constructed sector Local heritage	Environment of the residential context and farm buildings	**23**
Creation and upkeep of earth irrigation channels Creation and upkeep of dirt road around the farm Rehabilitation of dirt road outside the farm	Tracks Irrigation channels	Circulation space Spaces for open-air recreational and sporting activities	**19**
Mule local breeds conservation	Animals	Local breeds and biodiversity	**8**

While this establishment of the relationship between emission sources and externalities is needed in order to grasp the nature of the involvement of farms in generating landscape externalities, it does not allow an assessment of the effects of the generated landscape externalities on the farm. This would, rather, require establishment of the values associated with each of the landscape externalities identified and their spheres of positive trade-offs (see Appendix 4).

3.4. Agricultural landscape externalities and their positive trade-offs

Identification of the spheres of positive trade-offs calls first for definition of the main functions associated with the various externalities identified and the values associated with them in relation to the types of local and foreign receivers (see Table 10). Once these elements have been determined, they can provide better orientation for the task of evaluating impacts on emitters (farmers), particularly with regard to reduce rural poverty.

Table 10: Functions, values and receivers of the identified agricultural landscape externalities

Element of the agricultural landscape	Details of the landscape externality	Functions associated with the externality	Values associated with the externality	Potential receivers
Cultivated fields Plantations Stone walls	Green Shade Layering of vegetation Delimitation and edging	Places for work and visit	Direct use values	Emitters
Buildings	Environment of the residential context and farm buildings	Places for work and visit	Values of recreational and tourist use	Residents and tourists
Tracks Irrigation channels	Circulation space and environment for open-air recreational and sporting activities	Places for work and visit		
Natural patrimony (Animals)	Local breeds and biodiversity	Place of biodiversity	Biodiversity and ecosystem values	Ecotourists

The functions associated with agricultural landscape externalities depend to a large degree on the nature of the constituent and structural elements of the landscape and on the users' perception of its quality. From an aesthetic, recreational and cultural point of view, three major functions can be linked to the landscape externalities identified: first, as a residential and work place for the emitters (farmers) and local inhabitants; second, as a place for holidays, relaxation and open-air recreational and sporting activities for visitors, both national and foreign; and third, as a place of biodiversity and ecosystem for informed visitors who are sensitive to environmental issues (ecotourists, ecologists and others). The values associated with the externalities identified and the spheres of positive trade-offs can be defined in terms of these three functions.

The values associated with these various functions of agricultural landscape externalities vary according to the category of receiver considered. In the case of emitters and residents, direct use values associated with residential and work places are the most important, while in the case of visitors of various types, recreational and tourist values are the most important. Inasmuch as these values cannot all be measured by market mechanisms and knowing that most of the advantages and amenities of agricultural landscapes tend to profit tourists, the challenge is to identify how farmers, the main emitters of landscape externalities, obtain remuneration (or can obtain remuneration) for the environmental services they supply jointly with agricultural production.

3.5. Internalization forms of the agricultural landscape externalities

In the Moroccan context, where market mechanisms to pay for the environmental services are absent, the integration of agriculture and rural tourism seems to offer interesting possibilities for internalizing agricultural landscape externalities. The various functions associated with agricultural landscape externalities can thus be capitalized on through the reception and

lodging of tourists, the support of tourists during excursions and the practice of open-air recreational and sporting activities and services as guides and interpreters.

Identification of forms of internalization entailed an inventory of all the tourist services offered by farms in the four representative areas studied. This inventory revealed the considerable proportion of emitters lacking means to internalize the landscape externalities they emit (see Table 11), a category that covers over half the farms in Zone 1 (55 percent) and over one-third in Zones 2 and 4 (33 and 39 percent respectively), while in Zone 3 only a minority of emitters (11 percent) are not involved in tourist activities. Examination of the nature of the tourist services supplied in terms of geographical position shows an unequal distribution among the four zones. Board and lodging services are more supplied by farms in Zone 2 (33 percent), while support services (mule drivers and cooks) are more available among farms in Zones 4 and 1 (37 and 35 percent respectively) and a combination of tourist services is found among farms in Zone 3, with 44 percent of them combining board and lodging services and support and guide services.

Table 11: Amount of the internalization forms recorded per representative area (as a percentage)

Nature of tourist services supplied	Zone 1	Zone 2	Zone 3	Zone 4
Supply of tourist services (%):	**45**	**67**	**89**	**61**
Board and lodging	10	33	17	19
Support (mule drivers and cooks)	35	19	28	37
Board, lodging, support and guiding	0	15	44	5
Without tourist services (%)	**55**	**33**	**11**	**39**
Total	**100**	**100**	**100**	**100**

These findings reveal a certain specialization in the tourist services supplied by farms in function of their geographical location with regard to the main tourist circuits. In the foothill and high mountain areas (Zones 4 and 1), board and lodging structures are less widespread than in the medium mountain areas (Zones 2 and 3). These differences are a result both of the strong tourist attraction of the medium mountain area because of the wealth and diversity of its agricultural and mountain landscapes, and also its proximity to the summit of Toubkal and trekking and horse riding trails. The advantages and amenities of the agricultural landscapes supplied by foothill and high mountain farms are thus outside tourist circuits and cannot be directly optimized by their emitters.

