XXIIth World Road Congress
Special Session of C20 Committee: Appropriate Development

ECONOMIC EVALUATION OF LOW TRAFFIC ROAD CONSTRUCTIONS

By : A. RMILI & I. BENAZIZ
Direction des Routes et de la Circulation Routière- MAROC
phone : 037713258- 037713247
fax : 037713259/61
e-mail : rmili@mtpnet.gov.ma
benaziz@mtpnet.gov.ma

ECONOMIC EVALUATION OF LOW TRAFFIC ROAD CONSTRUCTIONS

Summary

Models developed for the economic evaluation of road projects are generally based on the costs and advantages related to the traffic. Usually, these models aren't adapted to cases of roads with low intensity traffics. In order to consider a wide range of benefits induced by other economic functions of the road, the Moroccan Road Directorate has developed an economic evaluation model for the low level traffics roads.

The specific feature of the model implemented is that, in evaluating the economic return of road projects, it includes not only the standard benefits derived from this type of project, such as reduced costs and transport time, but also the benefits stemming from the economic development of the area in witch the project is located. The latter, which are known as «exogenous benefits» mainly, concern the developments in agriculture and tourism. Sub-model to assess these exogenous benefits specifically were developed as part of the study.

The direct benefits (known as endogenous benefits) were quantified using the HDM-4 model which is a software program for assessing the economic return of maintenance policy and road projects. The specific feature of this program is that it models the relationship between traffic intensity, pavement deterioration and traffic conditions in terms of both time and cost.

All the data resulting from the modelling process described above, was then consolidated in order to calculate the indicators for assessing the economic project aspects.

Impact on the development of agricultural and animal farming

Depending on the agricultural potential in the area of a project influence, the model quantifies project benefits by comparing the added value for agriculture in reference to current situation with that of the project situation. The added value is the result of the increase in agricultural productivity due to the progress in technology resulting from improved access to input and training. There may also be a change in speculation generated by greater opening up to external markets on one hand, and the increase in the size of the cultivated fields due to the reduction of the fields left fallow following on from the progress in agricultural technology.

Impact on the development of tourism

The methodology used is based on an econometric modelling process which permits to quantify the effect of a construction of new paved road on tourism.

The dependent variable chosen was the variation in the tourist trade represented by the hotel capacity indicator. Modelling takes into account several dependent variables including the improvement in the road network during the period under consideration. Data related to the changes in road networks during the analysis period was provided by Local Administration of Equipment Ministry.

This economic model has been applied to a sample of roads constructions projects. The results show that their economic returns enhanced while taking into account exogenous benefits. The variations are very significant for areas with high agricultural and tourist potentials.

I - Introduction

In Morocco, most of low traffic roads have local incidence on the displacements if rural populations to facilities and basic services. Besides, they are a link between these populations and the road network. Thus, they facilitate the integration of these populations to the remainder territory.

Needs of road construction generally overpass the financial resources affected to this effect. It requires a rigorous selection of projects of road construction in order to achieve most advantageous among them. Thus, the economic evaluation of projects constitutes a precious tool that helps to take decisions based on road investments.

The more used method on road projects evaluations is the classic analysis of costs - advantages. It consists in valuing in monetary terms costs and advantages of the project procured to the community. However models that are developed to this effect take costs and advantages focus on traffic as a main variable and are less accurate when it is about low traffic roads. Based on this fact and in order to widen effects of a road construction to other economic sectors, the “Direction des Routes et de la Circulation Routière” (DRCR) developed an economic evaluation model adapted to low traffic road construction.

This model has been developed to provide a built-in tool that permits to measure the economic benefits for the community of the construction of a gravel or a paved road donned, whose economic impact is above all local while permitting to reduce isolation of a region by offering a comfortable accessibility. The aim of this model is to take into account the main impacts of road construction on concerned economic sectors, that is to say mainly agriculture, farming and tourism. One may add the usual effects on displacements of people and on other goods transportation.

While facilitating links with the surrounding regional agricultural markets, roads in rural environment can contribute to the improvement of production techniques already used as well as to the change of cultures in the road influence area. In the same way they can contribute to enhance accessibility to isolated tourist sites.

This communication presents the methodology used, the structure of the developed model and some specific results of the model applied to a sample of seven projects proposed by the DRCR.

II - CONSISTENCE OF THE ECONOMIC EVALUATION MODEL

The developed model has the particularity to include in its economic evaluation of a road project, besides the classic benefits procured by this project such as cost and time reductions, other benefits bound to economic development in the project area. These benefits so-called " exogenous " advantages mainly concern the development of agricultural and tourist sectors. Specific sub-models to estimate these exogenous benefits have been elaborated therefore in the setting of the survey done.

