Impact Evaluation of Rural Road Improvement Project in Morocco

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Evaluation Team

NISHINO Hiroshi	Evaluation Department, JICA / Metrics Work Consultants Inc.
ASAOKA Hiroaki	JICA Research Institute
SEKI Mai	Ritsumeikan University
YAMADA Eiji	JICA Research Institute

要旨

本報告書では、モロッコで実施された円借款事業「地方道路整備事業（II）」を対象として実施されたインパクト評価の結果を報告する。

本事業は、モロッコの地方部 5 県において、地方道路の整備を行い沿線住民の交通アクセスの改善を図ることで、地域住民の生活水準改善及び地域間格差の是正に寄与することを目的として実施された。本インパクト評価では、整備された 17 路線と整備の対象とならなかったが整備路線と類似する 18 路線を慎重に選定し、それらの道路周辺世帯の整備前後のデータを収集し、差の差法（Difference-in-Differences : DID）と呼ばれる評価デザインを用いて、道路整備の因果効果の検証を行った。

分析の結果、道路建設は公共交通の利用（通学バスを含む）、市場へのアクセス、就学に対し、統計的に有意な正の効果があったことが確認された。就学に関しては特に女子の中等教育への効果が顕著であった。経済的な側面では、農業セクターと自営セクターにおける就業と収入について、全体としては減少傾向にあるものの、道路整備を行った地域ではその減少幅が小さいことが確認された。同様に、道路整備を行わなかった地域では世帯支出が事業前後で減少したにも関わらず、整備を行った地域ではそうした減少が見られなかった。効果検証の前年に起きた深刻な干ばつの影響を勘案すると、これらの結果は道路整備が負の天候ショックの軽減に寄与したことを示唆すると考えられる。他方、期待されていた効果のうち、保健サービスの利用や農業生産、世帯の資産状況といったアウトカムに関する効果は確認されなかった。

これらの結果からは 2 つの政策的含意が示唆される。1 つは、精緻な定量分析によって、地方道路整備が実際に周辺住民に様々な側面から正の効果をもたらしていることが明らかになった。こうした結果は、地域レベルなどでの集約されたデータや質的な情報に基づくことの多い従来の道路整備事業の効果検証結果を補完するものであると考えられる。また、いくつかの側面では期待されていた効果が発現していないものもあり、道路整備がどの面においては実際に有効であり、どの面においてはそうではないのかという点を丁寧に検証していくことが、道路整備の効果を適切に理解する上で重要となる。

2 つ目は、道路整備と他の政策との補完関係を考慮に入れることの重要性である。例えば、本評価の結果からは、道路整備と通学バスの存在が女子の中等教育への就学に対し相乗効果をもたらしていることが示唆された。道路整備の潜在的効果を十全に発現させるためには、このような形で補完的な政策を合わせて検討することが重要であると考えられる。

Summary

This report presents the result of the impact evaluation of the Rural Road Improvement Project in Morocco.

The objective of this project is to enhance access to road infrastructure by rehabilitating and upgrading rural roads, thereby contributing to the improvement of living standard of rural population and decrease in the urban-rural gap. In this impact evaluation, we carefully selected 17 roads which were rehabilitated by the project and 18 roads which were not rehabilitated but shared comparable characteristics to the rehabilitated roads and collected data on various outcomes from households along these roads before and after the project. Then, we analyze the causal effect of the road rehabilitation employing a difference-in-differences approach.

The analysis shows that the road improvement has positive and statistically significant effects on the use of public transportation including school bus, access to markets, and school enrollment especially for female secondary education. From an economic aspect, although the employment and earning in agricultural labor sector and self-employment sector decrease between the baseline period and end-line period in both treatment and comparison areas, the results show that the decrease was smaller among the treated households than the comparison households. Similarly, the estimate shows net positive effect of the road improvement; per capita household consumption of the treated households was unchanged in contrast to the decrease in the comparison households at the end-line period. Given the serious drought occurred nationwide in the cultivation season of 2016/17, these results suggest that the project contributed to mitigation of the negative climate shock to some extent. On the other hand, though it was expected, no remarkable effect was found on several outcomes, such as health condition, the use of health services, agricultural production, and household assets.

The results of this impact evaluation have several policy implications. First, the quantitative rigorous analysis reveals that the rural road improvement indeed has positive impacts on a range of outcomes and affects the livelihood of rural residents in a various way. The findings would provide important information to complement JICA's conventional evaluations of rural road improvement projects in which the project impact tends to be analyzed by using aggregate indicators such as region-level indicators or qualitative information. Because no impact was found for some expected outcomes, it is necessary to carefully examine which changes were actually brought about as expected and which ones were not in order to fully understand the impacts of the road improvement project.

Second, it would be also important to consider complementarity between the road improvement and other policies. For example, the result suggests that the combination of road improvement and provision of school bus services has a synergy effect on the school enrollment of female students. As such, in planning similar rural road improvement projects, complementary policies should be considered for potential impacts to be fully materialized.

1 Introduction

The transport sector in Morocco played an important role in its socio-economic activities, accounting for 6% of its total GDP and creating 10% of urban employment. In particular, road transportation was of great importance conveying 90% of inter-city land passengers and 75% of inter-city land freight. Despite its importance, there was a substantial delay in the development of road infrastructure in rural areas. While more than 80% of major roads in Morocco—highways, national roads, and regional roads—was paved, nearly 50% of rural population was lacking a reasonable access to road infrastructure (JICA 2011a, 2011b)[1].

The limited access to roads in rural areas had been considered as one of the constraints to the rural development by hindering rural population from economic opportunities and social services. While only 1.1% of urban population was living under the national poverty line, the poverty rate in rural area reached 8.9% as of 2014 (High Commission for Planning 2015). In the social dimension, although there had been a remarkable improvement in the previous several decades, gaps in social indicators between urban and rural areas remain; the net enrollment rate in the secondary education in rural area was 30.7% compared to 84.9% in urban area, and under-five mortality rate was 25.4 in urban area and 35.0 in rural area for each 1,000 live births (Ibid).

Given this situation, Moroccan government launched the National Rural Roads Plan (Plan National des Routes Rurales: PNRR) I and II in 1995 and 2005 respectively , the national rural road improvement programs, aiming at assuring 80% of rural population of the access to reliable road networks by constructing and rehabilitating 11,200 km and 15,500 km of rural roads, respectively. Japan International Cooperation Agency (JICA) has supported these initiatives through two loan projects (Rural Road Improvement Project I and II [loan agreement signed in 2008 and 2011 respectively]) which provide concessional loans of 8,439 million and 5,981 million yen, respectively.

While these initiatives are expected to improve living standard of rural population and stimulate the rural economy by ensuring access to road infrastructure, there has been little rigorous evidence to date whether road construction actually deliver these expected outcomes to the rural population. Understanding the impact of these initiatives is of high relevance for policy makers because it would provide a knowledge base to inform future decision making and help both Moroccan and Japanese governments achieve accountability of such large investment. Given

[1] According to JICA's project document (2011a), rural road accessibility is defined as the proportion of rural population who lives in "douars" (villages) of at least 50 households and are located within one kilometer from an all-weather road.

this, JICA conducts a rigorous impact evaluation to examine the impact of the improvement of road by the Rural Road Improvement Project II on the livelihood of households living along the improved roads.[2]

This report presents the result of the impact evaluation. The rest of the report consists of the following sections: Section 2 provides a brief description of the intervention to be evaluated. Section 3 describe the evaluation methodology and data. Section 4 presents the results, and Section 5 summarizes the results and discusses policy implications.

[2] A rigorous impact evaluation is defined as an assessment of "the causal effects (impacts) attributable to specific interventions, where the outcomes of interest are compared with a counterfactual situation－that is, with what would have happened without the program" (IEG 2012, 14). For further explanation, see Gertler et al. (2016) or Khandker et al. (2010).

2 Rural Road Improvement Project II

2.1 Description of the Project

The first Moroccan national rural road program (PNRR I) was launched in 1995. The program rehabilitated and upgraded more than 11,000 km of rural roads, contributing to the increase in rural road accessibility from 45% in 2002 to 50% in 2005 (WB 2011 p1). However, the result was still below a policy target, and thus, the government started the second national rural road program (PNRR II) in 2005 to accelerate the pace of rural road improvement aiming at assuring that 80% of rural population have access to paved roads. The program has been financed by various development partners including World Bank, African Development Bank, European Investment Bank, French Development Agency, and JICA, in addition to Moroccan government itself. JICA's first project to support PNRR II, Rural Road Improvement Project I, was implemented between 2008 and 2015 and financed the construction of 67 sections in nine provinces with the total length of approximately 835 km.

Rural Road Improvement Project II, which is examined in this impact evaluation, is to finance JPY 5,981 million for the improvement of rural roads (530 km in total) in five provinces (Al Hauze, Chefchaouen, Essaouira, Safi, and Settat) in the framework of PNRR II. It was expected that more than 163,000 people in rural areas would gain access to an all-weather road by this project. More specifically, the project paves 30 sections of rural unpaved roads (on average 17.7 km per section) and widens the roads to allow two-way traffic. Figure 1 shows an example of a road before and after the improvement.

The loan agreement between the governments of Morocco and Japan was made in July 2011. While the commencement of construction works varies depending on sections, the first work started in February 2012. Timing of completion also varies, and construction works of the last road subject to this evaluation were completed in June 2016 (See Figure 2 for the timeline of project implementation and surveys). Each road started to be used by the populations once its construction works completed.

