

SOUTH MOTORWAY: A GENUINE FIELD FOR THE IMPLEMENTATION OF SUSTAINABLE DEVELOPMENT CONCEPTS

J. EL BLIDI

Environment Service, Morocco's Motorways National Society, Morocco

elblidi.jamal@adm.co.ma

ABSTRACT

At around 234 km length linking Marrakesh and Agadir, the construction of the South motorway at the center of the ARGAN Biosphere Reserve, illustrates a genuine field for the implementation of sustainable development concepts.

Argana forests are not only a place of extremely high ecological fragility but they also play a social role that is deeply entrenched in the daily life of local populations by using it at an extended scale.

Faced with such specificity, the challenge to build a motorway with no high social and economic disequilibrium on the crossed regions has incentivized ADM to get close to local populations and to explain to them the beneficial repercussions of such a project on local economy and above all on generating jobs in the region.

In the same optic, the concern of the continuity of exchanges and mobility in crossed areas propelled the study of implementation to advocate that all the ways crossed by the motorway should pave the way for the construction of vehicles and/or pedestrians passages as well as the construction ways and passages which are different at the height level for people living on the borders of the motorway and for animals.

Beyond EIE recommendations, the responsible environment management is manifested in ADM's will to diminish all forms of impact.

ADM has also contacted the administration of waters and forests in order to examine the possibilities of collaboration in order to preserve *Argania Spinosa* and to ensure the continuity of the vegetation cover of the area crossed by the motorway.

1. INTRODUCTION

Being last link of the big axe Agadir – Marrakesh – Casablanca – Rabat – Tangier – Europe, the South motorway is a key axe which will effectively take part in the economic and territorial boom of the Southern region as well as in the improvement of inhabitants' life quality.

Marrakesh – Agadir axe is destined to facilitate exchanges in the region rich in tourist, industry and agriculture potentials. It will link two metropolis which play paramount economic roles at both regional and national levels:

- Marrakesh, imperial city and authentic tourist pole in North Africa,
- Agadir, a dynamic city of the Atlantic Ocean coast.

The setting up of the Marrakesh – Agadir motorway is part and parcel of the approach of sustainable development through searching for technical solutions which will allow to preserve the environment and to well integrate the motorway into the landscape crossed

and also by taking part in the deep reflexion undertaken by ADM in a bid to benefit the maximum from this new infrastructure at the economic and social plan.

2. DESCRIPTION OF SOUTH MOTORWAY PROJECT

2.1. Layout description

Starting from the point of bifurcation with Settat – Marrakesh motorway, the effective length of the project is about 234 Km. Marrakesh – Agadir motorway project is comprised of the following six sections: Marrakesh railing (49,7 Km), NR8 – Chichaoua (33), Chichaoua – Imintanoute (33 Km), Imintanoute – Argana (56 Km), Argana – Amskroud (45,6 Km) and Amskroud – Agadir (12 Km) (Figure 1).



Figure 1: Plan of the six motorway sections between Marrakesh and Agadir

The layout is split from Settat – Marrakesh motorway in solid rocks of the Jbilets. The project follows the route linking douar Aït Lil and El Mouih getting through the col to the South of Jbel Saâda (600-meter altitude). At around 17 m from its origin, the lane intercepts the NR7. Oued Tensift is crossed 10 Km further. Starting from Oued Tensift until Tnine Oudaya interchange, the plan goes through a plain rich in agriculture bordering the Al Haouz irrigated perimeter.

Starting from Sidi Zwine, the plan crosses the NR8 and goes directly in the South-West direction towards Chichaoua which surrounds us from the Eastern part.

Beyond Imintanoute, the project penetrates at PK 8+500 into the High Atlas mountainous rocks by means of the 500- meter height Zaouiat Aït Mellal tunnel. It is expanded on about 12 Km in the difficult area long Oued Ameznaç.

After the NR8 crossing which constitutes the culminating point of the area (a 1340-meter altitude), the plan takes the SE direction in order to go down towards the difficult part of gorge located at the level of Ouchene village and then reach Ouled Aït Moussa valley. Afterwards, the plan changes the direction in order to reach Argana by expanding in relatively craggy hill.

From Argana to Tassademt, the project expands following the national road NR8. The plan remains at the Northern part of the latter until the Bigoudine height and then it goes south while remaining at the borders of Abdelmoumen dam. The NR8 is again crossed by the plan which goes into the bordering of Tassademt from the North and then penetrates the col of Tizi El Hajaj which reaches the height of 1000 meters and which enjoys a distance of about 7 Km.

After the col passage, the project follows the national road until Inezlafène Southern part; it penetrates it and runs along Oued Assif Lyan which it crosses with Oued Assif Anrouz near Talaïnt. Then, the project goes on following the NR8 until Aït Bach. Starting from this point, the plan departs from the NR8 but remains at around 1 km distance and continues towards Amskroud.