With a view to determining the level of involvement of farms in developing forms of internalization, a typology was established on the basis of the nature of tourist services supplied; distinguishing four groups of emitters (see Table 12). According to this typology, almost one-third (30 percent) of farms (Group 4) have no possibility of directly internalizing the landscape externalities they emit, which means that as things stand today this considerable proportion of farms is not able to obtain remuneration for the landscape services they supply jointly with their agricultural production. So far as farms with means of internalization are

concerned, they offer board and lodging services (19 percent), solely support services (mule drivers and cooks) (30 percent) or both (21 percent).

Table 12: Types of emitter according to the nature of their supply of tourist services

Emitter group	Features of the group	Number	% of total
Group 1	Emitters supplying board and lodging services	25	19
Group 2	Emitters supplying only support services	40	30
Group 3	Emitters combining both board and lodging services and support and guide services	28	21
Group 4	Emitters supplying no tourist services	41	30
Total		**134**	**100**

This distribution leads to two important observations: the major involvement of emitters in the supply of support services, which can be seen as an indirect means of capitalizing on agricultural landscapes as places for holidays and visits; and the high level of combination of tourist services by a considerable proportion of farms, which can be seen as having major potential in terms of internalization of a large part of landscape externalities. At this stage in the analysis, one of the major questions is that of whether there is a correlation between the level of emission externalities and the amount of internalization forms.

The distribution of the various emitter groups according to emission sources and types of externality generated helps provide an answer to this question. In terms of the number of sources of emission recorded, Groups 2 and 3 come first, each with 28 percent of the total cases recorded (see Table 13). Group 1 comes next, with 24 percent, while Group 4 has 20 percent. This trend undergoes slight modifications when the number of cases recorded per farm is considered. Group 3 again comes in first place, with an average of eight sources of emission per farm, then comes Group 1, with an average of seven, and Group 2, with an average of six, while Group 4 remains in last place, with an average of only four. These findings indicate that farms involved in supplying tourist services tend to emit more landscape externalities than those confined solely to agricultural production.

Table 13: Distribution of sources of externality emission according to emitter group

Source of agricultural landscape externality emission	Number of cases recorded per representative area				
	Group 1	Group 2	Group 3	Group 4	Total
Stone's Clearing and land reclamation	22	17	24	12	75
Water rehabilitation of dry land	14	19	18	11	62
Terracing and terraced plots	22	20	28	14	84
Fruit trees plantations on slopes	20	29	19	30	98
Construction of stone edges around plots	19	19	17	17	72
Planting of ornamental trees around houses	12	2	14	1	29
Growing of flowers and gardening around houses	19	4	22	4	49
Creation and upkeep of earth irrigation channels	20	20	22	11	73
Creation and upkeep of dirt road around the farm	12	20	13	20	65
Rehabilitation of dirt road outside the farm	2	10	6	1	19
Conservation of the typical architecture of houses	18	24	21	22	85
Renovation and landscape Integration of farm	4	3	6	2	15
Mule local breeds conservation	3	39	11	11	63
All cases recorded	**187**	**225**	**221**	**156**	**789**
Percentage of all cases recorded	**24**	**28**	**28**	**20**	**100**
Average number per farm	**7**	**6**	**8**	**4**	**6**

With regard to the nature and amount of the landscape externalities emitted by each group, the results show that farms in Groups 2 and 3 are more involved in generating landscape elements connected with the constructed sphere, with 35 and 30 percent respectively of the cases recorded (see Table 14). This result should be seen in relation to the amount of the board and lodging services supplied by these two groups of farms. On the other hand, most (62 percent) of the landscape externalities that involve the rearing of mules are generated by farms in Group 2, which are the main suppliers of support services (mule drivers and cooks).

Table 14: Amount of the various externalities identified according to emitter group (as a %)

Landscape element	Details of the externality	Group 1	Group 2	Group 3	Group 4
Cultivated fields Plantations	Green Shade Layers of vegetation	24	27	28	21
Stone walls	Delimitation and edging	26	26	24	24
Constructed areas Local heritage	Environment of the residential context and farm buildings	30	19	35	16
Tracks Irrigation channels	Circulation spaces and spaces for open-air recreation and sporting activities	22	32	26	20
Living natural heritage Animals	Local breeds and biodiversity	4	62	17	17

The second finding not only confirms the conclusion about the major involvement of farms offering tourist services in the generation of agricultural landscape externalities, but also makes it possible to nuance the unintentional nature of certain externalities, particularly those linked to modification of the constructed sphere and the rearing of animals of tourist interest. These two types of "externality" should in fact be classified as services, according to the definition of the economy of services, inasmuch as tourists play the role of sponsors and remunerate farmers directly for the services they supply to them.

3.6. Economic benefits associated with landscape externalities emitted

The typology of emitters thus established then allows separate evaluation of the contribution of each internalization form of externality and a comparative analysis of all the situations existing on the ground. The spheres selected for this evaluation concern essentially the benefits to local economy: employment, income, investment and food security.