2.1 Selection of the target roads

The selection of roads to be constructed/rehabilitated by this project took several steps. First, the provincial offices of "Direction des Routes[3]" in each province prepared the priority list of potential roads to be constructed under not only this project but also the PNRR II as a whole. The size of population covered by each road was one of the most important criteria for the

[3] Roads Directorate within the Ministry of Equipment, Transport, Logistics and Water.

inclusion in the list, and other criteria such as the number of markets, schools, and health facilities along roads, and the connectivity to existing road networks were also considered. Then, the list was scrutinized by communal, provincial, and state assemblies to accommodate the local needs and preferences, and some modifications were added. This process reflected the lessons learned from the PNRR I whose target roads had been selected by top-down process. Because communes are supposed to be responsible for the maintenance of roads after the construction, the participation of local authorities was regarded as crucial to ensure the sustainability of the roads.

Before the improvement After the improvement

Figure 1 Example of an Improved Road

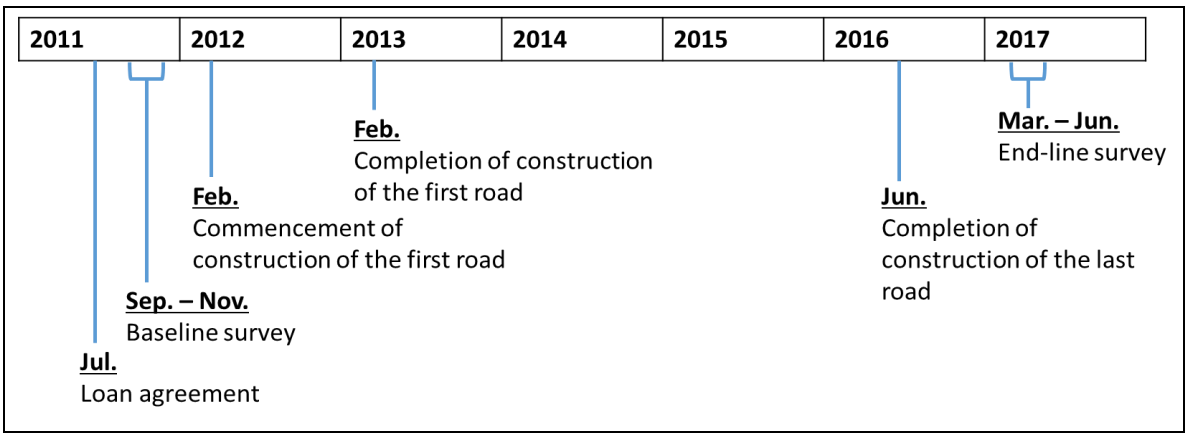

Figure 2 Timeline of Project Implementation and Surveys

The lists prepared by each province was assembled at the central level by the Ministry. Then, the target roads of this project were drawn from this list by JICA considering the preparedness of construction plan, coverage of other donors, and the necessity of land acquisition and/or resettlements, and then 30 roads were finally identified.

3 Methodology and Data

3.1 Identification strategy

The conventional JICA's evaluations tend to employ before-after comparison or simple with-without comparison for the estimation of project impact. However, these methodologies have a high risk of bias and cannot necessarily detect accurate project impact. A before-after comparison of project beneficiaries cannot control for any other factors than the intervention, such as overall economic situation, policy changes, or weather condition, which might also affect the outcome of interest. As a result, it becomes very difficult to decompose the observed before-after change into impact of the intervention and that of other factors. For a simple with-without comparison, because beneficiaries of the intervention are usually determined by targeting process or self–selection, beneficiaries are likely to have different characteristics than non-beneficiaries even without the intervention. Therefore, this methodology also fails to separate out the effect of initial differences from the observed with-without difference.

To establish evidence of the accurate project impact, it is necessary to compare an outcome of project beneficiaries with the counterfactual, a hypothetical outcome which would have been

achieved in the absence of the intervention. Thus, the central issue in impact evaluations is to appropriately estimate the counterfactual which cannot be directly observed. While random assignment of the intervention is an ideal way to estimate a credible counterfactual, it is not always feasible to randomly assign the intervention particularly for infrastructure projects, and this project is not an exception. Therefore, we employ the following two strategies in order to have an appropriate estimate of the counterfactual.

First, we carefully selected comparison roads which are as "similar" to the target roads as possible based on observable characteristics but were not improved by the project. Because the target roads of this project were determined by the selection process described above, other roads which were not selected as the target road may have different characteristics than the target roads, making them an inappropriate comparison group and naive with-without comparison biased. Therefore, we asked the "Direction des Routes" in each province to list several roads which were most similar to each of target road based on the same criteria considered in the selection process: size of population covered by the roads, the number of markets and facilities, and connectivity to the existing road networks. Then, the evaluation team identified one comparison road to each target road considering the criteria and the location of each road.[4]

However, although we carefully selected similar comparison roads, it does not ensure that the comparison group are similar to the treatment group in terms of unobservable characteristics as well because the similarity was determined by a few observed variables. Thus, as a second strategy, we employ a difference-in-differences (DID) method which is a combination of before-after comparison and with-without comparison. This method compares before-after changes in outcome over time between the treatment and comparison groups, considering change in the comparison group as the counterfactual of change in the treatment group. Taking before-after change in outcome (first difference) controls for factors which are constant over time in the group and might affect the outcome of interest. In addition, by comparing the treatment and comparison groups (second difference), we can cancel out any external factors other than the intervention which affect the both groups because the both groups are expected to be exposed to the same sets of socio-economic events. In this manner, the DID method eliminates potential source of biases both the before-after and simple with-without comparisons have and is expected to yield unbiased estimate of the project impact.

Empirically, we use the following regression model to estimate the impact.

[4] There are several target roads that had no candidate for their comparison road. These roads were excluded from the evaluation sample. The location was considered to avoid contamination.

$$y_{it} = \alpha + \beta_1 D_i + \beta_2 T_t + \beta_3 D_i * T_t + X\gamma_{it} + u_{it}$$

where, y_{it} be an outcome variable of interest for household/individual i at period t. D_i takes the value of one if household/individual i resides along the treatment roads and zero otherwise. T_t is a period dummy equal to one for pre-intervention and zero for post-intervention. $D_i * T_t$ is an interaction term of D_i and T_t, and its coefficient, β_3, is the parameter of interest which indicates the project impact on outcome y. X is a set of household and individual time-variant characteristics. u_{it} is an error term which is clustered at the douar level.[5]

3.1 Data and sample

Data used for this impact evaluation were collected in two rounds of original survey conducted by local survey firms hired by JICA. The first-round (baseline) was implemented during September-November, 2011 before the commencement of construction works. The second-round survey (end-line) was implemented from March to June 2017 approximately 2-5 years after the completion of construction[6]. In each round of survey, we conducted household survey and douar[7] survey. The household survey collected a variety of socio-economic variables of households and individuals including, but not limited to, basic demographic, access to facilities, economic activities, education, health, assets, and consumption. The douar survey was carried out to collect data on basic douar characteristics, availability of transport services, goods availability and price, infrastructure, etc. In the second-round survey, the same households and douars were surveyed again to construct panel data.

[5] In estimations of some outcome variables, we employ different specifications using different sets of samples. See footnotes of each tables in the following section for the details in specifications and samples used in each estimation.

[6] Due to logistical reasons it was impossible to conduct the endline survey in September-November as the baseline survey. The difference in the survey months might affect variables that are sensitive to the seasonality.

[7] Douar is a cluster of houses (small villages) in rural area which is used as the primary sampling unit in this survey.

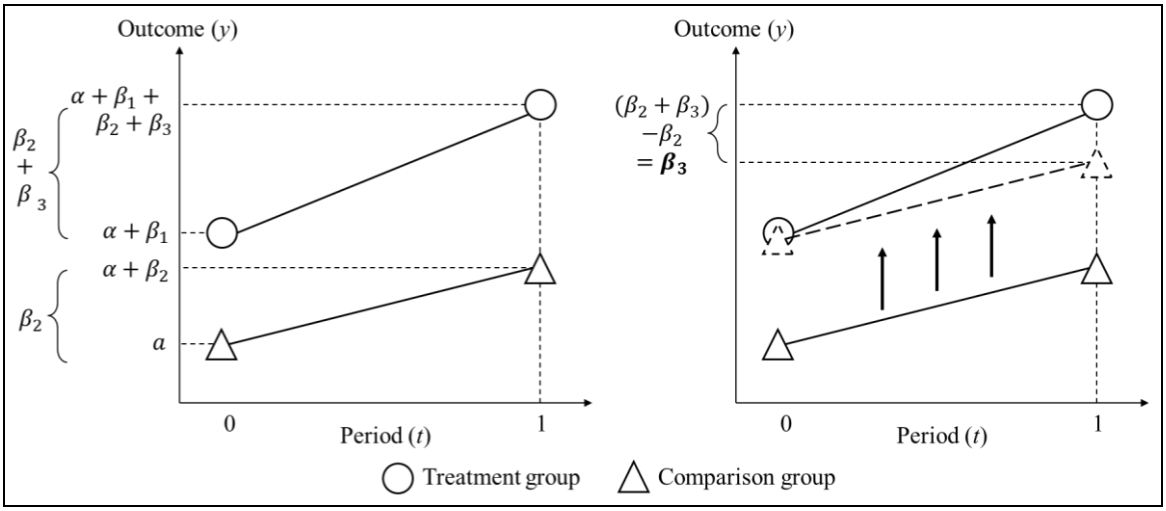

Figure 3 Difference-in-Differences

Table 1 Sample Size

	Baseline survey (2011)		End-line survey (2017)	
	Treatment	Comparison	Treatment	Comparison
Road	17	18	17	18

There were some additional components in the second-round survey. Since more than five years had passed from the baseline survey, we expected that a certain number of individuals moved away from the original douars and could not be re-interviewed. To address this possibility, we conducted phone survey to track individuals that migrant out and conduct interview via phone. In the phone survey, a range of information such as reasons for the out-migrant, occupation and well-being just before and after moving away and at the time of the interview, and relationship with the original household was collected. Detailed road observation and driver interviews were also conducted on selected sample roads, and basic information on communes where the surveyed douars are located was also collected to supplement the data collected in the household and douar survey.

