India

The National Highway-5 Improvement Projects (I) (II)

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Field Study: October 2006

## 1. Project Profile and Japan's ODA Loan


Map of Project Area

NH-5 Jagatpur, State of Orissa

### 1.1. Background

National Highway-5 was a major corridor linking Chennai (formerly Madras) and Kolkata (formerly Calcutta) across the four states of Tamil Nadu, Andhra Pradesh, Orissa and West Bengal. In Andhra Pradesh, NH-5 linked economically thriving districts like Guntur and Visakhapatnam with one of India's leading trade ports, the port of Visakhapatnam. In Orissa, NH-5 linked the state capital, Bhubaneswar; an industrial center, Cuttack; famous tourist spots, Puri, Konarak and Chilika Lake; and Paradip Port, one of India's most important seaports, with other regions both within and without Orissa. NH-5 was also an important carrier route for Orissa's staple products including cereals, mineral resources, and articles of iron or steel. In this way, NH-5 played an important role in Andhra Pradesh and Orissa, supporting the livelihood, industry and economy of the two states.

The average traffic between Chilakaluripet and Vijayawada in the sate of Andhra Pradesh and between Jagatpur and Chandikhol in Orissa were about 19,000PCU[1]/day in 1993 and 21,000PCU/day in 1994, respectively, far exceeding the standard traffic volume of 15,000CU/day for 4-lane roads in India, but the roads in both sections were still 2-lane roads. Also, in both sections, the roads were used by a mix of high-speed and low-speed vehicles

[1] PCU (Passenger Car Unit) represents the "number of vehicles in terms of passenger cars" calculated by converting vehicle units of different types (e.g., trucks, buses, motorcycles) into passenger car units and multiplying the latter by a certain coefficient.

such as horse-drawn carriages, bicycles and rickshaws (three-wheelers), resulting not only in congestion but also in frequent accidents. In addition to this predicament, the traffic volume in Andhra Pradesh was projected to increase further, making it necessary to upgrade the existing 2-lane road to a 4-lane road and reinforce the pavement to meet future traffic demand.

1.2. Objective

The project aimed to raise transport capacity and alleviate traffic congestion by widening the National Highway 5 (NH-5) from a 2-lane to 4-lane road between Chilakaluripet and Vijayawada (83km) in Andhra Pradesh state and between Chandikhol and Jagatpur (33km) in the Orissa state , thereby contributing to regional economic growth.

1.3. Borrower/Executing Agency

Borrower: The President of India

Executing Agency: The Ministry of Surface Transport (today the Ministry of Shipping, Road Transport and Highways).

In 1998, while the project was being implemented, the executing agency changed from the Ministry of Surface Transport to the National Highways Authority of India (NHAI).

1.4. Outline of Loan Agreement

| Item | Phase (I) | Phase (II) |
|---|---|---|
| Loan Amount/Loan Disbursed Amount | 11,360 million JPY/6,749 million JPY | 5,836 million JPY/3,541 million JPY |
| Exchange of Notes/Loan Agreement | December 1993/January 1994 | December 1994/February 1995 |
| Terms and Conditions<br>-Interest Rate<br>-Repayment Period (Grace Period)<br>-Procurement | 2.6%;<br>30 years (10 years)<br><br>General untied | |
| Final Disbursement Date | June 2003 | January 2005 |
| Main Contractors | IJM Corporation Berhad (Malaysia)<br>・Gayatri Projects Ltd.(India)<br>Consortium, other local firms | KMC Constructions Ltd. (India) |
| Consultant Agreement | Louis Berger International Inc.(U.S.), Nippon Koei Co., Ltd. (Japan), Consulting Engineering Services (India) Pvt. Ltd. Consortium, Pacific Consultant International (Japan) | SMEC International Pty Ltd. (Australia), SMEC India Pvt. Ltd. (India)<br>・SPAN Consultants Pvt. Ltd. (India) Consortium, Pacific Consultant International (Japan) |
| Feasibility Study (F/S), | 1990 Feasibility Study Report | 1993 Feasibility Study Report |

| | | |
|---|---|---|
| etc. | (prepared by Public Works Bureau, AP) | (Public Works Bureau, Orissa) |

## 2. Evaluation Result

### 2.1. Relevance

#### 2.1.1. Relevance at the time of appraisal

In the 8th Five Year Plan (1992-1997), building and strengthening of energy, transport, communications, irrigation and other components of the infrastructure that support sustainable economic development was cited as a priority target. To reach this target, the widening and strengthening of existing roads, and the construction and rehabilitation of large-scale bridges were given a higher priority. Public investment (PI) to the transport sector in the 8th Five Year Plan was 12.9% of total PI, in which PI to the road sub-sector shared the second largest portion (22.9%) after the railway sub-sector (48.6%). Investment in the road sub-sector was 3.0% of total investment, while investment in the railway sub-sector was 6.3% of total investment.

The length of India's road system was 2,037,000km as of March 1991 (road density: 0.62km/km$^2$; pavement ratio: 49.1%), of which only 34,000km, or 1.7%, were national highways. However, since most of the national highways were trunk lines connecting the principal cities in India, traffic tended to be concentrated on these national highways. On the other hand, since most national highways were single or 2-lane roads, their traffic capacity could not keep up with the demand. Thus steps had to be taken to upgrade the existing national highways to 4-lane highways.

National Highway-5 was a major corridor linking Chennai (formerly Madras) and Kolkata (formerly Calcutta) across the four states of Tamil Nadu, Andhra Pradesh, Orissa and West Bengal. In Andhra Pradesh, NH-5 linked economically thriving districts like Guntur and Visakhapatnam with the port of Visakhapatnam. In Orissa, NH-5 linked the state capital, Bhubaneswar; an industrial center, Cuttack; famous tourist spots, Puri, Konarak and Chilika Lake, and Paradip Port with other regions both within and without Orissa. NH-5 also served as an important carrier route for Orissa's staple products including cereals, mineral resources, and articles of iron or steel. Thus NH-5 played an important role in Andhra Pradesh and Orissa, supporting the livelihood, industry and economy of the two states.

The traffic volume between Chilakaluripet and Vijayawada in the sate of Andhra Pradesh − the section targeted in Phase I of the project − was about 19,000PCU/day in 1993, while the traffic volume between Jagatpur and Chandikhol in Orissa − the section targeted in Phase II − was

about 21,000PCU/day in 1994. In both sections, the traffic far exceeded the standard traffic volume of 15,000CU/day for 4-lane roads in India. Additionally, in both sections, the roads were used by a mix of high-speed and low-speed vehicles such as horse-drawn carriages, bicycles and rickshaws (three-wheelers), not only resulting in congestion but also frequent accidents. Since the traffic volume in both Andhra Pradesh and Orissa was projected to increase further, there was a real need to be prepared to meet future traffic demand by, among other things, upgrading the existing 2-lane road to a 4-lane road and reinforcing the pavement.

Around the same time that the project was undertaken, the 4-laning improvement project between Bhubaneshwar and Cuttack (27.8km) on NH-5 in Orrisa State was being planned with assistance from the World Bank. After the construction of the Jagatpur-Chandikhol section (33km) in Phase II, 4-laning of the entire section starting in Bhubaneshwar and extending to Chandikhol (61km) was expected to be completed. Thus the priority of the project was very high.
From the foregoing discussion, it is recognized that at the time of appraisal, the relevance of the project plan was very high.

2.1.2. Relevance at the time of evaluation

Meeting the growing traffic demand accompanying the GDP growth target is one of the policy goals set in the 10th Five Year Plan (FY2002/03-FY2007/08). Making 4-lane road on the Golden Quadrilateral (GQ)[2], which connects the four major cities of India – Delhi, Mumbai, Chennai and Kolkata – along with the East-West/North-South Corridors[3], is given top priority in the road sub-sector development. Public investment (PI) in the transport sector in the 10th Plan is 16.5% of total PI, in which PI to road sub-sector (40%) shared the largest portion with PI to railway sub-sector (41%). Investment in the road sub-sector was 6.7% of total investment, while investment in the railway sub-sector was 6.8% of total investment. Thus the share of road sector to both PI and total investment is increasing.

