

LINKED DOCUMENT 10: BENEFITS AND COSTS OF SAFEGUARDS

1. This technical appendix discusses the benefits and costs of implementing environmental and involuntary safeguards in selected projects. Benefit–cost analysis was conducted to assess the positive and negative impacts of safeguard application for the National Highways Sector Project (NHSP) in Sri Lanka that commenced implementation in 2009 and is expected to be completed in 2016. The analysis focused on five road segments that comprise 70% of the total road length built. A second case study using benefit-cost analysis focused on the Java-Bali 50 Kilovolt Power Transmission Crossing Project in Indonesia.

A. The Sri Lanka National Highways Sector Project

2. The five road segments were selected for benefit–cost analysis because of their category A ratings for either environmental or involuntary resettlement safeguards. These roads were also chosen because of the availability of monitoring data and local studies. The basic features as depicted in Table LD10.1 show that these roads differ in slope, proximity to environmentally critical areas, and estimated numbers of affected people. The economic returns were estimated to be above the 12% hurdle rate in the report and recommendation of the President.

Table LD10.1: Basic Features of Sri Lanka Road Segments

Features	Nuwara Eliya–Badulla (A005)	Habarana–Kantale (A006)	Puttalam–Anuradhapura (A012)	Hikkaduwa–Southern Highway (B153)	Alutgama–Southern Highway (B157)
Location	Nuwara Eliya and Badulla Districts, Central and Uva Provinces	Anuradhapura and Trincomalee Districts, North Central and North Eastern Provinces	Puttalam and Anuradhapura Districts, North Central Province	Baddegama, Ambalangoda and Hikkaduwa districts, So. Province	Mathugama, Aluthgama Districts of the Western Province
Length (km)	57.5	43.50	82.1	14.40	23.50
Slope	10%–60%	3%–15%	4%–6%	5%–6%	3%–25%
Date started	24-Sep-08	25-Apr-08	9-Jun-09	15-May-13	15-May-13
Date completed	1-Nov-11	10-Jul-10	1-Aug-11	Ongoing	Ongoing
Environment Category	A	A	A	B	B
Environmentally Critical Area	Hakgala Forest Reserve	Hurulu Forest Reserve	Tabbowa Wildlife Sanctuary	None	None
Involuntary Resettlement	A	B	A	A	A
Number of Payments to Affected People	1,020	Not applicable	2,633	820	665
Vulnerable household	125	Not applicable	12	90	166
EIRR per RRP	14.1%	18.8%	16.5%	27.6%	16.5%

^a Road Development Authority Monitoring Reports of 16 June 2016 indicate the number of payments in lieu of number of affected peoples since one person may receive more than one type of compensation as called for in SPS. The estimated number of vulnerable households is based on the Resettlement Plans at the time of project preparation.

Source: ADB. 2013. *Report and Recommendation of the President to the Board of Directors on Proposed Loan to Sri Lanka on the National Highways Sector Project.-Additional Financing.* Manila.

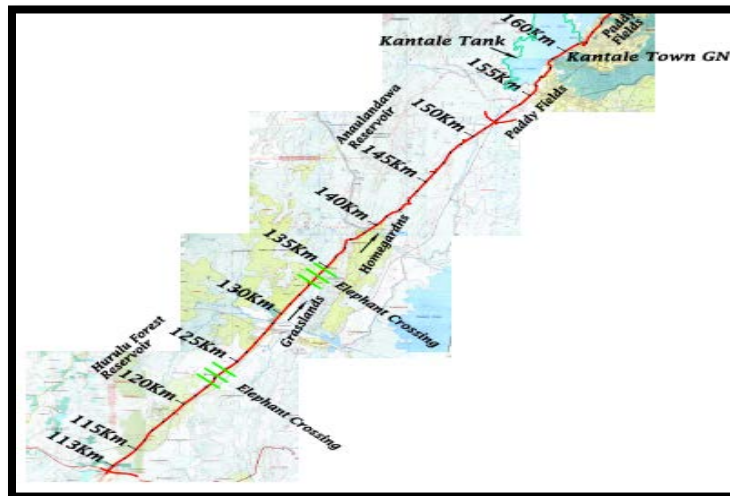
3. Three roads are important to biodiversity conservation. Puttalam–Anuradhapura (A012) traverses the Karuwalagaswewa (Tabbowa) Elephant Sanctuary and is near a boundary of the Wilpattu National Park Figure LD10.1). Habarana Kantale (A006) is adjacent to the Hurulu Strict Forest Reserve and Hurulu Elephant Eco-Park (Figure LD10.2). Nuwara Eliya–Badulla (Road A005) passes through the fringes of the Hakgala Botanic Gardens. While the construction activities on these road segments involved mostly the rehabilitation of old alignments and were approved before the 2009 Safeguard Policy Statement (SPS) adjustments were made during the latter stage of rehabilitation when additional financing was approved for additional road segments.

Figure LD10.1: Location Map of A012 Indicating Traversed Portion of Tabboa Elephant Sanctuary and Nearby Wipattu National Park



Source: Government of Sri Lanka. 2007. Road Development Authority. *Environmental Assessment Report*. Colombo.

Figure LD10.2: Location Map of A006 Indicating Various Elephant Crossings and the Nearby Reservoirs



Source: Government of Sri Lanka. 2007. Road Development Authority. *Environmental Assessment Report*. Colombo.

4. Four roads, the Nuwara-Eliya-Badulla (A005) and Puttalam–Anuradhapura (A012), both pre-SPS and the Hikkaduwa–Southern Highway (B153) and the Aluthgama–Southern Expressway–Madurugoda (B157), both post SPS, caused the involuntary resettlement of close to 1,000 households each. The construction of the additionally financed, post-2009 SPS roads began in 2013 and both are expected to be completed in 2016.

B. Framework for Analyzing Benefits and Costs

5. This analysis examines three future situations pertaining to variations in the implementation of environmental and involuntary resettlement safeguards: the “with safeguards” scenario reflecting the introduction of the ADB Safeguard Policy Statement 2009, with the national environmental and social safety measures that would have prevailed before the ADB Safeguard Policy Statement 2009 and the “without safeguards” scenario reflecting no such measures at all. More specifically, two alternative scenarios are described in greater detail as:

- (i) **“With safeguards.”** This refers to the continued implementation of current practices, i.e., most of the environmental and involuntary safeguards of ADB are carried out, albeit with some gaps noted during this real-time evaluation. The areas for strengthening include: improvements in road signs and installation of more speed bumps; relocation of electric fences to more strategic locations; strict enforcement of protection for construction workers; monitoring of changes in environmental quality including cumulative impacts; more timely compensation payments for the involuntarily resettled persons; improved livelihood enhancement activities for the affected peoples and enhancement of the readiness of the agencies that collaborate with the already strengthened implementing agency, the RDA.
- (ii) **“Limited safeguards.”** This refers to the situation where the previous, pre-SPS measures prevails and operate under conditions largely arising from inadequate budget allocation and capacity for implementing safe and socially responsible measures. These conditions may include insufficient monitoring and implementation of dust control measures during construction, poor road maintenance non-replacement of road signs and weak enforcement of speed limits, all of which would negatively affect the highway construction workers and roadside households. Poor management of wildlife crossings would reduce the safety of other road users while inadequate construction technologies would degrade the adjacent environmentally critical areas. This scenario may also include lack of strategic interventions that could be implemented by environmental agencies to address the usual negative impacts of increased access to environmentally critical areas brought about by roads and induced changing land uses. In terms of involuntary resettlement, this scenario includes deteriorating socioeconomic conditions of some of the affected people – the roadside households who were under-compensated for their losses, including disadvantaged persons.
- (iii) **“Without safeguards.”** This refers to the conditions where neither the ADB safeguards nor the national measures that ensure environmental protection and social safety nets are implemented thus generating negative impacts on the environment and affected peoples.

