Lao People's Democratic Republic

FY2017 Ex-Post Evaluation of Japanese Grant Aid Project

"The Project for Improvement of National Road No.9 as East-West Economic Corridor"

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0. Summary

This project aimed at improvement of National Road No.9 (hereinafter referred to as "NR9"), which is very important connecting neighbor countries, i.e. Thailand and Vietnam, with sufficient driving speed, safety and comfort as international highway according to traffic conditions by refurbishing pavement structure and road structure of damaged sections, thereby contributing to promotion of trade and investment in Laos Central Region and economic development of the hinterland of NR9.

The project has been highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high. Both the project cost and project period were within the plan. Therefore, efficiency of the project is high. Regarding the effectiveness, although the simple comparison cannot be made due to the difference in the measurement method, the traveling speed is much higher than the expected traveling speed at the time of planning by the actual measurement, and through the driver interviews, positive effects for safety during fine and rainy weather, traveling time and comfort on drive were confirmed. Regarding the impact, it was confirmed that the renovation of NR9 led to the reduction of transportation time and transportation expenses, leading to the promotion of agriculture and the motivation for expansion of production, and through interviews, improvement of trade and investment environment, vitalization of agriculture and commercial activities and contribution to the development of the regional economy were confirmed. Also, no negative impact was confirmed. Therefore, effectiveness and impacts of the project are evaluated as high. Furthermore, the operation and maintenance systems have been improved in terms of human resources and organization. For technical aspect, participants of the trainings in the capacity building program (soft component) still engage to maintenance duties. The financial condition is still tight, but it is expected that budget for periodical repair will be assigned in the future. No other problems have been observed. Therefore, sustainability of the project effects is high.

In light of the above, this project is evaluated to be very highly satisfactory.

[1] In this Ex-Post Evaluation, Mr. Souknilanh Keola, a researcher of Bangkok Research Center, Institute of Developing Economies, Japan External Trade Organization (JETRO), conducted an expert analysis in addition to the evaluation by external evaluators for more professional and technical analysis. His specialties are international division of labor, state-owned enterprise, econometrics, Lao economy. He also plays an active part in remote sensing and its analysis by using satellite information. He participated in 1st Field Study and wrote a specialist analysis paper. In this report, the summary of his specialist analysis paper is posted as a Colum.

1. Project Description

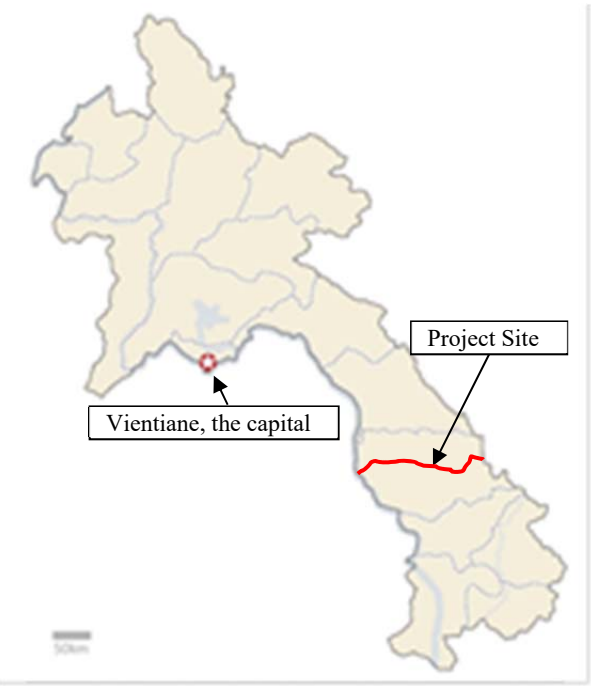

Figure 1: Project Location

Photo 1: Start Point of Section 1

Photo 2: End Point of Section 2

1.1 Background

The Lao government focused on development of the road network, since the road transport has been playing an important role in the country. However, even the pavement rate of the national roads was as low as 55% due to tight budget environment. Under such circumstances, improvements of NR9 had been implemented with supports of Japan's grant aid and Asian Development Bank's (ADB) loan from 1999 to 2004.

NR9 is about 240km long arterial road extending from Savannakhet to the national border with Vietnam at Densavan, and constitutes a key part of the East-West Economic Corridor traversing the Indochina Peninsula and ensuring access to the East China Sea. At the time, it also had an important meaning from the viewpoint of correcting regional economic disparity toward ASEAN integration.

However, development of the mine, etc. had changed traffic conditions after the improvements of NR9, and the road had suffered large-scale and extensive damage due to heavy use by large vehicles. The damage had reached to the extent that smooth traffic on the road had been hindered.

In view of the role of NR9 as the East-West Economic Corridor, Lao PDR was making its best efforts, allocating a quarter of its national road operation and maintenance budget for this

purpose. However, large scale rehabilitation of the damaged road had become difficult to handle within its own securable and implementable budget.

Aid for structural reinforcement, which meant to strengthen heavily damaged pavement sections and to complete drainage facilities of the road, was indispensable to recovering smooth traffic on NR9, as an international arterial highway. In addition, more optimization of the road maintenance and management work of the Laotian side was needed, because appropriate and timely maintenance activities for avoiding enlargement of the damages had not been done.

1.2 Project Outline

The objective of the project is to improve NR9 in order to achieve sufficient driving speed, safety and comfort as international highway according to traffic conditions by refurbishing the pavement structure and road structure of the damaged sections (Fig. 2) between Seno and Muang Phin, thereby contributing to promotion of trade and investment in the Central Region of Laos and economic development of the hinterland of NR9[2].

Table 1: Project Outline

Grant Limit / Actual Grant Amount	3,273 million Yen / 2,969 million Yen
Exchange of Notes Date / Grant Agreement Date	August 2011 / August 2011
Implementing Agency	Ministry of Public Works and Transport
Project Completion	March 2015
Main Contractor	Obayashi - Obayashi Road Joint Venture
Main Consultants	Consortium of Oriental Consultants Co., Ltd. and International Development Center of Japan Inc.
Basic Design	October 2010 ~August 2011
Related Projects	-Technical Cooperation "Project for Improvement of Road Maintenance Capability in Lao PDR" (JICA, September 2011~May 2018) -ODA Loans "Second Menkong International Bridge Construction Project" (JICA, December 2001) -Grant Aid "The Project for Improvement of National Road Route 9" (JICA, July 1999) "The Project for Improvement of National Road Route 9 (Phase 2)" (JICA, May 2001) "The Project for Reconstruction of the Bridges on the National Road No.9" (JICA, December 2016) -Other international organizations, aid agencies, etc.

[2] According to the Ex-Ante Evaluation, the objective of the project was "realization of smooth traffic of the East-West Economic Corridor by improving the pavement structure and road structure of the damaged sections of NR9". However, the evaluators rearrange the objective as mentioned above based on descriptions of the preparatory survey and the Ex-Ante Evaluation because outcomes and impacts are not clear.

	"Project for Improvement of National Road No. 9 (Between Muang Phin and Lao Bao)" (ADB, March 2000)

Source: Provided by JICA

2. Outline of the Evaluation Study

2.1 External Evaluator

Toru Shimada, ADAMIS ltd.