Employment and income effects

The tourist services supplied by farms create real employment opportunities both for family members and for other local inhabitants. Thus the survey data show that 181 of the 815 people in the sample are involved in tourist services of some kind. This gives a rate of involvement of all the population surveyed of 22 percent (see Table 15). The number of jobs created increases with the number of tourist services supplied by farms. On average, two people per household are employed full-time in board and lodging services during the tourist season. Support services (mule drivers and cookers) for excursionists employ on average one person per household, although this average masks situations in which there are more than three people per household involved in support services. This means that when a farm combines a number of tourist services, the number of employment it can create is on average three people per household. In most cases (85 percent), the employments created by tourist services benefit family members or neighbours.

Table 15: Potential of the various forms of internalization with regard to employment

Emitter group	Inhabitants surveyed	Average size of household	Number of those involved in tourism	Level of involvement in tourist activities (%)	Average number of household members involved in tourist activities
Group 1	149	5.96	50	34	2
Group 2	253	6.32	42	17	1
Group 3	171	6.11	89	52	3
Group 4	241	5.88	0	0	0
Total	**815**	**6.1**	**181**	**22**	**1**

When farmers supply board, lodging, food supplies and support to tourists during their, this provides them with the opportunity to receive remuneration, even if only partial, for the various efforts they make in terms of the upkeep and shaping of agricultural landscapes. Apart

from direct job creation, the supply of tourist services by farms can also generate substantial, diversified income. The survey data allowed an evaluation of the proceeds of the various tourist services supplied by farms. These proceeds are on average DH 14 000 per year for lodging, DH 9 000 per year for board, DH 5 000 per year for support services and DH 12 000 for guide services (DH 10 ≈ $1). The impact of each of these types of tourist income on the economy of the farm can be assessed through the degree of income diversification and the level of improvement in the household's overall income, for the more the farm diversifies its supply of tourist services, the greater the contribution of tourist income to the overall income (see Table 16).

Table 16: Potential of the various internalization forms with regard to income diversification

Emitter group	Average overall income (DH/year)	Share of agricultural income (%)	Share of tourist income (%)	Share of supplementary income (%)
Group 1	30 450	34	49	17
Group 2	18 870	62	29	9
Group 3	51 880	21	73	6
Group 4	16 250	68	0	32
Total	**26 830**	**40**	**46**	**14**

In Group 3, emitters supplying several tourist services, the share of tourist income represents an average of over two-thirds (73 percent) of the annual overall income (DH 52 000 per household per year). This level of contribution becomes close to half (49 percent) in Group 1 and close to one-third (29 percent) in Group 2. One of the effects of this diversification of income sources by tourist activities is the lower dependence of farms on supplementary income, particularly remittances. In Group 4, emitters without any tourist activity, the share of supplementary income is very large – over one-third (34 percent) of the household's overall annual income. However, examination of the structure of income in the four emitter groups shows the major share (70 percent) of the income category of more than DH 30 000 per year in Group 3 (see Table 17). This result points up the very considerable potential of forms of internalization based on tourist activities for improving the income of farms.

Table 17: Distribution of emitter groups according to income category (as a percentage)

Emitter group	Average overall income (DH/year)	Income category (DH/household/year)			
		< 1 000	10 000 to 20 000	20 000 to 30 000	> 30 000
Group 1	**30 450**	0	32	36	32
Group 2	**18 870**	3	72	20	5
Group 3	**51 880**	0	5	25	70
Group 4	**16 250**	24	56	15	5
Total	**26 830**	**8**	**45**	**23**	**24**

Effects on the investment

Adaptation of farms as tourist reception, board and lodging structures generally requires various operations to modify buildings (extension, consolidation, renovation etc.) and material resources to ensure tourists' comfort (sanitary installations, furniture, cooking and eating utensils etc.). Such operations require major investments, especially for farms hoping to supply full, high-quality services.

Survey data concerning the size of investments made during the five previous years show that one-third (33 percent) of farms had invested more than DH 20 000, with an average of about DH 45 000 for the period over the whole sample (see Table 18). However, the distribution of sums invested according to the various emitter groups shows large differences depending on the level of integration of tourist services. In Group 3, the sums invested were much higher than those in Groups 1 and 2, exceeding DH 20 000 in most cases (72 percent).

Table 18: Sums invested in tourist activities according to emitter group (as a percentage)

Emitter group	Average sum invested (in DH)	Categories of sums invested over the past 5 years			
		less than 5 000	5 000 to 10 000	10 000 to 20 000	more than 20 000
Group 1	**49 400**	4	16	8	72
Group 2	**9 500**	47	35	10	7
Group 3	**150 000**	7	7	14	72
Group 4	**6 400**	41	34	19	5
Total	**44 500**	**29**	**25**	**13**	**33**

The major role played by the supply of tourist services as a stimulator of investment also helps to improve the residential living conditions of farms (see Table 19). All the indicators of residential living conditions, especially drinking water supplies, electricity connections and the presence of showers and toilets, are much more favourable in Groups 3 and 1 than Groups 2 and 4. In other words, the greater the investments linked to board and lodging services, the greater the improvement in living conditions on farms. This finding reflects the real opportunities offered by tourist activities, as a form of internalization of agricultural landscape externalities, for farms to improve their residential living conditions.