Commune	27	21	27	21
Douar	75	69	75	69
Household	760	694	748	669
Individual	4,710	4,271	4,974	4,405

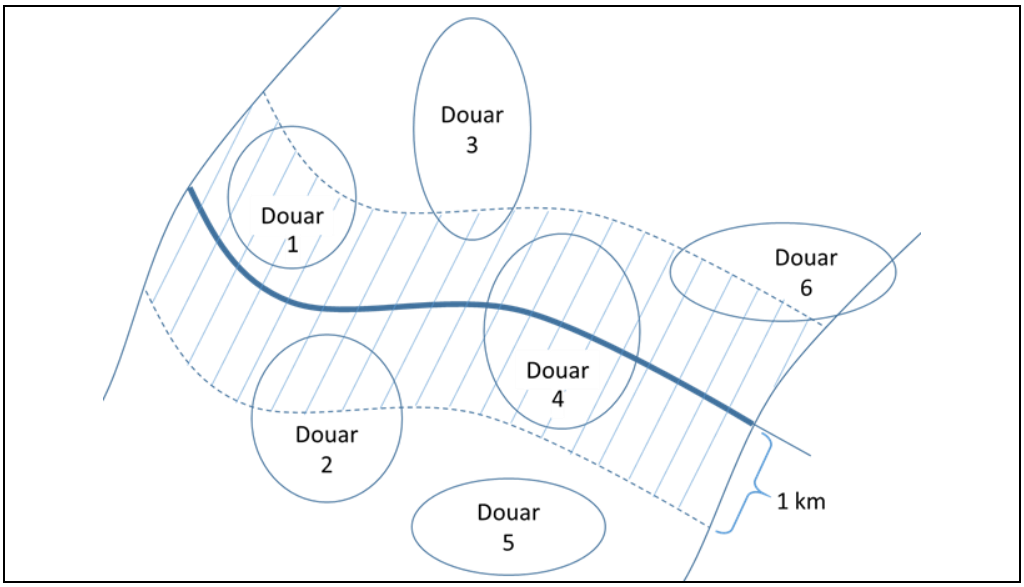

Figure 4 Catchment Area and Sampled Douars

The sample size in the baseline and end-line survey is shown in Table 1. The number of households which could not be followed up in the endline survey (attrition) is negligible: 12 (1.58%) in the treatment group and 25 (3.60%) in the comparison group. The sample (individual) includes ones who migrated out from original douars but recovered by the phone survey (442 in the treatment group and 385 in the comparison group).

In the sampling of douars, as shown in Figure 4, we defined the catchment area of each road (bold line) as an area within one-kilometer distance from each road (striped area) following the national definition of rural road accessibility and randomly selected five douars per road located in the catchment area[8].In each douar, 10 households are randomly sampled for the household survey[9].

3.2 Outcome variables and Descriptive statistics

[8] We regard a douar is within a road's catchment area if at least a part of douars overlaps the catchment area. In Figure 4, Douar 1, 2, 3, 4, and 6 are sampled, and Douar 5 is excluded because it has no part which overlaps the catchment area. If the number of douars in the catchment area is less than five, all douars in the catchment area was sampled.

[9] In the baseline survey, the survey team made a list of douars in the catchment area and that of household in each douar to prepare the sampling frame.

Given the importance of road infrastructure in both economic and social aspects, the road improvement is expected to have impacts on a wide range of outcomes. Considering the objectives of this project and results of existing evaluations of other similar projects, we depict a theory of change, which graphically illustrates how an intervention is expected to bring about outcomes from immediate ones to long-term ones, as shown in Figure 5.

The improvement of roads (output) is expected to reduce travel time and cost and improve availability of transport options as immediate outcomes. Then, these changes would improve access to social infrastructures and market. Improved access is in turn supposed to contribute to more use of social services, such as education and health services, and increased employment opportunities. Production in agriculture and small businesses would be also improved by using more inputs and/or introducing better inputs. In addition, improved access to market may allow farmers to have a transaction with many different retailers or buyers, which also affects their production pattern. These changes are finally expected to improve household welfare in long-term by increase household consumption and asset accumulation.

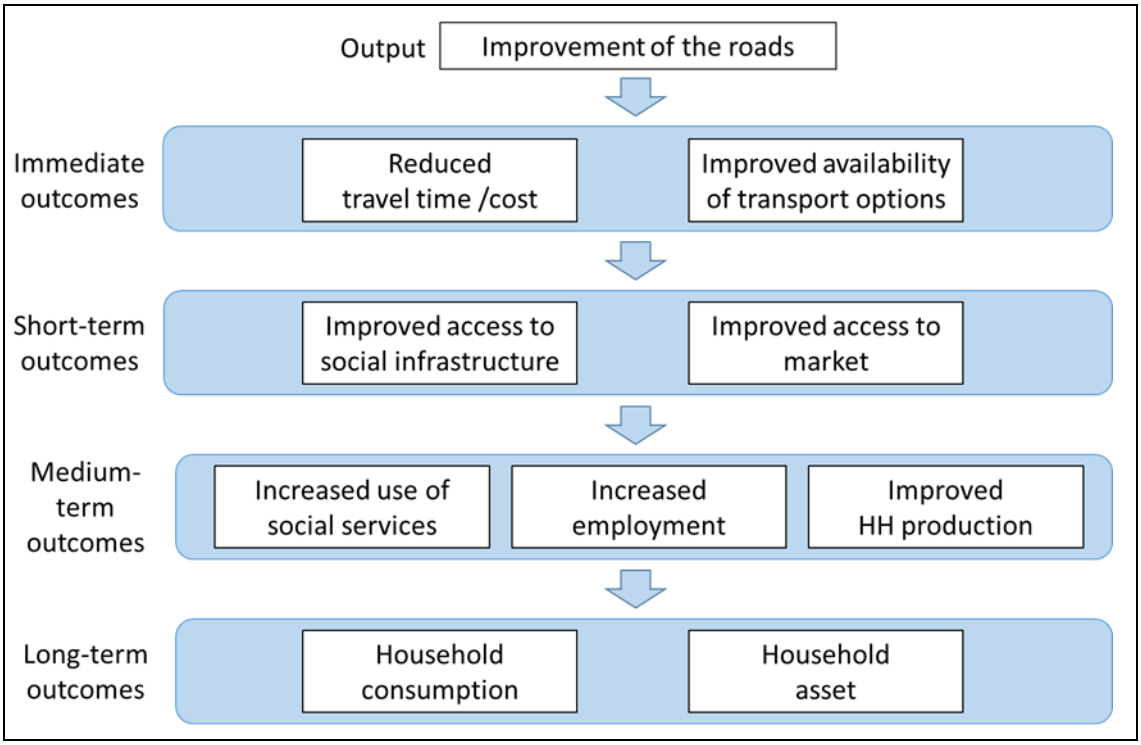

Figure 5 Theory of Change

Table 2 List of Outcome Variables

Category	Outcome variables
Functionality and use	Experience of road closure: dry / rainy seasons Frequency of use
Transport-related outcome	Use of public / motor transport to go to markets, administrative center, financial facilities, and health facilities Commute to school by foot / school bus Time to market /workplace
Access	Visit and frequency to go to markets, administrative center, financial facilities, and health facilities Visit to markets outside douar / commune
Social impact	Primary / middle school enrollment and completion (all and female) Proportion of households whose members suffered from any diseases / injuries Proportion of households which visit health facilities
Economic impact	Employment/ total hours worked / total earning in non-agricultural / agricultural / self-employment Any farming at the last 12 months Number of cultivated crops Monetary value of total agricultural input / output
Welfare impact	Household consumption (total, food, durable, fuel, agriculture, education, health transport, housing) Asset value (total, durable, land, farm equipment productive asset)
Emigration	Moved out for any purposes / job / schooling

Based on this theory of change, we categorized outcomes to be examined in this evaluation into several groups as shown in Table 2: (1) functionality and use, (2) transportation-related outcomes (travel time, cost, transport mode, etc.), (3) access (whether households visit to market and/or various facilities, frequency of visits, etc.), (4) social impact (school enrollment, use of health services, etc.), (5) economic impact (employment, production in agriculture and self-employment business, etc.), (6) welfare impact (household consumption and household assets), and (7) other impact (emigration). The summary statistics of these outcomes of treatment and comparison group at the baseline is presented in Table A1 in the Appendix. In the next section, we present estimated impact of the project on these outcomes.