Takahiro Yasukawa, Aviation Systems Consultants Co., Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: September, 2017 – October, 2018

Duration of the Field Study: January 7 – January 31 and April 2 – April 11, 2018

3. Results of the Evaluation (Overall Rating: A3)

3.1 Relevance (Rating: ③[4])

3.1.1 Consistency with the Development Plan of Lao PDR

The national development plan in place at the time of planning the project in 2010, *the National Socio-Economic Development Plan (2006-2010)* stated, as one of the guidelines, "Ensure the maintenance of existing infrastructure; establish additional infrastructure specifically to support the socio-economic development activities aiming to promote trade, investment and tourism; increase the investment in the infrastructure for socio-economic development; explore national resources including human resources to be used as potentials for development in an effective manner; establish and prioritize investment projects to establish effective economic structures and to be in a good position and ready for competition.", and stated as one of the strategy of inland transportation "The national roads connecting the Lao PDR to neighboring countries will be upgraded to standard roads. Priority will be given to highways and roads stretching to borders such as some sections of the North-South road to Bokeo, Luang Namtha; some sections of the East-West road to Savannakhet; roads to provinces within the Lao-Vietnam-Cambodia economic triangle (Attapeu, Sekong and Saravane); and the provinces within Lao-Thailand-Cambodia Economic Triangle (Saravane and Champasak)."

The current national development plan, *the 8th Five-year National Socioeconomic Development Plan (2016–2020)* sets "Sustained, inclusive economic growth with economic vulnerability reduced to levels required for growth support" as one of the three outcome, and sets

[3] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[4] ③: High, ②: Fair, ①: Low

priority activities of construction (Infrastructure) for ensuring sustained and inclusive economic growth as follows:

"Upgrade roads that connect to the neighboring countries, such as the Greater Mekong Subregion Corridor, Asian Highway, East-West Corridor and North-South Economic Corridor."

Therefore, the improvement of NR9 as East-West Economic Corridor has been consistent with the national development plans.

3.1.2 Consistency with the Development Needs of Lao PDR

At the time of planning the project, as there was no detour of NR9, improvement of the pavement structure and road structure of the damaged sections were urgent. Also, the NR9 was very important for economic development of Central Region using East-West Corridor in Lao PDR.

At this Ex-Post Evaluation, according to the Ministry of Public Works and Transport (hereinafter referred to as "MPWT") and Department of Public Works and Transport (hereinafter referred to as "DPWT"), NR9 is a part of the East-West Economic Corridor of 1,450km in length to Da Nang Port in Vietnam on the East, and through Thailand to Mawlamyaing Port in Myanmar on the West. It has been playing an important role in economic development of the inland country, Lao PDR. National Road No.12 became the shortest route connecting Thailand and northern Vietnam by the opening of the Third Thai-Lao Friendship Bridge in November 2011, but the role of NR9 in the economic development of Lao PDR is still large.

Therefore, at the both times of planning and ex-post evaluation, the development need of the project has been high.

3.1.3 Consistency with Japan's ODA Policy

Japan's Country Assistance Program for Lao PDR (September 2006) included "Developing socioeconomic infrastructure and effectively utilizing existing infrastructure". This Project for improvement of existing NR9 was highly consistent with Japan's ODA policy.

Also, in *JICA Country Analytical Work for Development (April 2011 version 1.1)* provided by JICA Laos Office, advocated infrastructure development as one of the important area which promoted economic growth considering environment and economic disparity, and stated that those were to be obtained by development of road networks. Therefore, the project was consistent with JICA Policy at that time.

3.1.4 Appropriateness of the Project Plan and Approach

Major differences between plan and actual were replacement of the existing sub-base course material, addition of access roads and associated crossing drainage pipes during construction period. The original

design of pavement assumed the existing sub-base course as a new subgrade of pavement structure based on the result of material physical tests including modified California Bearing Ratio (hereinafter referred to as "CBR") conducted in 1 to 1.5 km intervals, and estimated the strength of existing sub-base course as CBR 6%. However, in-situ CBR tests conducted in the construction phase at the places, where the pavement surface conditions were bad, indicated the average of CBR of 3% that is much less than the assumed CBR in the original design. Therefore, the replacement of the existing sub-base course material was needed to achieve adequate strength of pavements for the sections, where healthiness of the existing sub-base course had been deteriorated. As those places that require substitutions were scattered all over the project site, it was appropriate measures to establish amount based on the construction results, and to have paid the difference. Also, it was necessary measures to add the access roads and associated crossing drainage pipes for smoothly access from neighbors to NR9.

These design changes are considered appropriate, but it must be noted that the contract cost was increased from the original cost about 2,188 million Yen to about 2,678 million Yen.

As described above, this project has been highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

Table 2 summarizes planned and actual outputs of the project.

Table 2: Project Outputs（Comparison of Plan and Actual）

Item		Planned	Actual
Road pavement	Asphalt pavement	Section 1 (Replacing with new material of 47.6 km sub-base/ base course): 10.2 km Section 2 (Replacing with in-situ recycled material): 57.8km Total:	47.0km 11.1km 58.1km
	Concrete pavement	Entrance road of vehicle weigh station：215m	225m
Road earth works	Cut Fill	13,100m^3 48,100m^3	5,100m^3 19,900m^3
Box culvert		1 unit	Ditto
Drainage	Road gutter	53.4km（V type, U type w/cover, three-face armored ditch）	105.64km
	Crossing drainage	11 culverts（⌀800mm、⌀1000mm）	66 culverts
Road accessory works		1 lot (guard rail, lighting, etc.)	Ditto
Soft component (technical assistance)		Acquire the knowledge of appropriate construction management of large scaled road rehabilitation project by asphalt concrete	Ditto

Source: Preparatory survey report, documents provided by JICA and Consultants

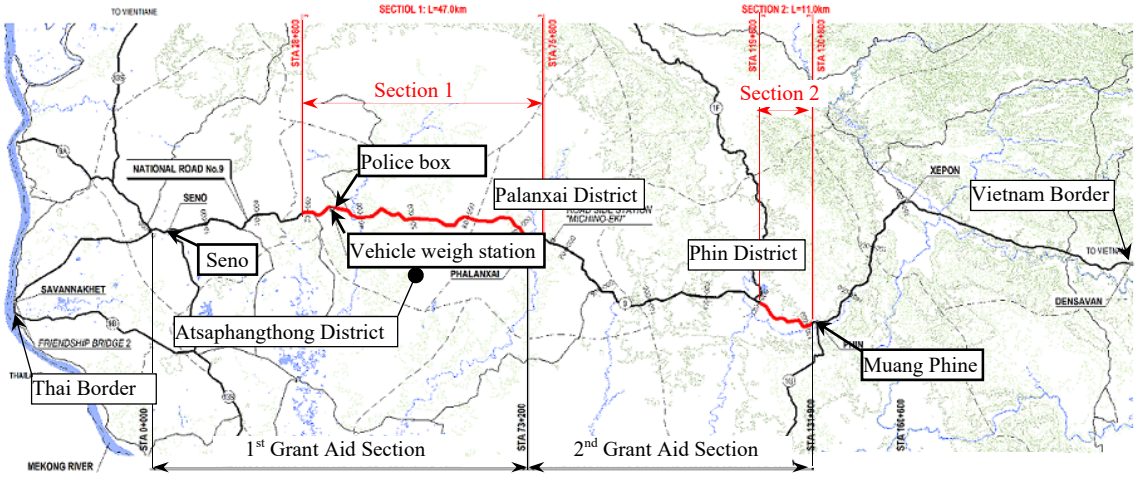

Figure 2: Sections of this Project and Sections of Past Grant Aids

As a result of the design review in the detailed design, the length of each section, the length of concrete pavement, volume of the earthworks, etc. were properly changed. Also, the design changes were made to replace the existing sub-base course material and to add the new access road and associated crossing drainage pipes during the construction period.

