B. Input Data for calculation

A) Total Annual Running Time by Vehicle Type for the Without/With Project

Tab. 13.14 Total Annual Running Time by Vehicle Type for Without and With Project Cases

(Unit: millions of vehicle·km/year)

		1999	2006	2010	2020
Car	Without	41.8	105.5	133.4	225.5
	With		121.9	153.6	248.4
	Net		13.6	18.0	40.7
Motorcycle	Without	13.5	36.1	45.2	85.8
	With		31.6	40.6	76.8
	Net		4.5	4.6	9.0
Bus	Without	22.6	36.1	40.6	63.2
	With		31.6	36.1	54.2
	Net		4.5	4.5	9.0
Taxi	Without	9.0	13.5	18.1	31.6
	With		13.5	13.5	27.1
	Net		0.0	4.6	4.5
Lorry	Without	18.1	36.1	45.2	72.3
	With		31.6	40.6	63.2
	Net		4.5	4.6	9.1

Source: JICAStudy Team

Note:

(1) A van is considered to be a car.

(2) It is assumed here for the year 2006 that the OCH will extend from Bandaragame to A1.

(3) It is assumed here for the year 2010 that the OCH will be fully completed.

B) Average Number of Passengers by Vehicle Type

The average number of passengers/vehicle is as follows:

Car	: 1.69	(excluding driver)
Motorcycle	: 1.30	(including driver)
Bus	: 40.0 *	(excluding driver)
Taxi	: 1.16	(ditto)
Van	: 12.0	(ditto)

Source: JICA Study Team and RDA surveys

Note* : According to RDA surveys it is 52.6

C) Ratio of Passengers with Trip Purposes to be Evaluated to the Total Number of Passengers: 43% *

Source: RDA

D) Time value of passengers

The time values for passengers in 1999 for different passenger vehicle types were derived based on the relationship for values of time contained in the "Economic Feasibility Study of Southern Highway" (1996) by the RDA and the University of Moratuwa. These values were also adjusted taking the Colombo consumer price index into account. The values of time for the different vehicle types are as follows:

- Passenger car & taxi: 68 Rs/hour
- Motorcycle: 41 Rs./hour
- Bus: 26 Rs./hour

E) Average Weight of Vehicle Cargo (unit: tons / vehicle)

Van : 1.5 tons
Lorry : 10.0 tons
Source : RDA survey.

F) Value of Vehicle Cargo per Ton

- Value of vehicle cargo per ton in 1998: 180,200 Rs/ton
- The above value is estimated in terms of export cargo from Sri Lanka. The value is estimated using the following data:
  - Value of export commodities (tea, rubber, other agricultural products, garment, petroleum products and mineral products, with a total value of 216,391 millions Rs, 1998),
  - Volume of corresponding export commodities (total volume: 1.201 million tons, 1998).

  (Data source: Central Bank of Sri Lanka, Annual Report, 1998)

C. Running Time Reduction Benefits till the Year 2020

Adopting the above-mentioned formulas and input data, benefits are forecasted till the year 2020 as follows:

Tab. 13.15 Running Time Reduction Benefits

(unit: millions Rs at 1998 economic prices)

	Total	For Passengers	For Cargo
2006	1,850.0	1,770.3	79.7
2010	2,512.3	2,404.1	108.2
2020	5,288.9	5,061.2	227.7

Source: JICA Study Team

Note:

(1) It is assumed here for the year 2006 that the OCH will extend from Bandaragame to A1.

(2) It is assumed here for the year 2010 that the OCH will be fully completed.

(2) Air Pollution Reduction Benefits

A. Procedure for Calculating Benefits

The procedure is comprised of two steps:

Step 1: Exhaust volume that would be reduced with the construction of the OCH project for the area of the Western Province is calculated.

Step 2 : The total installation cost of emission control equipment required to achieve specific levels of clean air.

In regards to the above produce the following assumptions below are applied.

Assumption 1:

Sri Lanka has and will import vehicles of all types. The ratio of vehicles with emission control equipment will surely increase in the future. As a result, it is assumed that the ratio of vehicles with emission control equipment in Sri Lanka will increase at 5% per annum in the future, which is a rather conservative estimate.

Assumption 2:

Emissions from any vehicle that installs emission control equipment satisfy the Sri Lankan Air Pollution Standard.

The estimation procedure for air pollution reduction benefit is shown in Fig. 13.2.

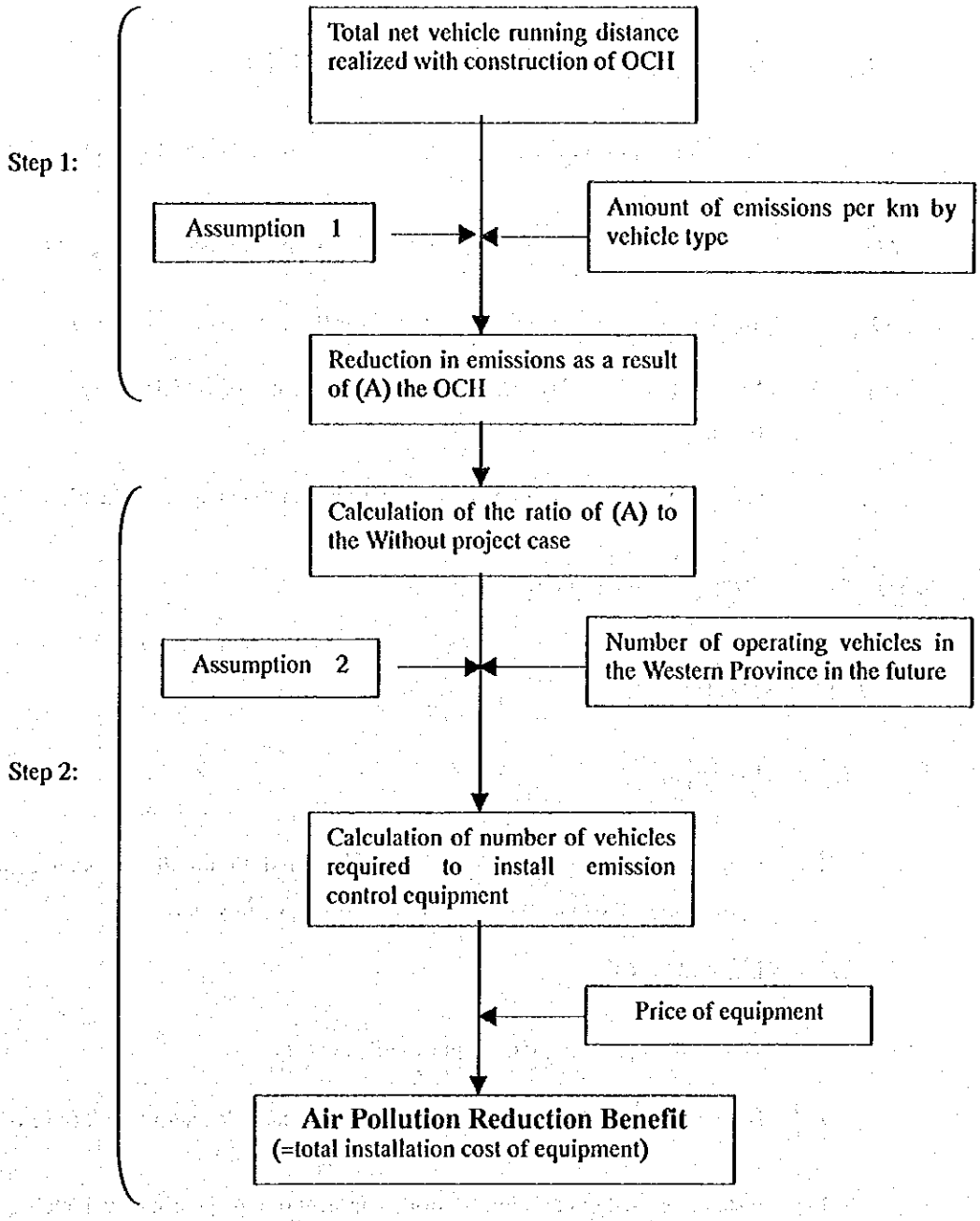


Fig. 13.2 Estimation Procedure for Calculating Air Pollution Reduction Benefits of OCH Project

B. Formulas for Calculating Benefits

$$E_{j,k,t} = \left| D_{j,t}^{WO} - D_{j,t}^{W} \right| \times e_{j,k} \times (1.0 - r_{j,1998}^{E})(1.0 - 0.05t) / 10^{-6}$$

$E_{j,k,t}$: Emissions of the type k that would be reduced with the OCH for vehicle type j in year t

$D_{j,t}^{WO}$: Total running distance of vehicle type j for Without project case in year t.

$D_{j,t}^{W}$: Total running distance of vehicle type j for With project case in year t.

$e_{j,k}$: Emission volume of type k per km running distance of vehicle type j (g/km)

$r_{j,1998}^{E}$: Installation ratio of emission control equipment of vehicle type j in 1998

10^{-6} : Unit adjustment coefficient

$$r_{j,k,t} = E_{j,k,t} / \left[\sum_{j=1} D_{j,t}^{WO} \times e_{j,t} / 10^{-6} \right]$$

$$R_{j,t} = \underset{k}{Max}(r_{j,k,t})$$

$R_{j,t}$: Ratio of vehicles of vehicle type j required to install emission control equipment of the total number of vehicles of type j in year t.

$$B_t^E = \sum_{j=1} V_{j,t}^{A} \times R_{j,t} \times C_j^I$$

B_t^E :Value of air pollution reduction benefits in year t

$V_{j,t}^{A}$: Number of operating vehicles of vehicle type j in the Western Province in year t

C_j^I : Installation cost of emission control equipment of type j during a vehicle's lifetime (at economic prices)

C. Input Data for Calculations

A) Emission Volumes by Fuel and Vehicle Type per km of Running Distance.

Tab. 13.16 Emission Factor

(unit: g/km)

		Fuel type	NO_x	CO	SPN
Small vehicles	Motorcycles	Petrol	0.25	26	0.1
	Three-wheelers	Petrol	0.65	30	0.3
	Cars	Petrol	1.4	32.5	0.05
Large vehicles	Mini-Buses	Diesel	4.6	1.5	0.8
	Buses	Diesel	7.8	2.1	1.5
	Trucks	Diesel	4.2	1.5	0.8
	Large trucks	Diesel	7.8	2.1	1.5

Source: National Building Research organizations, January 1999

B) Installation Ratio of Emission Control Equipment by Vehicle Type in 1998

Tab. 13.17 Installation Ratio of Emission Control Equipment (1998)

(unit: %)

Car		:2.0
Motorcycle	:	0
Bus	:	0
Taxi	:	0
Van	:	0
Lorry	:	0

Source: RDA estimate

C) Number of Operating Vehicles by Vehicle Type in the Western Province

Tab. 13.18 Number of Operating Vehicles in the Western Province

(Unit: vehicle)

	1999	2006	2010	2020
Car	204,950	426,890	649,260	1,201,180
Motorcycle	303,840	513,990	694,090	1,061,500
Bus	8,000	12,150	15,430	17,450
Taxi	35,130	41,570	45,770	56,240
Lorry	20,490	25,930	29,660	40,870

Source: JICA Study Team
Note: Van are considered as Cars.

D) Installation Cost of Emission Control Equipment by Vehicle Type

Tab. 13.19 Installation Cost of Emission Control Equipment during a Vehicle's Lifetime

(unit: Rs/vehicle at 1998 economic prices)

Car	:	13,760
Motorcycle	:	6,880
Bus	:	13,760
Taxi	:	13,760
Van	:	13,760
Lorry	:	13,760

Source: Consultant's estimate based on prices of equipment provided by Japan Automobile Industry Association

D. Air Pollution Reduction Benefits till the Year 2020.

Adopting the above formulas and input data, the total benefits that would be generated from a reduction in air pollution are forecasted as shown in Table 13.20.

Tab. 13.20 Air Pollution Reduction Benefits

(unit: millions of Rs at 1998 economic prices)

Year	Benefits from Reductions in Air Pollution
2006	78.5
2010	29.1
2020	0.0

Source: JICA Study Team

Note:

(1) A van is considered as a car.

(2) It is assumed here for the year 2006 that the OCH will extend from Bandaragame to A1.

(3) It is assumed here for the year 2010 that the OCH will be fully completed.

(3) Traffic Accident Reduction Benefits

A. Estimation Procedure for Calculating the Benefit

The procedure is comprised of two steps:

Step 1: Calculation of the number of traffic accidents that would be reduced by the OCH project covering the area of the Western Province.

Step 2 : Estimation of the medical treatment costs or compensation costs that would be saved with the OCH project.

In regards to the above procedure, the following assumption is introduced in Step 1:

As explanatory variables for the number of traffic accidents, the following are generally applied:

- Vehicle ownership,
- Driving speed,
- Degree of traffic congestion,
- Driving distance per trip, etc.

In general, vehicle ownership for a study area remains unchanged either for the Without or With project case. This is also the case for the OHC project. Therefore, this variable cannot be adopted for estimating benefits.

On the other hand, due mainly to a lack of basic data for estimation, it is difficult to quantify the relationship between the number of accidents and driving speed and traffic congestion.

Accordingly, driving distance per trip is adopted as the explanatory variable for the number of accidents. The explanatory variable represent the following situation: As driving distances become longer driving time increases and the degree of concentration decreases, resulting in traffic accidents easily happening as compared with short driving distances. The estimation procedure is depicted in Fig.13.3.