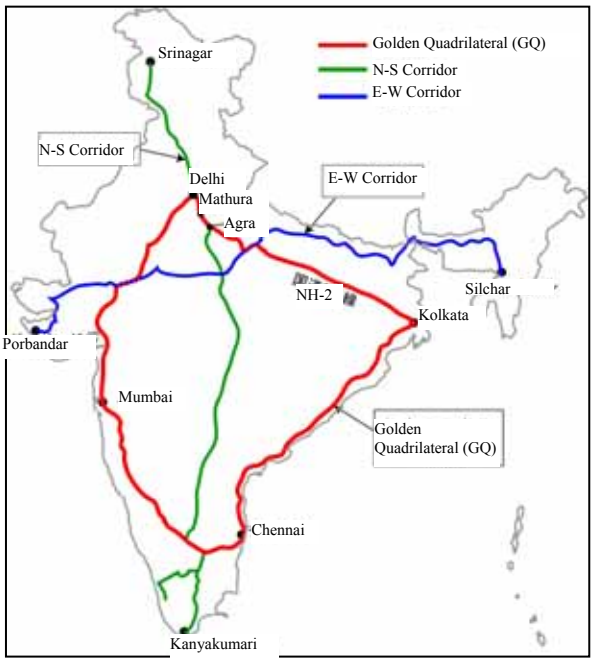
The National Highway Development Plans (I, II) (2002-2007) aim to construct 4-lane roads throughout the Golden Quadrilateral (5,846m) and the N-S/E-W Corridors (7,300km). As of

[2] Golden Quadrilateral (GQ) is a 5,846 km-long national highway linking the four principal cities of Delhi, Mumbai, Chennai, and Kolkata. The whole section between Delhi and Kolkata is scheduled to be upgraded to a 4-lane road sometime in 2007.

[3] The East-West Corridor is a 3,640km-long national highway that runs east and west across the northern part of India linking Silchar in Assam State and Porpadar in Gujarat State. Some sections of the Corridor overlap with the Golden Quadrilateral. The North-South Corridor is a 4,076km-long national highway that runs north and south across the central part of India. As of end of October 2006, 840km (11.5%) of the 7,300km of East-West and The The North-South Corridor has been upgraded to a 4-lane road, and a 4-laning improvement of 5,055km (69%) is currently being implemented. Four-laning improvement of the entire East-West and North-South Corridors is scheduled to be completed by 2008.

October 2006, 93% of the entire GQ have been upgraded to 4-lane roads. Since the 10th Five Year Plan is regarded in India as an important national project, the Government of India is continuing to expand GQ to meet growing transport demands. The section between Chilakaluripet and Vijayawada in the state of Andhra Pradesh − the section targeted in Phase I of the project − and the section between Jagatpur and Chandikhol in the state of Orrisa − the section targeted in Phase II − are included in NH-5 that make up a part of GQ. Thus the priority of the project remains high (see Fig. 1).

Fig. 1. Location of the Project within the National Highway Development Project




In recent years, the cotton ginning industry has developed along the Chilakaluripet-Vijayawada section of NH-5 in the state of Andhra Pradesh (Phase I of the project), and there is a plan to construct 4-lane road (on NH-5A) between Chandikhol, which connects the Jagatpur-Chandikhol section of NH-5 in the state Orissa, and the port of Paradip (Phase II). For these reasons, traffic demand in both sections is expected to continue to increase. Thus the project remains relevant and necessary.

For the above reasons, relevance of the project at the time of evaluation remains high.

## 2.2. Efficiency

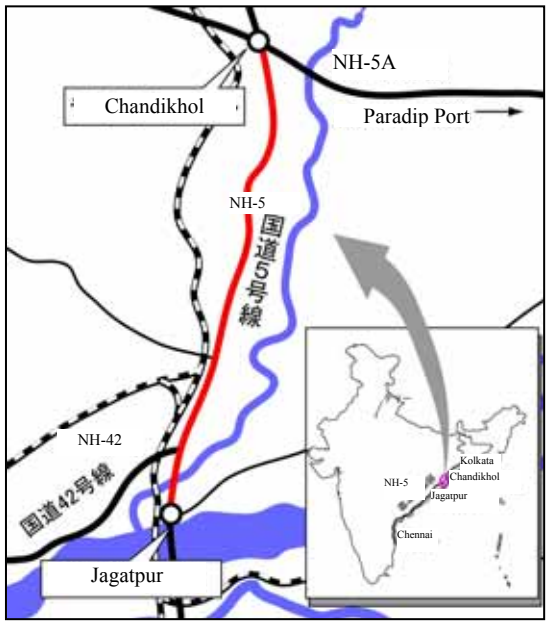
### 2.2.1. Output

The project's main output included the widening and improvement of the existing road (83km) between Chilakaluripet and Vijayawada on NH-5 from a 2-lane road to a 4-lane road, the reinforcement and installation of culverts and the construction of rail-over-bridges along the said existing road. In Phase II, the project output included the widening and improvement of the existing road (33km) between Jagatpur and Chandikhol on NH-5 in the state of Orissa from a 2-lane road to a 4-lane road and the reinforcement and installation of culverts along the same existing road. The project outputs in both Phase I and Phase II were for the most part implemented as planned. In Phase I, additional output was for the construction of an overpass at the intersection of NH-5 and NH-9, safety equipment (steel barriers, road signs, lighting devices), and installation of pedestrian bridges at four locations. In Phase II, additional output was for construction of a T-type juncture at the intersection of NH-5 and NH-42, construction

of a service road (9.4m long), construction of an underpass at three locations, and installation of safety equipment (steel barriers, reflectors for preventing collisions, bollards along the center divide, lighting devices). The abovementioned additional output was included in the project scope in response to request from the local administrative authorities and as policy responses to traffic safety concerns.

Fig. 2. Map of Target Area (I) (Andhra Pradesh State)


Fig. 3. Map of Target Area (II) (Orissa State)




2.2.2 Project period

In Phase I, the project period was supposed to be 5 years and 3 months (January 1994-March 1999), but actually lasted 10 years and 3 months (January 1994-March 2004), a delay of 5 years, or 195% longer than the original schedule. In Phase II, the project period was scheduled to be 5 years and 8 months (February 1995-September 2000), but actually lasted 8 years and 6 months (February 1995-July 2003), a delay of 2 years and 9 months, or 150% longer than the original schedule.

The reasons for the delay in Phase I included: (i) a two-and-a-half-year delay in selecting the consultants due to the executing agency's inexperience in procuring international consultants (ii) delays in various procedures that were being undertaken at the time caused by the 1998 change of the executing agency from the Ministry of Surface Transport to the National Highways Authority in India; and (iii) the delay in the construction work due to adverse weather conditions, such as heavy rain and flooding, and lack of pavement materials. The reasons for the delay in Phase II included: (i) the delay in obtaining government sanctions (e.g., the Expenditure Finance Committee [EFC] clearance, the Cabinet Committee on Economic Affairs [CCE] clearance, and environmental clearance) required for the execution of the Project caused by the long delay in site acquisition,

resulting in an approximate 3-year delay in implementation schedule after the consultants were selected; and (ii) the 1998 change of the executing agency from the Ministry of Surface Transport to the National Highways Authority, resulting in an approximate 1-year delay in implementation schedule after the consultants were selected in India.

2.2.3 Project cost

The actual project cost of Phase I is 10,683 million yen (6,749 million yen in ODA loan) against 13,482 million yen (11,360 million in ODA loan), that is, a reduction of 2,799 million yen, or 79% of the original cost. On the other hand, comparing the project cost of Phase I on a rupee basis reveals that the actual project cost is 3,815 million rupees (1 rupee=2.80 yen) against 3,644 million rupees (1 rupee=3.70 million yen) of the original cost, which means that the actual project cost constitutes a cost overrun of only 5%. This difference is due to the fluctuation in the yen-rupee exchange rate used.

The actual project cost of Phase II is 4,298 million yen (3,541 million yen in ODA loan) against 7,061 million yen (5,836 million yen in ODA loan), that is, a cost underrun of 2,763 million yen, or 61% of the original cost. On the other hand, comparing the project cost of Phase II on a rupee basis reveals that the actual project cost is 1,546 million rupees (1 rupee=2.78 yen) against 2,101 million Rupees (1 rupee=3.36 million JPY) of the original cost, which means that the actual project cost was only 74% of the original cost. This was because there was a large surplus in the slush fund that was allocated in the project cost. Also, there was the effect of the yen-rupee exchange rate used.