The implementing agency explained that replacement of existing sub-base course material was also necessary for achieving required strength of the pavement of the sections, where bearing capacity on top of the existing sub-base course was lower than that expected in the pavement design, and that the additional access roads connecting and crossing drainages were necessary for smooth access from/to surroundings to/from NR9. Therefore, it can be judged that replacement of the sub-base course material is effective for sustainability and new access roads are effective for improving ease of use of NR9

As described above, with the appropriate design changes such as the pavement structure, the outputs necessary for achieving the project purpose were generally achieved as planned. According to the consultant, "relocation of utility poles and distribution lines" and "securing temporary yards", i.e. obligations of the recipient country, were properly implemented.

3.2.2 Project Inputs

3.2.2.1 Project Cost

As shown in Table 3, the cost borne by the Japanese side was reduced to 91% of the plan by competitive bidding, the cost born by Laotian side was drastically reduced to 9% of the plan because tax exemption was taken outside the scope of DPWT's coverage. As a result, it fell within 85% of the plan.

Table 3: Project Cost (Comparison of Plan and Actual)

Item	Planned (Yen)	Actual (Yen)	Difference
Total Project Cost	3,523 million	approx. 2,991million	85% of planned amount
Cost borne by Japanese side	3,273 million	2,968 million	91% of planned amount
Cost borne by Laotian side	250 million	About 23 million	9% of planned amount

Source: Preparatory survey report, documents provided by JICA and Implementing Agency
Note: The Japanese Government burden was 2,464 million yen at the initial contract. Laos Government burden does not include expenses outside the scope of DPWT's duties such as tax-exempt measures.

3.2.2.2 Project Period

The planned project period from the detailed design[5] to the completion of the works was 43 months. As the project actually started in September 2011 by signing a consulting services agreement, the planned project period should be up to April 2015, for 44 months. The project was actually completed in March 2015, and the actual project period was 43 months (93% of the planned duration).

As mentioned above, both the project cost and project period were within the plan, and output was produced as planned with appropriate design changes. Therefore, efficiency of the project is high.

3.3 Effectiveness and Impacts [6] (Rating : ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects

At the time of planning the project, increase of the pavement load bearing capacity (maximum axle load) and increase of average travel speed were set as quantitative effects. However, the Pavement load bearing capacity (maximum axle load) cannot be used as an indicator of effect of the project, because limitation of the maximum axle load had been relaxed from 9.1 to 11 tons before this project. Incidentally, the cumulative axial weight[7] during the design period was to be increased from the previous 1.72×10^6 to 2.88×10^6 by this project, but this cannot be adopted as the effect indicator, because it is a design target

[5] Because the project period in the Ex-Ante Evaluation did not make clear the starting point of the project. Therefore, implementation schedule in the preparatory survey report was referred to. The implementation schedule didn't include the Exchange of Notes Date and the Grant Agreement Date in the project period and the project period was started from the detailed design, that is the date of the consulting service agreement. Therefore, in this ex-post evaluation, the starting point of the project is considered as the starting date of the detailed design in both planned period and actual period.

[6] Sub-rating for Effectiveness is to be put with consideration of Impacts.

[7] Cumulative axial weight is to be calculated based on the number of traffic of axial weight of 18kip = 8.16ton during subject time period, such as analysis or design period.

value.

On the other hand, with regard to the average travel speed , the baseline value was calculated by using a software package for traffic network analysis with setting parameters such as traffic volume and free flow velocity based on the road conditions and topographic conditions for each section to obtain the average of the whole NR9. As the consultant doesn't keep those particular parameter records, validation by recalculation was impossible. Therefore, actual average speed in Table 4 was measured based on one round trip with 8-seater one box car by the evaluators. As a result, the travel speed was significantly higher than the target value

Table 4: Average Travel Speed

Baseline (2011)	Target (2018)	Actual (2018)
44.8 km/h	56.3 km/h	Section 1: 69～83 km/h Section 2: 69～82 km/h

Source: Preparatory survey report

Note: Baseline and target values were calculated by the traffic network analyze software, Actual value was measured by actual one round trip by the evaluators.

It is inappropriate to simply compare the baseline and target values calculated on traffic network analysis software, and the actual value of one round trip by the rented car, but there is no doubt from the interviews of drivers and other concerned persons (described as qualitative effects below) that the average travel speed was increased considerably by the project.

In addition to the average traveling speed, the evaluators considered the adoption of traffic volume as an auxiliary indicator, but only traffic passing volumes at Vietnam and Thailand Border were available as historical data of traffic volume at the same observation point on NR9. The annual number of vehicles passing through the Vietnam border has increased dramatically from 6,633 in 2012 and 2013 average to 27,321 in 2016, and 71,443 at Thailand border to 135,420. However, the correlation between these traffic volumes and the traffic volume of this project target sections cannot be confirmed, because there are intersections with the National Road No. 1 and the National Road No.13 between this project sections and the borders with Vietnam, Thailand respectively.

3.3.1.2 Qualitative Effects

At the time of planning the project, improvement of safety and comfortability of the passing vehicle, due to maintaining smoothness of the road surface after the improvement, were set as qualitative effects. For the purpose of verifying these, interviews of the drivers[8]

[8] Sample size: 28 drivers. Near the Vietnam border: Large vehicle 4 (Male 4), Medium to small vehicle 1 (Male 1),

were carried out in the vicinity of the Vietnamese border, the vehicle weigh station and the police box near the vehicle weigh station in the section 1. The interviews were carried out with choosing among five or free answer format on the safety during fine weather, the safety during rain, the traveling time, and the comfort.

The results of the interviews in Tables 5 to 8 indicate a tendency to improve in safety during both fine and rainy weather, time required, and comfort and no negative opinion. In addition, as the size of the vehicle became larger, the evaluation tended to be higher. This may be because the vehicle becomes more susceptible to the influence of the road surface as the vehicle becomes larger.

Table 5: Safety during fine weather

Answer	Number
Improved very much	24
Improved a little	4
No change	0
Worsened a little	0
Worsened very much	0

Table 6: Safety during rainy weather

Answer	Number
Improved very much	23
Improved a little	5
No change	0
Worsened a little	0
Worsened very much	0

Table 7: Traveling time

Answer	Number
Shortened very much	22
Shortened a little	6
No change	0
Lengthened a little	0
Lengthened very much	0

Table 8: Comfort on drive

Answer	Number
Improved very much	25
Improved a little	2
No change	1
Worsened a little	0
Worsened very much	0

Major reasons for the changes are as follows.