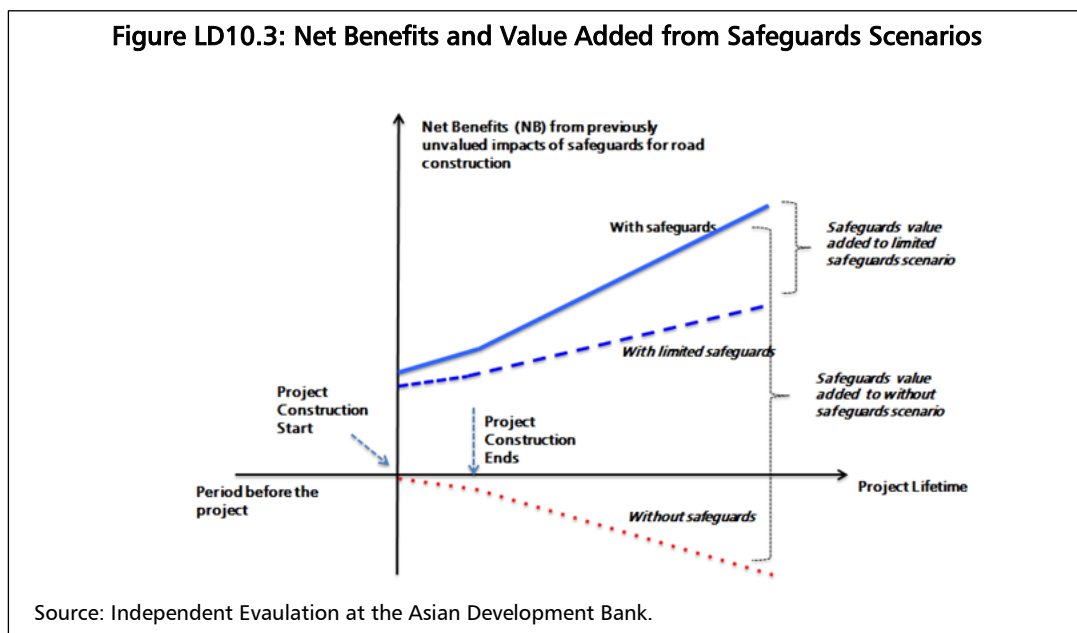
6. For each scenario, the usual economic efficiency measures are computed: present value of net benefits, the benefit–cost ratio (BCR), and the economic internal rate of return. The usual criteria for economically efficient investments hold: the NPV is greater than zero; the BCR is greater than 1; and the economic internal rate of return (EIRR) is higher than the social discount rate of 12%.

7. Values are estimated by multiplying environmental and involuntary resettlement quantity variables with their prices. The same trends of prices (or unit values) are applied for both scenarios while the trends of quantities are differentiated between the two scenarios. These result in net present value (NPV) estimates that reflect the environmental and socioeconomic conditions as influenced by either the environmental and involuntary resettlement safeguards, or by the country’s prevailing practices for managing environmental impacts and involuntary resettlement.

8. The value added by the ADB SPS is then analyzed by comparing the values of key economic indicators between the “with safeguards” scenario and each of the two other two scenarios. In particular, ADB’s value added through the safeguards policy is measured by the difference between (a) the NPVs from the safeguards and from the national measures and (b) between the ADB safeguards and without any safeguards at all.

9. The stream of net benefits through time for “with safeguards,” with “limited safeguards,” and “without safeguards” measures are illustrated in Figure LD10.3. The period of analysis, which consists of the construction period and the project lifetime of 20 years, are measured in the X axis.¹ The net benefits for each of the three scenarios are measured in the Y axis. It is expected that with the international (ADB) safeguard measures more stringent than the limited national practices, more net benefits would be generated under the “with safeguards” conditions than otherwise. This would hold only when when the increase in cost due to safeguards implementation is more than offset by the higher safeguards benefits. Both situations of “with safeguards” and “limited safeguards” are reflected by the two upward sloping net benefits curves.

10. Without any safeguards damage would be expected to occur in the form of adverse environmental impacts and welfare losses from involuntary resettlement. This is represented by the downward sloping curve.



C. Coverage of Benefits and Costs

11. The environmental effects of roads on different stakeholders can be observed through their physical impacts on ecosystems, ecosystem services, and road-side populations. Table LD10.2 lists these impacts and their expected magnitudes. Both quantified and unquantified effects are indicated for situations “with and without safeguards” for the sake of simplicity.

¹ Using the same period of analysis as the original project economic analysis ensures comparability of results.

Table LD10.2: Impact Matrix for Sri Lanka National Highway Sector Project

Impact	Expected Impacts, Without Safeguards	Expected Impacts, With Safeguards	Affected Party	Quantified?	Unit Value Estimated
Sri Lanka NHSP					
Air quality during rehabilitation				Yes	
- Illness from Asthma caused by exposure to PM10 and PM2.5	High	Nil	Construction workers; roadside residents		Cost of Illness from relevant pollutant; Colombo study
- Illness from upper respiratory infection from PM _{2.5} exposure	High	Nil	Construction workers; roadside residents		
Pollution on nearby land and water bodies	High, cumulative	Low	Households, wildlife, ecosystem services	No	
Noise	Medium	Low	Households	No	
Road deaths from collision between crossing elephants and motorists	High	Low	Elephant and Conservation Community. Motorists.	Yes	Willingness to pay for elephant conservation by urban population less damage on rural population from Human Elephant Conflict
Road deaths of High Crossing Small Mammals, Birds, and Reptiles	High	Medium	Local population, Foreign visitors, Global biodiversity conservationists	Yes	Already embedded in nature-based recreational values of foreign visitors at nearby wildlife parks
Change (Decrease) in Forest Area Of Adjacent Elephant Habitats and Number of Supported Elephants	Medium	Nil	Sanctuary/ reserve authorities.	Yes. Land use changes and equivalent elephants supported	Local study on willingness to pay for elephant conservation by urban population
Tourism Revenues from Foreign Visitors of Nearby Wildlife Parks	Medium. Partial attribution only	Low. Partial attribution only.	Foreign tourists. Park authorities.	Yes.	Ten per cent of revenues from foreign tourists
Involuntary resettlement	High, direct	Nil	Roadside residents within right of way construction	Yes	Yes
Reduction of Assets: - Residence; - Business Structure	High	Nil		Yes, but only 4%	Four per cent of the paid compensation for assets of forty percent of payees to reflect benefits from sudden liquidity and payment based on replacement value
- Loss in income, transition costs	High.	Zero; all paid for.		Excluded from BCA, treated as transfers	

BCA = benefits and costs analysis, NHSP = National Highways Sector Project, PM = particulate matter.

Source: Independent Evaluation at the Asian Development Bank.

12. Benefits from environmental safeguards generally pertain to the damage that is avoided because the negative environmental impacts anticipated in the EIA were addressed by appropriate measures as detailed in the environmental management plan for category A projects. For the National Highways Sector Project, these quantified benefits include: the avoided impacts on alternative construction sites at adjacent or nearby environmentally critical areas that were bypassed because the existing road alignments were used instead; reduced road accidents for wildlife (e.g., elephants) that result in either road kill or injury, and the avoided health risks for construction workers and roadside residents from air pollution during construction. Benefits may also include the positive impacts from explicit environmental enhancement measures such as roadside planting of ornamental features or economically valuable trees. The safeguard on rehabilitating old roads thus avoiding building roads at new locations in adjacent environmentally critical areas, keep existing habitats for wildlife, including elephants, intact. While better roads also mean increased access by poachers they also facilitate pursuit by law enforcers.