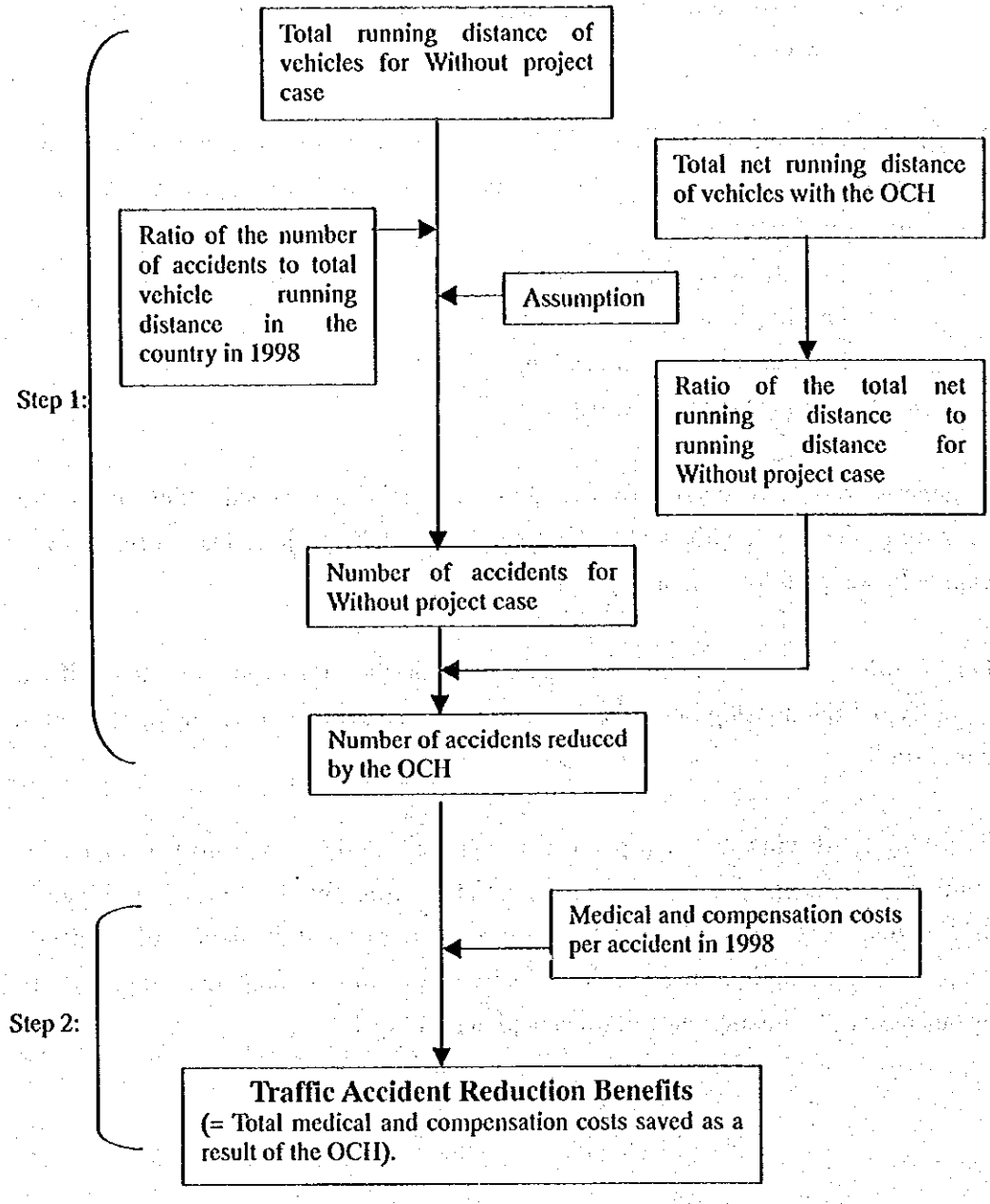


Fig. 13.3 Estimation Procedure for Calculating Traffic Accident Reduction Benefits of the OCH

B. Formulas for Calculating Benefits

$$r_t = \sum_{j=1}\left(D_{j,t}^{WO} - D_{j,t}^{W}\right) / \sum_{j=1} D_{j,t}^{WO}$$

r_t : Ratio of total net running distance of vehicles that would be reduced by the OCH to the total running distance for Without project case in year t.

$D_{j,t}^{WO}$: Total running distance of vehicle type j for Without project case in year t.

$D_{j,t}^{W}$: Total running distance of vehicle type j for With project case in year t.

$$A_{l,t}^{WO} = \sum_{j=1} D_{j,t}^{WO} \times a_l$$

$A_{l,t}^{WO}$: Number of persons involved in an accident at level l for Without project case in year t

a_l : Number of persons involved in accident level l per 1,000 km of running distance in 1998

$$A_{l,t}^{W} = A_{l,t}^{WO} \times r_t$$

$A_{l,t}^{W}$: Number of persons involved in an accident at level l that would be reduced by

$$B_t^A = \sum_{l=1} A_{l,t}^{W} \times C_l$$

B_t^A : Value of traffic accident reduction benefits in year t.

C_l : Medical and/or compensation costs experienced by persons involved with an accident by level (at economic prices)

C. Input Data Calculations

A) Number of Passengers Involved in Traffic Accidents per 1,000 km of Vehicle Running Distance in 1998

The medical and/or compensation costs experienced by persons involved with an accidental by level are tabulated in Tab.13.21. As for the number of passengers involved in a fatal accident by vehicle type, this is estimated by applying the

following formula:

$$P^F_{j,t} = P^F_t / D_{j,t}$$

$P^F_{j,t}$: Number of persons involved in fatal accident for vehicle type j in year t.

P^F_t : Total number of passengers involved in a fatal accident in year t.

$D_{j,t}$: Running distance for vehicle type j in year t.

The number of passengers involved in other types of accidents are estimated by applying the following formula:

$$P^I_{j,t} = P^I_t \times \frac{V^R_{j,1996}}{\sum_{j=1} V^R_{j,1996}} / D_{j,t}$$

$P^I_{j,t}$: Number of passengers involved in an accident at level I (excluding fatal accidents) for vehicle type j in year t.

P^I_t : Total number of the passengers involved in on accident at level I (excluding fatal accidents) in year t.

$V^R_{j,1996}$: Number of type j vehicles in the Western Province in 1996.

Basic data for estimating the numbers above are shown in Tab. 13.22, 13.23, 13.24, and 13.25.

However the values in Tab. 13.21 are clearly overestimated. This was deduced from the following:

- The number of passengers shown in Tab. 13.22 covers all accidents for all class of road, while running distance in Tab. 13.23 covers on A and B Class roads.
- The number of passengers involved in accidents in Tab. 13.22 includes those for land vehicles, bicycle, etc, together with the vehicles covered in this analysis.

Tab.13.21 Medical and/or Compensation Costs Experienced by Persons Involved with an Accident by Level

(unit: Millons Rs at 1998 economic prices)

		Car	Motorcycle	Bus	Taxi	Van	Lorry
1997	Fatal	0.150	0.141	0.380	0.380	0.241	0.381
	Grievous	0.745	1.373	0.092	1.250	0.530	0.209
	Non-Grivous	2.371	4.370	0.294	3.978	1.688	0.665
	Damage only	9.104	16.784	1.131	15.278	6.484	2.553
	Total	12.370	22.668	1.897	20.886	8.943	3.808
1998	Fatal	0.099	0.257	0.402	0.402	0.233	0.444
	Grievous	0.610	1.125	0.076	0.901	0.435	0.128
	Non-Grivous	2.611	4.814	0.324	3.852	1.860	0.732
	Damage only	8.894	16.397	1.104	13.122	6.335	2.774
	Total	12.214	22.593	1.906	18.277	8.863	4.078

Tab. 13.22 Number of Traffic Accidents and Persons Involved by Accident Level On All Classes of Roads in Sri Lanka

	Fatal		Grievous		None-Grievous		Damage Only	
	Accidents	Persons involved	Accidents	Persons involved	Accidents	Persons involved	Accidents	Persons involved
1996	1,560	1,755	2,615	3,512	11,510	16,233	32,990	54,100 *
1997	1,705	1,835	3,310	4,445 *	10,035	14,152 *	33,146	54,350 *
1998	1,921	2,023	2,849	3,826	11,608	16,367 *	33,998	55,750 *

Source: RDA survey

Note *: Consultant's estimate using the relevant data.

Tab. 13.23 Total Running Distance on A and B Class Roads in Sri Lanka

(unit:1,000 km/day)

	Car	Motor cycle	Bus *1	Taxi *2	Van *3	Lorry *4	Total
1996	3,800.3	5,217.5	3,552.7	794.1	4,216.8	2,693.8	20,275.2
1997	3,990.3	5,478.4	3,730.3	833.8	4,427.6	2,828.5	21,288.9
1998	4,189.8	5,752.3	3,916.8	995.8	4,649.0	2,969.9	22,473.6

Source: Originally RDA survey.

Note *1: Total running distance for "Bus" and "Medium Bus" are adopted.

*2 : Consultant's estimate using the running distance of Bus and the ratio of Taxi to Bus fatal accidents.

*3 : The running distance of "Light good vehicle" is adopted as is.

*4 : Total running distances for "Medium good vehicle" and "Heavy good vehicle" are adopted.

Tab. 13.24 Vehicle Ownership by Vehicle Type in the Western Province in 1996

Car	:	93,656
Motorcycle	:	237,047
Bus	:	10,872
Van	:	74,014
3-Wheelers	:	32,841
Lorry	:	18,614
Total	:	467,044

Source: University of Morotuwa, unpublished.

Tab. 13.25 Fatal Accidents by Vehicle Type

	1997	1998
Car	180	125
Motorcycle	231	302
Bus	425	472
Van	320	325
3-Wheelers	95	120
Lorry	323	396
Total	1,574	1,740

Source : RDA survey

B) Traffic Accident Cost per Passengers by Accident Level

Tab. 13.26 Traffic Accident Cost per Passenger by Accident Level

(unit: Rs/passenger)

Type of Accident	1996 *1	1998 *2
Fatal	904,775	1,100,760
Grievous	470,863	572,860
Non-Grievous	26,995	32,840
Damage only	37,555	45,690

Note *1 : Source : RDA survey

*2 : Consultant's estimate, using the following formula and data.

$$C_{l,1998} = C_{l,1996} \times (1.0 + P)^2$$

$C_{l,1998}$: Traffic accident cost per passenger involved in an accident at level l in 1998.

P : Increasing price rate in Sri Lanka (10.3%/annum, 1995 – 1997)

D. Traffic Accident Reduction Benefits till the Year 2020

Adopting the above-presented formulas and input data, cumulative benefit is forecasted till the year 2020 are as follows:

Tab. 13.27 Traffic Accident Reduction Benefits

(unit: millions of Rs at 1998 economic prices)

2006	:	75.9
2010	:	39.5
2020	:	240.0

3) Annual Cost and Benefit Flow for the OCH Project (Summary)

The costs and benefits of the OCH project at domestic economic prices base have been shown previously. These are now arranged in the form of annual flows in this subsection. Cost and benefit flows are estimated separately for four possible OCH options: (1) completion of Part 1 (Bandaragama – Rt. A4) only; (2) completion of Part 1 and Part 2 (Bandaragama – Rt. A1) only; (3) completion of Part 1, 2, and 3 (Bandaragama – CKE) only; (4) completion of the entire OCH (i.e., Part 1 to 4). This is carried out in order to determine the feasibility of constructing the entire OCH as well as its separate components. In order to assess and compare the economic viability of these options, which consist of various parts for the implementation of the construction of the OCH (see Chapter 14), various economic indices such as net present worth are estimated.

A. Items for Finalizing Annual Flows

A) Evaluation Period of the OCH Project

The evaluation period for the OCH has been set at 30 years. Operation is planned to begin in 2006. Depending on the phasing of the above-mentioned parts, the completion of construction can slightly vary. However, construction of the OCH in its entirety would be completed by the year 2010.

B) Estimation Method for Annual Benefits

a. Benefits from the OCH project were presented previously for the years 2006, 2010 and 2020.
b. Annual benefits between those years can be estimated by applying the compound rate calculation formula.

C) Forecasting Method of Annual Maintenance Costs and benefits after 2020

a. Annual amounts remain the same as in 2020.
b. Basis for using static amounts are as follows:
   - Uncertainty in the forecasts after the year 2020, and
   - In general, benefits should be estimated conservatively.

D) Estimation of Residual Value of OCH Facilities in the Last Year of Evaluation

a. Residual value is counted as a benefit of the OCH project. This implies that project cost for the evaluation period is the difference in and the residual value.

b. To estimate residual value, the following depreciation methods by type of facility are applied:

Tab. 13.28 Depreciation Methods Applied to OCH Facilities

Depreciable Assets	Lifetime (years)	Depreciation Method *1	Ratio of Residual Value (%) *2	Remarks
<Tangible and intangible assets> Road				* Roads are not depreciable assets, since annual maintenance retains the initial value of roads forever.
Bridge	60	Unit amount	0	* Lifetime of facilities built with reinforced concrete. * The ratio of the residual value shown in the table is 10%. However, 0% is assumed, taking into account the removal cost.
Land Compensation Cost		ditto	0	* No. of years for the evaluation period are adopted in this analysis. * The ratio is set at zero after considering intangible costs.
Arrangement cost of the land and the removal cost		Ditto	0	Ditto
<Replaceable assets> Machinery and Equipment for Maintenance	5	ditto	10	* The life time is an average one of "Other facilities of construction industry" (item 335)

Source : Life time Table of depreciable assets in Japan, 1999.