2.3. Effectiveness

2.3.1. Traffic Volume

Table 2 compares estimated traffic with actual traffic in Phase I in 2001 and 2005. Table 3 compares estimated traffic with actual traffic in Phase II in 2006. A glance at the average daily traffic volume (vehicles/day) by section in Phase I reveals that in 2001 the estimated traffic in Section 1 was 10,970 vehicles/day, but the actual traffic was 18,514 vehicles/day, or 169% of the targeted traffic. In Section 3, the estimated traffic was 20,124 vehicles/day, but the actual traffic was 26,223, or 130% of the targeted traffic. In 2005, the estimated traffic was 13,920 vehicles/day, but the

Table 1. Number of Registered Vehicles

(unit: vehicles)

| | 1998/9 | 2000/1 | 2002/3 | 2004/5 | 2005/6 |
|---|---|---|---|---|---|
| Phase I (Andhra Pradesh State) | | | | | |
| Krishna Dist. | 289,456 | 338,532 | 427,784 | 493,012 | 527,702 |
| Guntur Dist. | 11,589 | 10,953 | 19,556 | 29,441 | 36,224 |
| Total | 301,045 | 349,485 | 447,340 | 522,453 | 563,926 |
| Phase II (Orissa State) | | | | | |
| Cuttack Dist. | 10,872 | 18,111 | 20,631 | 23,030 | 24,825 |
| Jajpur Dist. | 2,543 | 4,132 | 5,944 | 8,014 | 8,955 |
| Total | 13,415 | 22,243 | 26,575 | 31,044 | 33,780 |

Source: Phase I data are for the state government of Andhra Pradesh, Phase II data are for the state government of Orissa.

actual traffic was 18,520 vehicles/day, or 133% of the targeted traffic. In Section 3, the estimated traffic was 25,940/day, but the actual traffic was 26,889 vehicles/day, or 104% of the targeted traffic (see Table 2). The traffic volume in Phase I was fully met. The increase in bus and truck traffic was much higher than the original estimate and this was the main factor contributing to the increase in overall traffic. Providing the background for the increase in the overall traffic was the 1.9 fold increase in the number of registered vehicles during the eight years from FY1998/9 to FY2005/6 from 300,000 to 560,000, respectively (see Table 1). Here it should be mentioned that, even in the PCU/day comparison of traffic, the actual traffic in Section 1 (146%) and the actual traffic in Section 3 (119%) fully met their respective traffic volume targets.

Table 2. Comparison of Predicted Traffic Volume and Actual Traffic Volume in 2001 and 2005 between Chilakaluripet and Vijayawada in Andhra Pradesh

(Phase I) (unit: vehicles/day)

| | 2001 | | | 2005 | | | 2006 |
|---|---|---|---|---|---|---|---|
| | Estimate | Actual | Achieved | Estimate | Actual | Achieved | Target (ref.) |
| Section 1: Chilakaluripet-Guntur (355.0km-396.8km) (*) | | | | | | | |
| 2-3 wheelers | 1,694 | 1,121 | 66% | 2,383 | 1,202 | 50% | 2,595 |
| Car | 1,805 | 1,682 | 93% | 2,420 | 3,877 | 160% | 2,604 |
| Bus | 965 | 1,982 | 205% | 1,237 | 2,544 | 206% | 1,316 |
| Truck/Lorry | 5,988 | 13,568 | 227% | 7,362 | 10,690 | 145% | 7,753 |
| Bicycle/Rickshaw | 499 | 148 | 30% | 499 | 161 | 32% | 499 |
| Other low-speed vehicles | 19 | 13 | 68% | 19 | 46 | 242% | 19 |
| Total | 10,970 | 18,514 | 169% | 13,920 | 18,520 | 133% | 14,786 |
| PCU/day (ref.) | 24,653 | 49,423 | 200% | 30,723 | 44,912 | 146% | 32,476 |
| Section 2: Guntur-Bypass (0.0km-15.2km) (**) | | | | | | | |
| 2-3 wheelers | 3,076 | n.a. | - | 4,326 | n.a. | - | 4,712 |
| Car | 2,910 | n.a. | - | 3,900 | n.a. | - | 4,197 |
| Bus | 1,756 | n.a. | - | 2,250 | n.a. | - | 2,394 |
| Truck/Lorry | 7,297 | n.a. | - | 8,971 | n.a. | - | 9,447 |
| Bicycle/Rickshaw | 562 | n.a. | - | 562 | n.a. | - | 562 |
| Other low-speed vehicles | 17 | n.a. | - | 17 | n.a. | - | 17 |
| Total | 15,618 | n.a. | - | 20,026 | n.a. | - | 21,329 |
| PCU/day (ref.) | 33,164 | - | - | 41,595 | - | - | - |
| Section 3: Guntur-・Vijayawada (408.2 km-420.6km[*], 0.0-13.55km [**]) | | | | | | | |
| 2-3 wheelers | 4,400 | 2,257 | 51% | 6,189 | 2,848 | 46% | 6,740 |
| Car | 4,011 | 2,858 | 71% | 5,376 | 6,019 | 112% | 5,785 |
| Bus | 2,493 | 4,180 | 168% | 3,195 | 4,977 | 156% | 3,400 |
| Truck/Lorry | 8,544 | 16,752 | 196% | 10,504 | 12,852 | 122% | 11,061 |
| Bicycle/Rickshaw | 652 | 172 | 26% | 652 | 160 | 25% | 652 |
| Other low-speed vehicles | 24 | 4 | 17% | 24 | 33 | 138% | 24 |
| Total | 20,124 | 26,223 | 130% | 25,940 | 26,889 | 104% | 27,662 |
| PCU/day (ref.) | 41,357 | 67,582 | 163% | 52,050 | 62,007 | 119% | 55,158 |

* Distance from Chennai、(**), distance from Guntur

Note 1. The actual traffic volume in 2001/05 for Section 2 is unknown because no survey on traffic volume was conducted in the section concerned.

Note 2. PCU/day is indicated for reference. The following PCU conversion coefficients were used: 2-3 wheelers=0.75（average of bicycle=0.5 and 3 wheelers=1.0）、car=1.0、bus=3.0、truck/lorry=3.0、bicycle/rickshaw=1.25（average of bicycle=0.5 and rickshaw=2.0）, and other low speed vehicle=5.0（Indian Road Congress standards）

Source: The estimated traffic is based on JBIC appraisal data. The actual traffic is based on the results of a traffic survey by the National Highways Authority of India (NHAI).

On the other hand, a looking at the average annual traffic (vehicle/day) by section in Phase II shows that in 2006 estimated traffic was 33,865 vehicles/day in Section 1, but actual traffic was 35,210 vehicles/day, or 104% of the traffic volume target. In Section 3, estimated traffic was 29,888 vehicles/day, but actual traffic was 17,417 vehicles/day, or only 58% of the traffic volume target. The actual traffic thus failed to meet the traffic volume target (see Table 3).

Table 3. Comparison of Predicted Traffic Volume and Actual Traffic Volume in 2006 (Phase II) between Jagatpur and Chandikhol in Orissa State

<Phase II> (unit: vehicles/day)

| | 2005 | 2006 | | |
|---|---|---|---|---|
| | Estimate (ref.) | Estimate | Actual | Target |
| Section 1 (28.4km at planned observation point, 24.0km at actual observation point )(*) | | | | |
| 2 wheelers | 4,841 | 5,282 | 13,704 | 259% |
| Car | 5,215 | 5,622 | 6,780 | 121% |
| Bus | 3,344 | 3,561 | 1,989 | 56% |
| Truck/Lorry | 15,159 | 16,447 | 5,951 | 36% |
| LCV | 1,011 | 1,097 | 4,164 | 380% |
| Bicycle | 1,724 | 1,724 | 2,336 | 135% |
| Rickshaw | 104 | 104 | 283 | 272% |
| Animal-drawn carriage | 26 | 26 | 3 | 12% |
| Total | 31,424 | 33,863 | 35,210 | 104% |
| PCU/day (ref.) | 65,835 | 71,107 | 45,444 | 64% |
| Section 2 (32.0km at planned observation point)(*) | | | | |
| 2 wheelers | 4,503 | 4,913 | n.a. | - |
| Car | 4,392 | 4,734 | n.a. | - |
| Bus | 2,979 | 3,173 | n.a. | - |
| Truck/Lorry | 13,597 | 14,752 | n.a. | - |
| LCV | 944 | 1,024 | n.a. | - |
| Bicycle | 2,568 | 2,568 | n.a. | - |
| Rickshaw | 162 | 162 | n.a. | - |
| Animal-drawn carriage | 56 | 56 | n.a. | - |
| Total | 29,201 | 31,382 | n.a. | - |
| PCU/day (ref.) | 59,620 | 64,334 | - | - |
| Section 3 (57.0km at planned observation point, 59.0km at actual observation point) (*) | | | | |
| 2 wheelers | 4,281 | 4,670 | 4,038 | 86% |
| Car | 4,092 | 4,411 | 3,239 | 73% |
| Bus | 2,507 | 2,669 | 970 | 36% |
| Truck/Lorry | 13,102 | 14,216 | 6,226 | 44% |

| | | | | |
|---|---|---|---|---|
| LCV | 812 | 881 | 1,267 | 144% |
| Bicycle | 2,745 | 2,745 | 1,593 | 58% |
| Rickshaw | 275 | 275 | 84 | 31% |
| Animal-drawn carriage | 21 | 21 | 0 | 0% |
| Total | 27,835 | 29,888 | 17,417 | 58% |
| PCU/day (ref.) | 56,284 | 60,729 | 29,711 | 49% |

* Distance from Bhubaneshwar

Note 1. The actual traffic in 2006 for Section 2 is unknown because no survey on traffic volume was conducted in the section concerned.

Note 2. LCV（Light Commercial Vehicle） refers to vehicles weighing 7.5 tons or less (minibus, tractor, roadrunner, etc.) defined under the 1998 Motor Vehicles Law.