13. The direct costs of implementing the environmental safeguards consist of the additional material and labor costs of redesigned or enhanced civil works, supervision, and environmental monitoring costs. For roads these costs include: sprinklers to reduce dust during construction; equipment for worker safety such as masks; road signs, speed limits and electric fences to manage movements by wildlife at crossing sites and monitoring costs by ADB, the implementing agency, Road Development Authority (RDA) and its partners, the wildlife, forest, environment and police institutions. Indirect costs or environmental damage may occur when inadequately implemented or inappropriate mitigation measures interact with other factors such as climate to impact on springs or natural tanks as sources of water for people and wildlife. Damage may also occur during instances of illegal use of electric fences during incidents of human-elephant conflict; but since this is anecdotal and the incidence is not known, such damage is not estimated.

14. For the involuntary resettlement safeguards, while the compensation paid to affected peoples is a component of the overall cost of implementing the land acquisition and resettlement plan (LARP), it is income received by the affected peoples to recover from their losses. These transfers cross each other out as plus (additional income flow for an affected people) and minus the cost of such payment from the project. Thus the net economic benefit from the LARP may be considered to be zero. However, there are likely unmeasured, social gains from a well implemented LARP in the form of avoided impoverishment and its associated social costs such as crime and family disorder.

15. There is economic gain only when the affected people's cash compensation and other assistance when taken together exceed their losses. This may arise in three situations for *some* affected peoples: (i) when the compensation for lost assets, which is based on replacement cost, is more than their depreciated value; (ii) when compensation for affected assets is paid to a non-poor person whose sudden, higher liquidity enables investments to be made; and (iii) when the salvage value of affected assets is high enough to enable money to be either saved or to increase consumption beyond normal levels.

16. The economic benefits from involuntary resettlement safeguards in such cases consist of: returns from more-than-adequate compensation for assets or the yield from higher value replacement assets and improvements in the quality of life. There can be a rich discussion of how benefits are to be counted when it comes to compensation, but main results are not affected much by differences on assumptions.

17. The opposite situation may arise for other affected peoples when: (i) the compensation for affected assets is neither sufficient nor timely, thereby making replacement difficult; (ii) sudden liquidity encourages wasteful consumption, leaving insufficient cash with which to replace the lost assets; and (iii) there are either bequest, uniqueness, or other values that are irreplaceable.

18. The involuntary resettlement safeguard costs are essentially the administrative expenses for conducting activities that are listed initially in the LARP and eventually expended in an adaptive manner by the host government as the land acquisition process ensues. These transaction costs include surveys, negotiations, supervision, and monitoring costs whose implementation period may include before, during and after the construction years.

19. The benefits and costs of addressing environmental and involuntary resettlement issues were analyzed only for those road segments with adequate local information on which to base the numerical estimates of safeguard impacts during construction and throughout the expected 20-year road lifetime.

D. Results and Discussions

20. While three scenarios were looked into, this exposition focuses only on the “with-without safeguards” features for brevity and since the with “limited safeguards” is in the mid-range or in-between the two exact opposite scenarios.

1. Net Benefits from Environmental Safeguards

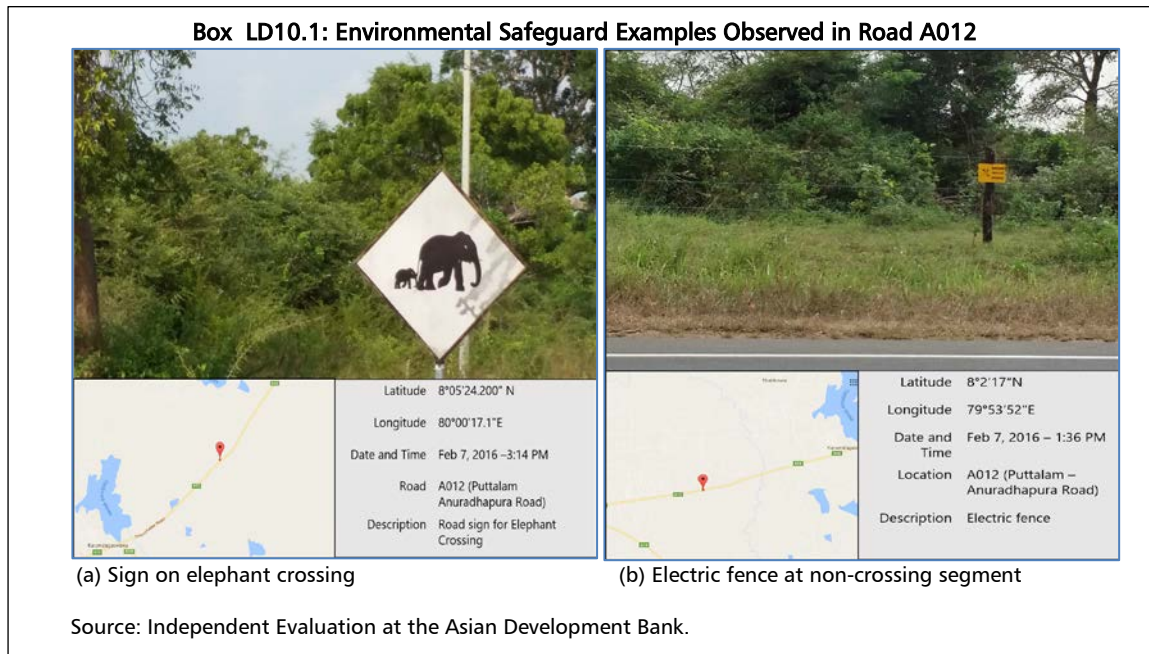
21. Table LD10.3 reflects the empirical results for biodiversity-conservation safeguards. Careful execution of valuation was implemented to ensure that there was no double counting of benefits, because different ecosystem services are important in various ways to non-overlapping interest groups:

- (i) the revenues from foreign tourists reflect returns to the park authorities (partly reflecting either foreign consumer’s surplus or park authorities’ producers’ surplus);
- (ii) the local willingness to pay (WTP) by local communities (Hakgala) do not overlap with these- they partly pertain to local consumers’ surplus from provisioning services or use in the form of recreation and possibly gathered products; informal and existence values;
- (iii) for (avoided) elephant road kills: the WTP for elephant conservation by urban Sri Lankans which pertain to urbanites’ consumer’s surplus, bequest, spiritual and existence values less the damage caused to the rural, agricultural population.

22. The benefits from environmental safeguards vary across the five road segments as a result of different environmental conditions. While many migratory wildlife cross these roads from their sanctuaries to sources of water and food, the benefits and costs analysis focuses on the Sri Lanka elephant, the country’s iconic mammal for spiritual and socioeconomic reasons.²

23. Two roads, A012 and A006 traverse or border elephant sanctuaries, as depicted with the location maps presented earlier. Environmental safeguards practices associated with elephant crossing include road signs, low speed limits of 25 kph and electric fences some exhibits of which were presented in Box LD10.1. This road was built through the National Highways Sector Project whose approval pre-dated the ADB Safeguards Policy Statement 2009 where safeguards biodiversity conservation is prominent. Nonetheless, approval of additionally financed road segments after 2009 enabled strengthened implementation of environmental and social protection measures.

² While road kills of smaller mammals and other wildlife are more common, data on their occurrence are presently being processed.