Note *1 : There are two (2) types the depreciation methods :

* Unit amount depreciation: A set unit amount of the value of facility concerned is depreciated every year.
* Unit rate depreciation: A set unit rate of annual depreciation every year.

*2 : Ratio of the residual value to the initial acquisition value.

In Tab. 13.29, the benefit/cost (B/C) ratio and the net present worth (or benefits minus costs) were estimated for each of the four options of the OCH and are as indicated in the said table. A discount rate of 12%, which is a common threshold for developing countries, was applied in the calculation of these estimates.

Tab. 13.29 B/C and Net Present Worth for the 4 Options of the OCH

Option	B/C	B-C
Option 1 (Bandargama – Rt. A4)	2.17	Rs.4,767 million
Option 2 (Banadargama – Rt. A1)	3.23	Rs.13,869 million
Option 3 (Bandaragama – CKE)	1.93	Rs.8,826 million
Option 4 (entire OCH) (Panadura – CKE)	1.74	Rs.7,713 million

As the above table indicates, from the perspective of the B/C ratio and net worth, all of the OCH options can be said to be feasible. That is, anything over 1 for the B/C ratio, or a positive net worth, is theoretically worth constructing.

However, Option 2 is by far the most attractive or feasible portion of the OCH, with a net worth of Rs.13,869 million, or approximately 1.81 times that of Option 3, which is the next most attractive scenario. In addition, the return on per rupee spent for option 2 is 3.23 times.

Therefore, the issue here is whether or not to construct anything beyond Part 2, i.e., whether or not to implement Option 3 or 4. For this purpose, the economic internal rate of return is calculated for Option 2,3, and 4 using the cost and benefit for the flows shown in Tab. 13.30. An evaluation of the EIRRs for these parts, via sensitivity analysis, is carried out in 4).

Tab. 13.30 Annual Costs and Benefits Flows of the OCH Project

(unit: millions of Rs. at 1998 prices)

Year	Option 2 (Banadargama – Rt. A1)		Option 3 (Bandaragama – CKE)		Option 4 (Panadura – CKE)	
	Benefits	Costs	Benefits	Costs	Benefits	Costs
2001	0.0	552.0	0.0	552.0	0.0	552.0
2002	0.0	1678.2	0.0	1678.2	0.0	1678.2
2003	0.0	1934.8	0.0	1934.8	0.0	1934.8
2004	0.0	3106.3	0.0	3106.3	0.0	3106.3
2005	0.0	183.5	0.0	2138.1	0.0	2138.1
2006	2756.1	99.5	2756.0	1527.6	2756.1	1527.6
2007	2756.2	30.5	2756.0	1795.4	2756.2	2026.1
2008	2756.6	30.5	2757.0	618.8	2756.6	1369.9
2009	2757.3	30.5	2757.0	36.0	2757.3	1162.7
2010	3511.8	28.3	2978.0	34.6	2909.6	40.0
2011	3488.7	28.3	2969.0	34.6	2901.5	40.0
2012	3469.9	28.3	2961.0	34.6	2894.9	40.0
2013	3455.0	28.3	2955.0	34.6	2889.7	40.0
2014	3442.9	28.3	2950.0	34.6	2885.5	40.0
2015	3433.2	425.0	2946.0	520.0	2882.1	600.0
2016	3425.3	28.3	2943.0	34.6	2879.3	40.0
2017	3418.8	28.3	2940.0	34.6	2877.0	40.0
2018	3396.6	28.3	2931.0	34.6	2869.3	40.0
2019	3409.1	28.3	2936.0	34.6	2873.6	40.0
2020	8901.7	28.3	8070.0	34.6	8050.6	40.0
2021	8901.7	28.3	8070.0	34.6	8050.6	40.0
2022	8901.7	28.3	8070.0	34.6	8050.6	40.0
2023	8901.7	28.3	8070.0	34.6	8050.6	40.0
2024	8901.7	28.3	8070.0	34.6	8050.6	40.0
2025	8901.7	425.0	8070.0	520.0	8050.6	600.0
2026	8901.7	28.3	8070.0	34.6	8050.6	40.0
2027	8901.7	28.3	8070.0	34.6	8050.6	40.0
2028	8901.7	28.3	8070.0	34.6	8050.6	40.0
2029	8901.7	28.3	8070.0	34.6	8050.6	40.0
2030	8901.7	28.3	8070.0	34.6	8050.6	40.0
Total	143396.2	9033.5	129311.2	15084.7	128445.3	17455.7

4) Economic Evaluation of the OCH Project based on Evaluation Indices

A. Outline of the Economic Evaluation

a. The evaluation is carried out by comparing the evaluation indices (see, the subsection 13-1-1, 2), D) calculated with the data shown in Tab. 13.30.

b. As is clear from Tab. 13.30, only tangible costs and benefits of the OCH project are used for calculating evaluation indices. On the other hand, both tangible and intangible costs/benefits are taken into consideration in a synthetic economic evaluation, which will be taken up later. Therefore, the evaluation carried out in this subsection deals only with tangible costs/benefits.

B. Values of Evaluation Indices

A) Sensitivity Analysis for Efficiency of Investment

a. Efficiency of investment is confirmed here via the application of the Economic Internal Rate of Return (EIRR). The purpose of the sensitivity analysis is to determine the degree of stability of that efficiency.

b. There are nine cases in total which are a combination of the following component cases:

* As to the costs of the project :
  - Case 1 : Increase in costs by 10% as compared to initial estimate
  - Case 2 : Costs remain unchanged.
  - Case 3 : Decrease in costs by 10% as compared to initial estimate
* As to the benefits of the project :
  - Case 1 : Increase in benefits by 10% as compared to initial estimate
  - Case 2 : Costs remain unchanged.
  - Case 3 : Decrease in benefits by 10% as compared to initial estimate

B) Values of the Indices for the Nine Cases

Tab. 13.31 (1) EIRR for the OCH Project (Option 2 (unit : % / annum))

		Cost		
		10% increase	Unchanged	10% decrease
Benefit	10% increase	26.35	27.92	29.75
	Unchanged	24.86	26.35	28.10
	10% decrease	23.29	24.70	28.46

Note: Colored box is base case for this option

Tab. 13.31 (2) EIRR for the OCH Project (Option 3 (unit : % / annum))

		Cost		
		10% increase	Unchanged	10% decrease
Benefit	10% increase	20.07	21.50	23.19
	Unchanged	18.71	20.06	21.66
	10% decrease	17.29	18.57	21.23

Note: Colored box is base case for this option

Tab. 13.31 (3) EIRR for the OCH Project (Option 4 (unit : % / annum))

		Cost		
		10% increase	Unchanged	10% decrease
Benefit	10% increase	18.88	20.30	21.98
	Unchanged	17.53	18.87	20.46
	10% decrease	16.14	17.4	19.91

Note: Colored box is base case for this option

Conclusion of the Evaluation

The EIRR for all of the scenarios of the above three options is greater than the social discount rate of 12%, indicating that construction of the entire OCH can be deemed feasible (i.e., the implementation of Option 4). Construction of the entire OCH would produce an EIRR of 18.87, which is in itself sufficient justification for its completion.

However, the Base Case (i.e., no change in benefits or costs) for each of the above options illustrates a significant difference in EIRR levels. For Option 2 it is 26.35%, for Option 3 20.06%, and for Option 4 18.87%. The high EIRR for Option 2,which was shown to be robust in the above sensitivity analysis, indicates a need for this portion of the project to be implemented as soon as possible. The EIRR for Option 3 is also robust and remains well above 16% (a figure that usually signifies the borderline for a desirable project). As for Option 4, it declined to the 16% level during the sensitivity analysis, indicating that some consideration should be given prior to its implementation.

It should also be mentioned here that although the total net worth of the project declines with the implementation of options beyond Option 2, they still produce benefits that are significant in absolute terms. In addition, Option 2's high EIRR does not negate the justification for Option 3 or 4, but indicates the urgency in which it should be addressed. Finally, from a road network viewpoint, it is crucial in the Study Teams opinion that the CKE be connected with the Southern Highway via the OCH.

5) External Economies and Diseconomies of the OCH Project

In this subsection, the external economies and diseconomies of the OCH project are reviewed. These are not taken into consideration in the evaluation indices discussed in subsection 4). The conclusions of this review will be reflected in the synthetic economic evaluation on the OCH project, which will be presented later.

External economies and diseconomies are defined as follows:

a. External economies: Contribution of the OCH to the socioeconomic development of the Western and Southern Provinces, and
b. External diseconomies: Impacts of the OCH project on the physical, biological, and social environment of areas along the OCH route.

(1) Contribution of the OCH to the Socioeconomic Development of the Western and Southern Provinces (External Economy)

A) Regional Development Policies in Sri Lanka

a. Sri Lanka has endeavored to implement a spatial distribution development policy both throughout the country as well as on an intra-regional basis. The first aspect of this policy is to establish autonomous socioeconomic regions, while the second aspect is the development of linkages between regions mainly in the field of economics.

The Southern Development Plan is an example of the first and the Colombo Urban Development Plan an example of the latter policy. Spatial coverage of the development policy will be surely enlarged, as the social order will be resumed gradually which the Civil War has hampered.

b. Background of the policies are as follows:

Ultimate objectives of the spatial distribution development policy are :

* Stabilization of social order, and
* Improvement of the economic welfare of the citizenry.

To realize these objectives, the following measures are adopted:

* Efficient utilization of natural and human resources to the greatest extent possible
* Leveling of income differences among regions, and
* Avoidance of the concentration of population developed or urban area.

B) Role of Trunk Roads in Regional Development Policies

a. Basically, regional development must originate from the residents themselves. Without this development cannot be expected. The central point of the development is industrial development. This is because industrial development alone can provide the employment opportunities and income a region requires.

b. Inter- and intra-regional trunk roads provide one of fundamental facilities for the industrial development.

C) Functions and Effects of the OCH

a. In the Western Province, especially in the Colombo District, the OCH will function as :

* A facility to connect planned growth centers and to connect existing business – commercial centers (e.g. Colombo Harbor) with said growth centers. Moreover, an alleviation in traffic congestion in Colombo can be expected, and
* A facility to create a green belt area in the green belt area that will control and development of the unregulated sprawl of the industrial commercial – residential area from the City of Colombo to the green belt area could be expected.

b. Between the Western and Southern Provinces, the OCH will contribute to the improvement of access between the two provinces, since it is planned to connect the OCH with the Southern Highway, which is now under construction.

D) Conclusion

Since the OCH would surely contribute to inter- and intra- regional development, it can be concluded that the OCH is indispensable for the development of the Western (and Southern) Province.

(2) Impacts of the OCH Project on the Physical, Biological and Social Environments along its Route (External Diseconomies)

A) Significant Negative Impacts of the OCH Project

The EIA Report for this project enumerated about 30 kinds of impacts that would be caused by the OCH. Of them, the Report mentioned that the following impacts would be significantly negative:

* Surface run-off and future flood levels,
* Inundation of flood plains,
* Loss of habitat with regards to wet lands,
* Relocation of people,
* Other socio-economic impacts associated with relocation and resettlement,
* Impacts on the long term established community relations caused by community reverence,
* Physical as well as psychological shocks to communities,
* Disruption of established livelihoods,
* Impact on productivity of lands as a result of fragmentation,
* Problem for the children studying in the schools whose buildings would be affected, and
* Impact on religious activities.

B) Recommendations on Measures to Mitigate Impacts

a. In a development project designed to be implemented in a highly developed area, environmental impacts can not be totally avoided. What is possible is to minimize such impacts to the extent most possible.

b. The major action to be taken is to design the road trace so as to minimize the negative impacts on adjacent communities, their properties, and wetlands. In the eventuality that a community is affected, proper compensation should be offered.

C) Conclusion

On the design of the OCH, the above-mentioned mitigation measures will be taken to minimize the expected negative impacts on the physical, biological and social aspects of areas along the OCH Route. Therefore, none of the expected negative impacts should be considered as a condition for rejecting the implementation of the OCH.

6) Synthetic Economic Evaluation of the OCH Project

The EIRR for the implementation of the entire OCH Project, which represents the investment efficiency of the project, is estimated to be 18.87% per annum, which exceeds the social discount rate or opportunity cost of capital of 12% per annum for Sri Lanka. Moreover, the OCH is expected to contribute greatly on the spatial distribution of socioeconomic activities, as well as mitigate traffic congestion in the Western Province.

On the other hand, the OCH would also have unfavorable or negative impacts on the social and natural environment of adjacent to the OCH route. However, with sufficient countermeasures these impacts should not result in the rejection of the OCH.

Accordingly, the Study Team recommends the implementation of the OCH project as early as possible.

13.2 Financial Evaluation of the OCH Project

13.2.1 Characteristics of the Financial Evaluation

1) Ordinary Financial Evaluation

This section clarifies the characteristics of the financial evaluation for the OCH project.