The clean benefits (so-called endogenous benefits) to the road project are quantified using the HDM-4 model whose particularity is to make relations between the intensity of the circulation, the deterioration of pavements and conditions of vehicle circulation in time and in cost.

The set of presented elements issued from modelling described above are then reconsidered to calculate indicators of the economic balance of the project.

II-1 The exogenous benefits

The exogenous benefits that have been taken in account in the economic evaluation of the road projects are:

- the impact on the development of agriculture and farming,
- the impact on the development of tourist activities.

A specific sub-model has been developed for every considered effect.

II-1.1 IMPACT ON THE DEVELOPMENT OF AGRICULTURE AND FARMING

a) delimitation of agro - ecological area

The first stage of the development of the model of new road impact on the agricultural activity consisted in a map carving into 27 homogeneous agro-ecological areas based on the combination of several criteria such as the climate, the relief, resources of soil and agricultural potentials.

This step achievement is based on a exhaustive revue of studies achieved in Morocco through a bibliographic investigations on previous studies and surveys, and also on discussions with experts of the Ministry of agriculture that have participated to these studies.

b) The actual impact model

Depending on agricultural potentialities of the project influence areas, the model quantifies the project benefits while comparing the agricultural added value in the reference situation to the situation with project. This increase of the value added is due to a higher agricultural productivity allowed by technological changes due to a better access to entrants, by an enhancement of farmers qualifications, by a possible change of speculation induced by a better access to markets and by a growth of cultivated surfaces.

A detailed description of production techniques (intermediate consumptions and outputs) has been achieved for the present situation and for a situation improved according to two scripts (maximal and minimal), where a bigger part of agriculturists of the agro-ecological considered area would adopt a more effective techniques of production, and would put in more remunerative and speculative cultures.

Consultations of experts permitted to determine surfaces and outputs of different technology levels at the level of project influence areas to value.

c) Results of model application to the selected projects

Two types of road constructions have been considered:

- construction of a gravel road: this operation consists in resurfacing an existing road by reloading the surface layer using a standard thickness;
- construction of a paved road: it is about to upgrade an existing gravel road to a paved standard.

The exogenous benefits have first been estimated in the case of the construction of a paved road, then adapted to the case of the resurfacing by applying a valued coefficient designed to this effect.

The application of the agricultural model to the sample of seven retained projects gives the results presented below in the table1, for the tenth year after the projects achievement (end of the period of rise in charge or "Build-up effects");

By comparison to reference situations, the agricultural added value raised in a wide range : between +2,3% for the TA01 project (resurfacing) and +18,7% for the TZ01 project (construction of a paved road).

Table 1-

Project	Type of works	Length (km)	Agriculture		Farming	
			added-value (1000 DH)	Evolution (%)	added-value (1000 DH)	Evolution (%)
TA01	Resurfacing	13.0	780	2,3%	106	2,6%
OU01	Paved road	28.6	3 272	10,5%	277	6,1%
AZ01	Resurfacing	35.0	926	4,7%	199	4,8%
SA01	Paved road	24.0	5 780	11,8%	249	6,7%
TZ01	Paved road	48.7	4 015	18,7%	161	6,4%
AL01	Resurfacing	27.0	3 276	9,2%	158	4,5%
TZ02	Paved road	33.0	799	18,6%	241	10,5%

II-1.2 IMPACT ON THE DEVELOPMENT OF TOURISM ACTIVITIES

The aim of this sub-model is to measure the road construction impact on the development of tourism in monetary terms in order to value the tourist benefits generated by the road project.

a) Analysis of the tourist sector in Morocco

As a first step, an analysis of the Moroccan tourist sector has been proceeded as well as a review of an exhaustive data compilation used thereafter in modelling and sensitivity analysis. The data was essentially extracted from the Statistical and the well stocked complementary information directly by the Ministry of the Tourism concerned the evolution of the hotel capacity notably, the tourist company as well as of tourist site inventories at the level of provinces.

b) Development of an impact model

The used methodology is based on a econometric modelling permitting the quantification of fallouts on the tourism of the creation of one kilometre of construction. The analysis of the tourism activity increase has been made by province.

The chosen explained variable is the variation of the tourist activity represented by the indicator of hotels capacity. The modelling takes into account of several explanatory variables among which the improvement of the road network during the considered period.