24. Elephants cross these roads twice in twenty four hours to reach the farther water tanks during the dry summer months and could collide with speeding motorists. While motorist-elephant collisions are said to cause more human deaths than elephant kills, six elephant deaths from such accident, said to be rare, occurred since 2010 with one each at A012 and A06 in recent years. These imply a 15 % chance of elephant death by road kill at either of the two roads and a higher 20% chance at other roads.³ The list of these recent elephant-motorist collisions that resulted in elephant death is presented in Box LD10.2.

25. A 2004 study on the willingness to pay for a fund for elephant conservation by urban Sri Lankans⁴ was adapted for this benefits and costs analysis into a per unit elephant value adjusted for real price changes. It yielded \$10,000 willingness to pay to an elephant conservation fund per elephant by the Sri Lankan urban population⁵ in 2012. It may be noted that in the case of Sri Lanka about 70% of elephants are wild and human-elephant conflict exists involving the rural population. Thus, adjusting this value to reflect damage during human elephant conflicts leaves a net value of \$5,000 per wild elephant. In the case of elephant injury, an average cost of treatment per incident was computed from the 2012 Performance Report of the Department of Wildlife Conservation (DWC).

26. Environmental safeguard costs were estimated using information on civil works (relocation of electric fences, road signs, speed bumps); 25% of estimated ADB safeguards supervision costs (costing

³ The probability of road kill at a road "with safeguards" is computed as follows:

Pr road kill in NHSP road when road kills occur = (2 road kills total at A012 and A006)/(5 total road kills) . Pr road kills happening in a year during the 7 years (2010-2016) data = 5 total road kills/7 years. The joint probability of road kill in a year happening at one NHSP road is = 1/5) *(5/7) = 1/7 or 14%. The joint probability of road kill in a year happening at a non-NHSP road=(3/5) *(5/7) =43%.Such data probably reflects already the increasing fragmentation of sanctuaries, parks and corridors and the recent increase in elephant population (3000 in 2002 to 6000 in 2015 (Fernando 2011).

⁴ R. Bandara and C. Tisdell. 2004. *The Net Benefit of Saving the Asian Elephant: A Policy and Contingent Valuation Study*. Ecological Economics, Journal, Volume 48, Issue 1, pages 93–107. Elsevier. <https://www.researchgate.net/publication/222223612>. Tisdell C. 2014. Human Values and Biodiversity Conservation: the Survival of Wild Species. Edward Elgar contains "The Economic worth of conserving the Asian Elephant. discusses further the scaling up of Colombo estimates to national urban values as well as the damage caused on rural population by wild elephant Exchange rate of LKR 130.8 per US dollar.

⁵ The reasons for contribution to an elephant conservation trust fund range from use (festivities), non-use (icon of culture), and spiritual values are presented in Tisdell (2014) in the previous footnote.

ADB staff weeks); local authorities enforcement of speed limits; post-construction monitoring of environmental quality) from various sources.

27. Based on the interpretation of changes in forest and non-forest cover from 2010 to 2015 the environmentally critical areas adjacent or traversed by the three roads experienced net increases in forest cover. Safeguard measures such as avoidance of new construction sites, planting of trees when removal cannot be avoided, and better protection by forest authorities against poachers likely contributed to the larger forest cover thereby helping enhance the tourism at the Wipattu National Park, Hakgala and Hurulu forests. Increased areas of the elephant habitats in Hurulu and Tabbowa also raise the potential number of elephants and other wildlife that could be supported.

28. The increase in forest cover at the high-value tourism site at the Hakgala Botanic Gardens that is tangential to road segment A005 enhances the gardens' foreign tourism revenues. They grew exponentially since 2010 reflecting mostly post conflict growth in Sri Lankan tourism. The present analysis uses a modest 2% real growth rate during the project lifetime on only 10% of foreign tourist revenues as the portion attributable to environmental safeguards. Similarly, only 10% of local communities' willingness to pay for conservation was attributed to the road safeguards that minimize disturbance of the larger Hakgala Forest where the Botanic Gardens are located.

Box LD10.2: Elephant-Motor Vehicle Collisions (2010–2016)

Of the five elephant road kills in 2010–2016 two occurred at NHSP roads:

- (i) One elephant death occurred near the 10th mile post (near Oya Bridge) on the Puttalam^a – Anuradhapura Road (A012) after 2010 (Information relayed to Dr. Shiranee Yasaratne, IED consultant, by Dr. G. A. Tharaka Prasad, BVSc, MSc, Director Wildlife Health, DWC). The same incident is mentioned to have happened in 2011–2012 at 10-11 Place (Bend) of the Puttalam-A'pura road due to an accident by a large vehicle like a Lorry in a conversation between Mr. Colin. Reese, IED consultant, and Puttalam Special Task Force guard (Manoj Waidyaratne). This was reiterated by same guard to Mr. Sujith Jayasooriya, IED consultant.
- (ii) One incident of elephant death following an accident on A006, at the Kurunegala – Dambulla – Habarana Road, a segment that is however not part of the NHSP. The animal died on the spot after collision with a milk bowser (from Dr. G. A. Tharaka Prasad, BVSc, MSc, Director of Wildlife Health. Same incident is reported to have occurred in 2010 in the Wijeya Newspaper 2011 headlined: "Speeding vehicles on roads driving wildlife to their early graves."
- (iii) Two deaths reported in 2015 at Hathreskotuwa, Polonnaruwa (6/9/2015) and Devagala, Ampara (29/10/2015) at non NHSP roads, per data sent by DWC to on October 11, 2016.
- (iv) The recent death of elephant calf from motor vehicle collision at Habanara-Trincomalee (Thalapathkanda) occurred on April 30, 2016 (see news item below):^b
 "An elephant calf died after it was knocked down by a van at Thalapathkanda in the Habarana - Trincomalee main road on Saturday. Five people who were travelling in the vehicle were also injured. The mother elephant who was with the calf sustained injuries, had fled into the jungle, source said. The dead elephant was about 10 to 12 months old, wildlife authorities said. The five injured people who were travelling in the van are receiving treatment at the Trincomalee and Dambulla hospitals."

DWC = Department of Wildlife Conservation, IED = Independent Evaluation Department, NHSP = National Highways Sector Project.

^{a, b} Two elephant road kills in 2010–2016 at the National Highways Sector Project roads.

Source: The Associated Newspapers of Ceylon Lt., 1996–2016. 2016. Elephant Calf Dies in Van Crash. May 2.

29. The results for biodiversity safeguards presented in Table LD10.3 indicate one case with negative NPVs due to lingering elephant deaths involving road segment A012 in the “with safeguards” scenario compared with all damages from environmental impacts in the “without safeguards” situation. For the latter (A012) the elephant loss is not compensated for by the increases in elephant population arising from avoided habitat loss and avoided losses from tourism in the large Wilpattu National Park. In the case of A005 and A006 high recreation revenues from foreign tourists and local communities’ values result in positive NPVs even when only 10% of these values are attributed to the environmental safeguards and costs of safeguards implementation are factored in.

30. With improved safeguards such as the road bumps, improved road signs, and the recently lowered speed limits to 25 kph at crossing sections, and relocation of existing electric fences the likelihood of elephant death from these roads not expected increase despite the growing elephant population. The value added by biodiversity safeguards are all positive for all three roads; benefit-cost ratios are larger than one for two of the three roads, and the economic internal rates of return of both roads are higher than 12%.