After the circumvention of this agglomeration, the plan changes its direction by following SO in a plain hill occupied by ARGAN forest in order to be connected to the national road near PR1010.

2.2. Cross-sectional Profile

This infrastructure is designed with a reference speed of 120 Km/h. The motorway plan adopts a cross-sectional profile in two times two ways of 7 m-width and a fully centered land reduced by 3 m-width and a 2, 5-meter transports emergency lane (figure 2).

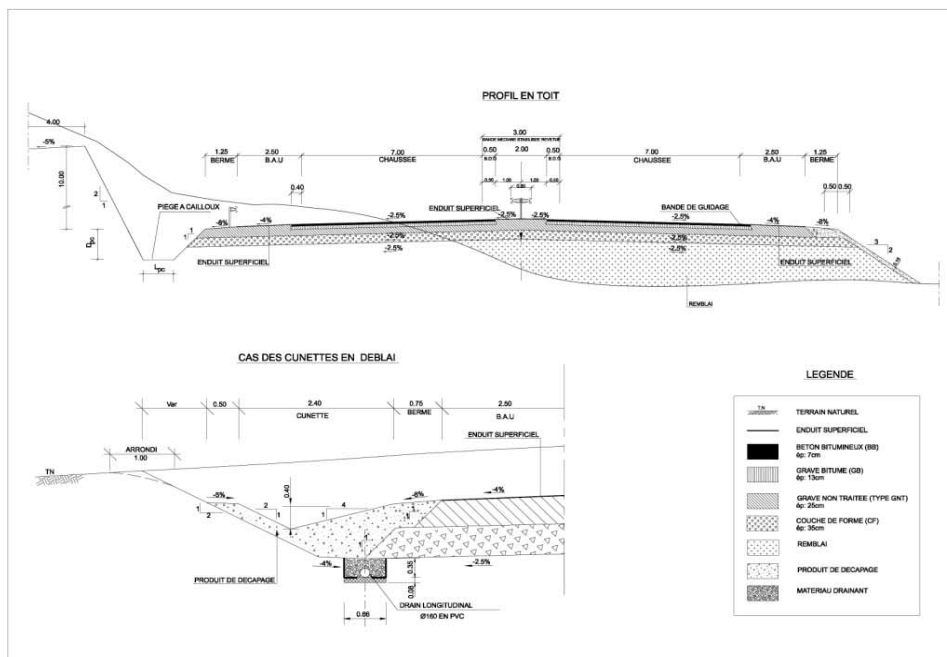


Figure 2: Cross-sectional profile, Marrakesh – Agadir motorway type

2.3. The mass of work

The construction of the motorway Marrakech – Agadir is characterized by an important amount of work in a short time allowed for its realization. The majority of work to be done is recapitulated on the table below.

Table 1- The mass of work of the southern motorway

Description	U	Quantity provided
Embanking		
<i>Cut</i>	m ³	38 506 664
<i>Fill</i>	m ³	24 657 777
<i>Loan</i>	m ³	7 393 613
Structures		
<i>Tunnel</i>	ml	500
<i>Exchanger</i>	U	6
<i>Service area</i>	Couple	4
<i>Viaduct</i>	U	11
<i>Overpass</i>	U	65
<i>Underpass</i>	U	14
<i>Vehicle underpass</i>	U	33
<i>Pedestrian passage</i>	U	10
<i>Pedestrian bridge</i>	U	5
<i>Hydraulic structure</i>	U	337

In spite of importance of the task expected to be done, the ministry of equipment and ADM decided to adopt tightened panning for the realization of motorway sections programmed for construction. The total time of realization of the different sections of the project is about 36 months. The planning of the realization of the works is indicated below:

Table 2- Planning of the realization of work

Sections	2006	2007	2008	2009
Marrakech – RN8				
RN8 - Chichaoua				
Chichaoua – Imintanout				
Imintanout – Argana				
Argana – Amskroud				
Amskroud – Agadir				

2.4. The cost of the project

The total cost of the Marrakech – Agadir motorway project is estimated at approximately 7,89 billion dirham. In other words, it's an average cost of a little more than 33, 7 million dirham per Km. The cost mentioned here rules out the secondary works related to the exploitation under toll which represent about 10% of the work of civil engineering. This would results in the raise of the cost to 37,15 million dirham.

The table below sum up the cost of realization (out the exploitation under toll).