Table 19: Indicators of the residential living conditions of the emitter groups (as a percentage)

Emitter group	Access to drinking water	Electricity connection	Presence of showers	Presence of toilets
Group 1	80	85	75	95
Group 2	58	75	10	70
Group 3	96	96	88	100
Group 4	41	63	5	63
Total	**63**	**77**	**34**	**78**

Others effects on the household economy

Apart from the economic effects discussed above, the supply of tourist services is also an activity that generates contacts and links with the outside world. Board, lodging and support services in their various forms also affect the behaviour and strategies of the suppliers, in this case farmers. One of the most important effects is linked to the supply of the goods needed to house and feed tourists, particularly the purchase of goods from nearby towns. This type of introduction into the market leads to modifications in dietary habits and hence to changes in the structure of food expenditure.

Examination of the part played by domestic production in the food expenditure of the various emitter groups threw light on the issue (see Table 20). The results indicate that the more involved a farm is in supplying tourist services, the more sharply the share of domestic production in food expenditure falls. While this share is over one-third of food expenditure for Groups 4 and 2, or 34 and 33 percent respectively, it is only 15 and 24 percent respectively for Groups 3 and 1, and in more than half of these latter groups (68 and 56 percent respectively) the share of domestic production in food expenditure is 20 percent or less. These figures show the major potential of the supply of integrated tourist services with regard to the opening up and insertion of farms into the market.

Table 20: Share of domestic production in the food expenditure of emitter groups

Emitter group	Average share (%)	Category of share in domestic production				
		less than 20%	20 to 40%	40 to 60%	60 to 80%	more than 80%
Group 1	**24**	56	24	16	0	4
Group 2	**34**	20	42	25	10	3
Group 3	**15**	68	32	0	0	0
Group 4	**33**	20	61	15	2	2
Total	**28**	**37**	**42**	**15**	**4**	**2**

The results examined so far have several important implications for the development of agricultural multifunctionality. On the one hand, the pull effects of the integration of tourist activities, as a form of internalization of landscape externalities, into agricultural production provide considerable support to the revitalization of farms and the strengthening of their capacity to promote multiactivity in rural areas. On the other hand, the direct contact that households establish with tourists encourages farms to open up to the market environment and hence to adopt new types of behaviour and approaches helpful to their modernization.

3.7. Measuring the impacts on the rural poverty reduction

Let us recall that the approach adopted in order to measure poverty was social in type, focusing mainly on comparisons of "economic well-being" through the concept of monetary poverty (Ravaillion, 1994), and that consumption rather than income was favoured in order to measure poverty, bearing in mind its direct links with an individual's or household's "well-being" (Aline *et al.*, 2002).

The starting point for this procedure was calculation of the food and overall expenditure of households, expressing these per adult-equivalent, in order then to measure monetary poverty through indicators concerning the incidence of poverty or poverty in numbers of inhabitants, the range of standards of living and the consumption deficit ratio (expenditure deficit ratio).

Level and structure of food and overall expenditure

The survey data concerning the food and non-food expenditure of households allowed an evaluation of the annual overall expenditure as about DH 6 000 per adult-equivalent (see Table 21). The share of food expenditure is almost half (47 percent) of overall expenditure, or DH 2 800 per adult-equivalent per year, while non-food expenditure is estimated at about DH 3 200 per adult-equivalent per year, or 53 percent of total expenditure.

Examination of the expenditure levels of the various groups shows that, overall, households in Groups 1 and 3 spend more than those in Groups 2 and 4. In terms of non-food expenditure, the levels of Groups 1 and 3 are on average more than double those of Groups 2 and 4, but the differences are less in the case of food expenditure, where the multiplier does not exceed 1.6 points between the Groups 1 and 4.

Table 21: Levels of food and overall expenditure according to emitter group, in DH

Emitter group	Food expenditure	Non-food expenditure	Overall expenditure
Group 1	3 500	4 640	8 200
Group 2	2 420	1 960	4 380
Group 3	3 390	5 910	9 300
Group 4	2 210	1 590	3 800
Total	**2 770**	**3 180**	**5 950**

The distribution of the various groups according to expenditure category shows that almost half (47 percent) the households in Group 3 spend more than DH 7 000 per adult-equivalent per year (see Table 22). This category is under one-third (28 percent) for households in Group 1 and almost non-existent (2 percent) for those in Groups 2 and 4. Consequently, in these two latter groups the proportion of households spending less than DH 3 000 per adult-equivalent is relatively high, or 15 and 24 percent respectively.

Table 22: Structure of annual overall expenditure according to emitter group (as a percentage)

Emitter group	Average overall expenditure	Category of expenditure in DH/adult-equivalent/year			
		less than 3 000	3 000 – 5 000	5 000 – 7 000	more than 7 000
Group 1	8 200	4	28	40	28
Group 2	4 380	15	50	32	2
Group 3	9 300	0	18	36	46
Group 4	3 800	24	59	15	2
Total	**5 950**	**13**	**42**	**29**	**16**

The levels of food and overall expenditure thus identified and their structure per group of households show a sharp difference in situation between Groups 1 and 3 on the one hand and Groups 2 and 4 on the other. This difference not only reflects a major income-effect as the source of variations in expenditure, but can also indicate the existence of major differences in the living conditions of the various groups.

Incidence of food poverty and overall poverty

The poverty thresholds used to measure the incidence of food and overall poverty in the households considered are DH 2 377 and 3 842 per adult-equivalent per year for the food poverty threshold and overall poverty threshold. The results show that more than one-third (37 percent) of the 134 households studied are unable to obtain the necessary food basket, that is, the equivalent of 2 400 Kcal per day per adult-equivalent (see Table 23).