(1) Premise for Conducting an Ordinary Financial Evaluation

In principle, an ordinary evaluation is not needed unless there is the following premise : The business entity in charge of the facilities of the planned project is able to obtain revenue from the operation of said facilities.

(2) Subjects of Ordinary Financial Evaluation

The ultimate objective of an ordinary financial evaluation for a project is to propose ideas on the following subjects, taking into consideration the degree and stability of profitability.

Subject 1 : Desirable levels of user charges for usage of facilities,
Subject 2 : Desirable methods of raising funds for construction of facilities, and
Subject 3 : Desirable mode of business

For Subject 1, the financial capability of potential users must be taken into account, along with the degree and stability of the profitability the project concerned. Otherwise, there will be cases where utilization of facilities goes down and sufficient revenue is not obtained.

As for subject 2, this is to ensure a stable system for realizing the construction of a facility. As for Subject 3, the desirable mode of business is approached mainly from the standpoint of the composition of the capital fund of a business entity, taking into consideration the following issues:

* The degree to which a project is a public good
* Managerial efficiency of the facilities, and
* Capability of raising required funds from the public sector, especially for public works projects.

2) Subjects of Financial Evaluation

(1) Characteristics of the OCH Project reviewed from the Standpoint a Financial Evaluation

a. In the Progress Report (Chapter 5) submitted in March 1999, the following conclusion on the collection of user charges for the usage of the OCH was reached, given that it was to be designed as a partially-controlled facility: It is realistically impossible for the OCH to be a toll way.

b. At present, the RDA also does not seem to be thinking about the application of PFI methods for the OCH project.

c. As a result, revenue from the operation of the OCH facilities should not be expected. This implies that Subject 1 and Subject 3 are outside the range of consideration for the OCH project.

(2) Subjects of Financial Evaluation

Taking into consideration the results discussed above, the following will be considered in the financial evaluation:

① Estimation and Evaluation of Pseudo User Charges for the Planned OCH.

② Evaluation of the Financial Background for Realization of the OCH Project.

The difficult financial situation of Sri Lanka's national treasury, which is common throughout the world, requires examination of ① in spite of the physical difficulty in collecting user charges (or tolls) from the OCH facilities given the proposed design. Issues to be analyzed are as follows:

* To judge whether or not potential user expenditure for OCH usage is possible when viewed from the user income perspective, and
* To tentatively estimate maximum user charges.

As for ②, which would require the RDA to raise all funds for the construction and operation of the OCH facilities, there exist strong and severe limitations on RDA's capability to raise the required money. Issues to be analyzed are as follows:

* Evaluation of the possibility of raising funds from the national treasury
* Estimation of the shortage of funds with national treasury support

13.2.2 Estimation and Evaluation of Pseudo User Charges (Tolls) for the OCH

1) Objectives

The objectives of this section are to clarify toll related issues via the following two approaches:

Approach 1: To judge whether or not potential user expenditures for OCH usage are feasible from a user income viewpoint. User expenditure is estimated based on user charges and frequency of OCH usage.

Approach 2: To tentatively estimate a user charge that would generate maximum revenue, as well as to present a similar example for the collection of user charges.

2) Theme

(1) Establishment of Theme

a. In Chapter 5 of the Progress Report submitted in March 1999, it was concluded that the OCH should not be a toll road for the following reasons:

* The OCH will contribute to regional development in the Western Province by providing services for relatively short-distance trips between existing and future growth centers and the existing radial routes. A toll road should not be built when the main purpose is development.
* The toll road scheme would have an adverse impact on overall or area vehicle running speed as a result of drivers avoiding the OCH.

b. On the other hand, given the national financial situation, the collection of user charges for the use of public facilities should be carried out based on the beneficiary pays principle.

c. Accordingly, both the implementation of tolls and no tolls are considered.

d. For these two issues, there are two major problems to consider:

Problem 1:

A relative high user charge will result in large decreases in the traffic demand for the OCH, which would result in the OCH not attaining its original objective of serving relatively short-distance trips between existing and future growth centers and existing radial routes. For this reason toll levels and demand elasticity must be considered carefully.

Problem 2:

It is very ambiguous whether or not total revenue from user charges would be attractive from the financial perspective of a business entity.

These two problems are closely examined in this section.

(2) Theoretical Analyses on Decision Processes for Traffic User Charges (Toll)

A. Outline of Actual Decision Processes for a Toll

A) Fundamental Logic for Approach 2

Approach 1 can be carried out via the simple application of numerical evaluation criteria. Accordingly, issues related to Approach 1 do not need a complicated logic. As for Approach 2, it requires a more refined logic.

a. A rise in user charges brings about a decrease in the total traffic demand for a road facility project in the following two (2) ways:

Way 1: Decrease in frequency of usage of the facility by individual potential users.

Way 2: Decrease in the number of potential users.

Actually, both of these occur simultaneously.

b. However, total demand is not affected by a rise in user charges. This is because the traffic demand model forecasts demand, which is not affected by user charges.

We can utilize Approach 2 with Way 2 given the following condition:

Condition: Potential users who can afford a proposed user charge will use the OCH facility at the frequency forecasted by the traffic demand model.

c. Based on this the toll and demand elasticity should reflect decreases in the numbers of potential facility users, as a sufficient condition to reflect the elasticity for demand.

B) Four Toll Levels

Four levels of tolls and their attributes are summarized in Tab. 13.31.

Tab. 13.32 Four (4) Levels of Tolls and their Attributes

Level of User Charges	Characteristics of User Charge	Remarks
Lowest	Total revenue of tolls covers the collection cost of the user charge.	* Complication in administration of OCH facility activities, and * Decrease in traffic efficiency due to collection charge handling.
2nd Lowest	Total revenue of tolls covers the maintenance cost of facilities.	Most proposed user charges are based on calculations for not only traffic facilities but also general public facilities.
Desirable	Total revenue of tolls can resume the total invested cost.	The user charge is ideal for business entities engaged in the operation of general public facilities.
Most Desirable	Total revenue of tolls can cover the total invested cost and produce gain a normal profit.	Adoption of BOT (Build Operate and Transfer) scheme possible.

C) Conditions Establishing Final User Charge

Condition 1 :

The total expenditure of potential users for the usage of facilities, which is the product of the proposed user charge per use and the frequency of the usage, is within the payment capability of users.

Condition 2 :

Both potential users and the relevant business entity authorities agree upon the final proposed charge.

D) Characteristics of Demand and Supply Curves

The tentative user charge is decided at a point of contact between the demand curve for the usage of the facilities and the supply curve for the provision of services.

The demand curve remains static against any position of the supply curve. This is because tolls and demand elasticity fix the shape of the demand curve and elasticity is decided based on the user's payment capability and his willingness to pay to use of facility. On the other hand, the supply curve is variable. These conditions enable the setting of the tentative user charge. The position of the supply curve is set taking into

account the following factors:

Factor 1 : Forecasted financial situation of the business entity,
Factor 2 : Degree of attaining the original objective of the project, and
Factor 3 : Acquisition of a potential user's agreement on proposed user charges.

The public nature of the facility has to be taken into consideration for Factor 1. The business entity can propose any of the four levels for user charges as shown in Tab.13.32. The level is mainly decided based on the managerial objectives of the business entity. Factor 2 implies that the user charge agreed between the business entity does not always bring about the targeted traffic demand.

E) Priorities of Factors in Deciding a Final User Charge

When deciding the final user charge, the above-mentioned three factors have the following priorities:

Highest priority : Factor 3
Middle priority : Factor 2
Low priority : Factor 1

F) Summary and Supplement

a. The three groups shown below decide the final user charge.

Group concerned	Function of group
Potential users	* As the final decision-makers for the demand of a service, they can express their will clearly by either refusing or assenting to use said service.
Business entities	* They can tentatively propose user charges but they are not the final decision-maker for setting the final user charge.
Public organizations	* Along with potential users, they are a final decision maker on the user charge.

b. In the case of a public service, a business entity cannot be the final decision-making body. It is in a "passive position" in regards to this issue.

c. In deciding the tentative user charge, the demand curve is more important than the supply curve. This because the demand curve is static, while the supply curve is variable depending on the situations mentioned in the above three

factors.

d. The government and business entities can permit any kind of final user charge if the charge exceeds the cost of collecting the charge.

B. Feasible Domain for Setting User Charges

A) Domains Relating to Setting of User Charges

As shown in Fig. 13.4, there exist three domains relating to the setting of a user charge.

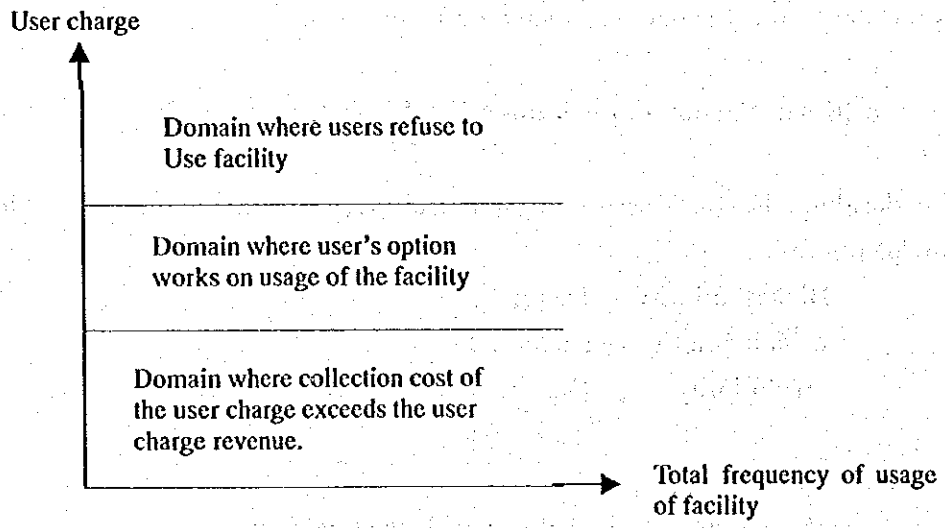


Fig. 13.4 Domains Relating to Setting the User Charge

In the domain where users refuse to use a facility, the final user charge cannot be set, since the proposed charge exceeds the potential user's payment capability.

On the other hand, in the lowest domain, the final user charge also cannot be set due to the generation of a minus financial surplus by the business entity. As a result, a final user charge can only be set only in the middle domain.

B) Existence and Meaningfulness of Demand and Supply Curves for each Domain

In the high domain	* Non existent demand curve. * The supply curve exists, but it is meaningless due to the lack of a demand curve.
In the middle domain	* The demand curve exists and it is meaningful. * The supply curve exists and it is meaningful.
In the low domain	* The demand curve exists. * The supply curve exists but it is meaningless.

C) Factors Determining Boundaries of Domains

a.There are two factors that determine the boundary between the domain where users refuse to use a facility and the domain where they will use a facility:

Factor 1 : Potential user payment capability, and

Factor 2 : Potential user willingness to pay for using a facility.

Factor 1 works as an upper limit in the setting of the boundary. The amount is a product of the final user charge and the frequency of use of the facility.

Factor 2 (willingness to pay) usually produces estimates below the user paying capability. It is also very difficult and troublesome to estimate precisely the willingness to pay. Surveys like ones for the estimation of a hedonic price, which is a proxy of natural environmental value, is required for this estimation. Factor 2 has a much longer impact than Factor 1 on the determination of the actual user charge.

b.A financial balance between total user charge revenue and total collection cost of the user charge decides the position of the boundary between the domain where users will use a facility and the low domain.

C. Analysis on Existence of Agreeable User Charge

The existence of an agreeable user charge is approached through the following two steps:

Step 1: Pursuit of a tentative user charge based on potential user demand and a business entity's supply of the service.

Step 2: Pursuit of final user charge where the degree of attaining the original objective of the project concerned is taken into consideration.

C-1 Tentative User Charge (Step 1)

A) Demand and Supply Curves

The demand and supply curve of the service is depicted in Fig13.5. In the figure, the points of contact (E^{D1} and E^{D2}) between the demand and supply curves are shown on the supply curve (Sm,Sm), which corresponds to situation of total user charge revenue covering the maintenance cost of the facility. In reality, the supply curve is used to determine the tentative user charge.

a. The shape of a demand curve can be largely classified into two types: $D_1 \cdot D_1$ and $D_2 \cdot D_2$ as shown in the figure.

The $D_1 \cdot D_1$ demand curve represents a demand curve for luxury goods and the $D_2 \cdot D_2$ demand curve represents a demand curve for daily necessaries. The characteristic common to both demand curves is that they are fixed, while the supply curve can shift. The demand curve depicted in Fig. 13.5 shows a curve where increases in user charges brings about a decrease in the total frequency of usage of the facility (the total traffic demand on the facility), which is brought about by the number of the potential users (see the paragraph A – A) presented before).

b. Four levels of supply curves are also depicted in Fig. 13.5 (see Tab. 13.32):

- Sc. · Sc curve: Corresponds to total user charge revenue being able to cover the collection costs of user charges.
- Sm. · Sm curve: Corresponds to total revenue covering the maintenance cost of facilities.
- Si. · Si curve: Corresponds to total revenue covering the total invested cost.
- Sp. · Sp curve: Corresponds to total revenue covering total invested cost and producing a normal profit.

Of the above curves, the one to be adopted depends on the managerial objectives of the operator.