Table 3- Cost of the project according to motorway sections

Sections	Cost in en million dirham
Contournement de Marrakech – RN8	783
RN8 - Chichaoua	1060
Chichaoua – Imintanout	975
Imintanout – Argana	2644
Argana – Amskrout	2132
Amskrout – Agadir	293

3. SPECIFICITES OF THE PROJECT ZONE

On the Imntanoute – Agadir section, the motorway is developed at the level of the Argan Biosphere Reserve (ABR). It is the first biosphere reserve created in Morocco by the UNISCO in December 1998.[1]

3.1. Biosphere reserve: Definition and functions

The origin of the biosphere reserves goes back to the “biosphere conference” organized by the UNISCO in 1968. [2]

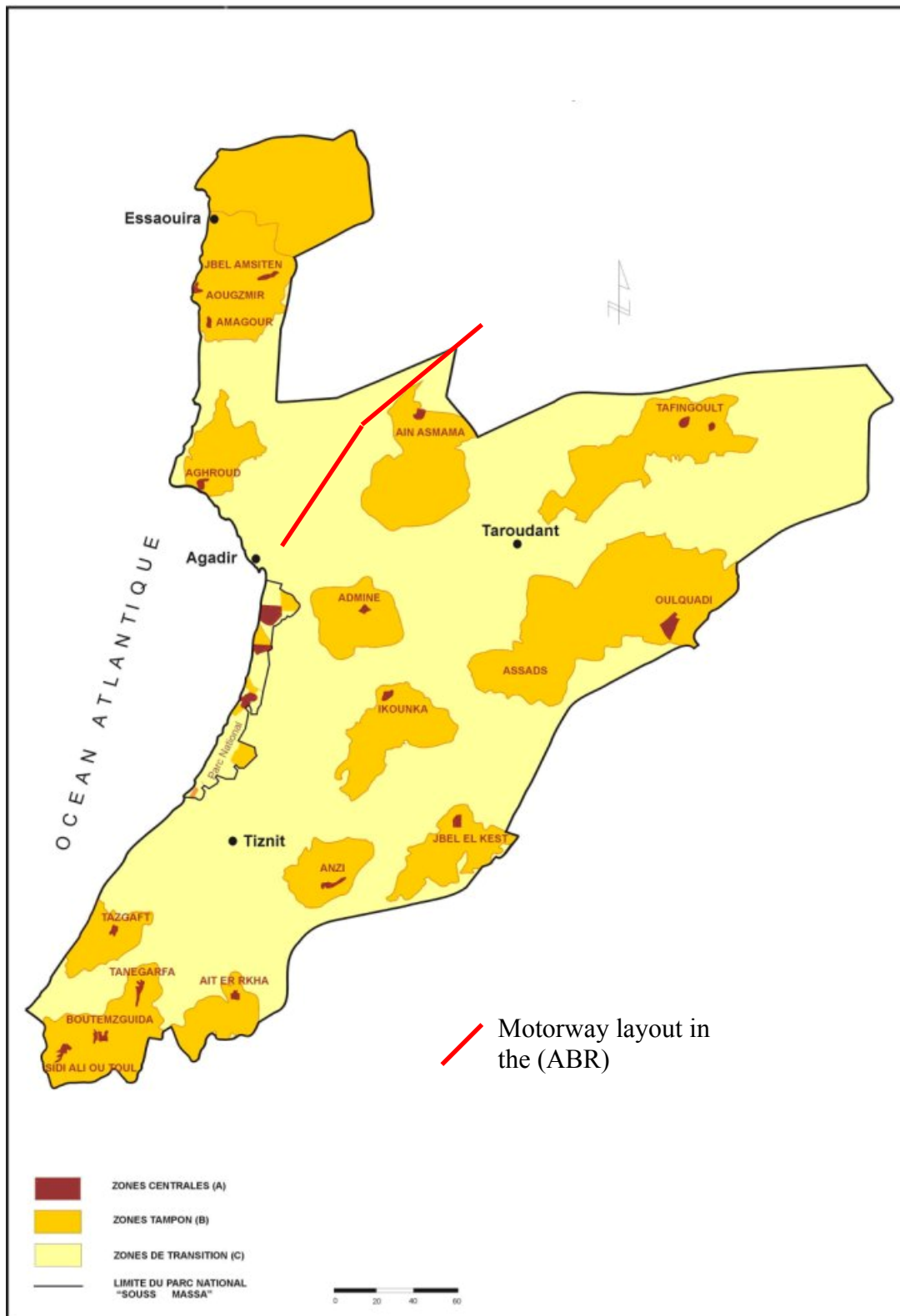
The biosphere reserves are areas belonging to the land and marine ecosystems whose aim is to promote solutions for the preservation of the biodiversity and its durable use. These reserves are recognized on the international level. They are proposed by the national governments and they remain under the sovereignty of the state on the territory to which they belong. They constitute to some extent alive laboratories of study and demonstration of the integrated management of the lands, water and biodiversity.

These biosphere reserves are organized according to three interconnected zones: the core area, the buffer zone and the transition zone [2]:

- The core area (A) must profit from a legal statute which guarantees, on the long term, the protection of landscapes, the ecosystems and species it contains. It must also be protected from human activities, except for research or continuous surveillance, and in few cases for the traditional collecting activities carried on by the local population.
- The buffer zone (B) must be clearly delimited. It surrounds the core area. The focus in this zone will be on the sustainable use of natural resources for the benefit of the local communities. The activities that are undertaken there should not go against the objectives assigned to preserve the core area, yet, they must contribute to its protection.
- The transition zone (C) is prolonged outside the Biosphere reserve. It may be an area for agricultural activities, human settlements or other usage. Taking into account the important role that the biosphere reserve play in the sustainable management of natural resources in the regions where they're located, the transition zone are considered of great interest for the regional socio economic development.