Table 23: Incidence of food poverty and overall poverty per group (as a percentage)

Emitter group	Incidence of food poverty	Incidence of overall poverty
Group 1	**24**	**28**
Group 2	**45**	**47**
Group 3	**8**	**10**
Group 4	**61**	**63**
Total	**37**	**40**

In other words, about four households out of ten are in a situation of food poverty, although there are considerable differences in this incidence of food poverty among the various groups of farms. It is particularly high in Group 4, emitters without means of internalization, with six households out of ten in a situation of food poverty, but the proportion falls progressively as farms diversify their activities by supplying tourist services. The lowest incidence of food poverty is thus found in Group 3, where only one household in ten lives below the required threshold, while Groups 2 and 1 fall mid-way, with respectively two and four households out of ten in a situation of food poverty. So far as the overall poverty threshold is concerned, households in Groups 4 and 2 are the poorest in comparison with the average recorded for the whole sample. In Group 4, the incidence of overall poverty is very high, with 63 percent of households living below the overall poverty threshold. In Group 2, the incidence is close to the average for the sample, with 47 percent of households living below the threshold. On the other hand, the incidence in Groups 3 and 1 is well below the average for the sample, with respectively 10 and 28 percent of households living below the overall poverty threshold.

These results indicate a strong correlation between the level of involvement of farms in tourist activities and the incidence of food and overall poverty. The more involved a farm is in supplying tourist services, and hence the more diversified its sources of income, the less affected it is by food and overall poverty. Moving from a farm without any form of internalization to another with board and lodging structures, the incidence of food and overall poverty falls by an average of 16 percent, and this difference is even greater (more than 50 percent) in the case of farms that combine a number of tourist services (Group 3).

However, in the case of Group 2, the supply of support services to tourists does not seem to improve the households' poverty status, inasmuch as the incidence of food and overall poverty remains above the average for the sample.

Situation of households in relation to food and overall poverty thresholds

With a view to determining the situations in relation to the poverty threshold of the various households making up the groups, a classification of households was established, distinguishing four "standards of living":

- The "non-poor", encompassing households whose total consumption is over 150 percent of the poverty threshold considered;

- The "vulnerable", encompassing households whose total consumption is between 100 and 150 percent of the poverty threshold considered;

- The "poor", encompassing households whose total consumption is between 75 and 100 percent of the poverty threshold considered;

- The "extremely poor", encompassing households whose total consumption is below 75 percent of the poverty threshold considered.

The results of this ranking showed that about 20 percent of the households considered fall into the extremely poor category in terms of the food poverty threshold; in other words, they are unable to cover 75 percent of the expenditure required to obtain the required minimum daily calorie intake (see Table 24). The distribution of households in terms of their food poverty status shows major differences among the four groups studied. The proportion of extremely poor households is very high in Groups 4 and 2, with respectively 39 and 25 percent of households classified as extremely poor in dietary terms. On the other hand, in Groups 1 and 3, extremely poor households are in a minority or non-existent (4 and 0 percent respectively). At the other extreme, Groups 1 and 3 have the highest proportions of non-poor households (28 and 25 percent respectively). Vulnerable households are the largest category, with almost half (47 percent) of all households falling into it, a finding that is also valid for the individual groups, except Group 4 where the proportion of vulnerable households is smaller (29 percent). There are similar proportions of households classified as poor in all the groups considered – about 20 percent – except Group 3, which has only 8 percent.

Table 24: Poverty status of the various emitter groups in terms of the food poverty threshold (as a percentage)

Emitter group	Non-poor	Vulnerable	Poor	Extremely poor
Group 1	28	48	20	4
Group 2	5	50	20	25
Group 3	25	67	8	0
Group 4	10	29	22	39
Taken together	**15**	**47**	**18**	**20**

Two essential elements stand out in the profiling of households according to their poverty status measured against the food poverty threshold: first, the considerable proportion of vulnerable households in all groups, which would indicate that a number of households are potential candidates for joining the ranks of the poor; and second, the extreme poverty that particularly affects households dedicated to agriculture without any supplementary activities.

However, the distribution of households according to their poverty status measured against the overall poverty threshold shows that while the proportion of non-poor households measured against the overall poverty threshold has doubled, rising from 15 percent (in terms of the food poverty threshold) to 30 percent, that of extremely poor households has been halved, falling from 10 percent (in terms of the food poverty threshold) to 11 percent (see Table 25). This finding should not mask the simultaneous increase in poor households, so that they now represent almost one-third (28 percent) of the whole sample.

Table 25: Poverty status of the various emitter groups in terms of the overall poverty threshold (as a percentage)

Emitter group	Non-poor	Vulnerable	Poor	Extremely poor
Group 1	24	48	20	8
Group 2	13	40	32	15
Group 3	63	29	8	0
Group 4	13	24	46	17
Taken together	**30**	**31**	**28**	**11**

Examination of the situation by group shows that vulnerable and poor households measured against the overall poverty threshold make up 90 percent of Group 4, 72 percent of Group 2 and 68 percent of Group 1, while in Group 3 the proportion of vulnerable or poor households is only 37 percent, with the non-poor accounting for 63 percent. In other words, the poverty status in terms of the overall poverty threshold indicates that all the groups of households, except for Group 3, should be classified among the priority targets for poverty reduction initiatives.