Safety during fine weather:

"Good condition of road surface", "Pavement surface is thick", "No hole", etc.

Safety during rainy weather:

"State of road surface is good", "White line is pulled and visibility is good", etc.

Traveling time:

"Good condition on the road surface", "Wide road width is wide and high speed" etc.

Comfort on drive:

"Good condition of road surface", "Travel time has been shortened", etc.

Incidentally, although there is a possibility that some of these answers may include evaluations of the sections other than this project, since this project was aimed improvement of the sections with the worst condition, the majority of responses may be regarded as the effect of this project.

According to the response of the Savannakhet provincial police to the questionnaire,

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Police station near the vehicle weigh station: Large vehicle 5 (Male 5), Medium to small vehicle 7 (Male 7), Motor bike 8 (Male 4, Female 4), Vehicle weigh station: Large vehicle 3 (Male 2, Female 1)

traffic accidents on NR9 decrease from an average of 211 cases/year in 2012 to 2014 to an average of 85 cases/year in 2015 to 2016, traffic death also decreased from 50 to 19 persons/year. Improvement of the safety on NR9 can be confirmed also by these data. However, this data is statistics for entire NR9, and it is considered that accidents occurred in sections other than the project sections are also included.

3.3.2 Impacts

3.3.2.1 Intended Impacts

It was intended in the planning stage that the project would contribute to:-

- Expedite trade and investment in the Central Region (Savannakhet, Khammouane, Bolikhamsai, Xaisomboun , Vientiane Provinces and Vientiane Capital), and
- Development of regional economy with agricultural and commercial activities.

(1) Trade and Investment Environment

The values of trade through border gates on NR9 in 2012 and 2017 are as shown in Table 9, the values of transit trade and import have been greatly increased, and the value of export has been slightly reduced. It seems that improvement of safety and comfort of NR9 by this project contributed to the increase of the value of transit trade, but the degree of contribution is unknown. Relationship between the changes in import/export and this project is unknown, because there are routes connecting to National Road No. 13 and National Road No. 1 without passing through the project target sections.

Table 9: Values of Trade through Border Gates on NR9 (Unit: USD)

		2012	2017	Rate of Increase
Thai Border	Import	1,549.63 million	3,014.34 million	1.94
	Export	873.21 million	784.5 million	0.90
Vietnam Border	Import	83.56 million	200.87 million	2.39
	Export	73.60 million	73.44 million	0.99
Transit Trade		83.19 million	700.65 million *	8.45

Source: Second Mekong Friendship Bridge Management Office, Densawan International Border Customs
Note: *Transit trade value in Year 2016

Approved Investments in Central Region from 2012 to 2017 were as shown in Table 10, and there is no particular tendency to be recognized.

Table 10: Approved Investments in Central Region (Unit: USD)

2012	2013	2014	2015	2016	2017
457 million	1,112 million	535 million	158 million	2,447 million	1,395 million

Source: raw data provided by Department of Investment, Ministry of Planning and Investment

In order to verify the promotion effect of trade and investment in Savannakhet Province by

this project, interviews[9] were carried out with choosing among five and free answer format about changes in the situation of trade and investment environment in Savannakhet Province and effects of this project onto trade and investment environment.

The results of the interview show that both the trade environment and the investment environment improved as described below.

Table 11: Trade environment

Answer	Number
Improved very much	6
Improved a little	1
No change	0
Worsened a little	0
Worsened very much	0

Table 12: Investment environment

Answer	Number
Improved very much	4
Improved a little	3
No change	0
Worsened a little	0
Worsened very much	0

The reasons for the main change are as follows.

Trade environment:

"The state of the road surface is good and the logistics have become faster", "Easy to move between Thai and Vietnamese borders and it has become shorter" etc.

Investment environment:

"The state of the road surface is good and logistics speeded up", "The road improved and the investment from foreign countries increased," "It was inconvenient during the construction period," etc.

Still more, as for the influence of NR9 on the trade environment and the investment environment, the number of answers that said "Improved very much" and "Improved a little" are comparable. In addition, it seems that effects of improvements of other sections of NR9 by Laos side under "Project for Improvement of Road Maintenance Capacity in Lao PDR[10]" (hereinafter referred to as "the Related Technical Cooperation") is also included in the above-mentioned results.

(2) Agriculture and Commercial Activities

The agricultural production value of Savannakhet Province, as shown in Table 13, increased by 1.5 times in four years, confirming activation of agricultural activities. According to the Savannakhet Provincial Agriculture and Forestry Department, agricultural production increase is mainly due to agricultural promotion projects by JICA, ADB, World

[9] Sample size: 7 persons, Provincial Department of Industry & Commerce (hereinafter referred to as “PDIC”) officers 3 (Male 3: Chief of Administrative Section, Chief of Planning Section and Vise Chief of Export-Import Section), Owners of trading company 4 (Male3, Female1)

[10] JICA's technical cooperation project, from September 2011 to September 2017, aimed at strengthening the capabilities for maintenance and management of roads and bridges, and assisted capacity building for preparation of maintenance management plan, development of technical manuals and guidelines, and improvement of skills of engineers of DPWT in Savannakhet and Vientiane Provinces.

Bank and others (expansion of planting area by irrigation etc.), increase of production of factories such as sugar, rubber etc. by foreign investment. The improvement of NR9 brings about reduction of transportation time and cost, leading to the promotion of agriculture and motivation for expansion of productions.

Table 13: Agricultural Production Value of Savannakhet Province (Unit: LAK)

2012	2013	2014	2015	2016
3,773 million	4,471 million	4,671 million	5,508 million	5,690 million

Source: data provided by Implementing Agency

For the purpose of verifying the promotion effect of agriculture and commerce in the hinterland (along the roadside) by this project, interviews[11] were carried out about changes in the situation of the agricultural and commercial activities of the hinterland in Atsaphangthong, Palanxai and Phin Districts, which almost overlap with the target section of this project, and effects of this project onto agricultural and commercial activities with choosing among five and free answer format.

As shown in Tables 14 to 16, the result of the interview is that transportation time is shortened, transportation costs are lowered, and the number of shops is increasing.

As for the reasons for the main changes, the following answers were obtained.

Transportation time:

Mainly "Good condition of the road surface and many things can be carried quickly", "We can carry things on the bus" etc.

Transportation cost:

"Road surface is good and we can carry quickly," "fuel saving", "vehicle damage is small", etc.

Number of shops:

"Condition of road surface is good and convenient", "Tourists increased", "Stores increased about 70% more", etc.