Note 3. PCU/day is indicated for reference. The following PCU conversion coefficients were used: bicycle=0.5, car=1.0, bus=3.0、truck/lorry=3.0、LCV=1.5, bicycle=0.5, rickshaw=2.0, and animal-drawn vehicle=4.0 (Indian Road Congress standards).

Source: The estimated traffic is based on JBIC appraisal data. The actual traffic is based on the results of a traffic survey conducted in November 2006 by the National Highways Authority of India (NHAI). But the actual and planned observations points are not always the same.

It is possible that one reason that the actual traffic in Section 3 did not reach the estimated traffic is that the observation points where the data for comparison were collected were not the same. That is to say, the observation point (at 57.0km mark) for estimating traffic in Section 3 was located in Chandikhol, which is the center of commercial activities in the target area. On the other hand, the observation point (at 59.0km mark) for actually counting traffic was located 2km from the center of Chandikhol traveling on NH-5 towards Kolkata. Consequently, it is conceivable that there was less traffic at the 59.0km mark than in the central part (57.0km) of Chandikhol. The number of registered vehicles in the target area increased by about 2.5 fold during the 8-year period from FY1998/9 (13,000 vehicles) to FY2005/6 (34,000 vehicles) (see Table 1). Considering the difference in geographical conditions of the aforementioned observation points in Section 3, the actual traffic volume in Phase II of the project is believed to have met a certain traffic volume target.

Comparing traffic volumes in terms of PCU/day for reference shows that at 64% and 49% respectively, the traffic volume target in 2006 was met neither in Section 1 nor in Section 3. But in this evaluation, average annual traffic (vehicles/day) is adopted as an effective indicator of traffic. Thus there is no change in the aforementioned evaluation.

2.3.2. Time saving

In Phase I area, traveling time was shortened by 30 minutes from 120 minutes before the project to 90 minutes after the project. In Phase II area, it was reduced by 15 minutes from 45 minutes before the project to 30 minutes after the project (see Fig. 4). It is recognized that

Table 4: Time Saving

| Section | Before (2-lane) | After (4-lane) |
|---|---|---|
| Phase I (Chilakaluripet-Vijayawada: 83km) | 120 min | 90 min |
| Phase II (Jagatpur−Chandikhol: 33km) | 45 min | 30 min |

Note: Time required is the average for all vehicles.
Source: National Highways Authority of India

traveling time was shortened in both Phase I and Phase II.

2.3.3. Improvement in average velocity

The average velocity in Phase I area increased 1.7 fold from 32km/hr before the project to 53km/hr after the project. The average velocity in Phase II area increased 1.5-1.6 fold from 45-50km before the project to 70-75km after the project (see Table 5). It is recognized that average velocity was improved in both Phase I and Phase II.

Table 5. Improvement in Average Velocity

| Section | Before (2-lane) | After (4-lane) |
|---|---|---|
| Phase I (Chilakaluripet-Vijayawada: 83km | 32 km/h | 53 km/h |
| Phase II (Jagatpur-Chandikoh: 33km) | 45~50 km/h | 70~75 km/h |

Note: Time required is the average for all vehicles.
Source: National Highways Authority of India

2.3.4. Gradual congestion length decrease and time saving

In Phase I area, before the project, congestion length and traveling time at peak hours were 10km and 135min, respectively. After project completion, congestion length was improved to 3.5km (Section 1:1.5km, Section 2: 2.0km) and traveling time to 90min. In Phase II area, before project implementation, congestion length and traveling time were 0.5km and 50-60min, respectively. After project implementation, congestion length was improved to 0km (congestion free) and traveling time to 30min (see Table 6). It is recognized that congestion length and traveling time were decreased in both Phase I and Phase II.

Table 6. Congestion Length Decrease and Time Saving

| Section | Before (2- lane) | | After (4-lane) | |
|---|---|---|---|---|
| | Length | Time | Length | Time |
| Phase I (Chilakaluripet-Vijayawada: 83km) | 10km | 135min | 1.5km (Section1) 2.0km (Section 2) | 90min |
| Phase II (Jagatpur-Chandikoh: 33km) | 0.5 km | 50~60min | 0 km | 30min |

Note: Data on congestion length and time saving were collected at peak rush hours. Congestion occurred mostly near Jagatpur.
Source: National Highways Authority of India

2.3.5. Number and frequency of traffic accidents

Table 7 shows the number and frequency of traffic accidents during the past eight years, from1999-2006, in Phase I area and Phase II area. The said number peaked in 2003 at 356 (average 29.7 per month) in Phase I area and began gradually decreasing in 2004, the year the project was completed. The number of traffic accidents decreased by about a quarter, from an average of 29.7 per month in 2003 to 22.3 per month in 2005. Thus it is recognized that in Phase I area, the project had a certain degree of effect in reducing the number and frequency of traffic accidents. On the other hand, the number of traffic accidents in Phase II area varied from year to year, and at one point in 2004, after project completion, it improved to 166 (average 13.8 per month), but it again began to increase in 2005. However, since there were

387 accidents (average 32.3 per month) in 1991, 391 (32.6 monthly average) in 1992, and 431 (35.9 monthly average) in 1993, a comparison of the number of traffic accidents in Phase II area over the past 13-15 years shows a decrease of nearly 50%. Nevertheless, since the average number of traffic accidents in Phase II area had already decreased to 18.8 per month in 1999, that is, before project completion, the direct effect of the project on reducing the number of traffic accidents is not yet evident.

Table 7. Number and Frequency of Traffic Accidents

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006* |
|---|---|---|---|---|---|---|---|---|
| Phase I (Chilakaluripet - Vijayawada: 83km) | 328 (27.3) | 256 (21.3) | 328 (27.3) | 305 (25.4) | 356 (29.7) | 315 (26.3) | 267 (22.3) | 187 (20.1) |
| Phase II (Jagatpur-Chandikoh: 33km) | 226 (18.8) | 217 (18.1) | 146 (12.2) | 185 (15.4) | 232 (19.3) | 166 (13.8) | 206 (17.2) | 185 (18.5) |

Note: Phase I data for 2006 are for 9 months from January to September; Phase II data are for the 10 month period from January to October.
The numbers in parentheses represent the average number of accidents per month.
Source: Phase I data are based on Guntur police authority data; Phase II data are based on Jagatpur policy authority data.

2.3.6. Economic internal rate of return（EIRR）

The economic internal rate of return (EIRR) at the time of project appraisal was 18.6% in Phase I and 18.3% in Phase II. EIRR was calculated by recording building costs, consulting service fees, and maintenance costs as expenses and the effects of cutting travel expenses as benefits, as well as by regarding the duration of 15 years after the project completion as the life of the project. In the post-evaluation, the result of the recalculation of the EIRR of the project under the same conditions as at the time of project appraisal was 23.5% in Phase I and 22.5% in Phase II. The reason the result of the recalculation of EIRR was higher than the original projection is that, on the one hand, benefits increased in Phase I because the actual traffic exceeded the estimated traffic at the time of appraisal, and on the other hand, the project cost decreased because the actual project costs in Phase I and Phase II were lower than the project cost estimation at the time of appraisal. As a result, the internal rate of return increased.

2.4. Impact

2.4.1. Impact on the alleviation of traffic congestion

As noted in “2.3.2 Time saving,” “2.3.3 Improvement in average velocity” and “2.3.4 Gradual congestion length decrease and time saving,” in Phase I, by widening the 83km section of NH-5 between Chilakaluripet and Vijayawada in the state of Andhra Pradesh from a 2-lane to a 4-lane road, congestion length before the project was improved from 10km to 3.5km (Section 1, 1.5km, Section 2, 2.0km) and time saving from 135min to 90min.. Average velocity was also improved from 32km/hr to 53km/hr. Thus Phase I had an impact on alleviating traffic congestion.

Similarly, by widening the 33km section of NH-5 between Jagatpur to Chandikhol in the state of Orissa from a 2-lane to a 4-lane road in Phase II, congestion length before implementation was improved from 0.5km to 0km (noise-free), and traveling time from 50-60min to 30min. Also, average velocity was improved from 45-50km/hr before the project to 70-75km/hr after the project. In Phase II, since the issue of congestion length had been resolved, it was clear the project had had an impact on alleviating traffic congestion.

2.4.2. Impact on the decrease in traffic accidents

As noted in "2.3.5 Number and frequency of traffic accidents," after peaking in 2003 at 356 (average 29.7 per month), the number of traffic accidents in the Chilakaluripet-Vijayawada section has shown a tendency for gradual decrease. The average number of accidents per month decreased by about 30%, from 29.7 in 2003 to 20.1 in 2006. As indicated in Table 2, the actual traffic in the Chilakaluripet-Vijayawada section exceeded the estimated traffic, and yet the number of traffic accidents has tended to decrease since 2003. This suggests that, along with other factors, the project has had a certain positive impact on reducing the number and frequency of traffic accidents. In the Jagatpur-Chandikhol section, as far as the change in the number of traffic accidents over the past 8 years is concerned, there has not been any significant improvement. Thus to this day there has not been any positive impact of Phase II on reducing traffic accidents.


