

WEST AFRICA
FACING THE LACK OF TRAFFIC LANES
A STUDY CASE : THE ROAD NOUAKCHOTT-NOUADHIBOU (MAURITANIA)

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The mystery of Africa was at least a question of traffic lanes and mechanical traction vehicles! Therefore other mysteries could appear tomorrow, as in Africa, a pure question of modernization of the means of transport!

Alberto Moravia
African walks, 1987

To develop their resources and their capabilities (Sen A., 1987) the African States in general and western ones in particular, have necessarily to face the weakness of their transportation networks. Those are crucial vectors of development. It has been well demonstrated by many scholars, attending to prove the role of transportation networks in the territorial structuration of the world (Taaffe, Morrill Gould, 1963; Rimmer, 1977; Hoyle and Knowles, 1998; Debie, Eliot, Steck, 2003). The roads are both the condition and the manifestation of the exchanges (Offner J-M, Pumain D., 1996). Furthermore, without roads, nothing can be done to settle a fruitful process of development. People are claiming roads as instruments of their mobility and by the way as means to attempt better conditions of life. How could it be possible to go to school, to hospital, to market place without roads? How could it be possible to sale the products of agricultural activities? How could it be possible to buy what is obviously necessary to satisfy the ordinary needs, increased, in addition, by the flows of image coming from all over the world, showing other ways of life consuming so many manufactured goods, spreading even to the core of land locked countries? This paper aims to contribute to a better understanding of the role of roads as instruments of development. In a first part, it will draw a kind of panorama of the problems which African countries have to face. In a second part it will expose some effects of the opening of a new road between Nouakchott and Nouadhibou in Mauritania, a fruitful example. The question of transportation network can be assessed as the main key for understanding the lack of development

The lack of traffic lanes in Western Africa

The failure of equipment in traffic lanes charges Africa with heavy negative effects. The development process is limited by a reduction of the fluidity of traffic concerning both the movement of men and that of the goods. But beyond the only strictly economic imperatives, this issue is a particular acuity for African States. Those try to assume the heritage of colonization, meaning boundaries drawn by the willing of European countries but agreed by the independent States as the sign of their sovereignty. At the same time they are moving towards regional large supranational entities aiming to open their economies into the global system of worldwide exchanges. Even though they need to continue the effort serving the unification of the interior territories, achieving the building of a national space, they must engage the essential connection of their infrastructure in a growing process of networks within the regional system under construction. In doing so, they are necessarily rediscovering old configurations of terrestrial networks prior to colonization (UNESCO, 1997). Deeply registered in their tradition, these reticular relations framed space registration but they have been disrupted and displaced by new

routes, those ordered by the logic of foreign domination, essentially maritime bifurcations (Debrie and Steck, 2001). Enabled by dynamic local economic actors, these older networks have never completely disappeared. But the establishment of borders and the necessities of globalization, promoted by colonization opened new traffic lanes. Networks are thus at the junction of political imperatives and economic imperatives. Networks are the condition to strengthen the process of emergence of a national consciousness based on a sovereign territorial entity and at the same time the way to development, in its circulatory dimension and therefore reticular, essential for the dissemination of progress.

The paved road, a necessity

Networks of highways, temporary runways, permanent tracks, tracks strengthened, paved roads, motorways, are decisive for the future. Undoubtedly there is also emergency and need to modernize and develop the rail tracks, theoretically effective tools for poor countries but as railways companies are often in a disturbing neglect, they serve only a small part of West Africa and mostly for goods transportation (Chaléard, Chanson-Jabeur, Béranger, 2006). At the same time, the benefits of air transport are evident as an instrument of the opening up and the reduction of distances, but their capabilities are limited and the situation caused by the effects of air transport world deregulation has made it worse for a while. It could be possible also to use waterways, Senegal, Niger, Congo, among others, which could play a major role in regional traffic but they are yet unable to meet the requirements of modern transport, whatever do the institutional structures in place as the OMVS (Organisation pour la mise en valeur du fleuve Sénégal: <http://www.omvs.org>).

It is why the roads, in West Africa, remain the major pathway to territorial development and integration into the regional and global trade system. But it is not enough to draw new tracks or maintain old tracks. Beyond a little sterile debate on the choices to operate between major infrastructure and networks of proximity allowing a fine capillary, paved roads are the link claimed by all transport operators and also local and national authorities. It improves mobility by offering greater efficiency of displacement. The paved roads allow a permanent traffic at speeds greater than those permitted by tracks. Although there is no universally significant average value, experience shows that the speeds on paved roads may be more than 80 kilometers per hour, while on many tracks, they are often reduced to 20 or 30 kilometers per hour. The condition of success is that the road is in good condition, without major degradation, which is unfortunately not always the case. The paved roads clear the risk of dust raised by vehicles on the tracks in the dry season, especially those resulting from the reduction of visibility. They remove the discomfort of so called corrugated road. They reduce the mechanical risks concerning braking, steering, tyres, suspensions... They diminish the risk of loss of control when tracks are transformed into a kind of marsh during the rainy season. The paved roads allow permanent relationship, even during the rainy season and the period of floods, especially when bridges or dikes have been built. In other words, the paved roads lead to lower transportation costs, by theoretically providing increased security, unless that excessive speed, little friendly driving practices and poor maintenance of vehicles reduce the positive effects. They can also be reduced by the upkeep of the roads. It is common that degraded roads are doubled by diversions on tracks plotted spontaneously by the drivers. Indeed, it is not enough to have a linear form of asphalt; it must be in good condition. The financial means of the States concerned are unfortunately often failed and the maintenance of the roads is a development concern just as decisive as their sole creation. To create new paved roads, the African States can get international funding, mostly multilateral, through the World Bank. For maintenance, they must rely primarily on their own internal resources.