Table LD10.3: Benefits and Costs of Safeguards: Wildlife and Biodiversity (\$)

Road Section, Construction Period and Length	With safeguards	With limited safeguards	Without safeguards	Safeguards Value Added	
				Limited safe-guards	Without safeguards
Nuwara Eliya-Badulla (A005); September 2008- November 2011; 57.5km					
Efficiency Analysis: Environmental Safeguards					
NPV	17,450	2,552	(39,270)	14,898	56,719
Benefit-cost ratio	2.0	1.2	n.a.	0.8	2.0
EIRR	25%	15%	n.a.	10%	25%
Benefits from Environmental Safeguards	34,769	14,616	(39,270)	20,153	74,039
Value of avoided losses in Hakgala Botanic Garden	27,686	11,075	(15,559)	16,612	43,245
Tourism Revenues attributable to SPS					
Local communities' WTP to conserve Hakgala	7,083	3,541	(23,711)	3,541	30,793
Costs of Environmental Safeguards	(17,319)	(12,064)	0	(5,255)	(17,319)
Habarana Kantale (A006); April 2008- July 2012; 43.5km					
Efficiency Analysis: Environmental Safeguards					
NPV	4,068	(9,454)	(61,429)	13,522	65,497
Benefit-cost ratio	1.2	0.3	n.a.	0.9	1.2
EIRR	22%	18%	n.a.	4%	22%
Benefits from Environmental Safeguards	27,011	3,472	(61,429)	23,539	88,441
Value of avoided Hurulu elephant road kill arising from signage, speed limits, bumps	(9,769)	(20,021)	(33,100)	10,251	23,331
Net change in forest cover that can support elephant	2,229	458	(687)	1,770	2,916
Value of avoided tourism revenue losses at Hurulu Elephant Eco-Park	34,552	23,035	(27,642)	11,517	62,194
Costs of Environmental Safeguards	(22,943)	(12,926)	0	(10,017)	(22,943)
Puttalam Anuradhapura (A012); June 2009- August 2011; 82.10km					
Efficiency Analysis: Environmental Safeguards					
NPV	(6,581)	(21,918)	(38,244)	15,337	31,663
Benefit-cost ratio	0.9	n.a.	n.a.	n.a.	n.a.
EIRR	n.a.	n.a.	n.a.	n.a.	n.a.
Benefits from Environmental Safeguards	24,400	(5,398)	(47,973)	29,798	72,372
Value of avoided elephant road kills in Tabbowa Sanctuary	(9,512)	(19,494)	(32,228)	9,981	22,716
Net change in forest cover that can support elephant	5,306	2,653	(3,980)	2,653	9,286
Value of avoided tourism revenue losses at Wilapattu National Park	28,606	11,442	(11,765)	17,163	40,370
Costs of Environmental Safeguards	(26,032)	(17,614)	0	(8,418)	(26,032)

n.a. = not applicable, NPV = net present value, EIRR = economic internal rate of return, WTP = willingness to pay.

^a The Net Present Value (NPV) is the superior indicator for economic efficiency versus the Benefit- Cost Ratio (BCR) and the Economic Internal Rate of Return.

Source: Independent Evaluation at the Asian Development Bank.

31. The additionally financed roads B153 and B157, which are in areas with high population densities, recorded emissions, surpassed the United States Environmental Protection Authority (EPA) and World Health Organization (WHO) standards during the construction (Table LD10.4). The population at risk include the construction workers and the proximate roadside population. Assuming that safeguards were undertaken 90% of the time through the use of sprinklers, masks, curtains and handkerchiefs health damages all of which are not costly risk aversion measures health damages are avoided. The rates of return to such measures are high; in contrast, high health damages are computed for the “without safeguards” scenario; thus Safeguards add value in the form of lower pollution damages.

Table LD10.4: Physical Impacts of PM₁₀ and PM_{2.5}

Nature of Impact: Morbidity	Particulate Matter (size, microns per cu.m.)	ΔPM (mg/m ³)	Scenario values	β	Y ₀	Exposed population	Cost of Illness
Asthma, In-patient	2.5	B153: 0.028 B157: 0.0194	Medium outcome, status quo scenario: as observed from monitoring data.	0.00227	0.009535	Affected Peoples from LARP	SLRs1,332 or \$ 10 for asthma; SLRs6,147 or \$47 for lower respiratory infections (updated values of Chandrasiri estimates)
Asthma, Out-patient	10	B 153: 0.018 B 157: 0.005	Low outcome, weak safeguards scenario: double the status quo’s ΔPM	0.0037	0.1		
Lower respiratory ailments, Out-patient	2.5	B153: 0.028 B157: 0.0194	High outcome, strong safeguards scenario ΔPM = 0	0.0272	0.023015		

PM = particulate matter.

Notes: β, Y₀ are from L. K. Akesson et al. 2000. *Final Heavy Duty Engine/Diesel Fuel Rule: Air Quality Estimation, Selected Health and Welfare Benefits Methods, and Benefits Analysis Results*. U.S. Environmental Protection Agency. North Carolina; The ΔPM are Independent Evaluation Department (IED) estimates based on the observed values presented in Table LD10.4 less the US EPA standards. Cost of illness is an update by IED of the estimates by S. Chandrasiri. 2006. *Controlling Automotive Air Pollution: The Case of Colombo City*, Appendix 3. Economy and Environment Program for Southeast Asia. Research Report, Economy and Environment Program for Southeast Asia. <http://www.eepsea.org/pub/rr/10536134820ACF1B6.pdf>. Source: Independent Evaluation at the Asian Development Bank.

Table LD10.5: Benefits and Costs of Safeguards: With and Without Dust Pollution SPS (in \$)

Road Section, Construction Period and Length	With			Safeguards Value Added	
	With Safeguards	Limited Safeguards	Without Safeguards	Limited Safeguards	Without Safeguards
Hikkaduwa-Southern Highway (B153); May 2013, on-going; 14.40km					
Efficiency Analysis: Environmental Safeguards					
NPV	76	(2,557)	(1,554)	2,633	1,630
Benefit-cost ratio	1.2	0.9	n.a.	0	n.a.
EIRR	17%	n.a.	n.a.	n.a.	n.a.
Benefits from Environmental Safeguards	1,884	(1,182)	(1,572)	3,067	3,456
Value of avoided asthma from PM ₁₀ exposure	592	(157)	(293)	749	885
Value of avoided asthma from PM _{2.5} exposure	16	(11)	(15)	26	31
Value of avoided lower respiratory tract infection from PM _{2.5} exposure	1,277	(1,015)	(1,264)	2,292	2,540
Costs of Environmental Safeguards					
Monitoring, supervision, masks	(1,512)	(1,375)	0	(137)	(1,512)
Alutgama-Southern Highway (B 157); 15 May 2013, on-going; 23.50km					
Efficiency Analysis: Environmental Safeguards					
NPV	348	(5,035)	(3,458)	5,383	3,806
Benefit-cost ratio	1.24	n.a.	n.a.	n.a.	n.a.
EIRR	30%	n.a.	n.a.	n.a.	0
Benefits from Environmental Safeguards	2,805	(1,563)	(3,727)	4,368	6,532

Road Section, Construction Period and Length	With Safe- guards	With Limited Safeguards	Without Safeguards	Safeguards Value Added	
				Limited Safeguards	Without Safeguards
Value of avoided asthma from PM ₁₀ exposure; workers and roadside population	530	(253)	(694)	784	1,225
Value of avoided asthma from PM _{2.5} exposure; workers and roadside population	29	(16)	(39)	45	68
Value of avoided lower respiratory tract infection from PM _{2.5} exposure;	2,245	(1,339)	(2,994)	3,585	5,239
Costs of Environmental Safeguards	(2,256)	(2,051)	0	(205)	(2,256)
Monitoring, supervision, masks					

EIRR = economic internal rate of return, n.a. = not applicable, NPV = net present value, PM = particulate matter.