4 Impact of the project

4.1 Impact on functionality of roads and road use

First, before examining impacts of the road improvement in detail, it would be important to examine functionality of the roads and whether the frequency of use has increased, because it is the precondition for subsequent changes are brought about. The results show that there is a positive impact in these aspects. As shown in Table 3, the functionality of the roads statistically significantly improved in the rainy season. The household living along the improved roads are less likely to experience road closure in the rainy season after the road improvement than those living along the comparison roads (32.2% and 65.8%), while the both groups had experienced almost the same level of road closure before the intervention. This result is qualitatively supported by the results of road observations and drivers interviews which show the overall improvement of road quality.[10] On the other hand, in the dry season, there is no impact because very few households experienced road closure even before the project. Lastly, though the frequency reduced somehow both in treatment and comparison households, the net positive impact is observed in the treatment area (about 3 use more per week).

Table 3 Impact on Functionality of Road and Road Use

Dependent Variables		Project Impact (DID)					
		Without control	95%CI		With control	95%CI	
(1)	Experience of road closure: Rainy season	-0.369 ***	-0.481	-0.256	-0.376 ***	-0.437	-0.315
(2)	Experience of road closure: Dry season	-0.012	-0.043	0.020	-0.010	-0.031	0.011
(3)	Frequency of use (per week)	3.101	-1.183	7.384	2.909 *	-0.341	6.159

Note: Household panel data are used for the analyses. Control variables are gender of household head, household size, dummies for member under 15/over 65 years old, dummy for new born baby, dummies for having land/transport assets, dummies for member with agriculture/non-agriculture employment, dummy for any self-employment activities, dummies for household head's education (primary/ secondary/tertiary completion), dummies for household infrastructure (piped water/gas/electricity), and province dummies.

Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

[10] The survey teams reported that it was possible to drive treatment roads at reasonable speed (approximately 40-50 km/h). In addition, more than 80% of drivers interviewed on improved roads evaluated the roads as “good quality”.

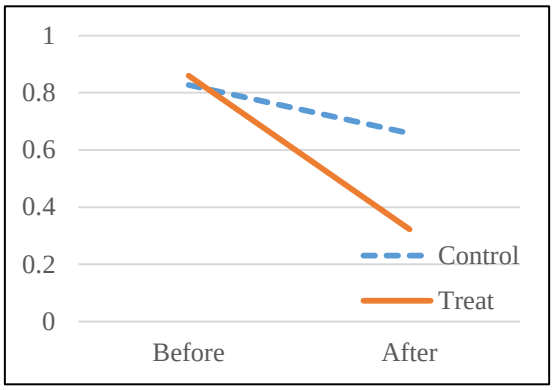

Figure 6 Experience of Road Closure: Rainy Season

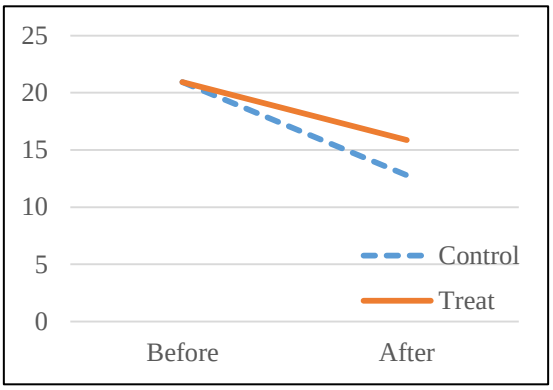

Figure 7 Frequency of Road Use

4.2 Impact on transport-related outcomes

There is some suggestive evidence that the project improves the availability of transport options. As shown in Table 4, the households in the project area are more likely to use public transport (bus, taxi, etc.) by 3-6 percentage point and motor transport (public transport and private vehicles including cars, trucks, and motor bikes) by 3-8 percentage point to go to markets and financial facilities than those in the comparison area. Although this analysis uses only cross-section data after the road improvement, the results suggests that the improvement of the

Table 4 Impact on Use of Transport

Dependent Variables	Project Impact					
	Without control	95%CI		With control	95%CI	
Use public transport to go to … (=1 if yes)						
(1) Local market	0.027	-0.091	0.145	0.032	-0.018	0.081
(2) City market	0.097 *	-0.005	0.198	0.065 ***	0.023	0.108
(3) Administrative center	0.027	-0.103	0.157	0.032	-0.029	0.094
(4) Financial facilities	0.032 **	0.004	0.060	0.029 **	0.006	0.052
(5) Health facilities	0.091	-0.034	0.216	0.057	-0.027	0.141
Use motor transport to go to … (=1 if yes)						
(6) Local market	0.045	-0.065	0.154	0.053 **	0.005	0.101
(7) City market	0.116 **	0.005	0.226	0.086 ***	0.039	0.133
(8) Administrative center	0.011	-0.119	0.142	0.027	-0.042	0.095
(9) Financial facilities	0.032 *	-0.004	0.069	0.033 **	0.004	0.063
(10) Health facilities	0.091	-0.037	0.218	0.068	-0.022	0.157

Note: Note: Household cross-section data (end-line only) are used for the analyses. Control variables are the same as Table 3. Standard errors are clustered at the douar level.
* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

Table 5 Impact on Way to Commute to Schools

Dependent Variables	Project Impact (DID)					
	Without control	95%CI		With control	95%CI	
(1) Commute to school by foot	-0.022	-0.081	0.036	-0.009	-0.064	0.045
(2) Commute to school by school bus	0.038 *	-0.003	0.079	0.034	-0.007	0.075

Note: Individual repeated cross-section data are used for the analyses. School-age children (age 7-18) as of 2011 and 2017 are included. Household-level control variables are the same as Table **3**. In addition, we include log of total consumption and log of total assets. Individual-level control variable is age. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

road provides rural households with a wider range of choices in transport mode.

We separately estimate how the project affects the way in which students commute to their schools (Table 5). Students in the treatment group are more likely to use bus for commuting to school than those in the control group as of 2017 (8.84% and 4.92%). There was almost no bus commuting in 2011 in either groups, so this difference could be attributable to the upgraded roads. In fact, school bus service is available once the road is upgraded according to the ministry of education of Morocco, thus the statistical findings are consistent with the implemented policy.

On the other hand, there is no clear evidence for a positive impact of road upgrading on travel time to a local market or workplaces. For the travel time to a local market, though its reduction is larger in the treatment area, the difference is not statistically significant. An average commuting time to non-agricultural employment shows statistically significant differences between the workers in the treatment group (near the upgraded roads) in contrast to the control group (near the un-upgraded roads), after the upgrading. However, this is mostly due to the increased commuting time for the control group. The reduction in commuting time for the treatment group appears relatively minor. Without a further investigation, it is hard to attribute such changes as an impact of road upgrading per se. For agricultural employment and self-employment, there is no significant impacts on commuting time. Due to small sample sizes (less than 100 in each period), it is hard to conclude whether there is no impact or lack of statistical precision.

4.1 Impact on Access

Next, we examine how the changes in transport options discussed in the previous sub-section in turn affect access to markets or other social infrastructures. The result shows that the percentage

Table 6 Impact on Average Travel Time

of households visiting local markets in the last 12 months increases by 7 percentage point compared to those living along the comparison roads and that the frequency of visit to city markets per week increases by 0.37 time (approximately once per month). However, there is little evidence that the road improvement facilitates the access to other infrastructure such as administrative centers or health facilities.

We further investigate the impact of road improvement on the access to market and find that the households along the improved roads tend to go to further markets. They are more likely to visit local markets outside their douars and communes by 10.6 and 6.2 percentage point, respectively. This finding is consistent with the fact that households in the treated area uses more public transport to visit markets compare to those in the comparison area.

Dependent Variables	Project Impact (DID)							
	Without control		95%CI		With control		95%CI	
(1) Average time to go to local market	-1.71		-9.44	6.03	-2.24		-6.97	2.49
(2) Average time to work in self-employment	12.7		-21.4	46.9	2.3		-40.3	45.0
(3) Average time to work in non-agricultural sector	-41.6	***	-64.0	-19.3	-31.7	***	-55.0	-8.3
(4) Average time to work in agricultural sector	1.2		-27.5	29.9	4.1		-19.7	28.0

Note: Household panel data are used for (1). For (2), only data on households with self-employment activities are used. For (3) and (4), individual repeated cross-section data are used for the analyses. Working-age population (age 16-59) as of 2011 and 2017 are included. In (1) and (2), control variables are the same as Table 3. In (3) and (4), Household-level control variables are the same as Table 1, excluding dummies for member with agriculture/non-agriculture employment/self-employment activities. Individual-level control variables are age, age squared, and a dummy for secondary education.
Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