B) Implication of Equilibrium Points E^{D1} or E^{D2}

a. The equilibrium points show the user charge and total frequency of usage of the facility on which both potential users and business entities agree.

b. Both E^{D1} and E^{D2} result in the maximum total revenue for a business entity.

c. However, it is not clear whether or not maximum total revenue is at a desirable level from the financial standpoint of the business entity. This judgement is made from the viewpoint of the original objective of the business entity.

d. Neither is it clear whether the total frequency of the usage of the facility, which can be shown by F^{D1} or F^{D2}, is at desirable level when reviewed from the original objective of the project. However, it can be pointed out that F^{D1} is much desirable than F^{D2}, if both points are within the production capacity of the service of the facility.

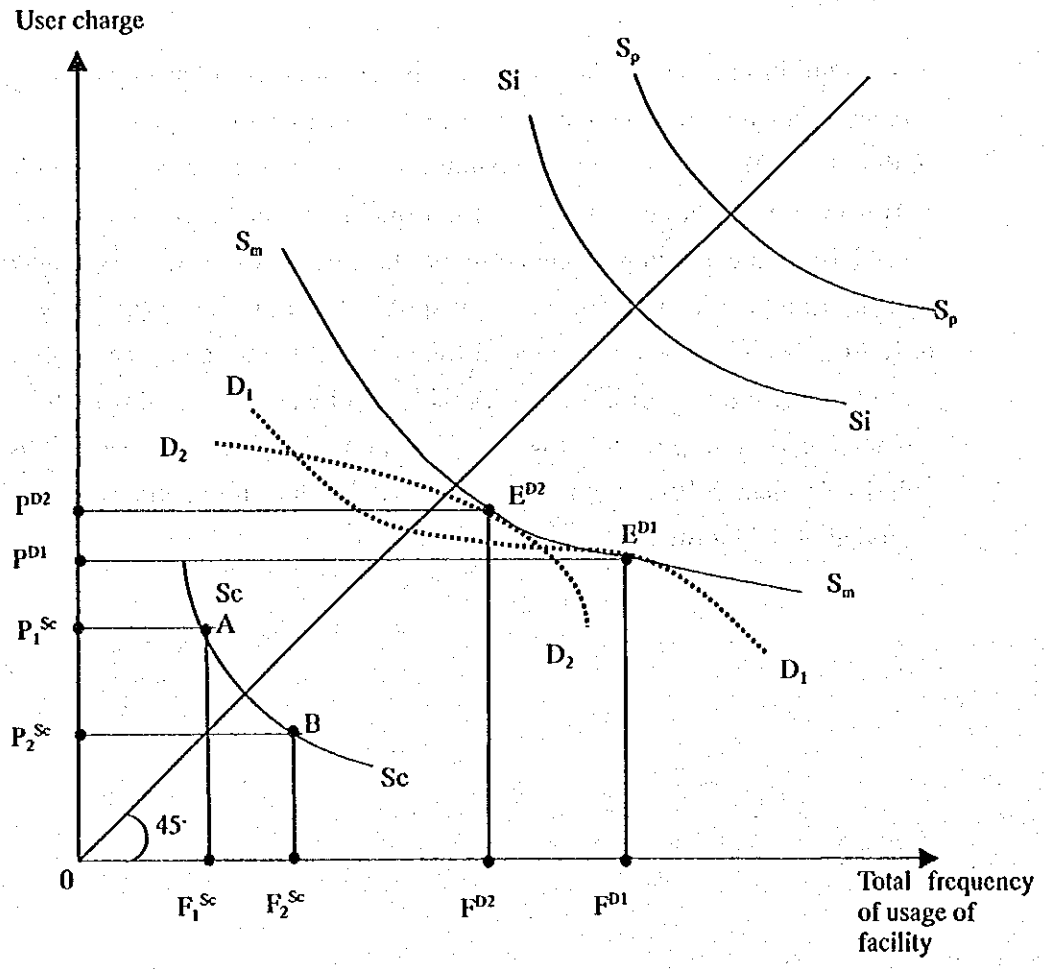


Fig. 13.5 Demand and Supply Curves for Service Provided by Facility

C-2 Final User Charge (Step 2)

A) Necessity of Step 2

As discussed before, it is not clear whether the total frequency of usage of the facility (total traffic demand for the facility), which is decided by potential users and the administrating business entity, (i.e. the point F^{D1}), is desirable when viewed from the standpoint of the original objective of the project. When the frequency is too small, measures for increasing frequency to that forecasted (F^0) should be implemented. Total frequency can be determined by the demand curve for potential users, which can be determined through a trial-and-error process (see Fig.13.6).

Demand curve D_1 ・ D_1 intersects at point E^M, which gives the forecasted total frequency (F^o) and the lowest user charge (P^M).

E^M is the starting position of the demand curve. The demand curve can be set based on the position and the potential user's toll and demand elasticity, both of which will be estimated later.

It is ambiguous whether or not the lowest user charge exceeds the collection cost of the user charge.

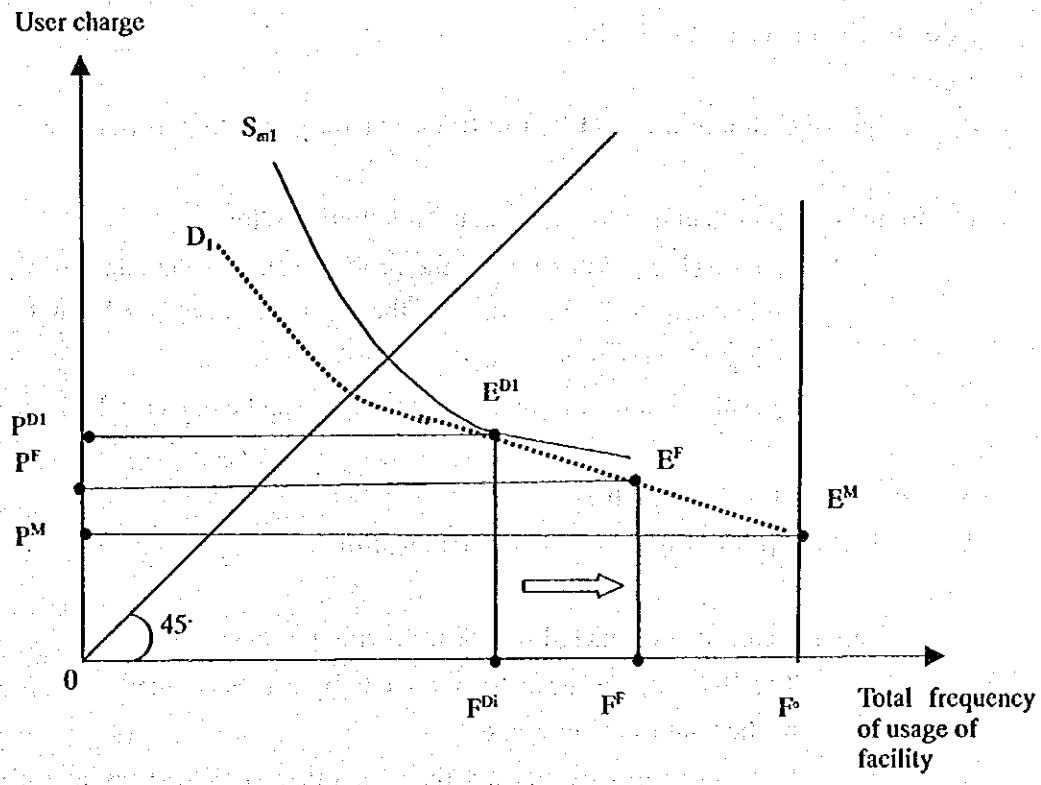


Fig. 13.6 Relationship between the Supply Curve And User Charge

B) Implication of Point E^F

a. Though E^F is on the demand curve D_1 ・ D_1, it is not an equilibrium point. E^F produces the final user charge (P^F) and the final total frequency of the usage of the facility (F^F).

b. Total user charge revenue at E^F is less than that at equilibrium point E^{Di}. The

issue here is whether or not total revenue is desirable when it is viewed from the managerial objectives of the business entity.

3) Analyses and Evaluation Methods

(1) Analyses and Evaluation Processes

A. Processes for Approach 1

A) Vehicle Types to Be Taken into Consideration

Vehicles that are allowed to use the OCH are cars, buses, vans, lorries (freight vehicle) and motorcycles over 250 cc engine, which there are very few of. Motorcycles under 250 cc and 3-Wheelers are not permitted to use the OCH, since they would have an unfavorable impact on traffic flow.

B) Logic of Calculations and Evaluations as Compared to Approach 2

The logic is simpler than that for Approach 2 due to the following:

* The user charge estimated in the process can be calculated using only the maintenance cost. Accordingly, the demand curve need not be directly considered in the process, and
* The evaluation for estimated user charges can be objectively determined.

B. Processes for Approach 2

A) Vehicle Types to Be Taken into consideration

a. Only cars are considered for the following reasons:
   * The frequency of usage of the OCH by cars accounts for a large portion of the total frequency, and
   * It is easier in case of cars than for other vehicle types to estimate the degree of additional expenditure that can be borne by from the potential users of the OCH facility.

b. The shape of demand curves for the OCH for other vehicle types seems to be similar to that for cars.

B) Functions of the Demand and Supply Curves in Approach 2

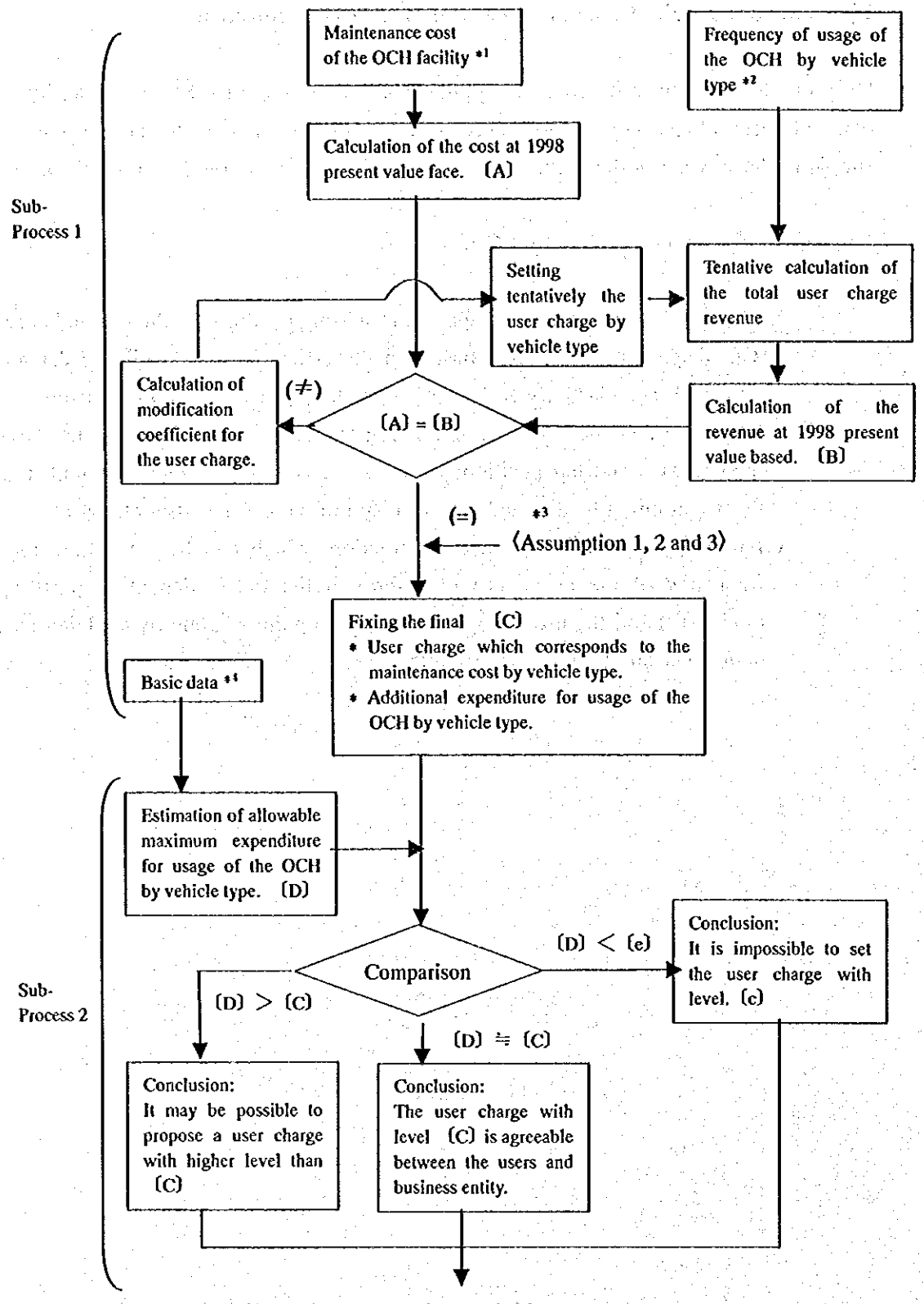
Only the demand curve function in Approach 2 is required since E^F can be set by the demand curve alone. The supply curve only functions to guarantee the existence of supply of the services at the point of contact with the demand curve (see Fig. 13.5).