NH-5 (Phase I) Chilakaluripet, AP State


NH-5, Krishna Bridge (Phase I) Vijayawada, AP State

Meanwhile, in the Chilakaluripet-Vijayawada section, there were 0.40 traffic accidents per 10,000 vehicles in 2001[4] and 0.32 traffic accidents per 10,000 vehicles in 2005[5]. In the Jagatpur-Chandikhol section, there were only 0.16 traffic accidents per 10,000 vehicles[6]. The frequency of traffic accidents in the Jagatpur-Chandikhol section was lower than that in the Chilakaluripet-Vijayawada section.


NH-5 (Phase II) Chandikhol, Orissa State

[4] The rate is obtained by dividing the number of traffic accidents per day in 2001 (206/365 days) by the average daily traffic (22,368 vehicles/day) counted in Section 1 and Section 3.

[5] The rate is obtained by dividing the number of traffic accidents per day in 2005 (207/365 days) by the average daily traffic (22,704 vehicles/day) counted in Section 1 and Section 3.

[6] Since the number of traffic accidents per day in 2006 counted in Section 2 covers a 10-month period, for descriptive purposes, the rate is obtained by dividing the number of traffic accidents per day in January 2005 (206/365 days) by the average daily traffic (35,210 vehicles/day) counted in Section 1.

Generally speaking, factors that cause traffic accidents can be divided into two categories: (1) issues related to road design and road structure and (2) issues involving road users' awareness of road safety and their road manners. The unique features of India's main national highways as they relate to the former category include: (i) roads are not designed as a highway to be used exclusively by motor vehicles, hence all types of vehicles including bicycles, rickshaws and animal- drawn carriages are also mixed with high speed vehicles (only a few of the sections are provided with service roads for use exclusively by local residents and low-speed vehicles), (ii) there are no crossing facilities such as underpasses for local residents and animals, and (iii) there are not enough traffic lights. Regarding the issue of road users' awareness of road safety and their road manners, the unique features include (i) drivers' lack of willingness to obey traffic rules and regulations, (ii) unlawful occupation of road shoulders and roadways by local residents, shops and others, (iii) on-the-street parking by large trucks and buses, and (iv) jaywalking by local residents and free entry of cattle into the road.

In the Chilakaluripet-Vijayawada section of Phase I and the Jagatpur-Chandikhol section of Phase II, various forms of reckless driving brought about by the alleviation of congestion are observed on a daily basis. They include speeding, dangerous passing, driving in the wrong direction on a one-way street, the mixture of high-speed and low-speed vehicles, unlawful use of road sides near urban districts and settlements, on-the-street parking by heavy vehicles, and jaywalking by local residents compelled by the lack of traffic lights and facilities for road crossing. Reckless driving is a risk factor that blocks traffic and causes traffic accidents. In addition, pedestrian overpasses that were installed in four locations in Phase I have not been used at all. The reason is that local residents are not accustomed to using overpasses or the overpasses are not user friendly. In order for the project to continue to have a positive impact on reducing traffic accidents and enhance its positive effect, efforts need to be made in both the hardware and software aspects of traffic safety. The former requires addressing the aforementioned issues through the improvement of road infrastructure including installation of traffic lights and crossing facilities. The latter involves providing traffic safety education for road users and having police double their effort to clamp down on traffic offenders.

### 2.4.3. Impact of development of regional economy

Table 8, Number of Registered Factories（Krishna District, Guntur District）

| | 2000/1 | 2001/2 | 2002/3 | 2003/4 | 2004/5 | 2005/6 |
|---|---|---|---|---|---|---|
| Krishna | 792 | 843 | 872 | 932 | n.a. | n.a. |
| Guntur | 1,691 | 1,598 | 2,067 | 2,035 | 4,002 | 4,115 |

Source: AP state government

Guntur is a district in the state of Andhra Pradesh where almost the entire Chilakaluripet-Vijayawada section of Phase I is located. Cotton, tobacco, chili peppers, turmeric and other crops have traditionally been grown in Guntur District, and against this background, agro industries such as ginning (the process through which cotton is removed from raw cotton and the seeds are separated) are the main indigenous industries. A glance at the number of registered factories in the district shows that it surged from 2,035 in FY2003/4 to 4,115 in FY2005/6 (see Table 8). The food processing and preservation industry accounts for the largest proportion of the registered factories, followed by the cotton processing and textile industries, most of which are concentrated along NH-5 between Chilakaluripet and Guntur (see Table 9).

Table 9. Breakdown of Number of Registered Factories

| FY | Cotton processing/ textile | Tobacco | Lumber | Food processing/ preservation | Total |
|---|---|---|---|---|---|
| 2004/5 | 518 | 202 | 174 | 2,348 | 4,002 |
| 2005/6 | 421 | 256 | 174 | 2,398 | 4,115 |

Source: AP state government

Table 10. Intrastate Production
(Krishna District、Guntur District)

(million rupee)

| | 1993/4 | 2000/1 | 2002/3 | 2003/4 | Growth rate |
|---|---|---|---|---|---|
| Krishna | 36,037 | 52,462 | 58,773 | 58,813 | 5.0% |
| Guntur | 39,278 | 54,977 | 53,266 | 60,120 | 4.3% |

Note: Above figures are constant prices based on 1993/4 prices. Average growth rate covers 11 years between 1993/4 and 2003/4.
Source: AP state government

According to a person in charge of Guntur District, the number of registered factories in the ginning industry jumped from 21 in 2001 to 87 in 2006 (of which 55 are applying for operation permits). The reasons for this growth include: (i) accessibility to the raw material because growing cotton is a traditional industry in Guntur; (ii) availability of a large work force because Guntur boasts a population of 4.5 million; (iii) government support of cotton ginning and related industries; and (iv) advent of low-cost cotton ginning realized by improvements in spinning machinery, brought about in turn by technical innovations in the ginning industry, made cotton manufacturing possible even in humid environments such as in Guntur, where the high humidity once rendered the manufacturing cost of cotton so high that the district was considered ill-suited for cotton ginning. In addition, the local government authority and factory owners have confirmed in hearings that the improved access to the port of Chennai (formerly Madras), made possible by the improvement of road infrastructure under the project, is one of the main reasons that so many weaving cotton ginning factories are today located in the Chilakaluripet-Vijayawada section of NH-5. Furthermore, after project implementation, the section witnessed developments such as increased housing construction, new textile and clothing manufacturers, and population inflow. The foregoing discussion confirms that Phase I contributed to regional economic development and particularly to the development of the cotton ginning industry in Guntur District.

Table 11. Number of Registered Factories
(Cuttack and Jajpur Districts)

| | 2000/1 | 2001/2 | 2002/3 | 2003/4 | 2004/5 | 2005/6 |
|---|---|---|---|---|---|---|
| Cuttack | 64 | 68 | 74 | 72 | 67 | 70 |
| Jajpur | 354 | 350 | 351 | 350 | 348 | 355 |

Source: Orissa state government

In Phase II, although the Jagatpur-Chandikhol section of NH-5 is part of the districts of Cuttack and Jajpur, in the state of Orissa, there has not been any noticeable change in the number of registered factories over the past six years (table 11). However, as the executing agency insists, after project implementation there has been development along NH-5 as evidenced by the large number of new shops and business establishments in the Jagatpur-Chandikhol section of the highway. In the hearings held for local residents, it has been reported that the economic situation of those living in the section of NH-5 under discussion improved after the project implementation as evidenced by the rise in land prices in the said section. Also, with improvements in the mode of transport and market accessibility for farmers, shipment of agricultural products has become much easier, resulting in many benefits including new market opportunities. It can therefore be said that Phase II had a positive impact on revitalizing the commercial and agricultural sectors in the Jagatpur-Chandikhol area along NH-5.

2.4.4. Impact on Job Creation

It is safe to assume that the project had a positive impact on job creation in the target area. In Phase I, through the development and the like of cotton ginning and other related industries; in Phase II, through the revitalization of the commercial and agricultural sectors in the Jagatpur-Chandikol area along NH-5.

2.4.5. Impact on the Environment

Since periodic monitoring of the environment was conducted in neither the Chilakaluripet-Vijayawada section nor in the Jagatpur-Chandikhol section after project completion, there have been no scientific data available concerning air, vibration, noise and other forms of pollution. Nevertheless, the executing agency is of the view that no outstanding environmental issues have developed in the two sections along NH-5.