The architecture of the networks of paved roads is controlled by borders

The colonization has not leaved many paved roads and four decades of independence and development claimed as sovereign, have not led to decisive results, even if the linear growth is sometimes spectacular, in some States, as for example in Nigeria. Networks are first and foremost all national. A border effect plays at full. It is the result of the former colonial rivalries as well as the failure of program of regional integration organized by colonization, such as the AOF (French West Africa). It has also to do with the will of the governments after the independence to build a State that can be recognized by all the populations living in it, as it has been observed everywhere in the world (Labasse 1966; Debrie, 2010). In other words, States have preferred infrastructure policies contributing to build a real sense of national belonging rather than promote transnational infrastructure programs, fearing centrifugal forces. Today, crossing the borders by paved roads constitute one of the most important challenge. The lack of modern traffic lanes connecting the States is an obstacle weakening the speech and the actual progress on the path to economic integration. But, at the same time, economic differentials caused by the borders, have also played as thrusters of activities. Borders are also creative places. Relative porosity yet hardly suffered the negative effects of the shortcomings of infrastructure but called accommodation. In an extended West Africa, from Mauritania to Congo, there was only twenty-eight crossings border on paved roads, in the 1990s). It has improved during the 2000s but it is not still enough. Among the continental States, seven have no full coated linkages with neighboring States; three have only one. Mostly paved-border links are internal to the West African area. There is only one link achieved between West Africa and North Africa (Morocco, Algeria, Libya), the western traffic lane between Morocco and Senegal via Mauritania. There is no paved road crossing borders between West Africa and Central, Eastern and Southern Africa (Sudan, Congo - Kinshasa, Angola). Links between the capitals are almost completed in West Africa, but it's very new and the network is based on only one lane connecting the capitals of those States.

An incomplete network

One can observe two roughly parallel axes, from West to East, one to the North linking Mauritania to Chad, the other to the South, the coast line, between Senegal and Cameroon, even if it's not totally achieved. These two main highways are linked together by North-South paved roads, sign of outgoing development, commissioned by colonization, although prior to it, and by the insertion in the global system of trade, that impulse a shift towards the ports. But remain vast territories, completely deprived of modern highways, particularly between Senegal and Côte d'Ivoire, in this region of the southern rivers, in which one can find some of the poorest and politically most unstable States in the world. In this area, took place some of the most atrocious civil wars in the past decades. It concerns Bissau Guinea, Guinea, Sierra Leone and Liberia. The network is also deficient from Chad to Congo through Cameroon and the Central African Republic, in the peripheries of Central Africa, sparsely populated, little put in value, just equipped, subject to certain forest natural determinism. To the North, the vast desert, from Mauritania to Chad, suffers of low density and lack of modern traffic lanes. Very ancient tracks still roam the Sahara but establishing modern links between the two shores of the desert is still only an objective. Morocco, Algeria, Libya are still carrying on with construction of asphalt roads, opening up to the southern States of the Sahara but the political instability slows down the opening of main traffic lanes through the desert.

In this framework, one must note a few special cases. Nigeria especially (31 000 km of paved roads), therefore a great part of them are in poor condition, but also Ghana (5600 km), Côte d'Ivoire (4700 km), even Senegal (3800 km), Mauritania and Cameroon, have developed networks tendering to a certain complexity. Burkina Faso, for its part, is distinguished by a considerable effort to develop its central position in the Sudano-Sahelian West African area, as a

major crossroad, allowing it to claim a vital role in the global circulation of the region. It enjoys a central position that the remoteness of the coastline and strong underdevelopment had been forgotten. It may help Burkina Faso in its way to development. The density, expressed in kilometers of paved roads for 100 km², leads to another ranking: Gambia (7 km / 100 km²), Nigeria (3.5 km / 100 km²), Togo (3 km / 100 km²), Ghana (2.5 km / 100 km²). In fact there is no relationship between the length of the network and the surface of the State (correlation 0.26). The surface directly served by paved roads is a better criterion of differentiation. Of course there is a difficulty: what is the relevant distance to a paved road to refer to. Although it is impossible to assert its legitimacy strictly, we have chosen to consider the spaces within five kilometers of a paved road that means about an hour of walking, in such societies where it is still the main means of travel. Very large disparities appear: in Guinea Bissau, Togo, Nigeria and Gambia more than 20% of the area is located within 5 kilometers of a paved road, whatever the quality of the coating; come behind Senegal 18%, Côte d'Ivoire 13%, Ghana 12%; at the other end of the series, Chad 0.16%, Central African Republic 1.03%, Mauritania 1.78%, Mali 1.81%, Gabon 2.51%, Niger 2.61%... The average space within five kilometers of a paved road is only 3.5% for all West Africa. One could say that the area is not in itself a relevant indicator. It would be much more legitimate to know the proportion of population concerned by this proximity. That's quite true but it would require demographic databases accurate, consistent and reliable which is not yet the case. Several peculiar studies have yet revealed the attraction of paved roads on the location of population. In a certain way, if the roads don't go to people, people do go to the roads. Going in the same direction, at the scale of States, there is a good correlation between the length of paved roads and population (0.96). More a State is populated, longer is its network. The establishment of networks is effectively conditioned by the public will to serve populations, strengthening both the State and territorial control and the economics, by facilitating movements of men and wealth. However establishing a relationship between the length of the network and a common unit of hundred inhabitants, the results are not so evident, taking into account an average regional value of 3 km of paved roads per 100 inhabitants. The little populated States are divided into two major groups. The first brings together those where the length of the network at the disposal of 100 inhabitants is high, such as Cape Verde (47 km/100 inhab), but also far behind Equatorial Guinea (13 km / 100 inhab), Sao Tome and Principe (8 km/100 inhab), Gambia (7 km/100 inhab), Mauritania (7 km/100 inhab), all States very little populated. The second brings together States, them also little populated, but where the length of the network at the disposal of 100 inhabitants is very low, such as Chad, Benin, Central African Republic. Those differences prove the inequality of wealth and of access to paved roads.