C) Methods for Setting Demand Curve

a. By establishing both the "shape" and "starting position" of the demand curve. The shape can be clarified based on the estimated user's toll and demand elasticity. The elasticity varies among the levels of vehicle owner income.

b. By setting the demand curve for vehicle owners at the lowest levels of income as a starting position, in order to accurately gauge the number of users that might be diverted off as a result of increases in user charges.

c. By using point E^M as a starting position, which can be set by the total frequency of the usage provided through the traffic demand forecasting model (F^o) and the user charge shown at the point P^M, and by applying user demand elasticity in regards to tolls.


Maintenance cost of the OCH facility *1
Frequency of usage of the OCH by vehicle type *2
Calculation of the cost at 1998 present value face. (A)
Sub-Process 1
Setting tentatively the user charge by vehicle type
Tentative calculation of the total user charge revenue
Calculation of modification coefficient for the user charge.
(≠)
(A) = (B)
Calculation of the revenue at 1998 present value based. (B)
(=)
*3
(Assumption 1, 2 and 3)
Fixing the final (C)
* User charge which corresponds to the maintenance cost by vehicle type.
* Additional expenditure for usage of the OCH by vehicle type.
Basic data *4
Estimation of allowable maximum expenditure for usage of the OCH by vehicle type. (D)
Sub-Process 2
Comparison
(D) < (e)
Conclusion:
It is impossible to set the user charge with level. (e)
(D) > (C)
(D) ≒ (C)
Conclusion:
It may be possible to propose a user charge with higher level than (C)
Conclusion:
The user charge with level (C) is agreeable between the users and business entity.
(Analysis Processes Approach 2.)

Legend :
Sub-processes: Estimate user charges that correspond to the maintenance cost of the OCH facility.
Sub-processes: For evaluating user charges.

Note *1 : Aside from maintenance cost, costs with other levels may be able to be adopted

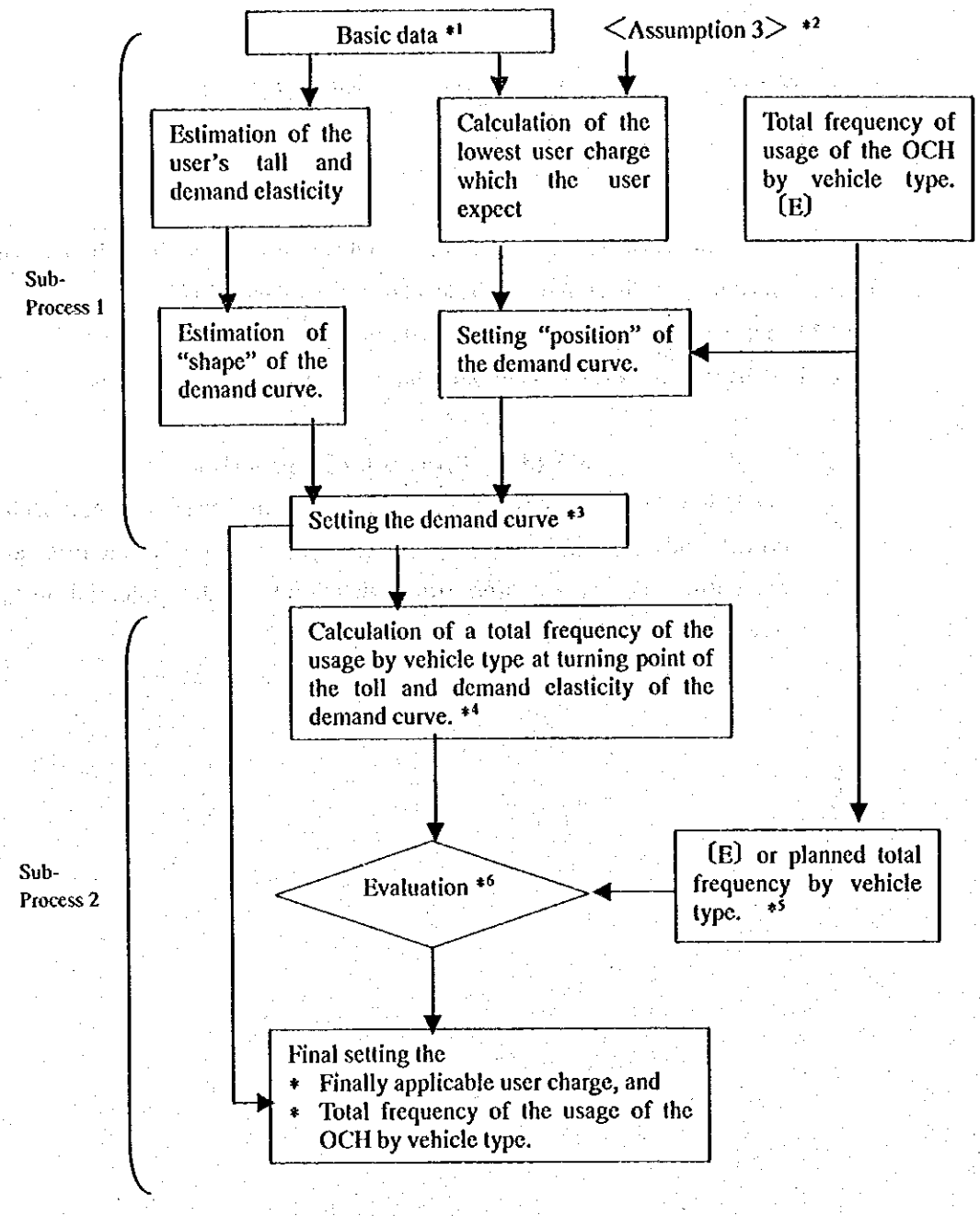
Note *2 : It is supposed that Car, Bus, Van and Lorry can use the OCH.

Note *3 : See the paragraph 1) – (3) – B entered before.

Note *4 : RDA site survey result is utilized in this analysis which is presented later.

Fig 13.7 Process for Approach I

- Detailed task procedures for estimating the user charge, which corresponds to the maintenance cost of the OCH facility, and evaluating the user charge from viewpoint of the potential user's payment capability -



Legend :
Sub processes 1 : The ones for setting the demand curve.
Sub processes 2 : The ones for setting the finally applicable user charge and the total frequency of usage of the OCH.

Note *1 : RDA spot survey results is utilized in analyses.

Note *2 : See the paragraph 1) - (3) – B entered before.

Note *3 : The demand curve is made concrete by setting "Shape" and "Position" of

the demand curve.

Note.*4 : The calculation is for the magnitude of F^{D1} shown in Fig13.5.

Note.*5 : One of these item is adopted as evaluation criteria for the magnitude of F^{D1}.

Note *6 : The evaluation is basically carried out by the public side or the business entity; thus, it is an unknown factor.

Fig. 13.8 Processes for Approach 2

- Detailed task procedures for setting the final user-charge and the total frequency of usage of the OCH where the original objective of the OCH project is taken into consideration -

(2) Formulas, Input Data and the Estimation Results Applied to Approach 1 and 2.

A. Maintenance Cost at 1998 Present Values.

A) Formula

The user charge that cover the maintenance cost of the OCH facility should be estimated on an annual average maintenance cost for a certain period and not for a specific year.. The following formula calculates maintenance costs in this manner at 1998 present values:

$$C_{1998}^{PM} = C_t^M / (1 + r_t)^{-1}$$

C_{1998}^{PM} : Present value in 1998 of the Maintenance cost.

C_t^M : Annual average maintenance cost for representative year t.

r_L : Long - term interest rate, 18.8%/annum for 1998.

B) Estimation Results

C_{2010}^{M} : 80.0 Millions Rs at 1998 constant prices. A part of the maintenance cost expected in 2018 is allocated to this cost.

C_{1998}^{PM} : 10.1 Millions Rs at 1998 present value base.

B. Total User Charge Revenue at 1998 Present Values

A) Formula

$$R^{P}_{1998} = \sum_{j=1} W^{C}_{j} \times P^{c}_{1998} \times F_{j,t} / (1 + r_L)^{-1}$$

R^{P}_{1998} : Present value in 1998 of the total user charge revenue

W^{c}_{j} : Ratios of user charge for vehicle type j to the user charge for "Car"

Tab. 13.33 Ratios of User Charge by Vehicle Type to the User Charge for "Car" (W^{c}_{j}) (unit : scalar)

	W^{c}_{j} *1	Remarks
Car	1.0	
Motorcycle		Not adopted in the calculation
Bus	1.6	
3-Wheelers		Not adopted in the calculation
Van	1.3	
Lorry	1.6	

Source : Consultant's estimate based on examples of Highway Tariffs in Japan.

Note *1 : Policy on OCH user charges can be reflected by changing the W^{c}_{j}.

P^{c}_{1998} : User charge for Car in 1998. This is the dependent variable or explained variable, which can be calculated from solving the following equation :

$$C^{PM}_{1998} = R^{P}_{1998}$$

$F_{j,t}$: Frequence of usage of the OCH of vehicle type j in the representative year t.

Tab. 13.34 Frequency of OCH Usage by Vehicle Type for 2010

(unit : Millions of trips / annum)

	$F_{j,2010}$	Remarks
Car	20.72	
Motorcycle		Not adopted in the calculation
Bus	4.33	
3-Wheelers		Not adopted in the calculation
Lorry	4.26	

Source : JICA Study Team

Note : "Van" is included in the "Car".

C. User Charges by Vehicle Type Corresponding to the Maintenance Cost of the OCH facility (P^c_{1998})

From the above-mentioned A and B, the user charges by vehicle type are estimated as follows:

Tab. 13.35 User Charge by Vehicle Type that Corresponds to Maintenance Cost of the OCH Facility.

(unit : Rs / trip at 1998 constant prices)

	P^c	Remarks
Car	2.5	It is evaluated in this analysis
Motorcycle		Unknown
Bus	4.0	Not evaluated
3-Wheelers		Unknown
Van		Not evaluated
Lorry	4.0	Not evaluated

D. Additional Expenditure of Car Owner for Usage of OCH

Based on the estimated values in Tab.13.35 and Tab.13.42, additional expenditure can be calculated as 1,500 Rs at 1998 constant prices.

E. Operation Cost of Car and Additional Expenditure Car Owners Can Bear

Tab. 13.36 Operation Cost of Car and Additional Expenditure Car Owners Can Bear By Income level.

(unit : Rs / car owner / annum in 1999)

Annual car Owner's income *1	① Average annual income	Sample Size (House-hold)	② Annual usage cost of car in 1999	②/① (%)	③ Annual allowable maximum usage cost	③ - ② Annual allowable additional expenditure for car
90,000～130,000	107,700	11	24,300	22.6	27,400	3,100
130,000～170,000	154,000	5	36,000	23.4	40,500	4,500
170,000～ *1	248,500	13	51,500	20.7	57,300	5,800
Average / total	178,800	29	38,500	21.6	43,000	4,500

Source : Consultant's estimate based on the RDA instant survey on the issues.

Number of sample	① Income	Expenditure for Car		② / ① (%)	③ - ② Allowable expenditure
		② Minimum	③ Maximum		
1	160,000	40,000	45,000	25.0	5,000
2	240,000	30,000	35,000	12.5	5,000
3	200,000	50,000	60,000	25.0	10,000
4	200,000	40,000	50,000	20.0	10,000
5	90,000	25,000	26,000	27.8	1,000
6	110,000	30,000	32,500	27.3	2,500
7	100,000	15,000	17,500	15.0	2,500
8	105,000	30,000	35,000	28.6	5,000
9	110,000	25,000	27,500	22.7	2,500
10	230,000	55,000	60,000	23.9	5,000
11	240,000	55,000	60,000	22.9	5,000
12	200,000	40,000	45,000	20.0	5,000
13	125,000	25,000	30,000	20.0	5,000
14	150,000	25,000	27,500	16.7	2,500
15	105,000	17,000	20,000	16.2	3,000
16	160,000	50,000	55,000	31.3	5,000
17	95,000	28,000	30,000	29.5	2,000
18	235,000	55,000	60,000	23.4	5,000
19	200,000	40,000	45,000	20.0	5,000
20	125,000	25,000	30,000	20.0	5,000
21	150,000	30,000	35,000	20.0	5,000
22	120,000	30,000	32,500	25.0	2,500
23	175,000	35,000	40,000	20.0	5,000
24	450,000	80,000	85,000	17.8	5,000
25	500,000	100,000	105,000	20.0	5,000
26	100,000	17,000	20,000	17.0	3,000
27	180,000	55,000	55,000	27.8	5,000
28	180,000	40,000	45,000	22.2	5,000
29	150,000	35,000	40,000	23.3	5,000
Average	178,800	38,500	43,000	21.6	4,500

Source : RDA survey

Tab. 13.37 Annual Income and Expenditure Data for Car Owners in 1999

(unit : Rs / car owner / annum)

Tab. 13.38 Annual Income and Expenditure Data For Motorcycle Owners in 1999 (for Reference)

(unit : Rs / motorcycle owner / annum)