Depending on the road length to construct, of the degree of tourist vocation of this road and on the region in which is located the road construction, the model permits to estimate the number of beds created. The benefits related to the increase of the tourist activity are calculated while comparing the tourist increment in situation of reference to the situation with project while taking account of the complementary tourist investments to achieve.

c) Application of the model to the selected sample

The application of the model evaluation of the impact of the new road construction on the tourism gives the following results for the sixth year (end of the period of "Build-up"), out investments done during the first five years:

Table 2-

Project	Length (km)	Province	Tourist vocation of the road	Added value (1000 DH)
TA01	13.0	Taounate	No	-
OU01	28.6	Taourirt	No	-
AZ01	35.0	Azilal	No	1 032
SA01	24.0	Safi	No	1 699
TZ01	48.7	Taza	No	-
AL01	27.0	Al Hoceima	Yes	982
TZ02	33.0	Taza	No	-

II-2 THE NON EXOGENOUS BENEFITS

II-2.1 Description of non exogenous benefits

The non exogenous advantages are constituted by costs savings on vehicle exploitation between reference and project situations, as well as those of gains on journey time. Their evaluation has been achieved using HDM-4 model, taking into account the interaction between the pavement behaviour, traffic and conditions of circulation (speed, deterioration and exploitation vehicle cost).

This part of the survey required:

- the determination of exploitation vehicle costs circulating in Morocco,
- the development of a traffic projection sub - model in order to evaluate the traffic growth on regional roads (formerly secondary roads and tertiary paths) of Morocco for the future years,
- the evaluation of the traffic generated by the project.

II-2.2 Determination of Exploitation Vehicle Cost

The determination of exploitation vehicle costs is the basis of the advantage evaluation process related to costs transportation savings induced by the road project. The set of the elementary unit costs of vehicle exploitation by class expenses have been collected and analysed then for the main types of vehicles circulating in Morocco regrouped according to the decomposition of the EVC of HDM-4 model.

EVC Data have been pulled of various documents published notably by the Ministry of Transportation and the Ministry charged of the Economic Business then completed from investigations and interviews achieved by professionals (carriers, car sale’s, mechanics, importing and wholesale, etc.).

II-2.3 Projection of Traffics

The future traffic evaluation in situation of reference and in situation of project required the clarification of a sub - model of specific traffic projection in order evaluate the traffic growth in the project duration and the traffic growth induced by the road quality improvement after construction.

(i) Traffic in reference situation

The traffic growth model is based on a econometric approach. It explains the growth of the circulation on the secondary and tertiary roads of Morocco by a set of meaningful explanatory variables. The variable that has finally been kept to explain the evolution of the traffic growth is the gross domestic product of Morocco that characterizes the economic activity as a whole.

These econometric models are in the form of Traf = f(GDP) (where Traf is an indicator of traffic and GDP is the gross domestic product). They have been adjusted therefore to all Morocco regions and to five sets of homogeneous provinces of the point of view of profiles of traffic evolution. The used sources are the yearly road numbering compilations done by the outside services of the DRCR and that provide traffics (TMJA) and the composition of the traffic by category of vehicles and by section of road.

(ii) Traffic induced by projects

The evaluation of induced traffic based on analyses of traffic profiles evolution on the newly constructed roads for a few years, starting from the road construction. According to the initial traffic intensity, one was able to thus to estimate coefficients of induced traffic (between 2,0 and 4,5) and the duration of the rise in charge of the induced traffic (between 6 and 10 years).

II-2.4 The gap of maintenance costs

To benefits procured by costs vehicle exploitation savings and by gains in term of shortening travel time, it is necessary to add differences of maintenance cost of roads between situations with and without project.

The yearly maintenance costs are defined using HDM-4 model from the elementary operation sequences defined in the general politics of road maintenance applied by the DRCR.

III – Application of the global model to the sample of seven projects

The model that has been developed has been applied to a sample of seven road projects to value the economic profitability : the calculation of the internal rate return (IRR).

The table3 below compares values of the SORTING " with " and " without " the exogenous advantages for the seven studied projects. For some projects the hold in account of the exogenous advantages modifies the appreciation of the economic interest that can be made very meaningfully, if the road is in a strong agricultural or tourist potentials area.

Table 3-

Project	Nature of works	Without exogenous benefits (%)	With exogenous benefits (%)
TA01	resurfacing	7.4	22.1
OU01	paved road	8.3	18.5
AZ01	resurfacing	36.3	39.6
SA01	paved road	16.8	35.5
TZ01	paved road	23.9	28.5
AL01	resurfacing	23.8	45.5
TZ02	paved road	33.9	35.4

IV - CONCLUSION

The use of the economic evaluation model of the road construction to a sample of roads shows that the projects economic profitability is enhanced because while taking into account the main exogenous benefits. This improvement is very meaningful when the road is situated in an agricultural or tourist potentials area.

The developed model is based on the Advantages costs analysis. This approach is recommended when project impacts can be expressed in monetary terms. When some impacts can be valued in monetary terms and others cannot, it may be useful to use a multi criteria analysis in complement of the costs-advantage analysis.