[11] Sample size: 34 people (Provincial Department of Agriculture and Forestry (hereinafter referred to as “PDAF”), Staff 4 (Male 4: Deputy Chief of Livestock Fisheries Division, Deputy Division of Agriculture Division, Deputy Chief of Planning Division, Deputy Chief of Public Relations Division), Phin District Office of Public Work and Transport (hereinafter referred to as “OPWT”) Officer 2 (Male 1: Director, Female 1: Deputy Director), Commercial Personnel 3 (Male 3: Convenience store Management 2, grocery store management), farmer 6 (male 6), Palanxai District shop owner 5 (male 5: mobile dealer management, gas station staff, grocery store management, motorcycle shop management, drink store management), Farmer 4 (Male 4), at Atsaphangthong District OPWT Staff 1 (Male 1: Director), Shop owner 6 (Male 4: Food Store Management 2, grocery store management, Transportation management, Female 2: Foods Store management, grocery store management), farmer 3 (Male 3))

Table 14: Time of Transportation

Answer	Number
Shortened very much	31
Shortened a little	3
No Change	0
Lengthened a little	0
Lengthened very much	0

Table 15: Cost of Transportation

Answer	Number
Reduced very much	27
Reduced a little	7
No Change	0
Increased a little	0
Increased very much	0

Table 16: Commercial Activities

Answer	Number
Increased very much	22
Increased a little	7
No change	1
Decreased a little	3
Decreased very much	1

Four negative opinions on the number of shops were from shop owners in Atsaphangthong District, and they insisted that installation of barrier curbs made it difficult for customers and delivery companies to park their cars in front of the store, making it difficult to operate the business. According to DPWT, this is a measure necessary for traffic safety, and consultants in charge of the design said openings had been made to minimize the adverse effects.

However, at Atsaphangthong District, there was a part where there was no opening over a relatively long section, and removal of the curbs, which may be done by the residents, were also confirmed. Therefore, OPWT at Atsaphangthong District is considering additional openings.

Photo 3: Opening curbs may be made by residence

(3) Situation of Flooding in the Surrounding Area

Although not clearly stated in the preparatory survey report, this project was supposed to give a positive impact on the situation of flooding in the Palanxai embankment area (decrease of inundation), therefore interviews[12] on the change of inundation situation and the effect of this project were carried out in the area around the embankment section of Palanxai with choosing among five and free answer format.

[12] Sample size: 11 people (OPWT staff 2 (Male 2: director, general affairs section manager), Shop owner 5 (Male 5: grocery store management, mobile dealer management, motorcycle dealer management, drink store management, gas station staff), Farmer 4 (Male 4))

As shown in Tables 17 and 18, the results of the interviews show that the areas and duration of inundation were decreased except for one person. In the Palanxai embankment section, it was confirmed by surrounding residents' interview that the areas and duration of inundation of paddy fields on the north side of NR9 decreased by improving existing pipe culvert to dual box culverts with high drainage capacity.

Photo 4: Drainage on north side of NR9

Table 17: Area of Inundation

Answer	Number
Decreased very much	10
Decreased a little	1
No Change	0
Increased a little	0
Increased very much	0

Table 18: Duration of Inundation

Answer	Number
Decreased very much	10
Decreased a little	0
No Change	0
Increased a little	0
Increased very much	1

The reasons for the main change are as follows.

Area of Inundation: "Good drainage", "Good flow of water" etc.

Duration of Inundation:

"Good wastewater", "Previously it was flooded for about 3 days, now it will be drained in one day" etc.

According to one farmer who replied that "the duration of inundation increased very much", "the rice field flooded about 50 cm for 3 days". During observation of the site, he explained that the volume of water flowing under the Houay Koa Bridge (Palanxai District), which had been existing even before the project, had increased. Although it is not possible to conclude because there are also irrigation projects supported by ADB in the vicinity, it cannot be denied that the drainage constructed on the northern side of NR9 by this project can be one of the causes of increase flooding of his land. The Implementing Agency also agreed to these opinions of the evaluator. In any case, if looking over the area surrounding the Palanxai embankment section, there is no doubt that the inundation situation was improved by this project. The root cause of inundation in the area is the overflow in the bent

Photo 5: The situation on the side of Houay Koa Bridge

section of the Xe Xamxoy River (Palanxai District) of about 1.4 km north of NR9, and secondarily cause is the lack of flow capacity of the river downstream of the Houay Koa Bridge.

3.3.2.2 Other Positive and Negative Impacts

The initial environmental evaluation of the project was conducted based on *JICA Guideline for Environmental and Social Considerations (April 2004)* was applied.

(1) Impacts on the Natural Environment

Initial Environmental Evaluation Report (June 2011) (hereinafter referred to as "IEE") stated "National Road No. 9 crosses Dongkapo Forest Production Area, but it is not part of the improved section. It is located outside the northern boundary of Dong-Phu-Vieng National Park. This project is a repair without widening and there is no negative influence on surrounding natural environment." According to the implementing agency, there was no negative impact on the natural environment, and no special mitigation measures were taken for conservation of natural environment.

Although no environmental monitoring report was confirmed, according to DPWT, there was no environmental impact during the construction period. According to the IEE, there would be no works that would cause soil erosion and water pollution, and required pollution control measures would be only watering for dust control, etc. Since such pollution control measures are quite common for road projects, it is considered that proper actions were made and that there was no remarkable pollution during the construction.

From these, the undesirable effects on the natural environment were minimal as planned.

(2) Resettlement and Land Acquisition

Since this project is improvement of the existing NR9 without widening, land acquisition was not required[13]. IEE assumed that within 10m and 14m from the center line of the road in the urban and rural areas respectively would likely be affected by the works, and identified 46 households, 218 people as affected peoples. As a result of the first consultation meeting under the condition without specifying the part that needs to be removed/relocated, 43 households agreed to remove and transfer the structures (small structures such as fences, eaves, etc.) in the right of way without compensation, and one household among the remaining three households stated "will remove and relocate without compensation, if necessary", another household stated "to remove/relocate if there is compensation", the last household stated "resulted in losing the income source, so it cannot be removed or

[13] Right of way of a national road is within 25m from the centerline. If necessary, it is allowed to use the land within the right of way under a permission of the authority.

transferred". According to the DPWT, in the subsequent consultation meetings, the progress of the design revealed that the extent/level of influence was small and income sources would not be lost, and all households agreed to remove and relocate structures (small structures such as fences, eaves, etc.) within the affected areas without compensation based on the previous agreement regarding designation of right of way on July 16 2002. The number of affected households was less than 50, so a resettlement action plan was unnecessary in accordance with Government Ordiance PM/WREA No. 12.

Still more, there was a comment "the pavement of the connecting part with the NR9 connecting to the store was broken by construction and it was not restored" in the interviews on agricultural and commercial activities[14], and that this person was not included in the above-mentioned 46 households.

From these, it was necessary to remove small structures (fences, eaves, etc.) placed within the right of way, but there were no land acquisition, resettlement of residents nor demolition of the stores or houses themselves.

As mentioned above, for the effectiveness, although simple comparison is inappropriate because there is a difference in measurement method, actual travel speed considerably exceeded the planned target speed, and certain effects could be confirmed in the interview. In addition, the improvements of safety and comfort of travelling, they were qualitatively confirmed.

With regard to the impact, activation of agricultural activities was quantitatively confirmed, improvement of trade and investment environments, vitalization of agriculture/commercial activities and development of regional economy were qualitatively confirmed, and other negative impacts was not confirmed.