3.2. The Argan Biosphere reserve (ABR)

The Argan Biosphere Reserve (ABR) is the first reserve in Morocco. The reserve is considered as an endemic forest of Morocco with its Argan trees (*Argania spinosa*) [2]. The Figure 3 illustrates the geographical distribution of this (ABR).



Source: AGROFOREST - PCDA.

Figure 3 - Geographical distribution of Argan Biosphere Reserve

According to ArabMAB Network Bureau [2], the information relating to the zones A, B, and C of Argan Biosphere Reserve are summarized as follows:

- Core areas (A): 18 zones are distributed on four provinces: The cumulated surface of the central zones rises to 16.620 ha which represents approximately 2% of the total surface of the (ABR).
- Buffer zones of the (ABR) (B): 13 buffer zones distributed on the same four provinces. The cumulated surface of the buffer zones rises to approximately 560.000 ha (not included the buffer zone of Chiadma), which represents approximately 70 % of the total surface of the (ABR).
- Durable development areas (C): The zoning of the RBA distinguishes two types: zone of transition consisted the plains and valleys agricultural and zones of transition consisted the forest formations

3.3. Argan tree: *Argania spinosa*

3.3.1. *Importance and social interest*

Argania spinosa, an ageold tree that only grows in the Western Southern area of Morocco. This tree gnarled and thorny, but always green, and establish a deep root system, thus stabilising the soil and combating erosion.

There is a weath of litterature on the topic of Argan tree. In 1219, Egyptian botanist Ibn Al Baytar discussed it in his word « Le traité des simples » and an explicit reference to it can be found in « Description de l’Afrique » by El Hassan El Wazzâan in 1515. These authors were already describing most of its plus points. The Phoenicians sold its oil in their trading posts all along the Atlantic seaboard.

Mankind realised just how to reap the benefits of this tree with its lifespan of several centuries. An excellent source of fuel, its wood is very dense and is thus as useful in the kitchen and for heating as it is for carpentry, the crafting of agricultural implements and even marquetry, as the tree provides overhead grazing for livestock (principally goats) reliant on the leaves for top quality forage and braving the thorns, this wood source is disrupted by the practice of branch grazing.

These forests of argan also play a major social role as well. They’re deeply established in the everyday life of the local populations by exercising of the wide rights of user. The mode of management of the arganeraie by the local populations is follows a tripolar model agro - sylvo - pastoral whose three dimensions are: forest production, the oil extraction and livestock production.

For centuries, the Berber tribes of the Atlas use its oil, extracted from its fruits’ seeds. The precious, honey-coloured and highly nutritious liquid is fascinating because of its abundance of essential fatty acids and antioxidants. Science also attributes it with being able to lower cholesterol levels, stimulate liver function and brain cells, reduce hypertension and help maintain eyesight. It is also used to treat minor ailments such as acne, rheumatism or burns.

The forestry exploitation and oil extraction provides annually respectively more than 800 000 et 20 million days of work [4]

3.3.2. Evolution of surfaces of argan

The argan ecosystem has been undergoing a steady unprecedented retreat estimated to several million hectares since the old climatic changes of Quaternary.

This retreat has accelerated since the beginning of the 20th century, where about half of the forests of argan disappeared because of the increasing demand for charcoal and cultivated surfaces [5]

In 1995, the forests of argan covered a surface at approximately 800 000 ha (Figure 4). [6]