Source: Independent Evaluation at the Asian Development Bank.

2. Net Benefits from Involuntary Resettlement Safeguards

32. The statistical t-tests performed on the IED survey results for two roads indicate no changes in income before and after resettlement. This indicates that the involuntary resettlement safeguards “do no harm” and has been effective, on the average. It may be noted though that the standard deviation is quite high implying a wide range of incomes.

Table LD10.6 : Income Tests, Affected Persons at B153 and B157:Pre-Construction and 2015 (SLR)

Monthly Income (in SLR) and Statistical tests	Hikkaduwa-Southern Highway (B153); May 2013, on-going; 14.40km		Alutgama-Southern Highway (B 157); 15 May 2013, on-going; 23.50km	
	Before construction	2015	Before construction	2015
Mean	32,986	39,159	57,708	53,880
Standard deviation	42,988	51,934	82,058	58,414
Observations	70	69	72	75
Hypothesized Mean Difference	0		0	
degrees of freedom	137		145	
t Stat	(0.76)		0.33	
P(T<=t) one-tail	0.22		0.37	
t Critical one-tail	1.66		1.66	
P(T<=t) two-tail	0.45		0.74	
t Critical two-tail	1.98		1.98	
t Critical two-tail	1.98		1.98	
Compensation for Assets: Affected Peoples at B157	Land, Statutory	Land, LARC	Building, Statutory	Building, LARC
Total Compensation	16,823,550	31,997,500	2,408,350	6,596,150
Per Cent difference		90%		174%
Observations	74	74	26	26

LARC = Land Acquisition and Resettlement Committee.

Notes: The high values for variances reflect the wide range of reported incomes. The t values indicate that there are no statistical differences between the income earned during the year before the road construction and the income earned in 2015 for both roads. Income data from Independent Evaluation Survey, February-March 201; Compensation data from RDA, 2016; subset, with complete data

Source: Independent Evaluation at the Asian Development Bank.

33. The benefits from involuntary resettlement safeguards were computed based on returns from 4% of the compensation paid on lost assets that is assumed to be set aside for investments by 40% of the APs (affected peoples).⁶ This amount is expected to grow by 2% annually in real terms. The conditions for this behavior are reasonably present for the National Highway Sector Project involuntary resettlement persons. While the global experience of IR compensation is replete with cases of unfair compensation and lower quality of life of resettled persons in developing countries there are emerging

⁶ Additional analysis of 50 affected people who were surveyed by IED and who received compensation for affected assets indicated that 40% started up new business undertaking, set aside savings or shared the windfall amounts with family members.

South Asian cases of compensation used for savings or investments by the recipient, resettled persons.⁷ Moreover, average income levels of the affected peoples that are higher than the poverty thresholds for the districts where these roads are located and high economic growth during the country's post-conflict period are positive factors for using part of the compensation for investments.

34. The proportion of payments for assets (residence, buildings, farmlands) to total compensation differs from one road to another (as do the involuntary resettlement transactions costs, with A012 having the highest unit cost per affected peoples as well as the lowest portion of asset compensation out of total compensation. Nonetheless under the "with safeguards" scenario all road segments generate positive NPVs (Table LD10.7). In contrast all affected peoples experience high damages from unpaid compensation in the extreme scenario without any safeguards.

35. These results do not include estimates on the impacts of resettlement safeguards on the vulnerable persons who comprise less than 5% of the total affected people for these roads. Considerable increase in the incomes of this group through well designed livelihood training – as required by SPS – would not only improve their quality of life but improve the project's economic returns as well.

Table LD10.7: Benefits and Costs of Safeguards: Involuntary Resettlement (\$)

Road Section, Construction Period and Length	Safeguards Value Added				
	With Safeguards	With Limited Safeguards	Without Safeguards	Limited Safeguards	Without Safeguards
Nuwara Eliya-Badulla (A005); Sept 2008- Nov 2011; 57.5km					
Efficiency Analysis: Social Safeguards					
NPV	353,787	124,910	(1,619,500)	228,877	1,973,287
Benefit-cost ratio	3.7	2.1	0	1.7	3.7
EIRR	22%	18.4%	n.a.	4%	22%
Benefits from Social Safeguards					
Value of avoided cost inflicted on affected people	483,745	241,872	(1,619,500)	241,872	2,103,245
Costs of Social Safeguards					
IR transactions costs: information, forging agreements, implementation	(129,958)	(116,962)	0	(12,996)	(129,958)
Puttalam Anuradhapura (A012); June 2009- August 2011; 82.10km					
Efficiency Analysis: Social Safeguards					
NPV	82,282	33,719	(1,808,015)	48,564	1,890,297
Benefit-cost ratio	3.2	2.3	n.a.	0.9	n.a.
EIRR	30%	24%	n.a.	6%	30%
Benefits from Social Safeguards					
Value of avoided cost inflicted on affected people	119,395	59,697	(1,808,015)	59,697	1,927,410
Costs of Social Safeguards					
IR transactions costs: information, forging agreements, implementation	(37,113)	(25,979)	0	(11,134)	(37,113)
Hikkaduwa-Southern Highway (B153); May 2013, on-going; 14.40km					
Efficiency Analysis: Social Safeguards					
NPV	87,486	12,402	(2,210,905)	75,084	2,298,391
Benefit-cost ratio	1.2	1.2	n.a.	0	n.a.
EIRR	15%	12%	n.a.	3%	15%
Benefits from Social Safeguards					
Value of avoided cost inflicted on affected people	488,380	293,028	(2,210,905)	195,352	2,699,285
Costs of Social Safeguards					
IR transactions costs: information, forging agreements, implementation	(400,895)	(280,626)	0	(120,268)	(400,895)
Alutgama-Southern Highway (B 157); 15 May 2013, on-going; 23.50km					
Efficiency Analysis: Social Safeguards					
NPV	160,177	45,322	(1,849,370)	114,855	2,009,547
Benefit-cost ratio	2.6	1.4	n.a.	2.6	n.a.
EIRR	33%	18%	n.a.	15%	18%

⁷ ADB. 2014. *Lose to Gain: Is Involuntary Resettlement a Development Opportunity? Chapter 6: Why is Compensation not enough to make resettlement an opportunity?* Manila. Depositing compensation money into a bank was the most frequently practiced action by Polavaram Dam IR persons in India.

Road Section, Construction Period and Length	With Safeguards	With Limited Safeguards	Without Safeguards	Safeguards Value Added	
				Limited Safeguards	Without Safeguards
Benefits from Social Safeguards					
Value of avoided cost inflicted on affected people	259,966	155,980	(1,849,370)	103,987	2,109,336
Costs of Social Safeguards					
IR transactions costs: information, forging agreements, implementation	(99,790)	(110,658)	0	10,868	(99,790)

km = kilometer, NPV = net present value, EIRR = economic internal rate of return.

Source: Independent Evaluation at the Asian Development Bank.

36. The potential value that would be added by enhanced involuntary resettlement safeguard implementation could still be higher for all roads, provided that the gaps in the compensation processes are addressed, as mentioned in the previous chapter. These gaps include the timing of compensation, design of appropriate livelihood enhancement for the vulnerable groups, monitoring the impacts on quality of life of the affected people, and efficiency measures for reducing transaction costs as noted in Chapter 3. In ADB, there is no system to track and trace the actual transaction cost incurred during project implementation, which makes it difficult to conduct benefit–cost analysis on a real-time basis. The operational cost of properly designing and implementing resettlement plans will depend on the demographic setting of the affected communities. In addition, most importantly, employment opportunities in the old or new locations would also change the analysis. Of course, people have diverse entrepreneurial skills and potential; which makes it even more difficult to project livelihood gains or losses. In order to take this further, a comprehensive tracer survey is needed for ADB and governments to carry out accurate benefit–cost analyses.