This inequality may be clarified by the measurement of the report that can be established between the length of paved roads and the wealth produced. The regional average is 0.81 km of paved roads for 1 million of GNP. The correlation is still high (0.95). Cape Verde, Equatorial Guinea, Sierra Leone come first, Gabon, Guinea, Chad, Cameroon come in tail. However, those differences can reveal quite dissimilar situations. Some States have undertaken an effort to build infrastructure relatively more important than others, taking into account specifically created wealth, therefore devoting a larger relative share of their wealth to this investment. But we can also consider that States have better value their network by creating more wealth than others for a length of paved roads proportionately less important than what it could be, taking into account its gap to the regional average. Specifically, Côte d'Ivoire for example, reaches the second largest of the regional GDP, with an index of investment of created wealth in the network of paved roads equal to two-thirds of the regional average; In contrast, Equatorial Guinea is at the last place in the regional GDP, has the best regional index. The effort of the larger regional States, apart from Nigeria, is generally less than that of small States, not in absolute terms, but to their GNP. One might conclude, too quickly clear, that after all the wealth depends little investment in modern infrastructure, this close to the list of the first GNP is the list of longest networks. The big

question in fact deals with effects that might have a policy of infrastructure more ambitious on the creation of wealth-induced by a linear of paved roads increased. If Côte d'Ivoire had the same index of Equatorial Guinea, it would mean that its GDP would be six times greater than what it is. The question deserves to be asked, even if this scenario ignores many other parameters neglected here.

Unequal complexities

Beyond this state of things and this short comparison of the data it can be instructive to compare the configurations that can assess the network complexity of paved roads. There are several types of networks: twelve are ongoing networks; four are constituted by two disjoint sets; six consist of two non-connected sets. The continuity of the network of asphalt roads is therefore a first separator between States. But it is not enough to qualify them. A continuous system can characterize equally complex networks, such as those of Nigeria deploying hundreds of relationships, or even those of Côte d'Ivoire and Ghana with dozens, and simple networks such as those of Central African Republic, Chad, or Liberia, Guinea, Guinea Bissau, barely more developed, Togo, Benin, Burkina Faso, occupying an intermediate situation between the two groups. In the case of States whose networks consist of disjoint sets, their situation is just as diverse: Senegal has in fact a complex network whose relationships are as numerous as those of Côte d'Ivoire and Ghana. Mauritania, Gambia, Sierra Leone, Gabon have a smaller number of relationships. Cameroon and Congo are special cases, with a network composed of a number of relatively high disjoint sets, respectively six and eight, however coupled with a number of relationships, relatively high for the region, but this architecture in stretches of road non-interconnected reveals the incompleteness of programmed links which have not been yet achieved. The complexity of networks can also be apprehended by the assessment of the average number of relationships from a node of the network. Eleven States have simple linear tree networks. Apart from Nigeria that displays more than hundred cycles, only Senegal, Côte d'Ivoire, Ghana have a number of cycles between five and ten. The theoretical model of a complete direct connections between all nodes anyway has no meaning for States under construction. Research of reticular trees is clearly better, even if such networks lose in connectivity.

All those questions need to be confronted to what is going on really in the proximity of people waiting for improvements in their ordinary life. The case study that follows is significant of several main evolutions observed everywhere in Western Africa, even if it's a very special case, because of the environmental challenge it has to face.

A case study : the road Nouakchott-Nouadhibou (Mauritania)