Deforestation and re-plantation were carried out as part of the road widening and improvement in Phase I and Phase II. In Phase I, the plan called for the cutting down of 949 trees and re-plantation of 1,898 trees, but actually a total of 110,000 trees were replanted, or 58 times more than the original plan. An additional 41,000 trees were planted along the center divider. Similarly, in Phase II, although the original plan called for the cutting down of 5,025 trees and re-plantation of trees (number of trees unknown), 42,000 trees were actually replanted.

2.4.6. Social impact of land acquisition and relocation of inhabitants

In Phase I, the project plan called for the acquisition of 26.92ha of land and removal of 1,318 squatter households (including dwelling and stalls), but 46.48ha of land was actually acquired, or 19.56ha more than the originally plan. The additional land was required for the provision of 15.5km of service roads, widening of road shoulders, park space for trucks and buses, and approach roads for bridges. Since records were not available, the number of squatters actually removed is unknown. On the other hand, in Phase II, the plan called for the acquisition of 10.92ha and removal of 276 squatter sites (mainly makeshift shops, shrines, etc., and no residents), but actually 12.99ha of land was acquired and 274 squatters were removed. In both Phase I and Phase II, the land acquisition and removal of squatters were carried out in accordance with the Land Acquisition Act. No problem is believed to have arisen over this issue.

2.4.7. Beneficiary survey

The beneficiary survey was conducted to determine what kind of impact the project had on the livelihood and living conditions of the inhabitants of the target area. The survey investigated two sections along NH-5 −(1) between Chilakaluripet and Vijayawada, in the state of Andhra Pradesh (Phase I), and (2) between Jagatpur and Chandikhol, in the state of Orrisa (Phase II) − and targeted 140 households (70 in each section), 100 commercial carriers (50 in each section), and 60 traders (30 in each section). [7]

Interview survey of local residents

[7] The beneficiary survey was conducted on a sample of 300 subjects (140 local residents, 100 commercial carriers, and 60 traders) randomly selected (from a number of randomly selected settlements in the Chilakaluripet-section of NH-5). Survey samples in each of the selected settlements were also randomly selected. The 300 subjects were interviewed using a prepared multiple-answer questionnaire. The sample was drawn from the combined population of 8.63 million in Guntur District and Krishna District, Andhra Pradesh State (2001 census), for Phase I and population of 4.24 milllion in Jajpur District and Cuttack District, Orissa State (2001 census), for Phase II.

(1) Change of means of transport

Before the Chilakaluripet-Vijayawada section of Phase I, the principal means of transport used by local residents was bus (36%), bicycle (33%), walking (14%), and motorcycle (10%), but after the project, this changed to motorcycle (31%), bus (30%), bicycle (16%), and auto rickshaw (14%). The principal means of transport for traders before the project was bicycle (43%), bus (27%), and walking (17%). This changed after the project to private car (20%), motorcycle (20%), auto rickshaw (17%), and bicycle (17%) (see Table 12.)

Table 12. Change of Means of Transport

＜Phase I＞ (%)

| | Local residents | | Traders | |
|---|---|---|---|---|
| | Before | After | Before | After |
| Private vehicle | 0 | 1 | 3 | 20 |
| Motorcycle | 10 | 31 | 7 | 20 |
| Bicycle | 33 | 16 | 43 | 17 |
| Bus | 36 | 30 | 27 | 13 |
| Auto rickshaw | 4 | 14 | 3 | 17 |
| Rickshaw | 0 | 0 | 0 | 0 |
| Walk | 14 | 7 | 17 | 13 |
| Others | 3 | 0 | 0 | 0 |

＜Phase II＞

| | Local residents | | Traders | |
|---|---|---|---|---|
| | Before | After | Before | After |
| Private vehicle | 3 | 19 | 7 | 10 |
| Neighbor's car | 1 | 3 | 0 | 0 |
| Motorcycle | 9 | 27 | 3 | 33 |
| Bicycle | 27 | 7 | 23 | 20 |
| Bus | 37 | 43 | 43 | 37 |
| Auto rickshaw | 0 | 1 | 0 | 0 |
| Rickshaw | 0 | 0 | 0 | 0 |
| Walk | 23 | 0 | 23 | 0 |
| Others | 0 | 0 | 0 | 0 |

Before the Jagatpur-Chandikhol section of Phase II, the principal means of transport used by local residents was bus (37%), bicycle (27%), and walking (23%), but after the project, it changed to bus (43%), motorcycle (27%), and private vehicle (19%). The principle means of transport for traders before the project was bus (43%), bicycle (23%), and walking (23%). This changed after the project to bus (37%), motorbike (33%), bicycle (20%), and private vehicle (10%) (see Table 12). In both Phase I and Phase II, the principal means of transport used by local residents and traders changed before and after the project. The principal means of transport before the project was public transport such as buses, but after the project, the use of man-powered means of transport like bicycles and walking decreased as the use of transport means relying on non-human power like buses, motorcycles, private vehicles and auto rickshaws increased.

(2) Improvement of public/private service accessibility

In the Chilakaluripet-Vijayawada section, 99% of the local residents responded that access to public and private services improved after the project. Of the various services, access to public transport services, health and medical services, and shopping centers and the like were perceived to have improved most noticeably. 67% of the consumer carriers responded that

Interview survey of bus drivers

the frequency of transport services increased after the project, and 95% said that passenger and cargo volume both increased after the project.

In the Jagatpur-Chandikhol section, 100% of local residents responded that access to public and private services improved after the project. Of the various services, access to public transport services, health and medical services, and educational services and the like were perceived to have improved most noticeably. 100% of the consumer carriers responded that the frequency of transport services increased after the project, and 100% said that passenger and cargo volume both increased after the project. It is assumed that the increase in frequency of transport services by commercial carriers, which are the main public transport service providers, led to improved public/private service accessibility. This improvement resulted in increased passenger and cargo transport volume.

(3) Improvement of traffic convenience

In the Chilakaluripet-Vijayawada section, 96% of local residents and 60% of traders said that traffic convenience improved after the project. Of the various conveniences, shorter traveling time and reduced traveling expenses, among others, were given in that order as areas perceived to have improved the most from the situation before the project. In the Jagatpur-Chandikhol section, 98% of local residents and 93% of traders said that traffic convenience improved after the project. Shorter traveling time and reduced traveling expenses, among others, were in that order the areas perceived to have improved the most from before the project.

Interview survey of shopkeepers

(4) Impact on socio-economic environment

In the Chilakaluripet-Vijayawada section, 100% of local residents and 90% of traders regarded the overall impact the project has had on the socio-economic environment as positive. Similarly, in the Jagatpur-Chandikhol section, 99% of local residents and 90% of traders regarded the overall impact the project has had on the socio-economic environment as positive.

Interview survey of repair shops

In both Phase I and Phase II, examples of favorable impact keenly perceived by both local residents and traders were given for all 7 questions: (i) increase in the creation of new business, (ii) increase in land and housing development projects, (iii) improvement in access to educational, health/medical and commercial services, (iv) increase in employment opportunities, (v) increase in business opportunities, (vi) rise in land prices, and (vii) increase in population (see Tables 13 and 14).

Table 13. Awareness of Change in Socio-economic Factors

(%)

| | ＜Phase I＞ | | ＜Phase II＞ | |
|---|---|---|---|---|
| | Local residents | Traders | Local residents | Traders |
| Greatly improved | 0 | 10 | 38 | 30 |
| Somewhat improved | 100 | 80 | 61 | 60 |
| Very little improved | 0 | 7 | 0 | 10 |
| Not improved at all | 0 | 3 | 0 | 0 |
| Don't know | 0 | 0 | 1 | 0 |

In addition, a comparison of income before and after the project reveals that in Phase I local residents enjoyed on average a 24% increase; commercial carriers, 34%; and traders, 21%. In Phase II, local residents and traders enjoyed on average a 15% increase. In particular, the increase in income of commercial carriers may be directly attributed to the reduction of travel expenses and the reduction of administrative and maintenance expenses. For both Phase I and Phase II, reduction in traveling expense, improvement of operating ratio and business hours and the like have a direct bearing on the awareness of change in socio-economic factors.