Depth of poverty among households

The last analytical component of the poverty profile of the four groups of households concerns the depth of poverty, determined through the consumption deficit ratio. This ratio allows both the proportion of poor households in the whole sample and also the difference between the average consumption of the poor and the overall poverty threshold to be taken into account.

The results of the survey reveal an expenditure deficit ratio with regard to the overall poverty threshold of 16 percent for all the groups of households taken as a whole (see Table 26). In other words, the poor households of the four groups, taken together, have an average consumption per adult-equivalent corresponding to 84 percent of the overall poverty threshold (DH 3 842 per adult-equivalent). It follows that, overall, the average consumption should

increase by at least 19 percent to make up the deficit and bring these households out of poverty. However, this situation does not affect all the groups of households in the same way.

Table 26: Consumption deficit ratio for the various emitter groups

Emitter group	Average consumption of the poor (in DH)	Consumption deficit ratio (%)	Rate of growth in consumption to make up the deficit (%)
Group 1	3 487	9	10
Group 2	3 237	16	19
Group 3	3 642	5	5.5
Group 4	3 129	19	23.5
Taken together	**3 230**	**16**	**19**

Examination of the situation of the various groups shows that the greatest depths of poverty are found in Groups 4 and 2, which are also the two groups most affected by both food and overall poverty. Given their consumption deficit ratios of 19 and 16 percent respectively, these two groups need to increase their average consumption by 23.54 and 19 percent in order to overcome their poverty. On the other hand, the average consumption levels are relatively high in Groups 3 and 1, rising above the average for the sample, as is reflected in generally small consumption deficit ratios. This again highlights the major potential of these two groups with regard to poverty reduction and improved food security.

The foregoing shows considerable differences between Groups 3 and 1 on the one hand and Groups 4 and 2 on the other in terms of the incidence of food poverty and overall poverty, as well as in terms of the depth of poverty. In other words, moving from farms without any form of internalization to others offering tourist services, all the standard of living indicators improve markedly. Although these results are of course closely linked to the diversification of income-generating activities on farms, it is also true that once tourist activities have been integrated into agricultural production as ways of capitalizing on agricultural landscapes, they have very great and real potential for reducing poverty in its various forms. However, while groups without any form of internalization must be a priority target in poverty reduction initiatives, it should not be forgotten that the possibilities of establishing tourist activities are also limited by a whole range of factors, connected for example with location, the environmental features of the area and the nature of the structural elements of agricultural and natural landscapes, as well as tourists' present and future preferences.

4. CONCLUSIONS AND POLICY IMPLICATIONS

The present research constitutes both an empirical analysis of landscape externalities of agricultural origin and an evaluation of their contribution to food security and poverty reduction in Morocco's Western High Atlas region. In attempting to establish linkages among the environmental "services" of agriculture and rural poverty reduction, the study opened up new fields of investigation that will make it easier to grasp the socio-economic roles of

agriculture. A number of results were thus produced concerning both methodological and analytical aspects in response to the main objectives of the ROA project.

With regard to the objective of formulating a methodology to analyse and quantify the environmental role of agriculture, four types of contribution were generated. First, use of the concept of externality led to a clearer picture of the links and interactions among the three main poles involved in the generation of agricultural landscape externalities: emitters, support-goods and receivers. This analytical approach, which is similar to that applied in the economy of services, made it possible to distinguish the differences and particular features of agricultural landscape externalities as against the environmental services of agriculture. The criterion of farmers' "non-intentionality" was explored for the case of the production of agricultural landscapes. Second, the inventory of sources of emission, applied on the farm level, led to the formulation of a procedure to identify, classify and analyse the factors that play a part in generating agricultural landscape externalities. The nomenclature and typology adopted in recording sources of emission can then be used in empirical identification of agricultural landscape externalities in other contexts and regions. Third, the linkage between emission sources and the constituent and structural elements of agricultural landscapes, after being used to identify and assess landscape externalities, then made it easier to determine the nature of farms' involvement in the generation of landscape externalities. Differentiation between agricultural landscape externalities according to area, definition of the functions and values associated with them and identification of receivers can all help in defining a procedure for empirical analysis of agriculture's contribution to the production of agricultural and rural landscapes. Fourth, the choice of rural tourism as the sector of activities through which the main trade-offs for landscape externalities take place threw light on the various forms of internalization existing on the farm level and also provided orientation for the choice of spheres in which to evaluate their economic contributions.

With regard to the objective concerning analytical conclusions, although our research was of the nature of a case study and was specific to Morocco's high mountain zones, it led to the production of some data and indicators useful not only in gaining an accurate picture of the environmental role of agriculture, but also in recognizing its present and potential contributions to rural poverty reduction.