Over the last decade, the "Parc National du Banc d'Arguin" (PNBA) in Mauritania, considered as one of the most important place in the world for protection of natural environments (UNESCO world heritage), became a major territorial issue for divergent interests. It is attractive in its maritime part for fishermen, although access is prohibited to those who are not identified as Imraguen, the local fishermen. It is appreciated by nomadic breeders. It's a focus point for oceanographers, geologists, ornithologists and botanists. It is also a destination for tourists looking for desert spaces but also for bird lovers and cross-cultural human encounters. The PNBA is thus subject to suffer because of increasing pressures since it has become easily accessible with the road Nouakchott-Nouadhibou, opened in 2004. This road is an excellent laboratory for enhancing scientific thinking about the effects of a new traffic lane structuring the territories and the populations concerned. The main issue is how to reconcile economic imperatives and policies aiming economic growth by developing potential sources of activities,

according to the wishes of people who would like to have better living conditions and, on the other side, imperatives of preservation of precarious environments recognized as indispensable for the maintaining of a real biodiversity, specially birds and fishes, in the frame of what is called sustainable development. It is the ambiguity of the road which is thus put forward. It can certainly improve the situation of the inhabitants but it may also submit them to external actors who will impose changes that they do not want. Finally, it can cause partial destruction of environments that would harm the life cycles of fish and birds, or even plants overexploited by inflows of herds or increasing pickups to urban markets. This road is exemplar first because it is enrolled in various scales of territorial operation, second because its opening has led to many transformations already even though it is still too early to assess the effects over the medium term and a fortiori the long term. The existence of the road in particular modifies the accessibility of places, a powerful factor of potential evolutions of the PNBA.

A multiscale trans-Sahara Highway

This road Nouakchott-Nouadhibou must be considered first at three scales, local, national and international, which complicates the analysis.

The impact of a road on a changing coastline

If this is not its primary purpose, the road however plays a quite decisive role in the organization of space crossed by it. It runs along the coastline on almost 470 km that's two thirds of Mauritanian coastline, even if it moves away of it, because of PNBA, at a distance that can reach sixty kilometers. This road, somehow, integrated the coastline in national territorial dynamics through circulations of any nature. It offers new opportunities to local populations. It allows the Imraguen to supply Nouakchott and Nouadhibou fish markets, much more actively as they did before. It also allows them to achieve more easily external consumption, goods primarily but also services, until then difficult to access (education, healthcare, water...). It makes it also easier for tourists to come, in the frame of a national policy favorable to the growth of this activity. However, this road is full of ambiguities: it can lead to significant economic benefits to the Imraguen and at the same time generate increasing pollution and exacerbate the risks on fragile natural environments. In addition, this road, in its southern part, accordingly to the South of the PNBA, facilitates the implementation of two other major projects of infrastructure, the Nouakchott international airport and the port of Tanit. Finally the road paves the way for the exploitation of wealth until then untapped, as for example gold Tasiast mine or hydrocarbon flagged off-shore close to PNBA. The road aims to satisfy all these interests which are difficult to reconcile. Especially, it is of greater interest to reconcile the imperative to safeguard natural areas, until then protected by their relative isolation, and the human will of better conditions of life.

The opening of a road linking the two main Mauritanian cities

At the national level, the main objective of this road is to link the political capital Nouakchott to the economic capital Nouadhibou. These two cities concentrate about a third of the population and constitute the economic lung, as they are the main poles of production and consumption. Nouadhibou is the second city of the country behind Nouakchott to which it was not connected by fixed traffic lanes. Exchanges between Nouadhibou and the rest of the country were, until the opening of the road, low, having regard to the economic and commercial potential of this city. Nouadhibou had very little links with Nouakchott, compared to its regular relations with Las Palmas of the Canary Islands or with the Morocco and the Spain, not to mention the specific enclave that is the national industrial and mining company (SNIM), inclusion in Mauritanian

territory of globalization by the trade in raw materials. It remained in a way foreign to the country. Gateway to Europe, and cosmopolitan city, it still fits circuits more international than national. The road, instrument of territorial control, has certainly thwart this initial trend (Antil and Choplin, 2003). Linking the two major cities of Mauritania, Nouakchott-Nouadhibou road facilitates economic exchanges, including products, between the major poles which are large urban centers, including the platforms of exchanges represented by the ports of Nouakchott and Nouadhibou, the Nouadhibou ore terminal and the two airports.

A new linking between West African and Maghreb

Internationally, this road axis is becoming one of the fundamental links between Maghreb and West Africa, the first one to be completed, before the opening of other tracks between Algeria and Mali or Libya and Chad for example. This route allows, on the one hand, an increasing potential for Mauritanian integration to these two sub regions, strengthening its position as an interface and, on the other hand, the connection for the first time by a fixed link tarred between West Africa and Europe, apart from the crossing of the Senegal River and the crossing of the Strait of Gibraltar. This road is also a new solution for the opening up of some countries of the West African sub region, such as Mali who seeks to escape from an uncertain one-on-one with Côte d'Ivoire and which is now linked by paved roads as well to Dakar and to Nouakchott and therefore this first trans saharian axis. For example, traders settled in Bamako can buy fish in Nouadhibou and sell it two days after in Bamako. For the Morocco which undergoes a certain diplomatic isolation in Africa, because of the conflict in Western Sahara (Antil and Choplin, 2003), this road materializes the axis Rabat-Nouakchott-Dakar, to say the Paris-Madrid-Rabat-Dakar. Any infrastructure of this type constitutes an instrument of the policy.

The effects of the road on the territorial organization

The road Nouakchott-Nouadhibou is a representative example of what goes on when a new paved road is open. Many political actors do believe the improvement of accessibility made possible by infrastructures would automatically generate economic growth and human development. In another way, if a territory is not properly developed, it's because of its poor accessibility. Many scholars have demonstrated that a new infrastructure can be a condition of development but not a sufficient one (Plassard, 1977; Offner, 1993; Steck, 2010). The opening of Nouakchott-Nouadhibou paved road modifies completely the accessibility of PNBA, considering accessibility as the process of interaction between a panel of numerous factors which are not all necessarily in direct relation with the movement. A road can actually promote the accessibility of places, enabling interrelationships between separate processes. But improving accessibility can also deeply disrupt the local population in their relation with the outside world. The question that arises concerns the capacity of the road Nouakchott-Nouadhibou to stimulate interactions in favor of the populations concerned.