As described above, this project has achieved its objectives. Therefore, effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

The institution/organization for operation and maintenance of NR9 has been changed from the time of planning to the ex-post evaluation as shown in Table 19, and the transfer of authorities to the region is being promoted in order to respond more quickly in line with the actual situations. For example, at the time of planning the project, MPWT was responsible for inspection and maintenance plans for daily maintenance, and DPWT did all the implementation, but at the time of ex-post evaluation, OPWT is responsible for everything other than the maintenance plan and project evaluation, for which DPWT and OPWT are

[14] The person made this comment stated “This is not for claiming compensation”.

jointly responsible.

Table 19: Institution/Organization for Operation and Maintenance of NR9

Operation and Maintenance Item[15]	Daily Maintenance		Periodical Maintenance		Repair/Emergency Repair	
	At Planned	At ex-post evaluation	At Planned	At ex-post evaluation	At Planned	At ex-post evaluation
Inspection Plan	MPWT	OPWT	MPWT	DPWT	MPWT	DPWT
Inspection	DPWT	OPWT	MPWT	DPWT	DPWT	DPWT
Update and Management of Data Base	DPWT	OPWT	MPWT	DPWT	MPWT	MPWT/ DPWT
Maintenance Plan	MPWT	DPWT/ OPWT	MPWT	MPWT/ DPWT	MPWT‣ Local government	MPWT/ DPWT
Budget Planning/ Allocation	MPWT	MPWT/ OPWT	MPWT	MPWT/ DPWT	MPWT‣ Local government	MPWT/ DPWT
Maintenance Management Implementation	Contractor		Contractor		Contractor	
Business Evaluation	DPWT	DPWT/ OPWT	MPWT	MPWT/ DPWT	MPWT‣ Local government	MPWT/ DPWT
Audit	Road fund	OPWT	Road fund	DPWT	Road fund	DPWT

At the ex-post evaluation, Department of Road (hereinafter referred to as “DOR”) is responsible for maintenance of the national roads, and DPWT and OPWT in each district cooperate with DOR for implementation of the maintenance. The number of staff involved in the road maintenance is 98 in DOR, 142 in DPWT Savannakhet Province and 125 in OPWT of 15 districts in the province (staff in the six districts concerning the operation and maintenance of NR9, i.e. Kaysone, Outhoomphone, Atsaphangthong, Phalanxay, Phin and Xepon, is 55). As the number of staff increased from 279 at the time of planning to 365 (OPWT staff of 6 districts involved in the operation and maintenance of NR9 was augmented from 28 to 55 people), and many staffs were transferred to local authorities with the transfer of authority to local organizations.

Also, DPWT/OPWT plans to establish a maintenance unit for conducting periodic inspections and minor repairs by themselves.

Taken together, it is considered that the institution/organization for operation and maintenance has been improved compared with the planning time.

3.4.2 Technical Aspect of Operation and Maintenance

Regarding technology for operation and maintenance, development and strengthening of

[15] "Daily maintenance" is a maintenance that is carried out on a daily basis, such as cutting grass and cleaning drainage facilities. In future, it is a direction to enable patrols and simple repairs as well. "Periodical maintenance" is a maintenance performed at regular intervals, such as repainting of road signs.

technical capacity of project members selected from DOR, DPWT, Public Transportation Training Center, and Public Transportation Research Institute were carried out through the Related Technical Cooperation. According to the termination evaluation of the Related Technical Cooperation implemented in March 2017, the DPWT in Savannakhet Province has improved its capability towards the goal in all aspects of maintenance activities.

Currently 28 staffs, who participated in the trainings by the soft component of this project and/or the Related Technical Cooperation, are involved in operation and maintenance of NR9 in DOR, DPWT and OPWT of the six districts[16]. Also in OPWT, the Road Manual (Technical Manual for Road Maintenance and Management) produced by the Related Technical Cooperation is used for their activities. Also, the construction company engaged in the project as a subcontractor is implementing repair work on other sections of NR9, and the technology of asphalt pavement works has been accumulated.

It should be noted that DOR, DPWT, and OPWT do not have their own staff training system, they train staff by taking opportunities of aid projects of foreign countries, and according to the termination evaluation of the Related Technical Cooperation, it is expected that JICA's strategic cooperation plans including training and long-term training will be fully utilized to continuously provide opportunities for higher education to potential talents.

Taken together, there is no problem with the technology of operation and maintenance, because most of the training participants in the soft component and the Related Technical Cooperation are still engaged in the road maintenance work, the operation and maintenance technology transferred by the training is utilized in the road maintenance work, and the technology of asphalt pavement works is also accumulated in the private companies.

3.4.3 Financial Aspect of Operation and Maintenance

Maintenance and repair expenses of NR9 are as shown in Table 20. When comparing 2012 and 2017, the maintenance cost increased to 1.6 times, and the repair cost increased to 9.2 times.

Table 20: Expenses of Routine Maintenance and Major Repair (Actual, Unit: LAK)

	Maintenance	Major Repair
2012	242 million	22,195,000 million
2013	242 million	-
2014	242 million	-
2015	387 million	202,376,000 million
2016	562 million	202,376,000 million
2017	387 million	202,376,000 million

Source: data provided by Implementing Agency
Note: In 2013, 2014 repair was done by this project.

[16] A few participants in the training have left the road maintenance and management work by moving within the organization.

However, according to the implementing agency, the maintenance cost is allocated for regular mowing and cleaning of the drainage, and it is necessary to increase the budget for periodic repair. Incidentally, the maintenance cost of NR9 (total 244km) in 2017 was 1.59 million LAK/km, and only about 27% of 747USD/km, the average annual maintenance cost of the project section (58km) in the initial four years estimated in the preparatory survey.

The Road Fund was established as a source of funds for the operation and maintenance of the national roads, and their revenues and expenditure of the resent years are as shown in Table 21.

Table 21: Revenue and Expenditure of the Road Fund (Unit: LAK)

	Revenue	Expenditure	Balance Carried Forward
2012	370,600 million	416400 million	25,400 million
2013 (Oct.-Sep.)	392,400 million	360,300 million	57,600 million
2014 (Oct.-Sep.)	549,300 million	437,700 million	169,100 million
2015 (Oct.-Sep.)	625,600 million	392,100 million	402,700 million
2016 (Oct.-Dec.)	148,100 million	142,100 million	408,600 million
2017 (Jan.-Dec)	664,300 million	948,700 million	124,200 million

Source: data provided by Implementing Agency
Note: For the transition period in 2016 from October to September of the previous fiscal year, changed from January to December, 2016 figure is three months from October to December

The revenue in 2017 was increased to 3.8 times of that in FY 2008, which was referred to at the time of planning, mainly due to increase in the fuel levy (1.4 times). However, further increase of the fuel levy will not be easy, and revenue of the Road Fund may remain to an increase in natural.

For example, in 2017, DOR carried out major repair works of other sections of NR9 by investing about 300 times the revenue from the Road Fund and reduced the balance carried forward significantly. Therefore, it is difficult to secure sufficient budget for routine maintenance, which is almost same situation as that at the time of planning. However, as the repair works of other sections of NR9 will be completed from now on, it can be expected to implement the recommendation to be mentioned later, i.e. "to secure the budget necessary for periodic repair of NR9".