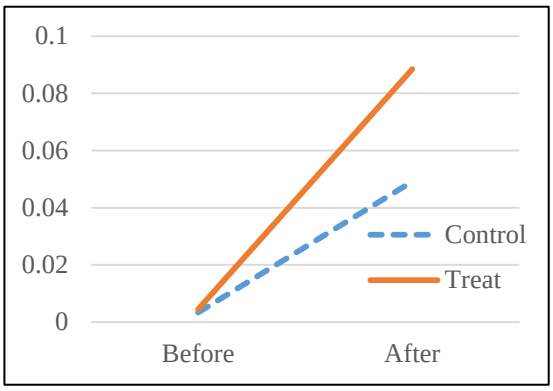

Figure 8 Commute to School by School Bus

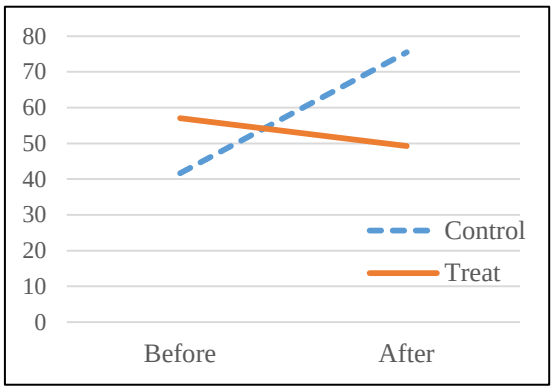

Figure 9 Average Time to Work in Non-agricultural Sector

Table 7 Impact on Access

Dependent Variables	Project Impact (DID)					
	Without control	95%CI		With control	95%CI	
Visit to …						
(1) Local Market (=1 if yes)	0.066	-0.020	0.152	0.070 ***	0.036	0.104
(2) City Market (=1 if yes)	0.000	-0.146	0.147	-0.013	-0.079	0.053
(3) Administrative Center (=1 if yes)	-0.132 **	-0.234	-0.029	-0.125 ***	-0.189	-0.060
(4) Financial Facility (=1 if yes)	-0.017	-0.062	0.027	-0.017	-0.058	0.025
(5) Health Facility (=1 if yes)	-0.011	-0.148	0.127	-0.031	-0.102	0.039
Frequency to visit to …						
(6) Local Market (per week)	-0.104	-0.310	0.102	-0.097	-0.259	0.065
(7) City Market (per week)	0.381	-0.252	1.013	0.372 *	-0.011	0.756
(8) Administrative Center (per week)	-0.056	-0.217	0.106	-0.050	-0.204	0.104
(9) Financial Facility (per week)	-0.015	-0.054	0.024	-0.013	-0.049	0.022
(10) Health Facility (per week)	-0.038	-0.146	0.070	-0.040	-0.139	0.060

Note: Household panel data are used for the analyses. Control variables are same as those shown in Table 3. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

Table 8 Impact on Access to Market

Dependent Variables	Project Impact (DID)					
	Without control	95%CI		With control	95%CI	
(1) Visit to local market outside douar	0.103 **	0.014	0.191	0.106 ***	0.068	0.143
(2) Visit to local market outside commune	0.057	-0.036	0.150	0.062 *	-0.001	0.124

Note: Household panel data are used for the analyses. Control variables are same as those shown in Table 3. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

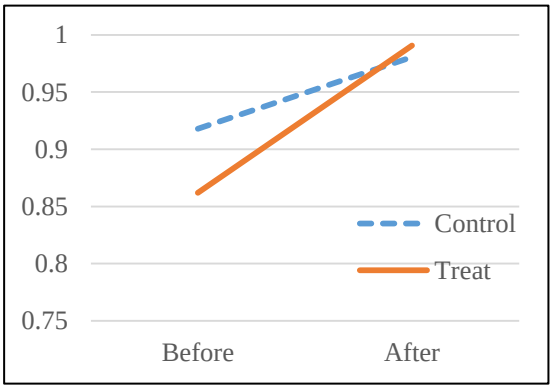

Figure 10 Visit to Local Market

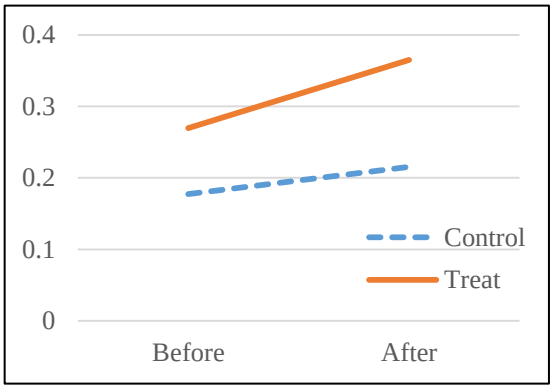

Figure 11 Visit to Local Market outside Commune

4.2 Social Impact (Education and Health)

Education

For educational outcomes, there is a suggestive evidence of positive impacts of road upgrading on middle school enrollment among female children (Table 9). While the control group households have kept the same share of female children enrolling to middle school in both 2011 and 2017, the treatment group households have increased the share. Though, a middle-school enrollment rate of female children is still very low and the magnitude of the impact is minor, the improved access to school (i.e., more use of school bus, less absence due to road condition) might have led to a better educational outcome for the females. However, the impact on total children, sum of male and female children, shows a different pattern. The treatment group households appear to catch up with the control group households in terms of a share of total children completing primary school and those enrolling to middle school.

The same pattern is observed in the individual level analysis (Table 10). Other than the significant and positive impact on female middle-school enrollment probability, educational outcomes of total children in the treated group have simply caught up with the control group. Based on these findings, we cannot fully rule out a possibility that the road upgrading has prioritized the areas

Table 9 Impact on Educational Outcomes (Household-level Analysis)

	Dependent Variables	Project Impact (DID)						
		Without control		95%CI		With control		95%CI	
(1)	Share of children with primary school completion	0.061	*	0.004	0.118	0.043	*	-0.004	0.091
(2)	Share of children with middle school enrollment	0.055	*	0.008	0.102	0.045	**	0.003	0.086
(3)	Share of children with middle school completion	0.027		-0.007	0.062	0.021		-0.012	0.054
(4)	Share of female children with primary school completion	0.021		-0.028	0.069	0.013		-0.032	0.059
(5)	Share of female children with middle school enrollment	0.040	*	0.006	0.074	0.036	**	0.003	0.069
(6)	Share of female children with middle school completion	0.015		-0.010	0.040	0.013		-0.011	0.037

Note: Household panel data are used for the analyses. Control variables are the same as Table 3. In addition, we include log of total consumption, log of total asset, median age of children, and number of school age children. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

Table 10 Impact on Educational Outcomes (Individual-level Analysis)

Dependent Variables	Project Impact (DID)						
	Without control	95%CI		With control		95%CI	
(1) Primary school completion rate	0.044	-0.030	0.117	0.055	*	-0.006	0.115
(2) Middle school enrollment rate	0.049	-0.020	0.118	0.055	*	-0.008	0.118
(3) Middle school completion rate	0.021	-0.032	0.073	0.023		-0.029	0.074

Note: Individual repeated cross-section data are used for the analyses. School-age children (age 7-18) as of 2011 and 2017 are included. Household-level control variables are the same as Table 3 In addition, we include log of total consumption and log of total assets. Individual-level control variable is age. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

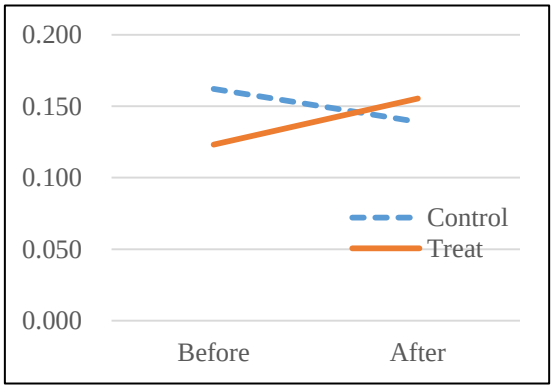

Figure 12 Share of Total Children with Middle School Enrollment

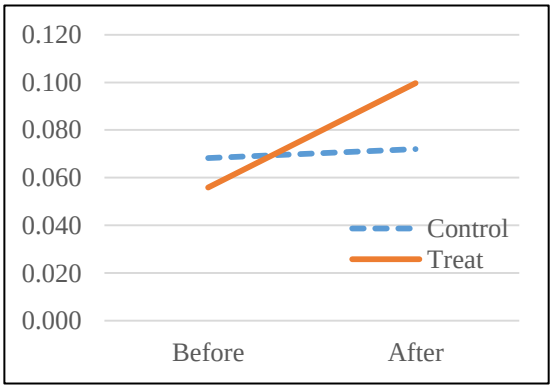

Figure 13 Share of *Female* Children with Middle School Completion

originally lagged behind in school access and educational outcomes. To separately identify a causal impact of road upgrading on educational outcomes via improved (physical) school access from such reverse causality, a further investigation using another identification strategy or different datasets is necessary.

Health

For health outcomes, we examine if the road improvement affects occurance of diseases or injuries and the use of health facilities when any cases arise. As Table 11 shows, no remarkable impact was observed on those aspects. Though the number of cases reported increases after the intevention, the parallel trend in the treatment and control area suggests that the increase is attributable to other factors than the project. For the use of health facililies, the null effect might be explained by the fact that most households (approximately 80%) which experienced any diseases or injuries at the baseline period had already gone to health facilities, and therefore there was little room for improvement of the indicator.