Table 14. Awareness of Change in Socio-economic Factors

＜Phase I＞ (%)

| | Local residents | | | Traders | | |
|---|---|---|---|---|---|---|
| | Increase | Decrease | Unchanged | Increase | Decrease | Unchanged |
| New business creation | 96 | 4 | 0 | 86 | 3 | 11 |
| Land/housing development | 100 | 0 | 0 | 90 | 0 | 10 |
| Improvement of accessibility to educational/health-medial/commercial services, etc. | 100 | 0 | 0 | 82 | 0 | 18 |
| Employment opportunity | 100 | 0 | 0 | 85 | 0 | 15 |
| Business opportunity | 100 | 0 | 0 | 92 | 4 | 4 |
| Land price | 94 | 6 | 0 | 100 | 0 | 0 |
| Population | 94 | 3 | 3 | 100 | 0 | 0 |

＜Phase II＞

| | Local residents | | | Traders | | |
|---|---|---|---|---|---|---|
| | Increase | Decrease | Unchanged | Increase | Decrease | Unchanged |
| New business creation | 96 | 4 | 0 | 90 | 0 | 10 |
| Land/housing development | 97 | 1 | 2 | 93 | 0 | 7 |
| Improvement of accessibility to educational/health-medical/commercial services, etc. | 98 | 0 | 2 | 97 | 0 | 3 |
| Employment opportunity | 95 | 0 | 5 | 78 | 11 | 11 |
| Business opportunity | 95 | 0 | 5 | 93 | 7 | 0 |
| Land price | 97 | 0 | 3 | 100 | 0 | 0 |
| Population | 100 | 0 | 0 | 100 | 0 | 0 |

(5) Economic impact

In the Chilakaluripet- Vijayawada section, most respondents perceived that three aspects of environmental pollution – air, noise and vibration – had deteriorated (air 82%, noise 86%, and vibration 82%). However, regarding garbage, 69% said the project improved the situation. This positive assessment is largely due to the improvements in garbage collection and road cleaning services that the Guntur District Authority has made.

In the Jagatpur-Chandikhol section, most respondents perceived that four aspects of environmental pollution – air, noise, vibration and garbage – had deteriorated (air 89%, noise 89%, vibration 84%, and garbage 67%). In both Phase I and Phase II, respondents cited increase in traffic volume as the principal factor impacting the environment (Table 15).

Table 15: Awareness of Changes in the Environment (overall)

(%)

| | ＜Phase I＞ | | | ＜Phase II＞ | | |
|---|---|---|---|---|---|---|
| | Increase | Decrease | Unchanged | Increase | Decrease | Unchanged |
| Air pollution | 82 | 6 | 12 | 89 | 9 | 2 |
| Noise | 86 | 4 | 10 | 89 | 11 | 0 |
| Vibration | 82 | 11 | 7 | 84 | 16 | 0 |
| Garbage | 12 | 69 | 19 | 67 | 33 | 0 |

(6) Satisfaction with the project and challenges

A solid 93% of overall respondents expressed satisfaction with Phase I (97% of local residents 96% of commercial carriers, and 80% of traders) (see Table 16). Asked to name an undesirable (i.e., negative) impact related to Project I, the largest percentage (37%) cited increase in traffic accidents, followed by increase in vehicle speed (9%). A relatively large number of respondents proposed promotion of safety education and a more thorough clamp down of traffic offenders as measures to prevent traffic accidents.

Interview survey of truck drivers

In Phase II, 94% of overall respondents expressed satisfaction with Phase I (95% of local residents, 100% of commercial carriers, and 83% of traders) (see Table 16). Asked to name undesirable (i.e., negative) impacts directly related to Phase II, as was the case in Project I, the largest percentage (14%) cited increase in traffic accidents, followed by increase in vehicle speed (7%). A relatively large number of respondents proposed installation of traffic lights, a more thorough clamp down of traffic offenders, promotion of safety education, and planting of trees along the road.

Table 16: Satisfaction with the Project

(%)

| | ＜Phase I＞ | | | | ＜Phase II＞ | | | |
|---|---|---|---|---|---|---|---|---|
| | Local residents | Commercial carriers | Traders | Overall | Local residents | Commercial carriers | Traders | Overall |
| Very satisfied | 0 | 6 | 7 | 3 | 15 | 54 | 10 | 27 |
| Satisfied | 97 | 90 | 73 | 90 | 80 | 46 | 73 | 67 |
| Not very satisfied | 3 | 4 | 13 | 6 | 4 | 0 | 14 | 5 |
| Not satisfied at all | 0 | 0 | 7 | 1 | 1 | 0 | 3 | 1 |

## 2.5. Sustainability

### 2.5.1. Executing agency

The National Highways Authority of India (NHAI) is the agency that operates and maintains the facilities provided under this project. Although the Ministry of Surface Transport (today the Ministry of Shipping, Road Transport and Highways) and the Public Works Department of the state of Andhra Pradesh were slated to implement the project in Phase I and the Public Works Department of the state of Orissa was scheduled to implement the project in Phase II, from the planning stage to the implementation stage of the project. After project completion, the National Highways Authority of India took over the operation and maintenance of the project in both phases in 1998. The National Highways Authority of India was established pursuant to the law concerned (1988) as an agency in charge of executing the construction and O&M of national highways. NHAI commenced its activities in February 1995. At present, there are 65,600 km of national highways in India, of which 41% (27,110 km) is under NHAI management.[8]

#### 2.5.1.1. Technical capacity

The technical capacity of NHAI was deemed acceptable since NHAI has a wide range of experience in the construction and O&M of the national highways of India.

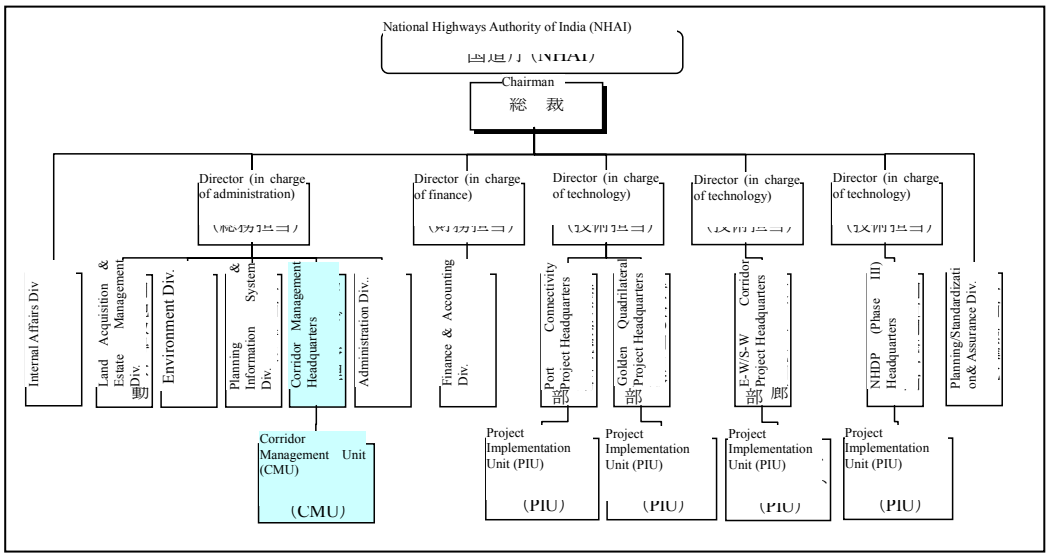
#### 2.5.1.2. Operation and maintenance system

The Corridor Management Unit (CMU) is the unit responsible for O&M of the project. In the Chilakaluripet-Vijayawada section, the Vijayawada Corridor Management Unit (CMU) executes the O&M of the project in the field; in the Jagatpur-Chandikhol section, the Bhubaneshwar Project Implementation Unit (PIU) executes the O&M of the project in the field [9] (see Fig. 4 for the organizational chart of NHAI).

[8] As of end October 2006.

[9] Corridor Management Units )(CMUs) are established at certain intervals across the country by mainly targeting national highways that are the targets of the Golden Quadrilateral (GQ) and the E-W/S-N corridors. In sections where a CMU has not been set up, the Project Implementation Unit (PIU) of each section will double as CMU.

Fig. 4. Organizational Chart of NHAI




Source: NHAI

However, actual execution of O&M activities in the field, including the management of toll gates, is subcontracted to private O&M contractors as well as supervisory consultants commissioned by NHAI, and the Vijayawada CMU and Bhubaneshwar PIU manage and supervise the O&A services that they execute. Mathura CMU manages and supervises the O&A services that they execute.

2.5.1.3. Financial status

O&M expenditure for facilities built under the project will basically be covered by toll revenue. A toll gate is set up in the Chilakaluripet-Vijayawada section and in the Jagatpur-Chandikhol section. However, in the latter, toll collection has been discontinued since March 2003 due to the opposition of local residents. NHAI plans to introduce a new toll collection system by, among other things, relocating the existing toll gates on the part of NH-5 in the state of Orissa. Under this plan, NHAI will resume toll collection in the Jagatpur-Chandikhol section by installing a new toll gate. The revenue collected at tollgates under NHAI management is pooled at NHAI and the state treasury together with the revenue collected at other toll gates across the country, after which it is allocated in the budget as O&M expenditure of national highways under NHAI supervision. According to NHAI, toll revenue from all of its highways exceeds its O&M expenditure (see Table 17). Thus, there are no outstanding issues related to sustainability on the financial front.