3.4.4 Status of Operation and Maintenance

As a result of the site observations, there was no remarkable problem in the present conditions of the sections of NR9 improved by this project. Major repair works on other

sections of NR9 are being continued by the Laotian Government with assistance of the Related Technical Cooperation. Number of overloaded vehicles at the vehicle weigh station within this project section is as shown in Table 22 and strengthening overloaded vehicle management by the Related Technical Cooperation is underway.

Table 22: Number of Overloaded Vehicles at Vehicle Weigh Station

Year	2014	2015	2016	2017
Number	96	5	0	6

Source: data provided by Implementing Agency

As mentioned above, there are no notable problems in the status of operation and maintenance.

Although overloaded vehicles became fewer than in 2014, it is hoped that the vehicle weigh station will be officially operated to further strengthen overload management.

Taken together, no major problems have been observed in the institutional, technical, financial aspects and current status of the operation and maintenance system. Therefore the sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed at improvement of NR9, which is very important connecting neighbor countries, i.e. Thailand and Vietnam, with sufficient driving speed, safety and comfort as international highway according to traffic conditions by refurbishing pavement structure and road structure of damaged sections, thereby contributing to promotion of trade and investment in Laos Central Region and economic development of the hinterland of NR9.

The project has been highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high. Both the project cost and project period were within the plan. Therefore, efficiency of the project is high. Regarding the effectiveness, although the simple comparison cannot be made due to the difference in the measurement method, the traveling speed is much higher than the expected traveling speed at the time of planning in the actual measurement, and through the driver interviews, positive effects for safety during fine and rainy weather, travel time, and comfort on drive were confirmed. Regarding the impact, it was confirmed that the renovation of NR9 led to the reduction of transportation time and transportation expenses, leading to the promotion of agriculture and the motivation for expansion of production, and through interviews, improvement of trade and investment environment, vitalization of agriculture and commercial activities, and contribution to the development of the regional economy were confirmed. Also,

no negative impact was confirmed. Therefore, effectiveness and impacts of the project are evaluated as high. Furthermore, the operation and maintenance systems have been improved in terms of human resources and organization. About technical heritage, participants of the training in the soft component still engage to maintenance duties. The financial condition is still tight, but it is expected that budget for periodical repair will be assigned in the future. No other problems have been observed. Therefore, sustainability of the project effects is high.

In light of the above, this project is evaluated to be very highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

Recommendations to the Laotian implementing agency are as follows.

- In order to sustain the effect of the project for a long time, MPWT/Department of Transport shall reinforce management of overloaded vehicles by operating officially the vehicle weigh station, which has been assisted by the Related Technical Cooperation.
- In order to increase effect of the project, MPWT/DOR shall complete improvement of other sections of NR9, which has been assisted by the Related Technical Cooperation. Also, MPWT/DOR shall support establishment of Maintenance Unit on the institutional and budgetary side so that DPWT/OPWT can perform periodic inspection and minor repair of NR9.
- DOR/DPWT shall secure budget necessary for periodic maintenance of NR9.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

(1) Improve Design Accuracy

It was fortunate in this project that the design change to deal with insufficient strength on the upper surface of the existing subbase course confirmed during the construction period was possible by using grant for contingencies. In the road improvement projects, it may not be easy to accurately grasp the status of all the lines at the time of designing, but it is necessary to secure accuracy of design by conducting sufficient soil investigations, etc. in the outline and/or detailed designs, because contingency budget has some limitation.

(2) Clarify Method of Measurement of Quantitative Effects

In this project, one of the two indicators for quantitative effects, which was set in the preparatory survey, was inappropriate, and the other indicator was not available for ex-post

evaluation because the measurement method became unknown. In order to avoid such a situation, it is necessary to specify the definitions and measurement methods of the indicators in the preparatory survey report, and to conduct these measurements at the time of completion of the project jointly by the consultant and the implementing agency, so that the implementing agency can measure the indicators independently at the time of ex-post evaluation.

Column: Summary of Impacts of Improvement of National Road Number 9 on Regional Economy in Lao People's Democratic Republic

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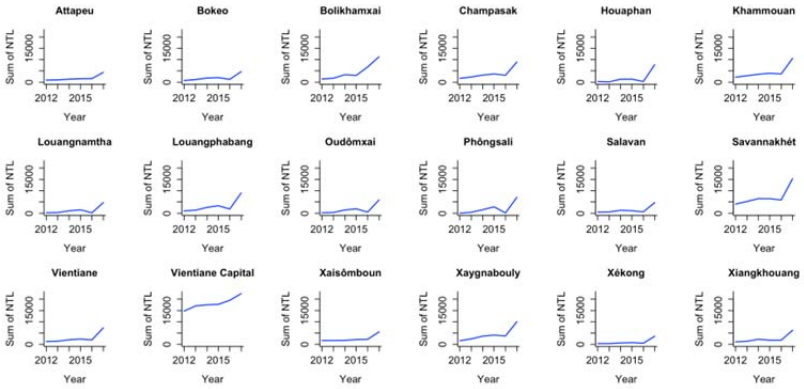
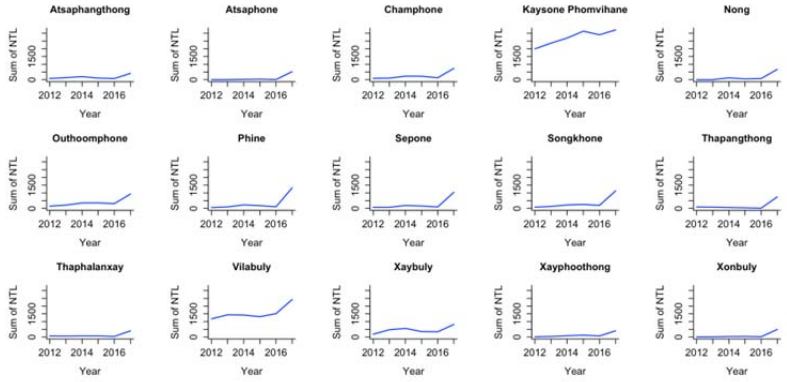
This paper examines the impacts of improvements of National Road No. 9 (hereinafter referred to as "NR9") under "The Project for Improvement of National Road No. 9 as East-West Economic Corridor of the Mekong Region", grant aid project conducted by Japan International Cooperation Agency (JICA) between 2012 and 2015, on regional economies in Laos with explicit consideration of location or geography. It addresses lack of spatial information in administrative data with spatio-temporally high resolution remote sensing data.



a. By Provinces

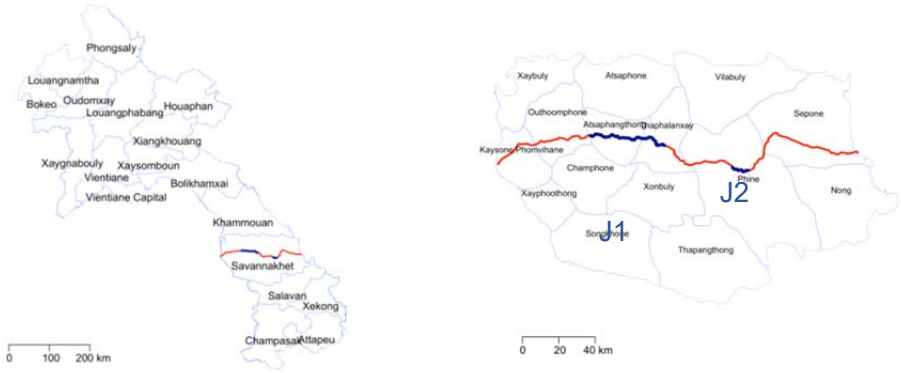


b. By Districts in Savannakhet

Figure 1. Change of Sum of NTL (2012 and 2017)

Source: By author based on GADM (Global Administrative Areas). NTL is based on Suomi NPP-VIIRS.