Table 11 Impact on the Health Outcomes

Dependent Variables		Project Impact (DID)					
		Without control	95%CI		With control	95%CI	
(1)	Any household members who suffered from any diseases / injuries	0.002	-0.122	0.126	-0.022	-0.092	0.05
(2)	Number of household members who suffered from any diseases / injuries	0.001	-0.209	0.211	-0.051	-0.162	0.06
(3)	Share of household members who suffered from any diseases / injuries	-0.010	-0.056	0.036	-0.018	-0.044	0.01
(4)	Visit health facilities in case of any diseases / injuries	-0.01	-0.105	0.094	-0.010	-0.087	0.07

Note: Household panel data are used for the analyses. Control variables are same as those shown in Table 3. For (4), only households whose member(s) sufferd any dieases/injuries are used for the analysis. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

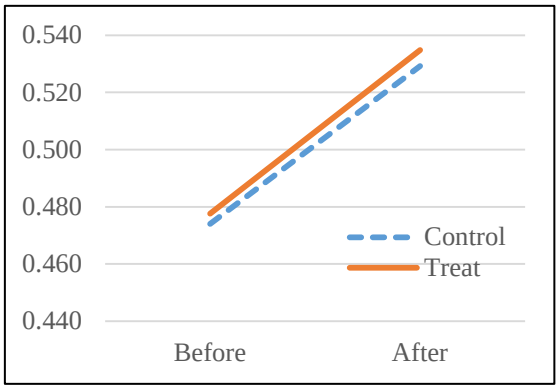

Figure 14 Any Household Members Who Suffered from Any Diseases/Injuries

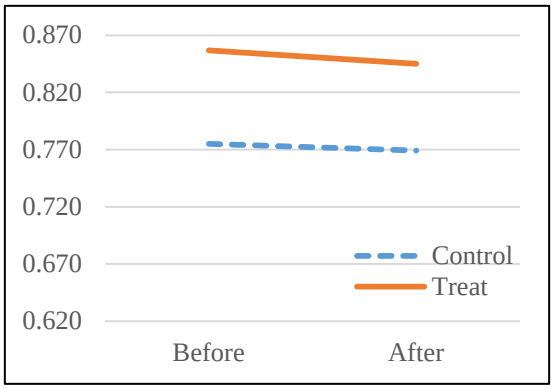

Figure 15 Visit Health Facilities in Case of Any Diseases/Injuries

4.3 Economic Impact (Employment and Agricultural Activities)

Employment

For employment outcomes, there is a variation in the impact of road upgrading across sectors as shown in Table 12. For *non-agricultural sector*, no impact is found. Instead, households in both the control and treatment groups are substantially less likely to gain employment in non-agricultural sector in 2017 (23.3% and 24.5%), in contrast to 2011 (38.6% and 42.4%). In fact, in both groups, the total hours worked are about 30% less and consequently, the total earnings are about 20% less in nominal terms. For *agricultural sector*, the control group households have lost employment substantially from 2011 to 2017 (11.5% to 3.1%), while such negative impact is slightly mitigated for the treatment group households (9.6% to 6.1%). The total hours worked and total earnings show the consistent pattern. These findings are all

Table 12 Impact on Non-agricultural, Agricultural, and Self- Employment Outcomes

statistically significant. For *self-*

Dependent Variables	Project Impact (DID)					
	Without control	95%CI		With control	95%CI	
Any employment in (at least one household member is employed in):						
(1) Non-agricultural sector	-0.026	-0.118	0.066	-0.040	-0.129	0.049
(2) Agricultural sector	0.049 **	0.002	0.096	0.039 *	-0.007	0.084
(3) Self-employment activity	0.055 **	0.013	0.097	0.058 ***	0.017	0.099
Total hours worked in (sum of all household members):						
(4) Non-agricultural sector	2.9	-248.1	253.8	-38.7	-283.1	205.6
(5) Agricultural sector	87.0 **	12.4	161.6	71.6 **	1.1	142.1
(6) Self-employment activity	80.8 *	-3.0	164.6	88.5 **	6.9	170.0
Total earnings in (sum of all household members):						
(7) Non-agricultural sector	-0.332	-1.925	1.260	-0.579	-2.127	0.968
(8) Agricultural sector	0.807 **	0.070	1.543	0.651 *	-0.066	1.368
(9) Self-employment activity	0.979 ***	0.261	1.697	1.025 ***	0.329	1.721

Note: Household panel data are used for the analyses. Control variables are the same as Table 3, excluding dummies for member with agriculture/non-agriculture employment/self-employment activities. Log values of total earnings in MAD are used for (7)-(9). Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

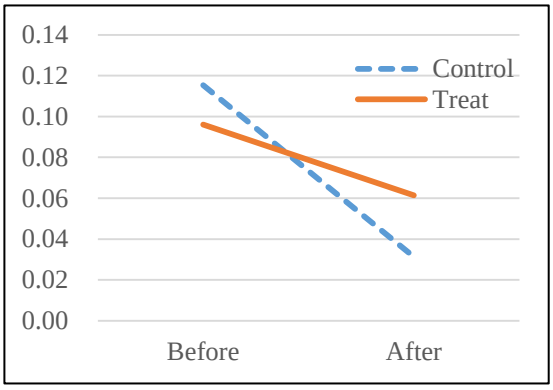

Figure 16 Any Employment in Agricultural Sector

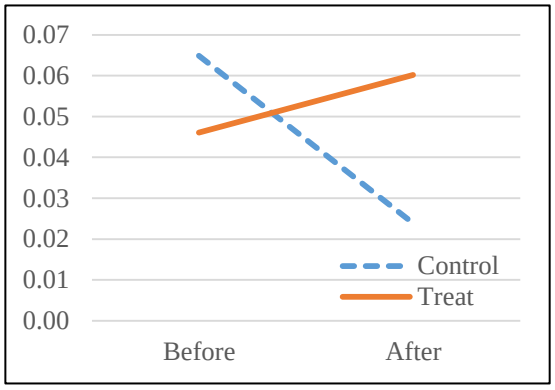

Figure 17 Any Self-Employment Activity

employment, a difference between the control and treatment groups is very clear. The control group households have reduced engagements in self-employment activities from 2011 to 2017 (6.5% to 2.4%), while the treatment group households have increased the activities instead (4.6% to 6.0%). The total hours worked shows the consistent pattern, yet the total earnings have declined for both groups with lesser reduction among the treated group. These findings are statistically significant.

Agriculture

There is no impact of road upgrading on the agricultural outcomes. The severe drought with little rainfall occurred nationwide in the cultivation season of 2016/17. Many households had little/zero harvests in 2017. Indeed, the reduction of total agricultural outputs from 2011 to 2017 is statistically significant. Consequently, the proportion of the household with farming and the number of the crop varieties decreased as well. There is a possibility that the farmers waited to plant seeds because of delay of the rainfall and decided not to plant some varieties in 2016/17 season. Since the drought effect was devastating, the impact of road upgrading was not captured.

4.4 Welfare impact (Consumption and Assets)

Consumption

The impact of improved road on consumption is observed for the total consumption per capita

Table 13 Impact on Agricultural Outcomes (Household-level Analysis)

Dependent Variables	Project Impact (DID)					
	Without control	95%CI		With control	95%CI	
(1) Any fariming in last 12 months	-0.022	-0.063	0.019	-0.012	-0.060	0.036
(2) Number of cultivated crops	-0.013	-0.177	0.150	-0.015	-0.193	0.162
(3) Monetary value of total agricultural output	0.415	-1.185	2.016	0.572	-1.147	2.291
(4) Monetary value of total agricultural input	-0.605	-1.876	0.667	-0.529	-1.851	0.793

Note: Household panel data are used for the analyses.. For (3) and (4), the dependent variables are log of values in MAD in the last 12 months. To avoid data attrition by taking logarithm, value of 0.0001 is assigned in place for zero. Control variables are the same as Table 3. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

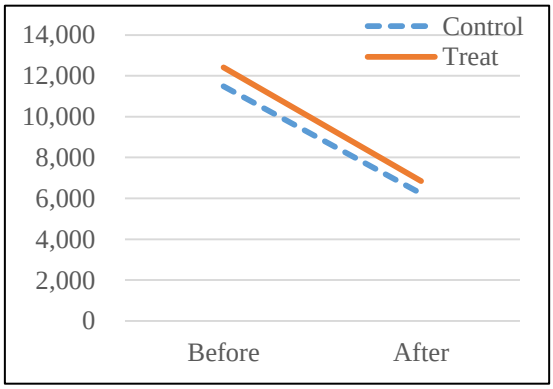

Figure 18 Monetary Value of Total Agricultural Output (MAD, last 12 months)

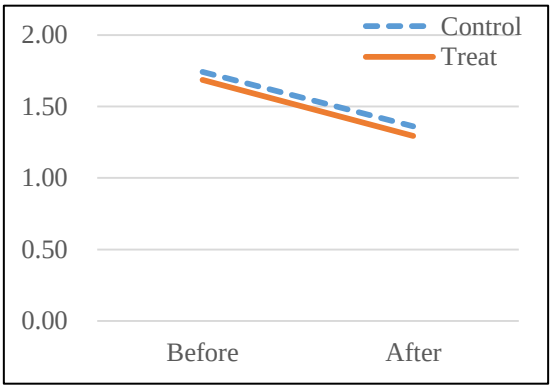

Figure 19 Number of Cultivated Crops

Table 14 Impact on Consumption

in the past 12 months. When we look at the impact by the items of expenditure, only food and

Dependent Variables	Project Impact (DID)					
	Without control	95%CI		With control	95%CI	
(1) Food consumption	0.203 **	0.044	0.362	0.181 **	0.030	0.332
(2) Durable consumption	0.002	-0.427	0.431	-0.028	-0.424	0.368
(3) Fuel consumption	-0.234	-0.649	0.182	-0.191	-0.567	0.185
(4) Agricultural consumption	-0.153	-0.738	0.432	-0.090	-0.696	0.516
(5) Educational consumption	0.373 **	0.035	0.710	0.349 **	0.029	0.669
(6) Health consumption	-0.005	-0.710	0.701	-0.065	-0.729	0.599
(7) Transport consumption	-0.013	-0.335	0.309	-0.063	-0.390	0.263
(8) Housing consumption	-0.065	-0.755	0.625	-0.136	-0.753	0.482
(9) Total annual consumption	0.152 **	0.035	0.268	0.146 **	0.031	0.261

Note: Household panel data are used for the analyses. The dependent variable is per capita household consumption for the listed items. The total annual household consumption is divided by the size of household, with assigning the weight 0.7 for children under 15. All values are log of values in MAD in last 12 months. To avoid data attrition by taking logarithm, value of 1 is assigned in place for zero. Control variables are the same as Table 3. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