A strong increase in traffic

First, the opening of the road leads to a strong increase of traffics, multiplied by about thirty, within five years, even if uncertainties remain on counts made by the technical national services in Mamghar, on the trail through the Park, for the years prior to the opening of the road. These counts are however a reference to attempt to assess the magnitude of the changes introduced by the paved road. In the same time, polls conducted since the opening are also uncertain, regardless to the methodological precautions implemented, because they do not cover changes in flows throughout the year. Despite these reservations, the data are eloquent and even if it is too early to know if forecasts of a nearby traffic 1000 vehicles per day on average in 2015, established by the

State services, will be verified, the opening of a new road makes traffics growing up. It allows the needs and expectations to be satisfied even if new traffics appear that were unthinkable before its opening.

The road as a fixer of men

The road Nouakchott-Nouadhibou is becoming an attracting area for fishermen and pastoralists but also for new populations coming from elsewhere. It's becoming a mean for the prosperity of the economic activities that are already installed. Yet the phenomenon has not, till now, the same magnitude that the one observed on the Road of Hope, between Nouakchott and Nema, in the southern part of Mauritania (Dede, 2006). The opening of this axis has led to new territorial configurations: urban growth of the former centers (Boutilimit, Aleg, Kiffa, Aioun, Timbedra and Nema) and development of new towns (Tintane, Guerou, Magta Lahjar). This development is explained both by the rural exodus that occurred during years of drought and by the actions of the State distributing food aid and implement collective social services (education, health) in these urban centers. The situation of Nouakchott-Nouadhibou road is different: no pre-existing city, a human presence more disseminated and much less dense, a great scarcity of water, much less numerous activities, including in pastoralism. The setting policy favored by the Mauritanian State should, however, find a new field of application with the Nouakchott-Nouadhibou road. The deep drillings excavated during the construction of the road make water supply easier and therefore allow permanent human installation. Also attractive is the installation of pylons for mobile telephony networks, which becomes an essential instrument of communication, called by the inhabitants. The road becomes a territory where one can take advantages of new opportunities offered by the flows going through. The road returns thus to a question of accessibility but, as we have to say, the level of accessibility, although decisive, is only one factor among others to assess the impact of road infrastructure. Accessibility can be approached in two ways, one quantitative based on graph theory and on the theory of gravitation, the other qualitative based on a series of factors not directly measurable but yet decisive.

A quantitative approach to accessibility

Two tracks of research allow to identify accessibility in a better way: one focuses on the position of the sites in the network, settlements or drillings; the other is more on the attractiveness of these same places on all of the other belonging to the same network.

Differential accessibility of the villages

Accessibility can be evaluated in various ways (Berge, 1967, Beguin and Thomas, 1997, Boeglin and Nedjai, 2000). Calculations applied to Nouakchott-Nouadhibou paved road highlight accessibility very differentiated between the Imraguen villages. Graph simplified tracks within the PNBA network, allows to visualize the localities and the axes connecting them between them and the road paved, from a work survey of tracks by GPS made in 2008. Places, positioned according to their specific geographic coordinates, are connected by straightened lines. First, it take into consideration the accessibility of each of the villages in this network that integrates the Imraguen villages and main human settlements on the paved road. The calculation is to add all the kilometric distances separating each village of all other points of the network. It leads to a matrix to classify villages according to their accessibility. The sum of distances is the lowest is the most accessible. Doing so, the most accessible villages are Iwik, TenAlloul and Arkeiss and the least accessible villages are respectively R'Gueiba, Mamghar and Agadir. Such a result shows the effects of the paved road. Mamghar, for example, major village of the Park was previously its

inescapable position on the trail through the Park. However this village suffers its remoteness of paved road which damages thus its position.

It's also of major interest to calculate accessibility to drilling, vital for the development. Accessibility matrix brings greater access to water for Arkeiss, TenAlloul, Iwik points and bad accessibility for Awguej, uninhabited for several years, R'Gueiba and Mamghar. The construction of the road, needed water by deep drillings, available to all. It led to a new deal which damages the position of some villages. Once appears the case of Mamghar, suffering of its remoteness of the main drillings nearby the new road.