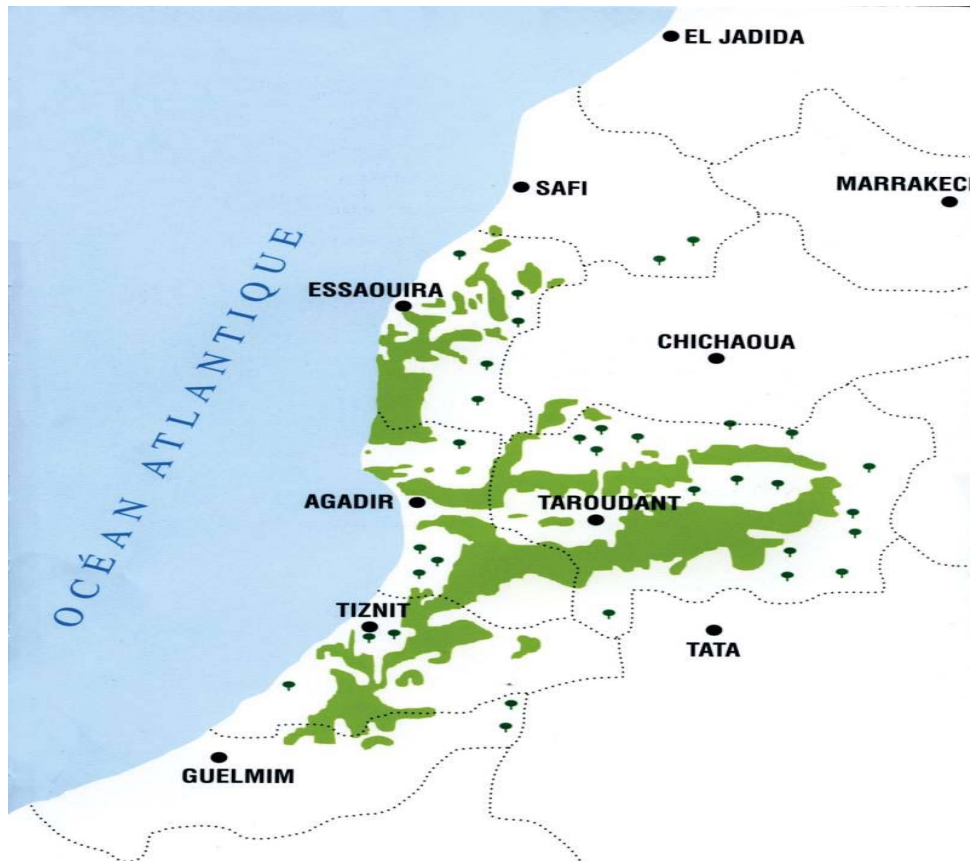


Figure 4 - Geographical distribution of the forests of argan

A clear reduction in the density of the trees was noted by the Service of Forestry in 1994, which passed from 120 feet by hectare at the beginning of the 20th century, with 40 feet per hectare approximately at the beginning of the 90's.

In 2003, the average density would be 30 feet per hectare approximately.[5]

The deforestation rate of 600 hectares is alarming not only it because of the damage to the landscape but also because of the extreme importance of this tree as an ultimate recourse against the rural migration phenomenon.

Given these ecological and social specificities of the area of the project (Dictated by the presence of the Reserve of Biosphere combined with the social importance the species *Aragania Spinosa* in the everyday life of the local populations) , the real stake in the construction of the motorway consists of : ***Which approach implemented to take in to consideration these specificities?***

4. SOUTH MOTORWAY: A PROJECT FOR SUSTAINABLE DEVELOPMENT

To take into account these specificities for this motorway entails a comprehensive strategy which necessitates a comprehensive approach that does not separate the project neither from the territories it crosses, serves and structures nor from the populations concerned and the public authorities who finance it.

In other words, the strategy should conciliate the economic, social and environmental performance; this is the definition of the concept of sustainable development (*to give birth to an infrastructure which satisfies today's economic and environmental needs while preserving the capacities for the coming generations* [7]). Such is the strategy that ADM is tremendously trying to implement in the setting up of the South motorway.

4.1. At the economic level

The easy flow of transports has repercussions on regional and national economy and on road security.

According to conclusions made within the framework of studies of economic profitability, this motorway project will generate an expected economic benefit of (TRI = 12, 3%). [8]

The creation of a rapid link between the big cities of the Southern region will generate a boom of regional exchanges profitable for numerous domains, be they industrial, tertiary or agricultural; this will pave the way for the emergence of competence poles.

At the local level, the South motorway will efficiently serve, by means of its 6 interchanges, the communes that are situated on its plan and will contribute to promoting local employment. It will also help a great number of visitors reach easily the tourist cities of Morocco. Marrakesh – Agadir will be beneficial tourism service activities.

In fact, the geometric characteristics of the national road NR8 in the High Atlas Mountain constitute an obstacle for heavy weights: narrowness, dangerous slopes, often-reduced visibility. These are factors which increase the risk of accidents. Furthermore, the very different speed between light and heavy-weight vehicles is responsible for the often dangerous excess at the present national road. Presenting to NR8 users an alternative rapid route in order to link Marrakesh and Agadir, the South motorway will reduce pressure on NR8 currently taken by more than 4000 vehicles per day.

Motorways are the most secure road network because the number of victims is 4 times less than that generated at the level of national roads. By reducing traffic at NR8, the South motorway will contribute to improving security.

4.2. At the social level

In addition to public inquiries carried out from July 26 to August 26 by virtue of Article 3 of law no 4-89 related to motorways and in order to allow the public to be informed of the project and to make possible remarks, many meetings to present the project were held at different steps of the conception of the project for different actors of the region (rural communes, local populations, people who quickset on the borders of the motorway, etc).

The participation and the integration of the public at different steps of the project guarantee the taking into consideration of all the stakes, whether they reach global consensus or not, they seem to be the key to the social acceptance of the project.

The aspirations that came out of these debates and ADM are summarized as follows:

- Reconstructing collective infrastructures covered by the project (schools, mosques, etc), adding a number of passages and footbridges, opening roads parallel to the plan so that the project could establish an easy link between people who quickset on the borders of the motorway.
- Indemnifying usage rights for Argan tree forests.
- Committing to give priority to local workforce.