3. Safeguard Policy Statement Value Added

37. Despite some gaps in implementation and missing information on the unvalued environmental benefits (leading to instances of a high, negative net present value under the status quo for one road segment), estimates of apparent value added from both safeguards are positive, as measured by the differences in NPVs between the “with safeguards” and “without safeguards.” (Table LD10.8). Continuation of the current implementation of safeguards for the analyzed roads add high value.

38. Environmental benefits will be boosted when safeguards measures are properly designed and implemented; if the area to be developed is environmentally sensitive, such as an elephant sanctuary or a biodiversity-rich zone. The additional revenue stream from tourism (visitor fee collection based on willingness to pay) can be potentially higher than the cost to implement safeguards.

Table LD10.8: Estimates of Safeguards Value Added to Without Safeguards (NPV in \$)

Road Section, Construction Period and Length	Environment Safeguards	Involuntary Resettlement Safeguards	Both Safeguards
Nuwara Eliya-Badulla (A005); September 2008-November 2011; 57.5km	56,719	1,973,287	2,030,007
Habarana Kantale (A006); April 2008- July 2012; 43.5km	65,497	n.a.	65,497
Puttalam Anuradhapura (A012); June 2009- August 2011; 82.10km	31,663	1,890,297	1,921,960
Hikkaduwa-Southern Highway (B153); May 2013-on-going; 14.40km	1,630	2,223,307	2,224,937
Alutgama-Southern Highway (B 157); 15 May 2013-on-going; 23.50km	3,806	2,009,547	2,013,353
NHSP (70% of total)	159,316	8,096,438	8,255,753

NHSP = National Highway Sector Project, NPV = net present value.

Source: Independent Evaluation at the Asian Development Bank.

4. Comparison with Original Economic Analysis

39. The net present value and benefit–cost analyses above provide only a partial picture of efficiency. The safeguards would not have been necessary had these roads not been constructed. Thus, a comprehensive analysis of benefits and costs means that the extended benefit–cost analysis of environmental and involuntary resettlement safeguards needs to be incorporated into the original economic analysis. This results in the overall picture in Table LD10.9 where all roads have safeguard-modified net present values that are higher than the original values.

Table LD10.9: Safeguards in the Modified Economic Analysis

Economic Viability Indicators	Road Section, Construction Period and Length				
	Nuwara Eliya-Badulla (A005); September 2008-November 2011; 57.5km	Habarana Kantale (A006); April 2008-July 2012; 43.5km	Puttalam Anuradhapura (A012); June2009-August 2011; 82.10km	Hikkaduwa-Southern Highway (B153); May 2013, on-going; 14.40km	Alutgama-Southern Highway (B 157); 15 May 2013, on-going; 23.50km
Original Economic Analysis					
NPV (\$)	4,670,960	5,967,520	4,706,680	10,462,920	3,616,080
EIRR	14.1%	18.8%	16.7%	27.6%	16.50%
Present Value of Safeguards Benefits	501,195	27,011	143,794	490,265	262,772
SPS-Modified Economic Indicator					
NPV (\$), with SPS	517215456%	5,994,531	4,850,474	10,953,185	3,878,852
Per cent addition to original NPV	10.7%	0.5%	3.1%	4.7%	7.3%

EIRR = economic internal rate of return, NPV = net present value, SPS =safeguard policy statement. Note: Adjustments were made to the NPVs in the RPP using only the present value of benefits from the safeguards because the original economic analysis already included the costs of both the environmental and social (involuntary resettlement) safeguards. Source: Independent Evaluation at the Asian Development Bank.

E. The Java-Bali 500-Kilovolt Power Transmission Crossing Project

40. Benefit cost analysis was for the Java-Bali 500-Kilovolt Power Transmission Crossing Project that involves the extension of power from the islands of Java to Bali. The project entails the development of 220 km of 500 kilovolt transmission lines, the development of 500/150kV and 150/20 substations in Bali and East Java and project management support. Two towers are to be constructed at both ends of a line that would cross the Java Bali strait through a loan and from other funding sources; each of these towers are to be located on the Baluran National Park in Hava and the Bali Barat National Park in Bali. The project was effective on 29 September 2014; both the environmental management and involuntary resettlement plans are under revision based on the recommendations of various missions that were conducted during the past two years.

1. Potential Impacts of Air Pollution during Construction: Indonesia Java-Bali 500 kV Power Transmission Crossing Project

41. For the Indonesia Java-Bali 500 kV Power Transmission Crossing Project in Indonesia, since the analysis is ex-ante and the existing environmental management plan (EMP) includes dust control measures, the avoided pollution damage is valued in terms of willingness to pay estimates from a Jakarta study.⁸ The parameters and estimation process applied for a construction period of 4 years are in Table LD10.10.

⁸ M. Amalia. 2010. *Designing a Choice Modelling Survey to Value the Health and Environmental Impacts of Air Pollution from the Transport Sector in the Jakarta Metropolitan Area*. Environmental Management and Development Program, Crawford School of Economics and Government, Australian National University. Canberra. http://www.eepsea.org/pub/rr/12898006221Mia_2010-RR3.pdf

Table LD10.10: Avoided Costs of Pollution from Dust (PM₁₀) during Construction: Key Variables and Values

Assumptions	Value	Source
Total population exposed	1,300	
Affected peoples based on LARP	1,200	LARP
No. of workers	100	EIA
Average WTP ^a to reduce PM ₁₀ pollution, \$ per year over three years	33	Amalia, 2010
WTP (2013)	44	
Construction period (in years)	4	EIA

EIA = environment impact assessment, LARP = land acquisition and resettlement plan, WTP = willingness to pay.

^a WTP from M. Amalia. 2010. *Designing a Choice Modelling Survey to Value the Health and Environmental Impacts of Air Pollution from the Transport Sector in the Jakarta Metropolitan Area*. Environmental Management and Development Program, Crawford School of Economics and Government, Australian National University, Canberra. http://www.eepsea.org/pub/rr/12898006221Mia_2010-RR3.pdf

Source: Independent Evaluation at the Asian Development Bank.

2. Impacts on Local Airlines Flight Path

42. Two flight paths are directly affected. They normally cross the strait where the transmission line would hang and thus would have to be altered so they can avoid the line Figure LD10.4. This would increase the distance travelled by an estimated 5%. The adjustment costs by local airlines are reflected in Table LD10.11. Costs borne by non-Indonesian airlines are not included in the benefit–cost analysis, which was undertaken from a national perspective.

Figure LD10.4: Costs from Avoidance of Towers by Local Air Lines



Source: Independent Evaluation at the Asian Development Bank

Table LD10.11: Adjustments of Flight Paths of Indonesian Air lines to Avoid the Java-Bali Strait Overhead Transmission

Item	Unit	Route	
		Medan to Denpasar	Bandah Aceh to Denpasar
Straight Line Distance	km	2310	2772
Approximate Minimum Distance to Transmission Line	km	0	0
Crossing the transmission line		Yes	Yes
Flight Distance, per Airline data	km	3157	3605
Assumed, potential flight path adjustment	%	5	5
Original flight data	Hour/minute	4 hours 30 min ^a	5 hours 50 minutes ^b
Flying time per flight			
Frequency of flights	No/day	5	4
Flying time per day	Hours	25	24
Total Flying time per year	Hours	9,125	8,760
Gallon equivalent ^d	Gallon	304,257	292,086
Adjustment Cost per year			
Cost of extra 5% mileage	\$'000 ^e	419.9	403.0
Total adjustment cost for both paths, per year	\$ '000		822.9

^a With onestop, rounded to 5 hours.