Table 17: Revenue from All NHAI Tolls and O&M Expenditure

(1 million rupee)

| | 2002/03 | 2003/04 | 2004/05 | 2005/06 |
|---|---|---|---|---|
| Toll revenue | 3,130 | 3,594 | 4,605 | 7,980 |
| Q&M expenditure | 2,005 | 2,752 | 2,786 | 2,448 |

Source: NHAI

2.5.2. Operation and maintenance status

Project facilities are kept in good repair by implementing measures for daily maintenance, traffic accident management, and preventive maintenance in accordance with the O&M manual issued by the National Highways Authority of India. Daily maintenance measures include (i) managing the planting of trees along the roadside and along the center divider, (ii) cleaning the vehicular road, (iii) repairing pot holes, (iv) periodically inspecting traffic signals, and (v) cleaning the draining facilities on bridges and along the roadside. Traffic accident management measures include conducting daily patrols, mobilizing ambulances when accidents occur, and towing vehicles damaged in accidents. Preventive maintenance measures include overlaying pavements and replacing road traffic signs that have been stolen or damaged. Additionally, the Vijayawada CMU and Bhubaneshwar PIU are engaging various activities to promote traffic safety including a traffic safety education campaign in each section of the project. At this point, there are no outstanding issues with the O&M of the project facilities.

## 3. Feedback

### 3.1. Lessons Learned

The reduction in traffic accidents that was expected in Phase II (the Jagatpur-Chandikhol section of NH-5 in the state of Orissa) was not fully met. One reason that has been put forth is the lack of crossing facilities such as underpasses for local residents and cattle. Considering the safety of residents living along the roadside, the project should have provided such crossing facilities at least in heavily populated areas near the road. Furthermore, in installing facilities to reduce traffic accidents, the actual state of their use by local residents should have been considered.

### 3.2. Recommendations to NHAI

According to NHAI, in the next phase of the project, the four-lane road will be upgraded to a six-lane road. The upgrade will involve the implementation of road safety measures such as providing a separate service road for low speed vehicles, an underpasses for pedestrians, and a parking zone for heavy vehicles. However, even before providing such transport safety measures, NHAI should take steps to tackle the following issues:

(a) Promotion of traffic safety education and traffic safety awareness campaigns for all road users including drivers and local residents.

(b) Especially in and near urban areas, many cases are observed in which squatters unlawfully occupy the road by setting up stalls, and drivers do the same by parking their trucks and buses. These stalls and heavy vehicles obstruct the flow of traffic and cause traffic accidents. NHAI should take strong action to solve these problems in cooperation with the local organizations concerned such as the local administrative authority and the local police.

**Comparison of Original and Actual Scope**

| Item | Plan | Actual |
|---|---|---|
| (a) Outputs<br>＜Phase I＞ | | |
| (1)Project site | ・Chilakaluripet-Vijayawada section, AP State（83km） | ・As planned |
| (2) Widen roads | ・4-lane（15m）<br>・Install shoulders (1.5m) on both sides | ・As planned<br>・Install shoulder（2.5m） |
| (3)Reinforce existing roads | ・Asphalt 115mm、cement-concrete 40mm) | ・As planned |
| (4)Reinforce and construct bridges | ・Construct a 2-lane bridge in Krishna State（Krishna Bridge:1,800m）<br>・Reinforce bridges (7)<br>・Construct new bridges(29) | ・As planned |
| (5)Reinforce and construct drainage facilities | ・Reinforce culverts(13 locations)<br>・Construct culverts (130 locations) | ・As planned<br>・Constructed (144 locations)（2 locations used also by cattle） |
| (6)Construct 2-lane rail-over-bridge | ・2 locations (executed by Railroad Ministry) | ・As planned |
| (7)Consulting Services<br>・Review of detail design<br>・Overseas training<br>・Execution management | ・International consultant: 139M/M<br>・International consultant: 132M/M | ・International consultant: 91.6M/M (only for execution management; detail design review and overseas training are unknown)<br>・International consultant: 158M/M |
| (8)Additional outputs | | ・Built an overhead bridge where NH-5 and NH-9 intersect.<br>・Installed safety equipment (guard - rails, road signs, lighting systems).<br>・Installed footbridges (4 locations) |
| ＜Phase II＞ | | |
| (1) Project site | ・Jagatpur-Chandikhol section of NH-5 in Orissa State (33km） | ・As planned |
| (2) Widen roads | ・4-lane（15m）<br>・Install shoulders (2.5m) on both sides | ・As planned |
| (3)Reinforce existing roads | ・Install asphalt shoulders<br>・Repair road pavement<br>・Realignment of curves at 2 locations (at 49.0km and 58.0km) | ・As planned |
| (4)Reinforce and construct bridges | ・Construct a new bridge (52.55m)<br>・Widen bridges（5）<br>・Rehabilitate bridges (4) | ・As planned<br>・Widened bridges（8）<br>・Rehabilitated（7） |

| Item | Plan | Actual |
|---|---|---|
| (5)Reinforce and construct drainage facilities<br><br>(6)Consulting Services<br>・ Detail design review<br>・ Formulation of future M/P national highway development plan<br>・ Overseas training<br>- Execution management | ・ Reinforce slab culverts (41 locations)<br>・ Construct box culverts (1 locations)<br><br>・ International consultant: 69M/M<br>・ International consultant: 178M/M | ・ As planned<br>・ Constructed (4 locations)（2 locations used also by cattle）<br><br>・ International consultant: 69M/M（but formulation of M/P and overseas training were not implemented）<br>・ International consultant: 160M/M |
| (7)Additional outputs | | ・ Built a T-type juncture between NH-5 and NH-42.<br>・ Built an access road (9.4m long)<br>・ Built under underpasses in 3 locations.<br>・ Installed safety equipment (e.g. guardrails, delineators and bollards). |
| (b) Project Period<br>＜Phase I＞ | | |
| Signing of ODA Loan Agreement | January 1994 | January 1994 |
| Site acquisition | April 1993-March1994（12 months） | April 1993-Sep. 1994 (19 months) |
| Selection of detail design review consultant | June 1993-March 1994 (9 months) | Unknown-Jan. 1997 |
| Execution of detail design review | April 1994-March 1995 (9 months) | July 1997-March 1998 (9 months) |
| Section of execution management | Dec. 1994- Sep. 1995 (10 months) | Jan. 1997-March 1999 (27 months) |
| Implementation of execution management | Oct. 1996-March 1999 (30 months) | May 1999-March 2004 (59 months) |
| Bidding & evaluation of main construction | Oct. 1993-Sep. 1995 (12 months) | Aug. 1997-Jan. 1999 (18 months) |
| Civil engineering | Oct. 1995-March 1999 (42 months) | April 1999-Feb. 2003 (47 months) |
| Bidding & evaluation of rail-over-bridge construction | Oct. 1993-Sep.1995 (24 months) | April 2000-July 2000 (4 months)) |
| Construction of rail-over-bridge | Oct. 1995-March 1999 (42 months) | Aug. 2000-Oct. 2002 (27 months) |
| Project completion | March 1999 | March 2004 |
| ＜Phase II＞ | | |
| Signing of ODA Loan Agreement | February 1995 | February 1995 |
| Site acquisition | June 1994-October 1995 (24 months) | Unknown |
| Selection of detail design review consultant | July 1994-April 1995 (11 months) | July 1997-Oct. 1997 (4 months) |
| Execution of detail design review | June 1995-March 1996 (10 months) | Unknown-Dec. 1997- |
| Section of execution management | Nov. 1995-Aug. 1996 (10 months) | Sep. 1997-Sep. 1999 (25 months) |

| Item | Plan | Actual |
|---|---|---|
| Implementation of execution management | Oct. 1996-Sep. 2000 (48 months) | Oct 1999-July 2003 (46 months) |
| Bidding & evaluation of main construction | Feb. 1995-Sep. 1996 (20 months) | June 1998-Dec. 1999 (19 months) |
| Civil engineering | Nov. 1996-April 2000 (42 months) | Feb. 2000-June 2003 (40 months) |
| Project completion | September 2000 | July 2003 |
| (c) Project Cost | | |
| ＜Phase I＞ | | |
| Foreign Currency | 3,634 million yen | 2,297 million yen |
| Local Currency | 9,848 million yen<br>（2,662 million rupees） | 8,386 million yen<br>(2,662 million rupees) |
| Total | 13,482 million yen | 10,683 million yen |
| ODA Loan Portion | 11,360 million yen | 6,749 million yen |
| Exchange Rate | 1 rupee=3.70 yen<br>（as of April 1993） | 1 rupee=2.8yen<br>（1994-2004 average） |
| ＜Phase II＞ | | |
| Foreign Currency | 1,668 million yen | 375 million yen |
| Local Currency | 5,393 million yen<br>（1,605 million rupees） | 3,923 million yen<br>（1,411 million rupees） |
| Total | 7,061 million yen | 4,298 million yen |
| ODA Loan Portion | 5,836 million yen | 3,541 million yen |
| Exchange Rate | 1rupee=3.36 yen<br>（as of April 1994） | 1 rupee=2.78 yen<br>（1996-2003 average） |