During these meetings, open debates took place so as to spot the great potentials of social and economic development of these regions. Particular attention were given to ecotourism, biological cultures, medicinal and aromatic plants, wood for craft industry as well as to enhancing the value of Argan tree through improving the product quality and its marketing.

In this optic, ADM will contribute to enhancing the value of Argan and to promoting the identity of the region through boosting the cultural, historical and natural richness of the regions crossed by the motorway. It will also create thematic service area destined in order to highlight the specific aspect of the region and to become a place of exchange with the territory crossed by the motorway. The overall budget allocated for this project is estimated at about 2 millions dirham.

4.3. At the environmental level

During the elaboration of South motorway project, ADM has tried hard to go beyond the recommendations of the study of the impact on the environment.

The optimization of the motorway plan and its circumvention of the main agglomerations in order to reduce acoustic disturbance, the tunnel passage, the maximum limitation of argan deforestation, the important reduction of motorway right-of-way, creation of sewage networks for collecting and treating used waters which are poured into the Oueds, the partnership with the delegation of waters and forests to develop native species attest for the ADM's will to search systematically technical solutions which duly respect the landscape, nature and the environment in general.

Table 4, with some commitments, summarizes the construction and the exploration of South motorway which respects the prescriptions of environment protection.

Table 4- ADM commitments in favour of environment protection

Elements	Phase	Impacts	Commitments taken
Argan Biosphere Reserve		<ul style="list-style-type: none"> • Destruction of argan surfaces belonging to Argan biosphere reserve. • Loss of trees important to local populations for producing ARGAN oil and for breeding. • Right-of-way surfaces in the forest domain are estimated to be 470 h. • Trees' density was estimated to be 26 trees/hectare according to photogrammetric samples 	<p>To involve the Haut commissariat aux Eaux et Forêts et à la Lutte contre la Désertification (HCEFLCD) in the study of the expressway routing which crosses the ABP in order to jointly examine solutions to reduce the impact on resources.</p> <p>The chosen expressway routing has circumvented areas (A), (B) of the reserve but it has encroached on the Eastern edges of SIBE Ain Asmama on 10 Km. Given that this part does not enjoy a great ecological and biological significance for SIBE, the decision has been made to take the motorway work as a new limit from the Eastern side for Ain Asmama's SIBE.</p> <p>Implementation of the 1998 convention related to deforestation: ADM will finance the planting of Argan on a surface that is two times superior to the surface deforested by the project. This means that 100 000 argan trees are to be planted during the period 2006-2008; Works of the first part are already under way and involve an area of 200 hectares, meaning 40 000 argan trees. The amount of this operation is 2 millions dh.</p> <p>Implementation of the convention related to argan development at the level of dependences of Marrakesh – Agadir motorway. Convention no 234/05/S, dated July 2005: this convention, signed between HCEFLCD and ADM, stipulates the execution of the following works:</p> <ul style="list-style-type: none"> • Construction of motorway limits by quickset hedges; • Planting in order to stabilize the slope of cutting and embankment; • Planting of motorway surroundings, service areas, payment stations and interchanges. <p>Within the framework of this convention, HCEFLCD commits to:</p> <ul style="list-style-type: none"> • Define native and climacteric species (bushes and trees) along the South motorway plan, to be associated with ARGAN Spinosa according to every type of landscape rehabilitation to be realized: road red stabilization, quickset hedges put along the closure limiting the right-of-way, and the planting of interchanges and services areas. • Ensure the production of forest plants, namely Argania Spinosa in regional plant nursery. The needs for plants is estimated to be 350 000 units. • Ensure ADM technical assistance in the study phase and in the realization of landscape rehabilitation projects. <p>This operation necessitates an important budget of 18 millions dh, and whose realization is scheduled for 2007 – 2009. The construction should be accompanied by Planting</p>
Wildlife	Works	<ul style="list-style-type: none"> • Temporary disturbance of wildlife on the borders of the project.. 	<ul style="list-style-type: none"> • No specific measure is envisaged during the working place.
	Exploitation	<ul style="list-style-type: none"> • Inhabitants' quality deterioration. • Ecological inhabitants' fragmentation • Risk of blocking fish circulation in Oueds. • Wildlife mortality risk. 	<ul style="list-style-type: none"> • Preserve the ecological quality of Oueds: Banked edge vegetable diversity and fish circulation. • Avoid creating a threshold of more than 30 cm height in the Oueds' bed in a way to preserve fish circulation. • Set up adapted closure in the sectors of potential circulation of the higher mammals.
Flora	Works	<ul style="list-style-type: none"> • Fire risk, especially in cases of burning stock or wastes. • Risk of additional impacts on ecological inhabitants by machines' rumbling outside the right-of-way. • Risk of excessive deforestation 	<ul style="list-style-type: none"> • Formally forbid burning stock or any waste near wooded areas. • Mark trees to be cut so as to limit deforestation as necessary as possible. • Inform people concerned before starting deforestation to allow them to exploit forest resources. • Machines routes are submitted to the approval of the main contractor with the obligation to evaluate their impact on the environment and safeguard actions.
	Exploitation	<ul style="list-style-type: none"> • Destruction of natural places' surfaces important for their flora. • Risk of reducing banked edge ecological diversity by encroachments or gabions. 	<ul style="list-style-type: none"> • Planting of adapted local species in the concerned places within the framework of landscape rehabilitation.