Number of sample	① Income	Expenditure for Car		② / ① (%)	③ - ② Allowable expenditure
		② Minimun	③ Maximun		
1	110,000	15,000	16,000	13.6	1,000
2	85,000	15,000	17,500	17.7	2,500
3	85,000	9,000	10,000	10.6	1,000
4	75,000	15,000	17,500	20.0	2,500
5	50,000	12,500	13,500	25.0	1,000
6	60,000	11,500	12,500	19.2	1,000
7	50,000	12,250	13,500	24.5	1,250
8	150,000	17,500	20,000	11.7	2,500
9	80,000	12,000	13,500	15.0	1,500
10	75,000	14,500	16,000	19.3	1,500
11	60,000	12,500	13,500	20.8	1,000
12	120,000	30,000	35,000	25.0	5,000
13	200,000	35,000	40,000	17.5	5,000
14	125,000	15,000	17,500	12.0	2,500
15	95,000	14,000	16,000	14.7	2,000
16	135,000	20,000	22,500	14.8	2,500
17	120,000	20,000	23,000	16.7	3,000
18	80,000	15,000	17,500	18.8	2,500
19	75,000	15,000	17,000	20.0	2,000
20	115,000	20,000	23,000	17.4	3,000
21	125,000	16,000	17,500	12.8	1,500
22	85,000	15,000	16,000	17.7	1,000
23	120,000	20,000	22,500	16.7	2,500
24	70,000	14,500	16,500	20.7	2,000
25	120,000	25,000	28,000	20.8	3,000
26	125,000	17,000	18,500	13.6	1,500
27	120,000	18,000	20,000	15.0	2,000
28	110,000	20,000	23,000	18.2	3,000
29	95,000	15,000	17,000	15.8	2,000
30	115,000	27,000	30,000	23.5	3,000

Source : RDA survey

F. Tentative Car Owner's Toll and Demand Elasticity.

A) Formula for Elasticity

a. General formula for elasticity is as follows:

$$e = -\frac{\Delta D}{D} / \frac{\Delta P}{P}$$

e : Potential user's toll and demand elasticity (scalar)

D : Total demand on the service

ΔD : Incremental total demand (usually plus value)

P : User charge for the service

ΔP : Incremental user charge (usually plus value)

As is clear from the formula, elasticity is the incremental decrease in the demand expressed in term of percentages (%) when the user charge increases by 1%. Usually, elasticity is calculated using data on demands and user charges observed in similar projects. Unfortunately, no such data exists in Sri Lanka due to the non-existence of similar projects.

b. We can redefine the above formula for estimating elasticity in this study :

$$e = -\frac{\Delta O}{O} / \frac{\Delta E}{E}$$

O : Total number of the potential users of the OCH.

ΔO : Incremental total number of the users.

E : Allowable additional expenditure of the potential users for usage of the OCH.

ΔE : Incremental allowable additional expenditure.

As stated before, the total number of potential users (O) is used as a proxy for total demand (D),based on the assumption that potential users of the OCH will use it at any level of the final user charge.

Also, the allowable increases in additional expenditure for usage of the OCH (E) is used as a proxy for the user charge for usage (P).

B) Estimated Potential User charge and OCH Demand Elasticity

Applying the formula shown in b above and the data in Tab.13.36, the elasticity by income level for car owners is estimated as follows:

Tab. 13.39 Toll and OCH Demand Elasticity by Income Level for Car Owners

Income level (Rs/car owner/annum)	Elasticity
90,000～130,000 :	- 6.584
130,000～170,000 :	- 3.103
170,000～ :	Calculation is impossible

The elasticity of the income level 130,000 ～170,000 Rs / car owner functions only as finding out the position of turning point of the demand curve. The elasticity is meaningless for setting the final user charge. This is because a user charge with relative small total frequency of usage for the OCH is meaningless.

Elasticity by income level decides the "shape" of the demand curve as discussed previously. The estimated elasticity implies that the demand curve of the potential users is one with demand curve type 1, i.e. elasticity is high for relatively lower user charges and weak for relatively high user charges.

G. Number of Cars to Use OCH and Frequency

Along with the maximum allowable additional expenditure of potential users for usage of their cars, the number of cars and their average frequency of usage of the OCH are used for estimating the user charge which can owners with the lowest level income want to be set.

Tab. 13.40 Number of Cars that Would Use the OCH

(unit : cars / day)

	2006	2010	Remarks
Car and Van	20,800	32,270	
Motorcycle			Out of the consideration
Bus	6,410	6,360	For reference
3-Wheelers			Ditto
Lorry	4,940	6,670	Ditto

Source : JICA Study Team

Tab. 13.41 Frequency of OCH Usage per Car

(unit : Frequency / car / annum)

	2006	2010
Car and Van	600	600
Motorcycle		
Bus	600	600
3-Wheelers		
Lorry	600	600

Source : JICA Study Team

II. User Charge for Usage of OCH which Potential Car Users at Lowest Income Levels Wants

The user charge can be calculated using the data in Tab.13.36 and Tab.13.41.

Tab. 13.42 User Charge for OCH Desired by Low-Income Users

User charge : 5.2 Rs / trip at 1998 constant prices.

I. Demand Curve of Potential Car Users for OCH

The demand curve is depicted in Fig.13.9. The demand curve can be derived using the data and information shown in paragraphs B, F and H above.

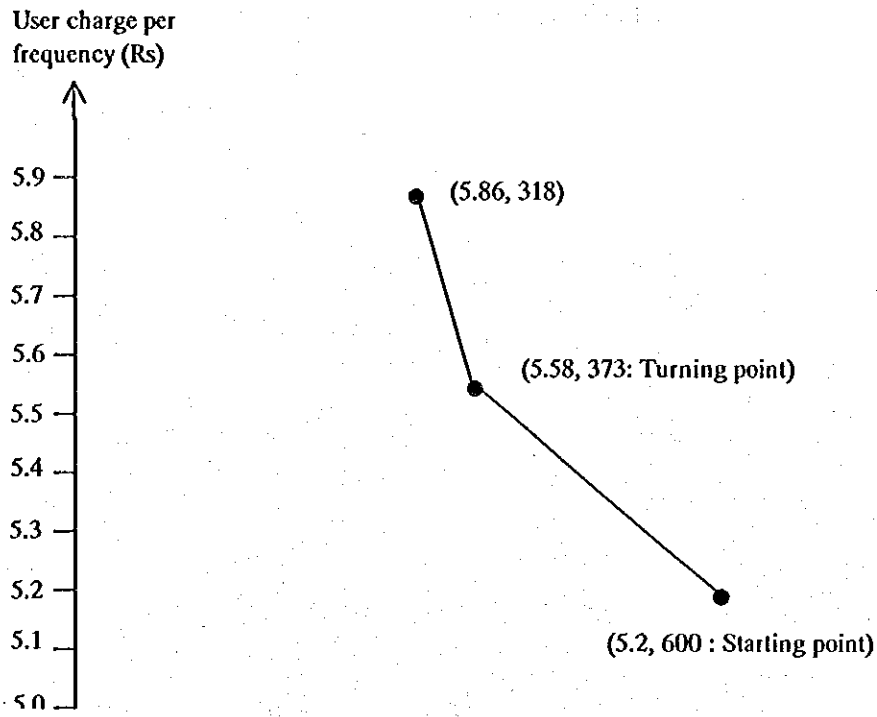


Fig. 13.9 Demand Curve of Potential Car User for OCH

4) Conclusions

Conclusion 1: The total annual user charge of the car owners for using the OCH is estimated at 1,500 Rs at 1998 constant prices, and the user charge per trip on the OCH is estimated at 2.5 Rs at 1998 constant prices.

The expenditure is fairly below the additional allowable expenditure of low-income car owners (3,100 Rs / annum, 1999). Accordingly, a business entity could set a higher user charge per trip than 2.5 Rs per trip, and recover a portion of the project cost along with the maintenance cost.

Conclusion 2: Toll and demand elasticity of low-income car owners is estimated at – 6.584. This is very high. Car owners wish for the user charge per trip to be set at 5.2 Rs at 1998 constant prices, which is the rate recommended here. However, the following comments should be noted regarding user charges:

* It is not clear whether or not the user charge will exceed the collection cost of the user charge per trip, and
* It is not clear whether the total revenue expected from user

charges is desirable when viewed from the financial standpoint of a business entity.

13.2.3 Funding of the OCH Project

1) Background and Issues

(1) Raising of Funds for the OCH Project

a. The total funds required for construction and operation of the OCH facilities consist of:

* Project cost (construction cost of the facilities), and
* Maintenance cost of the facilities.

b. As discussed in 13.2.2, a business entity that will construct and operate the OCH facilities cannot expect to get any revenue from potential users for usage of the facilities. This implies that the conventional method of financial analysis cannot be applied to this project.

c. Given "b" above, this implies that a public entity must raise the funds to build and manage the OCH project itself, since a lack of revenue will obviously not entice any private business entity. In Sri Lanka, the public entity (i.e., the implementing agency of the project) is the RDA.

d. The Sri Lankan national treasury imposes a ceiling on the amount of funds that can be raised for a project since it cannot provide funds ad infinitum. Although the OCH project is a very important project, it is still just one project among many other national projects. Therefore, the public entity must take this ceiling into consideration when deciding on raising funds for the project.

(2) Issues

The issues to be dealt in this section can be summarized as follows:

- To evaluate the possibility of raising funds from the national treasury
- To estimate the amount of funds that may be required from sources other than the national treasury

2) Outline of Evaluation and Estimation Procedures

(1) Base Year of Prices Used in this Analysis

Prices/values used in this analysis are expressed at nominal or current prices, while the

values used in the previous sections were expressed at real or constant prices (see Section 13.1 and Section 13.2.2)

(2) Evaluation and Estimation Procedure

The following proccdure is used:

Step 1: Breakdown of OCH project cost and maintenance cost.

Step 2: Forecast of the RDA's total budget, and

Step 3: Conclusion (evaluation of the possibility of raising funds for the project)

3) Breakdown of the OCH Project Cost and Maintenance Cost (Step 1)

(1) Cost of OCH Project

The OCH project cost is given in the RDA's budget under the heading of "Widening Improvements and New Construction of Roads and Bridges" shown in Tab. 13.46. Project cost is broken down into a foreign and local portion as shown in Tab. 13.5, and calculated using the following formula.

$$V_t^C = V_t^F \times (1+P)^{t+2}$$

V_t^C : Value at current prices base in year t.

V_t^F : Value at 1999 constant prices for base year t
(see Table 13.5 attached before)

P : Annual increasing rate of price (% / annum)
for Foreign portion : 4.5% / annum
Local portion :10.0% / annum

Assuming the entire OCH is build, total project cost is estimated at 22,126 thousand Rs. (exclude operation and maintenance costs) for the period from 2001 till 2009, which can be raised via foreign funds. As for the costs that must be raised domestically (i.e., taxes and land acquisition/compensation costs), these would total about 8,745 thousand Rs. and are calculated by applying the following formula:

$$T_t^C = P_t^C \times T_t^F / P_t^F$$

T_t^C : Taxes at current prices base in year t.

P_t^C : OCH project cost at current prices in year t (see Table 13.43 attached before)

T_t^F : Taxes at 1999 constant prices base in year t. (see Table 13.8 attached before)

P_t^F : OCH project cost at 1999 constant prices base in year t (see Table 13.8 attached before)

(2) Operation and Maintenance Cost of the OCH Facilities

This cost corresponds to RDA's budget item "Routine and Periodic Maintenance, and Rehabilitation of Roads and Bridges".

A. Methods for Cost Estimation

a. The full cost of operation and maintenance, which will be generated in the early years after the completion of the OCH facilities, is adopted as the basis for calculating the maintenance cost to be applied in this analysis.

b. To compare costs with RDA's budget for its maintenance activities, maintenance costs are averaged.

c. Operation and maintenance costs expressed at 1999 constant prices are converted into current prices by applying a forecasted weighted price inflation rate, which can be calculated based on the following categories of price inflation rates and the weights shown in Tab. 13.43.

Tab. 13.43 Forecast of Price Inflation Rates by Categories

(unit : % / annum)

Category of Prices	Actual			Forecast		Applied for Estimation of :
	1990 | 1995	1995 | 1998	1990 | 1998	2000 | 2005	2005 | 2010	
GDP deflator	9.6	10.3	9.8	9.0	8.0	RDA's total budget
Import commodity (Wholesale price)	6.0	6.5	6.2	6.0	7.0	Maintenance cost of the OCH
Domestic commodity (Wholesale price)	7.6	7.7	8.2	4.0 *1	4.0 *1	ditto
Wage (Workers in Wage Board Traders)	10.3	8.8	9.7	8.5	9.0	ditto

Source : Actual: As given in Central Bank's publications

Forecast: JICA Study Team

Note *1: Forecasted growth rates are only for construction materials and the rates do not correspond to "Domestic commodity".

The overall trend of price inflation in Sri Lanka, which underlies the forecasted price inflation rates, is as follows:

Sri Lanka is now at a stage of high growth in economic development. In general, prices increase at relatively high rates in this stage due to adjustments in the economic and social activities of the country. Until the year 2010, such adjustment will continue in Sri Lanka, resulting in relatively high inflation rates. However, beyond 2010, the adjustment will gradually be completed, resulting in lower inflation than before the year 2010.

B. Operation and Maintenance Costs

Table 13.44 Average Annual Operation and Maintenance Costs

(unit : Millions Rs at current prices)

Amount *1 : 71

Note *1 : Up to 2020

4) Forecast for RDA's Total Budget (Step 2)

The possibility of raising funds for the OCH project depends on the amount of RDA's total budget.

(1) Type of RDA Budget

There are two types of RDA budgets:

Type 1: RDA budget that the RDA requests from the national treasury (Ministry of Finance and Planning), and

Type 2: RDA budget to which the national treasury has given its approval.