Differential attractiveness of the villages of the PNBA

The accessibility of a place is not sufficient to assess its position in a network. The only distance approach must be complemented by taking account of the attributes of each node depending on the gravity model. This is what allows the calculation of accessibility called potential, revealing the attractiveness of the site. In fact it is strongly linked with two underlying concepts: attractiveness, i.e. the ability of a place to receive flows and emissivity, i.e. the ability of a place to issue flows, in a global network. The selected attributes chosen are: the number of inhabitants, essential element of the theory of central places which, applying the theory of gravitation to towns, stipulates that their attractiveness is proportional to their size; the number of lanches, the local boats, indicator of the major economic activity of the Imraguen and therefore likely to contribute to the assessment of their economic attractiveness; the number of vehicles, essential instruments in the productive capacity and the opening in a circulatory system. From different calculations, not shown in this text, it appears that potentially the most accessible villages are Iwik, Teichott and Mamghar. The case of the village of Mamghar is again interesting: he went from a situation of compelled attendance to a situation of reduced traffic flow to local, most of the vehicles using the road nowadays. Although this village shows a difficult geographical access, as seen in the two approaches to accessibility presented above, it appears, however, as the potentially most attractive village in the park, given the number of vehicles, lanches and its demographic weight, although it is declining rapidly (944 inhabitants in 2000, according to the Census of Population and Housing, 462 inhabitants in 2008, according to the Baseline Survey on Population Imraguen conducted by the Ministry for the Environment and Sustainable Development and PNBA), the first sign of plausible statistical effects of the distance from the road. It is true that he is the chief town of the district and is one of the two functional bases of the Park, the other being in Iwik, these two locations decided by the Park authorities are well in line with calculations attractiveness presented here. However, only Iwik combines a strong appeal and high accessibility. We could also calculate potential accessibility based on the price of water, feed prices, the price of diesel, in fact translation distances as already mentioned. For example, the village of R'Gueiba which is marked by difficult access within the network of villages and the park road and points of water, must bear a price of barrel of 200 liters of water can reach up to 2800 UM (10 euros in 2008), while prices and Iwik or Mamghar oscillate between 1000 and 1500 UM. It is true that water is free in the small villages where the vehicle can ensure the supply cooperative, which is the case of Arkeiss, Agadir, Ten Alloul and Tessot.

The results obtained by the calculation of quantitative indicators of accessibility (graph theory and gravity model) are not sufficient to properly assess the accessibility of a site. It depends not only on the position of the sites in the network in which they fit, but also the subjective nature of the accessibility that is felt and expressed by the population, physical constraints of the environment (soils, climates and natural resources), regulations in force.

Representations of accessibility by the population

Accessibility matters in fact with perceptions and representations. Before the opening of this road, travel between Nouakchott and Nouadhibou took two to four days for four-wheel-drive cars and six to eight days for trucks. To local populations, their move to Nouadhibou has been long operated by the sea on the lanches, their special boats (Lopez Bargados and J.Martinez Milan, 2010). It is always the case for the inhabitants of Agadir. Water and food, for long periods, could only come from Nouadhibou by the sea. Access to the market and other basic services (health, education, water...) was very difficult. In addition, many people died, according to what says the local population, because of the lack of means for a rapid evacuation or by the loss of road in the middle of a desert area without water and without communication network. The use of road vehicles has increased in the 1980s but remained still rare. The proximity of the road boosts residents to move, although most of the Imraguen have no car, even if their number is growing up slowly. But they know all the opportunities available to them to move, whether there are not so many crossing vehicles, cars of the administration of PNBA in mission or, for those who reside near the road, public transport vehicles, even if rare are those who stop to take passengers between Nouakchott and Nouadhibou. Despite difficulties that remain, the families of nomadic pastoralists living in the hinterland and the Imraguen believe however that since the opening of the road it is easier to move, access to services, make purchases and communicate. Only the inhabitants of Mamghar and Ten Alloul say they are more landlocked since the opening of the road, which confirms the already presented quantitative approaches. The old runway Nouakchott-Nouadhibou flows used to get through Manghar and stopped there where the drivers could find shops and places to sleep. The new road which now bypasses the PNBA has negative effects on the people of these two villages, because less and less people choose to drive through PNBA. So the population has to face the paradox of the road. On the one hand they recognize the positive effects of improvement of accessibility: reduction of costs and delays in the movement, promoting the maintenance of existing activities and attracting of new settlements and better ease of access to basic services. On the other hand, they understand that ease of access may become counterproductive and may generate nuisance and pollution caused by the development of traffic resulting from this increased and/or uncontrolled accessibility (Breton, 2003). It is this paradox that officials must be able to manage. Or difficulty is growing up quickly with the effect of the road on the flow of people in the protected area: young Mauritians who are employed on Imraguen boats, South of the Sahara migrants who come to engage in fish processing, shepherds employees with their herds during favorable periods, merchants moving more easily to their customers... Moreover many young Imraguen contract today matrimonial alliances with women "of the city". It has become easier to go to the main towns and they can also easily communicate by mobile phone. Young people believe that the city is more able to satisfy the needs of their families (including school, drinking water, health...). PNBA is considered as a more difficult environment by the lack of services and high living costs (prices of food and especially freshwater which are widely higher than in the city). The road is felt as an opportunity to aim better conditions of life.

The physical constraints of environments

Accessibility is also a matter of natural barriers. The PNBA has a network of trails which for the most part are not marked. The former track, is certainly still dotted with tags, relics of past times. But in most cases, the limits of the trails are not defined clearly, and there are several bundles of tracks that lead to the same destination. Thus, a "trail" may reach a width of several kilometers and is in fact a wide corridor of passage. The state of the tracks is variable according to the frequency of crossings but also their physical characteristics. Usually sandy, the track quality depends on paradoxically especially moisture. Two types of soil characterize the PNBA southern tracks:

-the first type is a sandy soil characteristic of the trails that pass through fields of bright dunes of Azeffal, Akchar, Agneitir, connecting on the one hand the area of the Tijirit where is the southern entrance to the PNBA and the villages (Mamghar, R'Gueiba, Teichott, and Tessot) and, on the other hand, these same villages between them. These tracks are often silted, difficult to cross, especially during the so frequent sandstorms. This may explain the difficult access of these villages and confirm the results of the calculations of geographical accessibility.