Following Henderson et al. (2012) and Keola et al. (2015)[17], it uses Nighttime Light (hereinafter referred to as "NTL") data, observed with satellites from outer space, as a proxy of the level of economic activity on the ground. Nevertheless, it uses NTL data collected through Visible Infrared Imaging Radiometer Suite (VIIRS) mounted on Suomi National Polar-orbiting Partnership (Suomi NPP), instead of Operation Line Scan (OLS) on Defense Meteorological Satellite Program (DMSP) used in aforementioned studies, because latest version of the latter is currently available up to 2013, so does not cover major part of the study period. On the one hand, aggregation of NTL (for the month of December) by provinces in Laos between 2012 and 2017 reasonably reflect relative scale of Gross Regional Products (Figure 1a). On the other, aggregation by districts in Savannakhet shows sharp increase of amount of NTL in 2017 for all but its capital district of Kaysone Phomvihane. Figure 2 depicts relative position of NR9, and improved sections in Laos and Savannakhet. This study main aim is to examine the impact of these improved sections.



a. Whole Country b. Savannakhet

Figure 2. National Road Number 9 in Lao PDR

Source: Provincial and district maps are based on GADM. Red line represents NR9, whereas blue line represents section improved by JICA.

The results of econometric analyses of relationship between NTL, by grids of approximately 500 by 500 meters, and reciprocal distances to NR9, and improved sections conducted by JICA (J1 and J2 in Figure 2.) can be summarized as follows. First, when differences among all approximately 140 districts in Laos are controlled for, the reciprocal distances have robust, significant and positive relationship with NTL. In other words, when all else is equal, the closer a grid to NR9 the higher the NTL (Table 1 and Figure 4). However, the relative importance of

[17] Refer to Henderson, J. Vernon, Adam Storeygard, and David N. Weil. "Measuring economic growth from outer space." American economic review 102.2 (2012): 994-1028. Keola, Souknilanh, Magnus Andersson, and Ola Hall. "Monitoring economic development from space: using nighttime light and land cover data to measure economic growth." World Development 66 (2015): 322-334.

NR9 decreases with distances, while districts with alternative accessibility depend less on the road. This is evidenced from negative coefficients of district dummies for many districts in Savannakhet including adjacent and nearby provinces such as Khammouan, Salavan and Attapue (Figure 4). Negative coefficients imply higher dependence of corresponding districts on NR9. On the contrary, coefficients of district dummies for the rest of provinces and some districts facing Mekong River in Savannakhet and nearby provinces are positive.

Second, effect of road improvement is detected for both sections, i.e. J1 and J2 through comparing difference of year effect of regions defined by 2km buffers from improved section of 2017 against 2015 when improvement works are basically completed. Such differences are illustrated in Figure 3. Year effects capture many factors including the impact of road improvements. The difference of year effects (2017-2015) for J1 shows an increasing trend, from a distance of 50 km, towards this improved section. If the part of year effect arising from factors other than road improvements can be considered uniform among regions, I argue that this is an evidence suggesting that the road improvement, of this ODA project, generated positive impacts to regional economies, between 2015 and 2017, but decreasing by distance. The increasing trend of difference of year effect (2017-2015) for J2 can be observed from about 45 km and 30 km, before becoming more or less stable to slightly declining. However, the distance of J2 is less than a fourth that of J1. This may contribute to less obvious impacts in area closer to J2. Dozens of local people living along the road interviewed by author in January 2018 responded quickly and with seemingly absolute confidence of the positive impacts of road improvements. Official macro statistics of movement of people and goods, and traffic along NR9, obtained from provincial divisions, obviously depict sharp increasing trend from 2016. The analysis of this paper confirms the subjective insight based on partial facts on the ground, with inclusive and comparable evaluation of the project, using information collected remotely at outer space.

Table 1. Main Result for NR9

	Estimate	Std. Error	t value	Pr(>|t|)
log(1/dis_r9)	0.293	0.002	125.524	0.000
factor(year)2012	(0.885)	0.015	(57.137)	0.000
factor(year)2013	(1.372)	0.015	(91.537)	0.000
factor(year)2014	(1.940)	0.015	(131.560)	0.000
factor(year)2015	(1.990)	0.015	(135.217)	0.000
factor(year)2016	(1.187)	0.015	(79.067)	0.000
factor(year)2017	(1.241)	0.015	(84.624)	0.000

Residual standard error: 0.9277 on 1885886 degrees of freedom
Multiple R-squared: 0.8978, Adjusted R-squared: 0.8978
F-statistic: 1.119e+05 on 148 and 1885886 DF, p-value: < 2.2e-16
Note: Coefficient of district dummies are shown separately in Figure 4.

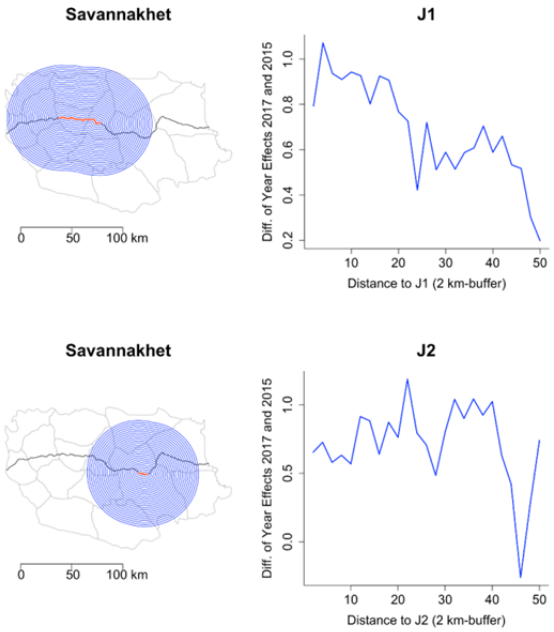


Figure 3. Difference of Year Effects 2017 and 2015

Source: By author.

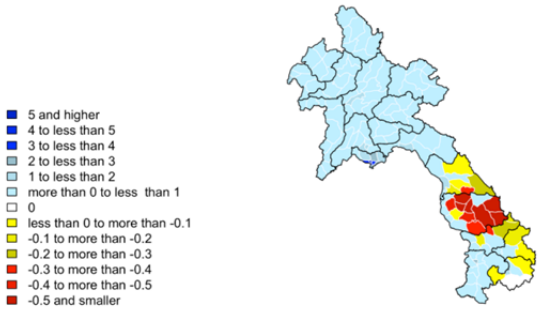


Figure 4. Coefficients of District Dummies

Source: By author.