Elements	Phase	Impacts	Commitments taken
----------	-------	---------	-------------------

Table 4- ADM commitments in favour of environment protection (continue)

Link, geology and landscape	Works	<ul style="list-style-type: none"> Outflow of the link related to the course and cutting opening. Uplift of the land linked to the embankment and to the temporary or final material deposit. 	<ul style="list-style-type: none"> The topsoil, resulting from the stripping of a good agronomical quality of soil, will be treated on road red, central land, interchanges and service areas. Modeling of earthwork in order to encourage the landscape integration of the motorway (create landscaped earthwork on the borders of the inhabited areas and the existing roads so as to limit visual disturbance and to extend road red ridges. The final deposits may be realized in courses for exploitation purposes in order to allow a renovation of the link near the initial state.
	Exploitation	<ul style="list-style-type: none"> Opening of digging which is often deep or creating high embankments, that are perceptible in the landscapes. The same impacts of courses and creation of final deposits. 	<ul style="list-style-type: none"> The topsoil, resulting from the stripping of a good agronomical quality of soil, will be treated on road red, central land, interchanges and service areas. Implementation of convention no 234/05/S, dated July 2005, signed between HCEFLCD and ADM, stipulates the execution of the following works: <ul style="list-style-type: none"> * Construction of motorway limits by quickset hedges; * Planting in order to stabilize the slope cutting and embankment; * Planting of motorway surroundings, service areas, payment stations and interchanges.
Underground and Superficial Waters	Works	<p>Qualitative Impacts</p> <ul style="list-style-type: none"> Changing the quality of underground and superficial waters for the earthwork generates fine particles which infiltrate into the wells. <p>Cleaning and maintaining worm machines (namely drain) or used waters, dangerous products and wastes are potential risks which jeopardize the quality of underground and superficial waters.</p>	<ul style="list-style-type: none"> Positioning of working place installations' areas far from sensitive sectors (main Oueds (rivers), inhabited areas). Placement to be submitted to the preliminary opinion of the main contractor. Forbidding the storage of polluting products near the Oueds, especially when there wells. Setting up of specific tools to store these products and to limit environmental risks (Leak-free and covered areas). Maintaining, supplying and cleaning machines in areas specifically designed to limit the deterioration of waters' quality. Installing sanitary facilities attached to a tight cesspool and regular evacuation towards a treatment site. Recovering and regularly evacuating wastes of the working place. Companies must precise within the framework of their plan to respect the environment the destination of the different wastes generated by the the working place, namely drain oil and oil filter; this should be validated by the main contractor. Cleaning of concrete tops in specific cesspools far from the Oueds' bed. Forbidding clearing of works right-of-way more than one month before. Implementing temporary cleaning-up devices (cesspools, setting pond, rustic filter) near the main Oueds and the main underground waters' sources. Precautions during the manipulation of materials extracted from restrictive areas: they are deposited far from the Oueds so as to avoid polluting suspended fine particles.
		<p>Quantity Impacts</p> <ul style="list-style-type: none"> Earthworks hamper the flow of the Oueds in the working place. The working place's need for water might sanction the current water users (supply of drinkable water, irrigation, water for stock). <p>In case of heavy rains, the flow of the Oueds menaces works and creates potential disorders at the working place.</p>	<ul style="list-style-type: none"> Material storage or deposit areas will be chosen according to the flow of the Oueds and inundation risks It will be forbidden to deposit, even temporarily, materials or wastes in sectors that can pose an obstacle to the flow of waters. Working place's roads will be designed in order not to hamper the flow of waters. A specific dossier entitled "Supplying Water to the working place" will be produced by the Company. It will localize the envisaged pumping points and will precise pumping modes: flow, volume, precautions. This dossier will be submitted to the prior assent of the main contractor. Techniques to stabilize the slope cutting, may be used to stop erosions (Pebbles, planting) Intercepting ditches of the slope of cutting, destined to collect naturally flowing waters of drainage basin, will be set up at the outset of works, in order to block great quantities of waters to the working place. This measure will limit fine particles downstream of the working place and the erosion of the slope cutting.