The first result highlighted the multiplicity of agricultural landscape externalities and the variability in their breadth. In all the zones considered and whatever the predominant land use there, there is a minimal generation of landscape externalities. This generation is mainly a result of the interaction among acts of intervention, natural resources and the environment, and varies in breadth depending on the nature and degree of the modification of agricultural-use support-goods. The main factors that showed a positive correlation with the level of landscape externality emission concern location-linked features of farms, the ways in which

natural resources, particularly soil and water, are used, especially when combined with conservation management techniques, and crop diversification in relation to land use patterns. This means that there are few landscape externalities generated outside farms. However, in line with the conclusions drawn from a review of the literature (ROA-1), the environmental effectiveness of certain farming practices of the mountain system was confirmed: the rehabilitation of valley bottoms and lower slopes by shaping soil into terraces, the planting of fruit trees along water courses, the construction of irrigation channels and the development of an irrigation system all not only play environmental and landscape roles but also enhance local assets.

This first component of the results thus allowed identification of the farming practices that should constitute a priority target for all agri-environmental measures aimed at boosting agriculture's environmental performance in mountain zones.

The second major result concerned the identification of agricultural landscape externalities as concluded from the systematic inventory of the four representative areas studied. This contribution fills in the gaps in statistical data on landscape externalities of agricultural origin. Assessment of landscape attributes and their distribution according to the spaces involved (production, consumption and circulation) thus revealed the major trends regarding local ways of generating agricultural landscape externalities. From an aesthetic, recreational and cultural point of view, three main functions are then associated with the landscape externalities identified: as residential and work places for the emitters (farmers) and local inhabitants, as places for holidays and open-air recreational and sporting activities for visitors, whether national or foreign, and as places of biodiversity and ecosystem for those interested in discovering nature.

The third result concerned the proportion of farms with means, through tourist activities, of internalizing the landscape externalities generated jointly with their agricultural production. Apart from their numbers, the combined supply of several tourist services was what offers the greatest potential, allowing farmers to receive remuneration for the landscape services they emit. On the one hand, on-the-spot reception, board and lodging allow them to capitalize on their agricultural landscapes as places of residence and visit (the constructed sphere). On the other hand, support in its various forms (the services of mule drivers, interpreters and guides) also offers an opportunity to capitalize on agricultural landscapes as places for holidays, biodiversity and ecosystems, and also to obtain a return on certain components (tracks, mules etc.).

With regard to the economic contributions of the various internalization forms identified, the increased levels recorded in terms of job creation, income generation, investment stimulation, market introduction and improved living conditions are all indicators confirming the

effectiveness of rural tourism as a means of capitalizing on agricultural landscapes. Another equally important contribution concerns changes in farmers' behaviour concerning landscape production. The more involved farmers are in supplying services, the more intentional their supply of landscapes and amenities becomes, thus raising certain externalities – such as those concerned with the modification of buildings and the rearing of animals of tourist interest – to the status of services. This dynamic highlights the influence of local features in terms of position in the local economy, particularly the amount of tourism, on the generation of agricultural landscape externalities. The central question then arises of how to compensate the remainder of farmers who do not have their own means of obtaining direct remuneration for the landscape services they emit, and one solution could be sought in the shape of local-level organization.

Evaluation of the impact of the various internalization forms and comparisons made with control farms (those without any form of internalization) showed major differences in the incidence of food and overall poverty and in the depth of poverty. All these indicators of the standard of living improve considerably when the farm combines the supply of tourist services with its other functions, a fact that highlights the very great potential of tourist activities, once they have been integrated into the farm as means of capitalizing on agricultural landscapes, to reduce poverty in its various forms.

Nevertheless, this trend should not be interpreted as a recommendation for the generalized extension of tourist services within farms, but as a possible approach to be promoted where local conditions permit. It should not be forgotten that the possibilities of establishing tourist activities are also limited by a whole range of factors, connected for example with location, environmental features of the area and the nature of the structural elements of agricultural and natural landscapes, as well as tourists' present and future preferences.

However, in the context of developing countries where financial resources are limited, the establishment of measures to integrate agriculture and rural tourism under a programme to promote a multi-activities approach in rural areas would surely be more effective and practical than a transfer of cash – or more specifically as a replacement for the system of payment for environmental services. This also means that debate on the issue of environmental externalities must broaden its focus from agriculture and the environment to encompass rural tourism as well. In other words, any system to compensate farmers for the environmental services they supply, whatever its nature (agri-environmental measures, payment for environmental services etc.), cannot be really effective or sustainable without an integrated territorial approach, allowing organizational and operational foundations to be laid in order to facilitate the emergence of multifunctional farms. In this perspective, the development of agro-tourism farms would then be a model to be promoted as a way of capitalizing on both agricultural resources and landscape and tourist potential.