^b With onestop, rounded to 6 hours.

^c Boeing 737 consumption of kerosene type jet fuel is based on https://www.airberlin.com/en/site/seatplan.php?seatTyp=B737_800. Info. Garuda, which is the Indonesian's flag carrier has a fleet consisting of 53% of Boeing 737.

^d 1 kg is 0.264172051242 gallon.

^e Price per gallon of kerosene type jet fuel is \$1.38 as of 6 June 2016. <http://www.indexmundi.com/commodities/?commodity=jet-fuel>

^f \$1 = Rp13,410 as of 6 June 2016.

Source: Independent Evaluation at the Asian Development Bank.

3. Impact on Nature-Based Tourism

43. Temporary impacts are expected during construction from the disturbance that occurs during road widening to transport construction materials and construct towers, workers' quarters, and storage facilities. Estimating a buffer of 300 m. on each roadside, altogether construction impacts 5.4% of the total area of the Bali Barat National Park (Table LD10.12). Tourism is valued at around \$32 million for the whole park, using a local willingness to pay study by an official of the park.⁹ This value is much higher than the official tourism revenues implying that there is considerable opportunity to raise the fees to capture the visitors' consumers' surplus. 5.4% reduction of the total willingness to pay value was assumed for a period of 10 years covering both the construction period and adjustment phases for both local and foreign tourists.

⁹ S. D. Penguji. 2015. *Valuasi Ekonomi Taman Nasional Bali Barat Dengan Pendekatan Travel Cost Method*. Masters Thesis submitted to the Gadjah Mada University. Yogyakarta.

Table LD10.12: Zone of Direct Influence of the Java-Bali 500kV Power Transmission Crossing Project

Park and/or Affected Road (300 m. strip each side)	Total Park Area (ha) ^a	Forest (ha) ^b	Non Forest (hectares) ^c	Affected Park Area (ha) ^d	% of total	Forest (ha) ^e	Non Forest (ha) ^f
Baluran: Road 1	29,763	11,010	18,753	1,236	4.0	1,032	204
Bali Barat	13,953	10,207	3,746	756	5.4	348	407
Jl Raya Denpasar - Gilimanuk				248	1.8	55	192
Jl Sirangaraja - Gilimanuk				508	3.6	293	215

^a Forest and non-forest areas were calculated using the global 25-meter resolution ALOS PALSAR-2/PALSAR Forest/Non-Forest images from the Japan Aerospace Exploration Agency (JAXA). The dataset has a classification accuracy of about 84%.

^{b,e,f} Forest is defined as the natural forest with the area larger than 0.5 hectares and forest cover over 90%, in line with the Food and Agriculture Organization definition.

^c Non-forest areas include croplands, wetlands, grasslands, settlements and other types of land cover.

^d 300 meter strip along both road sides includes towers and anchor support.

Source: Independent Evaluation at the Asian Development Bank.

4. Reduced Revenues from Bali Barat National Park due to temporary Impacts on the Bali Starling

44. Some 200 Java Bali starling birds are estimated to live in the Bali Barat National Park. Of these, 100 are mature birds¹⁰ whose breeding habits are expected to be affected over a period of 10 years during construction and afterwards. The disturbance to their habitat arises from noise and movements during construction, affecting 5% of the total park area, relocation of water sources by the park authorities, and relocation of the sites where they are normally released from captivity. The current market value use in the analysis is \$500 per bird,¹¹ considerably lower than the \$6,000 some 20 years ago when captive breeding was not in place at the parks and at private breeders, which have helped to increase the bird population. An estimated 3,000 birds are reported to be in successful captive breeding centers, mostly by private breeders who have collaborative arrangements with park authorities.¹²

5. Impact on Mangroves

45. Disturbance to mangroves is expected to be minimal. One transmission tower will be constructed on Gadung Island affecting 23 hectares of mangroves. The tower is to be set up on a platform as required by the Department of Forestry in an agreement with the PLN (National Electric Company) as a condition of the permission to construct the tower. The construction of the platform itself will also cause damage. The value used in this analysis ranged from some \$32 million to \$89 million for a nearby mangrove ecosystem.¹³ The upper limit of the total economic value translates to a value of about Rp 500,000 per hectare per year or only \$39 per ha per year, much lower than the values reported for other countries' studies.

6. Partial Results and Preliminary Implications

46. The overall results that are summarized in Table LD10.13 indicate that the economic valuation of environmental benefits and costs from safeguards as they were originally designed would result in

¹⁰ Birdlife International. 2016. *Species factsheet: Luecopsar rothschildi*. <http://www.birdlife.org> on 06/16/2016

¹¹ J.B.C. Harris et al. 2015. *Using Market Data and Expert Opinion to Identify Overexploited Species in the Wild Bird Trade*. Science Direct, Biological Conservation, Volume 187, July 2015, pages 51–60.

¹² A. Dipa. 2015. Government, Breeders Join Forces to Save Endangered Bali Starlings. *Jakarta Post*. October 17.

¹³ S. Mangkay et al. 2013. *Economic Valuation of Mangrove Forest Ecosystem in Tatapaan, South Minahasa, Indonesia*. IOSR Journal Of Environmental Science, Toxicology And Food Technology (IOSR-JESTFT) e-ISSN: 2319–2402, p-ISSN: 2319–2399. Volume 5, Issue 6 (Sep– Oct. 2013), PP 51–57 www.iosrjournals.org

lower net benefits by \$29.7 million. Since there are other environmental impacts that are unvalued, this result only captures partial impacts and may be considered as inconclusive.

47. Nonetheless, the effects of the partial analysis on the economic internal rate of return and the benefit cost ratio are insignificant. This implies that even if the current project redesign of environmental safeguards would cost \$29.7 million in order to avoid the estimated equivalent damages the project would still be highly feasible.

Table LD10.13: Benefits and Costs (Original and Extended)

Economic Analysis	Net Present Value (\$) (million)
A. Original Economic Analysis	
Total Benefits (Original B)	2,470.3
Non-incremental Benefit Valued at Replacement Cost of and Diesel Generation	
Incremental Benefit Valued at Willingness to Pay	
Total Costs (Original C)	(2,281.6)
Resource Cost of Incremental Benefit Valued at Java Generation Costs	
Investment and Maintenance Cost of Project	
Net Benefits and other Economic Criteria	
Net present value @ 12%	188.7
Benefits and Costs ratio	1.1
Economic internal rate of return	25.5%
B. Benefits and Costs of Environmental Safeguards	
Benefits	
Avoided health costs of from reduced PM ₁₀ pollution during construction	0.05
Costs (Extended C)	(29.8)
Rerouting of Indonesian flights from Java airports to Bali/Denpasar airport (additional aviation fuel cost), beginning year 5	(15.1)
Reduced WTP by Bali-Barat National Park Visitors over ten years	(10.9)
Reduced population of Bali Starling over ten years	(3.8)
Reduction in total economic value of affected mangroves	(0.01)
C. Unvalued Benefits and Costs of Safeguards (partial list)	
Effects on marine life during construction of the jetty	
Avoided disturbance of wildlife such as the ebony monkey and the banteng	
Avoidance of core areas in the two parks as sites for the towers	
Effects on marine-based tourism during the construction period	
D. Partially Adjusted Economic Indicators	
Total Benefits (Original B + Extended B)	2,470.33
Total Costs (Original C + Extended C)	(2,311.34)

Source: Independent Evaluation at the Asian Development Bank.