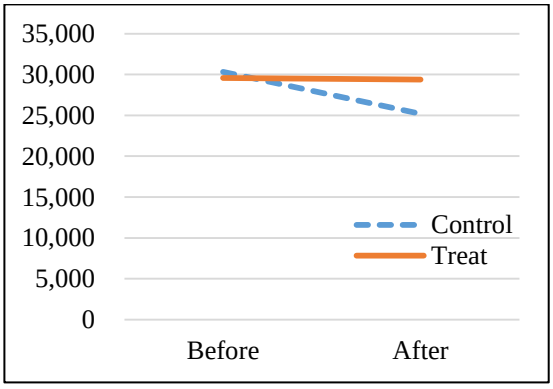

Figure 20 Total Consumption in the Past 12 Months

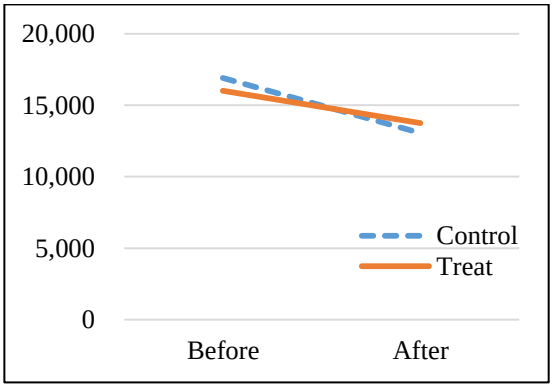

Figure 21 Food Consumption in the Past 12 Months

education show positive and significant impact. However, there is a significant baseline difference for the food consumption, which indicating the concerns for selection bias and mean convergence. For food consumption and total consumption, the overall trend is declining from the baseline to the endline, most likely reflecting the negative shock of droughts happened in 2016 and 2017. The positive and significant estimate of the impact suggests that the improved road has helped to mitigate this negative shock. Large and significant (greater than 30%) impact is observed for educational expenditure. This might be consistent with the findings on the improved access to schools especially for the middle school age female children. Despite the declining trend of total consumption, the educational expenditure shows the large increase even

in level only for the treated group.

Asset

While there is no significant impact of improved road on household's total asset value (1), some negative effect is observed if we separately analyze land asset (4) and durable asset (5). For both land and durables, the average value increased regardless of treatment status, however, the control group has gained more than the treatment group, which makes the impact negative (10% significant only for durable assets). The results are virtually the same when other control

Table 15 Impact on Household Assets

Dependent Variables	Project Impact (DID)					
	Without control	95%CI		With control	95%CI	
(1) Total asset value	-0.149	-0.396	0.098	-0.130	-0.376	0.116
(2) Share of land in household asset value	0.011	-0.024	0.046	0.016	-0.017	0.049
(3) Share of durables in household asset value	-0.142	-0.467	0.183	-0.154	-0.455	0.148
(4) Land asset value	0.001	-0.255	0.258	0.038	-0.190	0.266
(5) Durable asset value	-0.248 *	-0.524	0.028	-0.261 *	-0.534	0.012
(6) Farm equipment value	0.001	-0.328	0.331	-0.021	-0.356	0.315
(7) Productive asset value	0.196	-0.176	0.568	0.159	-0.193	0.511
(8) Land area (km2)	0.265 **	0.056	0.474	0.327 ***	0.081	0.573

Note: Household panel data are used for the analyses. For (1) and (4)-(7), the values are log of values in MAD. Control variables are the same as Table 3. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

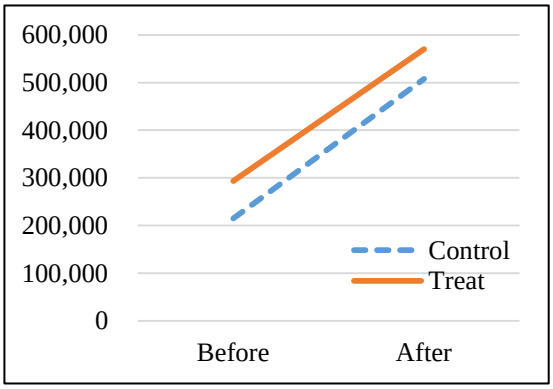

Figure 22 Land Asset Value

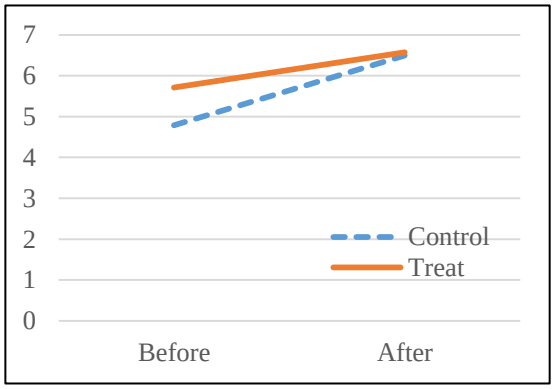

Figure 23 Durable Asset Value (log)

Table 16 Impact on Migration

Dependent Variables	Without control		95%CI		With control		95%CI	
(1) Moved out for any purposes	-0.026	*	-0.053	0.001	-0.029	**	-0.052	-0.006
(2) Moved out for job	-0.016	**	-0.029	-0.003	-0.018	***	-0.031	-0.006
(3) Moved out for schooling	0.001		-0.007	0.008	0.000		-0.007	0.006

Note: Individual cross-section data at the end-line are used for the analysis. Only those who were alive at the time of the end-line are included. Control variables are the same as Table 1. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

variables

are included. However, the mean asset values in the baseline were larger for the treatment (significantly larger for the durable asset, especially), implying that the selection bias and mean convergence might be behind the observed impact. Conversely, as shown in (8), the land area owned by household in the treatment area significantly increased.

4.5 Emigration

Original household members at the time of the baseline are tracked where they currently live at the time of endline. As shown in Table 16, people in the treated area significantly less likely to move out during the period between the baseline and the endline. If we assume the baseline propensity to migrate was the same across two treatment status, this could potentially be interpreted as the project impact that reduces emigration from the treated area. Since the baseline propensity of migration is unobservable, it is difficult to argue that this effect is attributable to the project. However, this is a suggestive evidence consistent with the narrative that the necessity to send migrant to cities for poor rural household reduced by the growth of local economic opportunity thanks to the road improvement.

5 Conclusion

5.1 Summary of Key findings and discussion

This study has examined potential impacts of a rural road upgrading project on a wide range of outcomes using difference-in-differences approach with the carefully selected comparison group at the sampling stage. As summarized in Table 17, the analysis shows that the road improvement has positive and statistically significant effects on the use of public transportation including school bus, access to markets and school enrollment especially for female secondary education. From an economic aspect, although the employment and earning in agricultural labor sector and self-employment sector decrease between the baseline period and end-line period in both treatment and comparison areas, the results show that the decrease was smaller among the treated households than the comparison households. Similarly, the estimate shows net positive effect of the road improvement; per capita household consumption of the treated households was unchanged in contrast to the decrease in the comparison households at the end-line period. Given the serious drought occurred nationwide in the cultivation season of 2016/17, these

Table 17 Summary of Key Findings

Positive Impact
Use of public transport to markets and financial facilities
Use of school buses to commute schools
Access to markets
Primary school completion
Middle school enrollment (particularly female students)
Employment, hours worked, and earning in agricultural sector and self-employment
Household consumption (overall, food, education)
Reduction of emigration from the original residences (for any purposes and job)
No Impact
Use of public transport to administrative centers and health facilities
Access to financial and health facilities
Middle school completion
Incidence of diseases/injuries
Use of health facilities
Employment, hours worked, and earning in non-agricultural sector
Agricultural output, input, and number of crop cultivated
Household assets

results suggest that the project contributed to mitigation of the negative climate shock to some extent. In addition, it can also be considered as a favorable result that the project appears to reduce emigrations from rural areas.

On the other hand, though it was expected, no remarkable effect was found on several outcomes, such as health condition of people living along the improved roads, the use of health services, agricultural production, and household assets. For health-related outcomes, one possible explanation is that the quality of roads and access are not major constraint to the use of health services. This interpretation may be supported by the fact that approximately 80% households visited health facilities even before the intervention using various transport modes. The inconclusive results regarding agricultural production and household assets are likely to be affected by the serious drought occurred before the end-line data collection.

5.2 Limitations

As any other evaluations do, this study inevitably has several limitations. First, this study does not employ randomized control trail (RCT), which would have provided the most rigorous results. Because the roads to be improved under this project was purposefully selected before the onset of this study, there was no room to select the project roads (or timing of the upgrading) randomly. Though we selected the comparison road as carefully as possible and employ difference-in-differences to minimize potential biases as discussed above, it was not possible to fully rule out biases.

Second, this study focus on “micro” impacts which were brought about by the project to households and/or individuals along the project roads. Although it is important to examine potential “macro" impacts of the improvement of road network, such as enhancement of overall regional economic activities beyond the areas around the project roads, it is beyond the scope of this present study.

Third, as already mentioned, a severe drought with little rainfall occurred during the study period and seriously affected the agricultural production which is the main industry in rural Morocco. Although the difference-in-differences method can control external factors such as a weather shock which affects both the treatment and comparison group to some extent, the possible impact on agricultural production might be washed out, if any, by this huge climate shock. In this sense, this study may fail to fully capture potential impacts of the project, and thus the results of this study should be interpreted with caution in particular when one tries to generalize the findings to other contexts.