-the second type of tracks has to do with sebkhas. The difficulty is the salinity of the soil and the risks of temporary flooding due to salt water. It is the case of tracks connecting the villages including South of Iwik. During rain flows which are certainly rare but can associate brevity and violence and also at very high tides that flood the coastal sebkhas, accessibility degrades very strongly. It can lead to situations of absolute although temporary isolation.

With regard to the connection of the northern villages of the PNBA from Chami to Iwik, Ten Alloul or Arkeiss and from the Wadi Chibkha or Chelkhet Leghtouta to Agadir, tracks usually are flat, hard and sometimes rocky. The Arkeiss-Agadir track which connects the South with the North of the Park is flat, covered with sand more or less hard, and it crosses virtually no sebkha. This is a fairly straight, monotonous, little frequented and traces of cars are rare, hence the absence of cues that can serve as a guide. Agadir is an island. So people need to use motor canoes, exceptionally permitted, from Techekche where the trail stops. Given this set of physical constraints, it is possible to establish that the villages south of the Park (Mamghar, Awguej, R'Gueiba, Teichott and Tessot) are less accessibility than the villages to the North (Iwik, TenAlloul, Arkeiss). That said, the capacity of response of human societies to the natural constraints can limit the effects. Improvement of transport and the expansion of the city of Nouakchott, after the 1970s, gradually changed the major orientation to Nouadhibou, reached by the sea, part of the Imraguen, for the benefit of the capital, despite difficult conditions of land circulation. The road now enables the deployment of a complex set of relationships sometimes to Nouadhibou sometimes to Nouakchott less ordered by the state of the tracks.

A protected area

The specificity of the Nouakchott-Nouadhibou road from other Mauritanian roads lies in its very close proximity with a high place for the protection of the nature, around the world. Over 12 000 km², half of them in marine areas, the PNBA is an exceptional ecological environment of reproduction and nurseries for several animal species. It is the largest marine herbarium of the Eastern Atlantic, the largest area haven for Atlantic migratory animals and the largest wetland area of the Sahara by the richness of its biodiversity. The PNBA, become RAMSAR in 1982 and site of the world heritage of UNESCO in 1989, is the object of attention of international institutions responsible for the allocation of labels and evaluation policies implemented to comply with very demanding specifications. In protected sites, environmental policies seek the most often limit or regulate access to the site on the basis of a number of ecological principles: anthropogenic pressure, capacity, workflow management, etc. The protection policy involves regulations restricting access to certain areas and prohibiting certain types of exploitation of natural and archaeological resources. These closures are in fact that little effective, given the relative weakness of trafficking on the one hand and the lack of controls on the other hand. Increasing pressure on these vulnerable environments, made possible by the nearby road, should result in more restrictive closures. He was raised, among others, a worrying growth of plant poaching. This mainly concerns the cutting branches and two species *Maerua crassifolia* and *Salvadora persica* tree roots in the area of the Agneitir. These species sold in the country and abroad, in Morocco, for example, and also, according to some informants, in the countries of the Gulf, are used in the pharmacopoeia and as toothpicks. But they are also very interesting in terms of feeding the animals and are able to stabilize and fix the dunes and thus combat the silting (Correa, 2003). They are therefore vital for nomads. More serious than this poaching, the risk of

overgrazing is growing with the arrival of herds which shepherds are attracted to areas now easier accessible from the road. One can also wonder about the spectacular explosion of the exploitation of fisheries resources of the Gulf of Arguin croaker, mule, and also skates and sharks during the 1990s and early 2000s. It sparked fears of the PNBA. The ecological arguments led to the ban the exploitation of elasmobranchs, very fragile because of the peculiarities of their life cycles, in 2003 (Worms, 2003). The road came in a crucial moment where the population is under the combined influence of a brutal rarefaction of species traditionally targeted (as the mule), the prohibition of fishing for very lucrative elasmobranchs and increasingly insistent demands of external operators. This leads to a difficult dialogue between Park officials and fishermen. In a country where the recent application of environmental assessment as tools of sustainable development is still fledgling, the presence of the road becomes a real problem: on the one hand, the fear of degradation, possible and which could be irreversible to environment, caused by socio-economic changes, linked to the opening of the road, on the other, hoping to benefit from the impact of better accessibility. The real question posed by the future of the PNBA, after the opening of the road, is that the overflow of the opposition or at least the separation between man and nature, opposition structuring too postures and which is in fact an impasse. Innovation that is a new infrastructure is a generator or an accelerator of territorial Dynamics transforming in depth the relationship between man and his natural environment. It is this hybridization must be issue. The future of the Park is not conceivable off the men who live there.

Linking protection of the environment and human development

The road Nouakchott-Nouadhibou raises the question of conciliation between the socio-economic development of the populations who live there and the protection of nature. This refers to the problem of "sustainable development", or more properly said, according to the term used in the contexts of the protected areas, of "integrated conservation" (IUCN, 1980). This approach attempts to involve the local population in conservation of nature, through an economic valuation of biodiversity (Rodary, 2003). However it must be recognized that the policy of conservation in the PNBA, pushed by numerous non-governmental organizations and many international institutions, is increasingly challenged by population which became rebel ban exploitation of natural resources in a territory regarded as ancestral. This has led the authorities to register in the logic of the policy of "integrated conservation" which articulates the nature conservation, resource management, development, human and socio-economic acceptance requirements. This policy also leads to "invention" of an identity of "green" in the Imraguen (Ould Cheikh, 2010).