Table 4- ADM commitments in favour of environment protection (continue)

Elements	Phase	Impacts	Commitments taken
<p>Underground and Superficial Waters</p>	<p>Exploitation</p>	<p>Qualitative Impacts</p> <ul style="list-style-type: none"> • Risks of impact on underground waters' points (wells, sources) used by people living on the borders of the motorway. • Risk to alter the quality of water • Qualitative risks for the Oueds posed by chronic pollution (linked to vehicles' traffic) and by accidental pollution (flowing of dangerous products on the roadway) <p><u>Note:</u> Qualitative impacts involve namely the Oueds whose flow is permanent as well as the water points along the road.</p> <p>The transport of dangerous products by heavy weight vehicles occasions a risk of accidental pollution. However, this risk is reduced compared to the current situation where heavy weight vehicles circulate in roads whose geometrical characteristics are less secure than a motorway.</p>	<ul style="list-style-type: none"> • A setting up of a topsoil might be scheduled in sectors where it is available. A thickness of 20 to 30 cm at the depth of the trickle channel or a cesspool will facilitate diminishing chronic pollution. In case of accidental pollution, the tainted topsoil will be scraped clean and sent to dump. • Upstream of wells designed for domestic use by people living on the borders of the motorway, exploitation services of the motorway will intervene positively in case of accidental pollution: the tainted topsoil will be scraped clean and sent to dump. • Owners of the wells which are destroyed because of the works will be indemnified within the framework of the expropriation procedures. • A campaign to measure the level of water and to analyze the physical and chemical aspects will be carried out on the wells located near the motorway project before the beginning of works. Physical and chemical analyses will be realized on the main Oueds crossed by the project or situated along its borders. These analyses will give a reference picture before the outset of works, which will help avoid the abusive requests of indemnity; they will also help carry out a future follow-up, under exploitation. • In most cases, waters of motorway platform will not be collected. They will flow freely and will be directed towards natural places by means of roof drains which will help avoid erosion of road red by surface runoff. <p>On Argana – Ameskrout section, at the right side of the main Oueds, platform waters will be collected by means of covered cesspools and then they will be treated before being used in natural places. The treatment device will be simple to be constructed and easy to be maintained: Sodded Sub-horizontal cesspools.</p>
		<p>Quantity Impacts:</p> <ul style="list-style-type: none"> • Risk that the erosion of the Oueds' lands and banked edges becomes worse. • Risk that inundation phenomena become worse because of shortage of a lay out of hydraulic works and embankment construction of flood-prone areas. 	<ul style="list-style-type: none"> • At the entry and exit of the hydraulic work, the setting up of encroachments so as to break the energy of the flow. • Setting up of a device to break the energy of water at the foot of roof drains. • To law out hydraulic works for the springs whose comeback frequency 100 years and to avoid as hard as possible to encroach on the field of the Oueds' inundations (major bed). • Techniques to stabilize the slope cutting might be installed so as to limit erosion (Pebbles) in sectors where there are problems of slope stability. • The longitudinal system to collect waters will be designed in order to avoid erosion phenomena: cesspools or concrete trickle channel for slopes superior to 3%.

It is worth specifying that the estimated cost to protect the environment independently from other project costs is only available for individualized measures and corresponds to specific rehabilitations of the motorway (planting, tourist signalization, cesspool, etc) which were already noted. For the South Motorway, the estimated cost is 80 millions dirhams, meaning 1% of the project overall cost.

5. CONCLUSION:

On the basis of the analysis carried out above, it appears that the environmental and social measures of project accompaniment that ADM devised or envisaged to implement will help reduce and globally compensate the impacts of Marrakesh-Agadir motorway.

Through a series of agreements which help paving the way for integration and a synthesis of the environmental, economic and social dimensions, it shows that the project will achieve the objective assigned to it: a motorway that will enhance sustainable development.

BIBLIOGRAPHICAL REFERENCES

1. CID, (2005). Etude d'Impact sur l'environnement de l'autoroute Marrakech – Agadir. Rapport.
2. Arab Network of Man and Biosphere Programme (MAB). Page web : <http://www.arabmab.net/bra.htm>
3. Mhirit O, Benzyane M, Benchekroun F, El Yousfi SM, Bendaanoun M. *L'arganier, une espèce fruitière-forestière à usages multiples*. Sprimont : Mardaga, 1998 ; 150 p.
4. Deutsche Deutsche Gesellschaft für Technische Zusammenarbeit. (2003). Exploiter pour Conserver : Comment les animaux d'élevage et plantes cultivées délaissés constituent un potentiel économique pour le développement rural. GTZ GmbH, Rapport.
5. Michel R. Tarrier et Mohamed Benzyane. (2003). L'arganeraie marocaine se meurt : problématique et bio-indication. Sécheresse. Vol 1E, numéro 1.
6. Leipzig. (1996). Rapport de pays pour la conférence technique internationale de la FAO sur les ressources phylogénétiques.
7. Cofiroute, (2005). Au service du développement des territoires. Rapport du développement durable.
8. CID, (2005). Evaluation de la rentabilité économique de l'autoroute Marrakech – Agadir. Rapport avant projet.