5.3 Policy implications

The results of this impact evaluation have several policy implications. First, the quantitative rigorous analysis reveals that the rural road improvement indeed has positive impacts on a range of outcomes and affects the livelihood of rural residents in a various way. The findings would provide important information to complement JICA's conventional evaluations of rural road improvement projects in which the project impact tends to be analyzed by using aggregate indicators such as region-level indicators or qualitative information. Because no impact was found for some expected outcomes, it is necessary to carefully examine which changes were actually brought about as expected and which ones were not in order to fully understand the impacts of the road improvement project.

Second, it would be also important to consider complementarity between the road improvement and other policies. For example, the result shows that the project facilitates the use of school buses and middle school enrollment particularly for female students. Though a careful interpretation is needed, considering the anecdotal evidence that the availability of safe transportation is a key factor for female students to attend middle schools because of long distances to commute, it would be possible to assume that the combination of road improvement and provision of school bus services has a synergy effect on the school enrollment of female students. As such, in planning similar rural road improvement projects, complementary policies should be considered for potential impacts to be fully materialized, and the coordination with stakeholders in multiple sectors would be necessary.

Reference

Gertler Paul J, Sebastian Martinez, Patrick Premand, Laura B. Rawlings, and Christel M. J. Vermeersch (2016) Impact Evaluation in Practice, Second Edition. Washington D. C.: World Bank.

High Commission for Planning (2015) Morocco between Millennium Development Goals and Sustainable Development Goals: Achievements and Challenges National Report 2015

Independent Evaluation Group [IEG]. 2012. World Bank Group impact evaluations: Relevance and effectiveness. Washington, DC: World Bank.

Khandker, Shahidur R., Gayatri B. Koolwal, and Hussain A. Samad (2010) Handbook on Impact Evaluation: Quantitative Methods and Practices. Washington D. C.: World Bank.

国際協力機構 [JICA] (2011a) 事業事前評価表：モロッコ王国 地方道路整備事業 (II)、国際協力機構.

―― (2011b) 審査調書：モロッコ王国 地方道路整備事業 (II)、国際協力機構

Appendix

Table A1 Baseline Balancing Test

Variables	Mean Comparison as of 2011						
	n	Comparison	Treatment	Difference		95%CI	
Functionarily and use							
Experience of road closure: dry season (=1 if yes)	1,443	0.036	0.036	0.000		-0.031	0.031
Experience of road closure: rainy season (=1 if yes)	1,443	0.827	0.860	0.033		-0.029	0.095
Frequency of use (per week)	1,443	20.9	20.9	0.0		-4.4	4.4
Transport-related outcomes							
Average time to go to local market (one way: minutes)	1,284	50.4	46.4	-4.0		-13.5	5.4
Average time to work in self-employment (one way: minutes) +	61	35.4	37.6	2.2		-23.1	27.5
Average time to work in non-agricultural sector (one way: minutes) +	759	41.7	57.1	15.4	*	-2.5	33.3
Average time to work in agricultural sector (one way: minutes) +	68	39.3	27.3	-12.0		-35.1	11.1
Commute to school by foot (=1 if yes) ++	1,275	0.942	0.918	-0.024		-0.066	0.018
Commute to school by school bus (=1 if yes) ++	1,275	0.003	0.004	0.001		-0.010	0.012
Access							
Visit to local market (=1 if yes)	1,454	0.918	0.862	-0.056		-0.140	0.028
Visit to city market (=1 if yes)	1,454	0.448	0.475	0.027		-0.095	0.149
Visit to administrative center (=1 if yes)	1,454	0.703	0.786	0.082	**	0.014	0.150
Visit to financial facility (=1 if yes)	1,454	0.085	0.128	0.043	**	0.001	0.084
Visit to health facility (=1 if yes)	1,454	0.418	0.484	0.066		-0.025	0.158
Frequency of visit to local market (per week)	1,454	1.1	1.2	0.1		-0.1	0.3
Frequency of visit to city market (per week)	1,454	0.3	0.3	0.0		-0.1	0.2
Frequency of visit to administrative center (per week	1,454	0.2	0.2	0.1		-0.1	0.2
Frequency of visit to financial facility (per week)	1,454	0.0	0.1	0.0		0.0	0.1
Frequency of visit to health facility (per week)	1,454	0.1	0.1	0.0	*	0.0	0.0
Visit to local market outside douar (=1 if yes)	1,454	0.909	0.825	-0.084	*	-0.174	0.006
Visit to local market outside commune (=1 if yes)	1,454	0.177	0.270	0.093	*	-0.008	0.193
Social impact							
Health							
Any members who suffered from any diseases (=1 if yes)	1,454	0.474	0.478	0.004		-0.096	0.103
Number of members who suffered from any	1,454	0.699	0.659	-0.040		-0.216	0.137
Share of members who suffered from any diseases	1,454	0.130	0.124	-0.006		-0.042	0.030
Visit health facilities in case of any diseases (=1 if yes)	692	0.775	0.857	0.082	**	0.012	0.152

Table A1 Baseline Balancing Test (cont.)

Variables	Mean Comparison as of 2011						
	n	Comparison	Treatment	Difference		95%CI	
Social impact (cont.)							
Education							
Share of children with primary school completion	1,447	0.260	0.212	-0.049	**	-0.093	-0.005
Share of children with middle school enrollment	1,447	0.162	0.123	-0.039	*	-0.080	0.002
Share of children with middle school completion	1,447	0.083	0.061	-0.022		-0.053	0.009
Share of female children with primary school completion	1,447	0.142	0.128	-0.013		-0.050	0.023
Share of female children with middle school	1,447	0.068	0.056	-0.012		-0.040	0.015
Share of female children with middle school	1,447	0.028	0.025	-0.003		-0.020	0.015
Primary school completion (=1 if yes) ++	1,763	0.415	0.353	-0.062	**	-0.124	0.000
Middle school enrollment (=1 if yes) ++	1,763	0.243	0.202	-0.041		-0.099	0.017
Middle school completion (=1 if yes) ++	1,763	0.116	0.099	-0.017		-0.062	0.028
Economic impact							
Employment							
Any Employment in (=1 if yes):							
Non-agricultural sector	1,454	0.386	0.424	0.038		-0.051	0.126
Agricultural sector	1,454	0.115	0.096	-0.019		-0.057	0.019
Self-employment activity	1,454	0.065	0.046	-0.019		-0.051	0.014
Total hours worked in (sum of all household members):							
Non-agricultural sector	1,454	831.0	869.4	38.4		-193.2	270.0
Agricultural sector	1,454	141.1	98.7	-42.4		-112.2	27.4
Self-employment activity	1,454	106.9	80.6	-26.2		-90.5	38.1
Total earnings in (sum of all household members):							
Non-agricultural sector (MAD, last 12 months)	1,454	9,070	9,956	886		-1,857	3,629
Agricultural sector (MAD, last 12 months)	1,454	1,278	982	-296		-913	321
Self-employment activity (MAD, last 12 months)	1,454	4,824	4,899	75		-4,690	4,840
Agriculture							
Any fariming in last 12 months (=1 if yes)	1,426	0.839	0.813	-0.026		-0.090	0.038
Number of cultivated crops	1,426	1.741	1.686	-0.054		-0.283	0.174
Monetary value of total agricultural output (MAD, last 12 months)	1,426	11,488	12,411	922		-2,441	4,285
Monetary value of total agricultural input (MAD, last 12 months)	1,426	3,498	3,777	278		-890	1,447

Table A1 Baseline Balancing Test (cont.)

Variables	Mean Comparison as of 2011						
	n	Comparison	Treatment	Difference		95%CI	
Welfare impact							
Consumption							
Food Consumption (MAD, last 12 months)	1,439	16,911	16,003	-908		-2,358	543
Durable Consumption (MAD, last 12 months)	1,439	1,193	907	-286		-984	411
Fuel Consumption (MAD, last 12 months)	1,439	1,591	1,984	393	*	-61	847
Agricultural Consumption (MAD, last 12 months)	1,439	4,102	3,981	-121		-1,328	1,086
Educational Consumption (MAD, last 12 months)	1,439	612	622	10		-159	178
Health Consumption (MAD, last 12 months)	1,439	1,564	1,595	31		-509	571
Transport Consumption (MAD, last 12 months)	1,439	1,999	2,019	19		-649	688
Housing Consumption (MAD, last 12 months)	1,439	1,690	1,958	268		-289	825
Total Annual Consumption (MAD, last 12 months)	1,439	30,343	29,594	-749		-4,727	3,229
Household assets							
Total Asset Value (MAD)	1,454	230,930	313,919	82,989	*	-12,476	178,455
Share of Land in HH asset value	1,447	0.866	0.881	0.015		-0.017	0.047
Share of Durables in HH Asset Value	1,447	0.084	0.081	-0.003		-0.028	0.023
Land Asset Value (MAD)	1,454	215,178	293,538	78,359	*	-12,047	168,765
Durable Asset Value (MAD)	1,454	7,906	11,056	3,149		-1,750	8,048
Farm Equipment Value (MAD)	1,454	7,581	9,254	1,673		-2,987	6,333
Productive Asset Value (MAD)	1,454	264	72	-192		-569	184
Land Area (km2)	1,454	32,977	34,209	1,232		-9,786	12,251

Note: Household-level data are used. However, for + and ++, individual-level data of working-age population (age 16-59) and school-age students (age 7-18) as of 2011 are used, respectively. Standard errors are clustered at the douar level. * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.