In fact, it is the policy of nature conservation which is in the spotlight. Out of what might be an impasse, it should implement a permanent dialogue. The attitude of local actors to benefit locally road is logical. It must therefore support the modernization of the existing production units, so-called "endogenous", develop suitable storage centers, encourage the purchase of the new tools of production (lanches, nets...), processing and transport. New attractiveness that causes the road must be thought in terms of local development strategy: while it is not possible to accept permanent installations in the park itself but its outskirts, along the road, is likely to accommodate new economic players from outside of the considered territory and acting in the Park in consultation with stakeholders already implanted premises. The most obvious is to enable the populations concerned to best capture the road as a factor of an improvement in their living conditions, while ensuring that there is not a rise of conflicts between different levels of players competing for scarce resources, or degradation of the environment such that it would impair the populations themselves.

Reconciling effectiveness, expectations social, financial and technical

This paper aimed to clear many crucial questions.

The first is the need for further essential investment effort to open the still largely landlocked territories, whether certain States or regions, yet neglected by modern infrastructure. But such an effort requires funding which exceeds the possibilities of the majority of sovereign States. The call for international aid is indispensable but obviously means subscribe to the requirements imposed by international organizations, to the first rank of which the IMF and the World Bank. Sectorial programs for transport, which have the States concerned by this study, are part of this logic of submission requirements commissioned by the global liberalization of international trade. Among the partners of these policies are the European Union and China. Rare are still local businesses that can take a chance on this niche. Some examples however, particularly in Burkina Faso, prove that the challenge is in the scope of local entrepreneurs, dynamic and competent.

The second deals with all required maintenance of open traffic lanes. What could be put into service new sections tarred if the previous sections were so degraded that they cannot ensure the traffic correctly. The crisis of public finances in most of West African States, the past decade, obviously related to the fragility of their exporting abilities on too limited niche, accompanied by a strong deterioration of road infrastructure. Reclamation is almost everywhere before necessary even to consider the extension of the tracks. The observed economic improvement since five years allows them to undertake effective rehabilitation programs, here again with the valuable assistance of external partners.

The third refers to the development of exchanges, decisive instrument of rapprochement of peoples and States, engine for a growth of productive activities carrying of progress and development. Extending road networks responds in fact growing deployment of commercial activities that characterized throughout West Africa. "The large West African traders operate as well regional than national, transboundary and intercontinental. They indeed tend to put in place several structures which, heavily nested, allow them to cover these different scales simultaneously and at less expense. (...) This territorial registration of merchant networks materializes by correspondents, dependents, brokers, landlords, purchasers - collectors, permanent resellers (...). If cities and countryside fit into an overall spatial strategy, it remains no less that the first are the privileged place where is manages the occupation of commercial space, focus media material and financial market activities and the infrastructure, and to converge the information." (Grégoire and Labazée 1993 p.22). The growth of transport activities and the rise of local and regional actors, alongside major international groups such as group Bolloré and Maersk Logistics, illustrate an often overlooked vitality. The unions of carriers are now a force of economic and political importance to all of these countries.

The fourth also returns to service ports, gateways to the world, enclaves of the world economy, major activities, concentration of population came from across, synapses of Africa in its contact with the main regular lines of international shipping that they seek to capture. Those of the port cities that will be better connected to the rest of the Inland territories, those who will be the best related to backcountry in growth, will have the most assets to capture the ship-owners, insured to find sufficient cargo to profit from their stopovers. Each coastal State thus has interest to build good roads to reach inland and landlocked States. They also seek by all means put them in competition ports and do not depend on one of them. The case of Mali who decided the creation of the "Entrepôts maliens", in all major ports from Nouakchott to Cotonou illustrates this will loosen the straitjacket of the link preferred with Abidjan. The Malian road network is tailored to this political will (Benjamin Steck. 1996)

The fifth deals with the problem of development, i.e. the problem of spatial equity, moreover sustainable development. Territorial imbalances are compounded by reticular imbalances. Increase the effort of serving territories in difficulties is a considerable but inevitable challenge. Gold trend, as everywhere, is rather to strengthen capabilities of the sections already the most active and best equipped. International links are more preferred, given the growth of internal trade and especially the will of more and more clear to firmly establish regional cooperation, an ambitious program of economic union, or even monetary (Debrie 2001). Anyway, for developing States, it is not question to consider in the immediate future, given the costs, the development in relation to the set of the points of the territory by paved roads. What is needed is optimize the network by a reflection on reticular trees. Absolute connectivity has no meaning. The touting on privileged axes is the most effective way to operate a development in relation to coherent and less expensive though even it leads to accentuate first spatial inequality. Still more important for the future is the environmental emergency. Networks must be decided and built to serve people and not to destroy their living environment.

The launch of NEPAD, this great ambition for a new beginning for Africa, in partnership with the most developed States, express very clearly the urgent need for an ambitious program of infrastructures of any type, and road plan in particular, to advance towards development.

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