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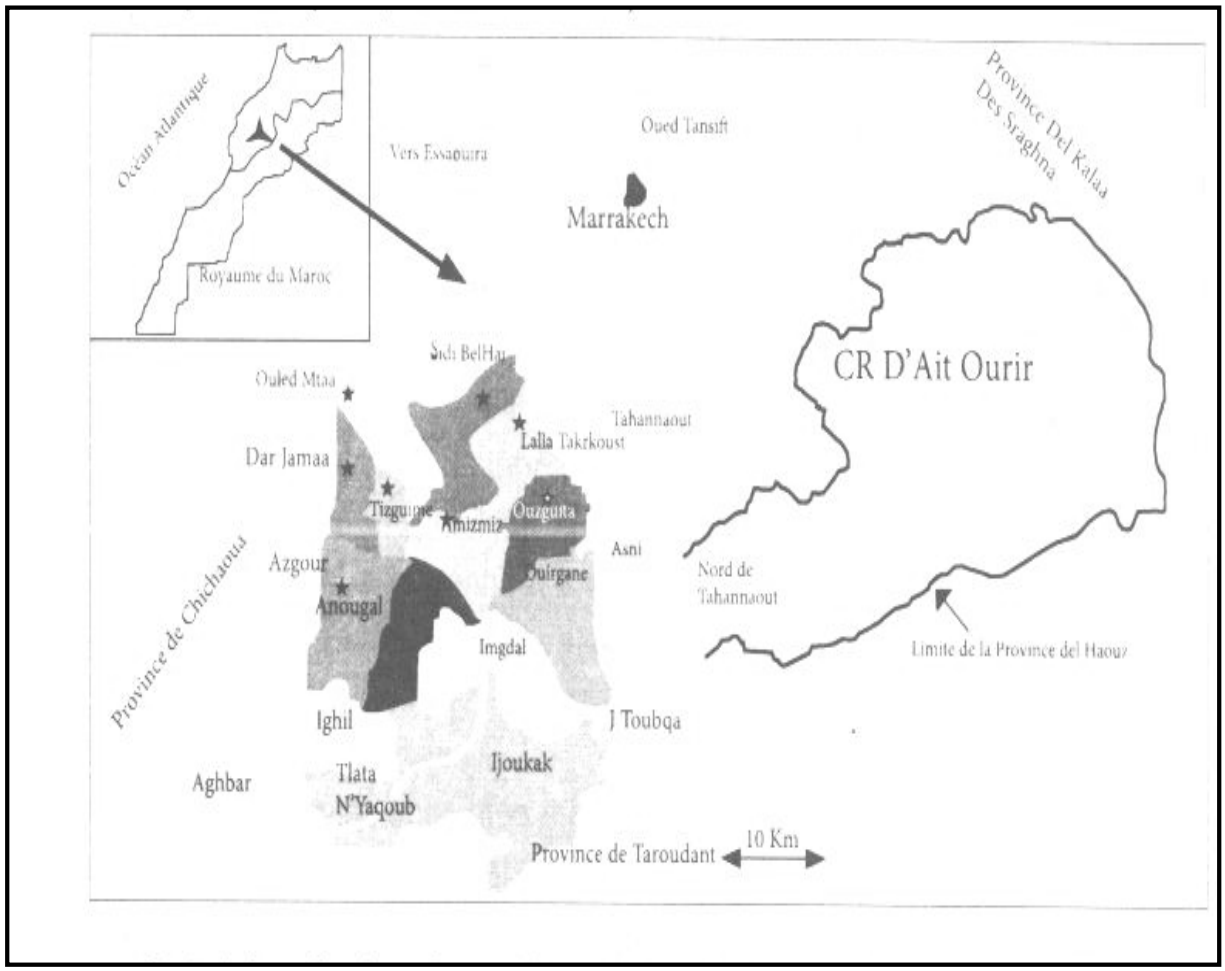
Appendix 1: Geographic localisation and administrative limits of study zones



Appendix 2: Main features of the four representative areas studied

Representative area	Agro-ecological zone	Dominant use	Amount of natural resources	Production system(s) practised	Development state of rural tourism	Rural communes selected
Zone 1	High mountain	Agrosylvo-pastoral	Abundant water resources Limited soil resources	Very little crop diversification Tree growing predominant Goat rearing preponderant	Very little or no tourist activity	Imgdal
Zone 2	Medium mountain	Agro-pastoral	Limited water resources Relatively large soil resources	Diversified crops Intensive tree growing Considerable dairy farming	Expanding tourist activity	Anougal
Zone 3	Medium mountain	Agro-pastoral	Limited water resources Limited soil resources	Cereal crops predominant Intensive tree growing Extensive sheep rearing	Major and well-established tourist activity	Asni
Zone 4	Foothills	Agro-pastoral	Limited water resources Greater soil resources	Less diversified crops Major cereal-, olive- and almond-growing Extensive animal husbandry	Marginal and localized tourist activity	Amzmiz Amghras Lala Takarkoust

Appendix 2: Composition of the sample of farms studied

Representative area	Agro-ecological zone	Rural commune(s) concerned	Total number of farmers	Farmers surveyed	Percentage of all farmers	Percentage of the sample
Zone 1	High mountain	Imgdal	500	20	4	15
Zone 2	Medium mountain	Anougal	579	27	5	20
Zone 3	Medium mountain	Asni	1 600	46	3	34
Zone 4	Foothills	Amzmiz Amghras Lala Takarkoust	421 595 379	41	3	31
Total			**4 074**	**134**	**3.3**	**100**

Appendix 3: Spheres of trade-offs in terms of categories of externality studied

Category of externality	Spheres of positive trade-offs
Landscape	Rural tourism – Jobs – Poverty Rural tourism – Income – Poverty Rural tourism – Investment – Poverty – Standard of living Rural tourism – Sociocultural heritage – Income – Poverty
Plant and animal biodiversity	Domestic production potential – Food security Rural tourism – Income – Poverty
Natural resources: soil and water	Domestic production potential – Food security