In this analysis, Type 2 is adopted. There has been only a small difference in the amounts between the Type I and Type 2 budgets in recent years.

(2) Outline of the Forecasting Procedures of the RDA's budget

The procedure of forecasting RDA's budget is depicted in Figure 13.10.

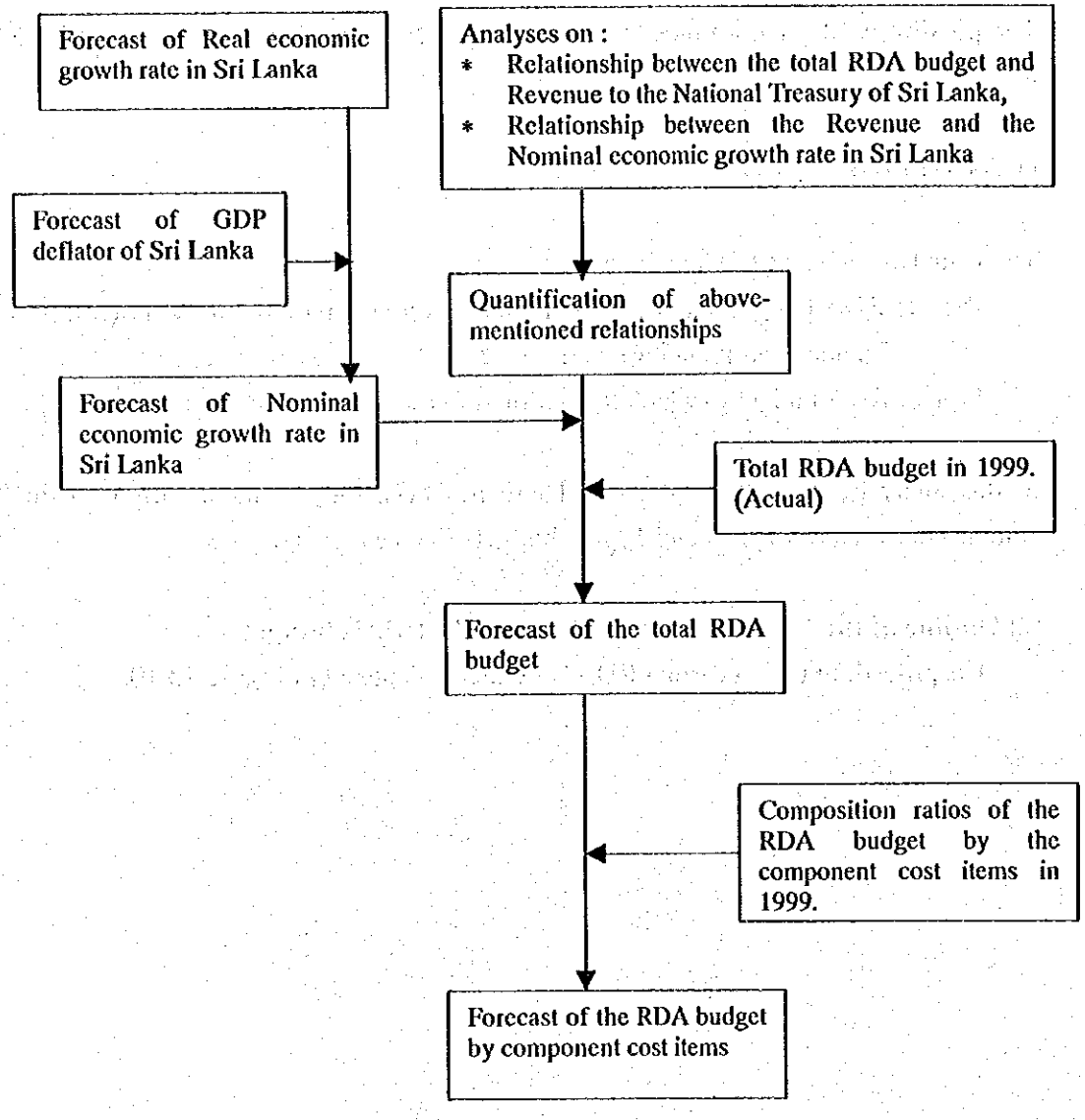


Fig. 13.10 Forecasting Procedures for RDA's Budget by Component Cost Item

(3) Formulas and Input Data for the Forecast

A. Past RDA Budgets

RDA's budget for previous years is shown in Tab. 13.45. From this, the following points can be made:

a. The total budget for the period 1995 – 1999 has increased at a fairly lower rate of 10.5% per annum as compared to 18.4% per annum for the budget between 1990 – 1995, though there was a only small difference in the real economic growth rates between the two periods (5.4% per annum for the period 1990 – 1995 and 5.1% per annum in 1995 – 1998).

b. For the period 1995 – 1999, the total budget for the "Routine and Periodic Maintenance Cost and Rehabilitation of Roads and Bridges Cost (Category 1 budget)" has increased at a rate of only 0.5% per annum, sharpely down from the rate of 17.6% per annum for the period 1990 – 1995. While the budget for the "Widening, Improvement and New Construction of Roads and Bridges (Category 2 budget)" for the period 1995 – 1999 has increased at a rate of 25.9% per annum as compared to a previous rate of 20.2% per annum. This implies that the RDA's budges allocation policy has recently changed from a large budget for maintenance to a large budget for the construction of new roads and bridges. The rapid increase in road traffic in recent years seems to have resulted in this change of policy.

c. As a result of a and b above, the composition ratios of the above-mentioned two sub-budget categories has changed as follows.

	Category 1 Budget	Category 2 Budget
1990	70.7%	29.3%
1995	68.4%	31.6%
1999	46.8%	53.2%

Table 13.45 RDA's Budget (at National Treasury's Approval Base)

1. Budget Amount

(unit: Million Rs at current prices)

	Category 1				Category 2	
	Routine Maintenance	Periodic maintenance	Rehabilitation of Roads & Bridges	Subtotal	Widening, Improvement, New construction of Roads & Bridges	Total
1990	183.3	148.0	1,072.2	1,401.5	581.5	1,983.0
1991	181.9	210.0	951.0	1,342.9	664.5	2,007.4
1992	195.9	190.0	1,074.9	1,460.8	631.5	2,092.3
1993	195.9	370.0	792.5	1,358.3	745.0	2,103.4
1994	198.1	473.0	1,535.1	2,206.2	1,202.9	3,409.1
1995	208.3	800.0	2,142.1	3,150.4	1,456.4	4,606.8
1996	278.2	930.0	2,090.0	3,298.2	1,923.5	5,221.7
1997	279.6	700.0	1,857.2	2,827.8	2,440.3	5,268.1
1998	278.6	800.0	2,203.0	3,281.6	3,008.3	6,288.9
1999	315.3	700.0	2,199.0	3,214.3	3,656.7	6,871.0

2. Composition Ratios

(unit: %)

1990	9.2	7.5	54.0	70.7	29.3	100.0
1995	4.5	17.4	46.5	68.4	31.6	100.0
1999	4.6	10.2	32.0	46.8	53.2	100.0

3. Changing Rates

(unit: % / annum)

1990 | 1995	2.6	40.1	14.9	17.6	20.2	18.4
1995 | 1999	10.9	△3.3	0.7	0.5	25.9	10.5

Source: RDA

B. Formulas and Input Data

a. Formula and input data for forecasting RDA's total budget are as follows:

$$B_t^T = B_{1999}^T \times \left(1.0 + g^N \times e^{RN} \times e^{RR}\right)^{-1}$$

B_t^T : Total RDA budget (at the national treasury approved base in year t)

g^N : Normal GDP growth rate (% per annum).

2000 – 2005 : 14.0% per annum
2005 – 2010 : 14.0% per annum

$$g^N \fallingdotseq g^R + P^{GDP}$$

g^R : Real GDP growth rate (% per annum).

1998 – 2005 : 5.0% per annum
2005 – 2010 : 6.0% per annum

Source : Consultant's forecast ; see the Table 4.2.1 in Chapter 4.

p^{GDP} : Changing rate of GDP deflater (% per annum).

(see, the Table attached before)

e^{RN} : Elasticity of the National Revenue to the Nominal GDP growth

$e^{RN} = 0.717$

Sourse : Consultant's estimate based on the national revenue and the nominal GDP for the period 1995 - 1997 / 98.

e^{RR} : Elasticity of the total RDA Budget at the National Treasury approval base and the national revenue.

$e^{RR} = 0.921$

Sourse : Consultant's estimate based on the total RDA budget and the national revenue for the period 1995 - 1999.

b. Budget for routine and periodic maintenance and rehabilitation of roads and bridges.

$$B_t^m = B_t^T \times 0.468$$

B_t^m : Budget for Routine and Periodic Maintenance and Rehabilitation of Roads and Bridges in Year t.

0.468 : Share of the Budget in the Total RDA Budget in 1999.

c. Budget for widening, improvement and new construction of roads and bridges.

$$B_t^n = B_t^T \times 0.532$$

B_t^n : Budget for Widening, Improvement and New Construction of Roads and Bridges in Year t.

0.532 : Share of the Budget in the Total RDA Budget in 1999.

(4) Forecast of the RDA Budget till the Year 2010

Using the above-mentioned methods, a forecast is carried out in Tab. 13.46.

Table 13.46 Forecast for RDA Budget (at the National Treasury Approval Base)

- Without the OCH project case -

(unit : Millions Rs at current prices)

		Routine & Periodic Maintenance, & Rehabilitation of Roads & Bridges	Widening, Improvemet & New Construction of Roads & Bridges	Total
Actual	1997	2,827.2	2,440.3	5,268.1
	1998	3,381.6	3,008.3	6,288.9
	1999	3,214.3	3,656.7	6,881.0
Forecast	2000	3,522.9	4,004.0	7,526.9
	2001	3,858.8	4,386.6	8,245.4
	2002	4,227.3	4,805.3	9,032.6
	2003	4,630.8	5,264.0	9,894.8
	2004	5,072.8	5,766.6	10,839.4
	2005	5,557.1	6,317.0	11,874.1
	2006	6,087.6	6,920.1	13,009.7
	2007	6,668.7	7,580.7	14,249.4
	2008	7,305.3	8,304.4	15,609.7
	2009	8,002.7	9,097.1	17,099.8
	2010	8,766.7	9,905.5	18,732.2

Source : Actual : RDA
Forecast : Consultant

5) Evaluation of Possibility of Raising Funds Required for OCH Project (Step 3)

(1) Evaluation of Possibility of Raising Fund for the OCH Project

A. Estimation of the Portion of Project Cost to Be Raised from National Treasury

a. The RDA uses the following formula for estimating the maximum amount of the funds that can be raised from the national treasury:

$$A_P^{MAX} = 20\% \times B^{C2}$$

A_P^{MAX} : The total maximum amount of the fund for the OCH project cost which the national treasury will be able to provide.

B^{C2} : Total of the Category 2 Budget (Budget for Widening, Improvement and new Construction of Roads and Bridges) for the construction period of the OCH facilities.

On the setting of the "20%" factor, the following is taken into account:

* The National Cabinet has already approved the OCH project, which implies that some additional budget will surely be drawn up for the realization of the OCH project. However, the severe situation of the national treasury will not permit the provision of funds for the entire cost of the OCH project. This is because the national treasury must take into consideration various other national projects as well as the OCH project.
* "20%" of the Category 2 Budget would increase the total RDA budget in the "Without project" case by 5.3% for the construction period of the OCH facilities. The RDA expects that an increase from the national treasury by 10.6% may be possible.

b. By adopting the formula mentioned in a, and the forecasted budget (Category 2) as tabulated in Tab. 13.46, the following maximum amount is estimated:

A_P^{MAX} :5,405.5 millions Rs at current prices.

On estimating the A_P^{MAX}, the following assumption is made: the OCH facilities will be constructed during the period 2002 – 2009 (eight years).

B. Evaluation of Possibility of Raising Funds

a. The OCH project cost is estimated to be 22,126 millions Rs at current prices (including operation and maintenance costs). The national treasury will not be able to supply an amount of more than 5,405 millions Rs at current prices. The national treasury has to raise this difference (i.e., Rs. 2,032 million) either from domestic or foreign financial markets.

b. Of the total OCH project cost, the portion of cost that must be raised from the national treasury is estimated to be 8,745 millions Rs at current prices (see the Tab. 13.44). The national treasury probably will not be able to meet that cost.

(2) Evaluation of Possibility of Raising Funds for OCH Operation/Maintenance Costs

A. Estimation of the Portion of Funds to Be Raised from National Treasury

a. The RDA uses the following formula for estimating the maximum amount that can be raised from the national treasury:

$$A_M^{MAX} = 5\% \times B^{CI}$$

A_M^{MAX} : The maximum amount of the fund for the OCH maintenance cost which the national treasury will be able to provide.

B^{CI} : The annual Category 1 Budget (Budget for Routine and Periodic Maintenance and Rehabilitation of Roads and Bridges).

On the setting of the "5%" factor, the following is taken into consideration:

* Basically, the all funds have been supplied from the national treasury though there have been some exceptions in the past (i.e., funds were raised from international banks).
* During the period 1990 – 1999, the fund for maintenance at the national

treasury approval base has increased at rate of 9.7% per annum. The growth rate is almost equal to the growth rate of general prices plus the real growth rate of around 1% per annum of the annual maintenance cost. This implies that it will be difficult to request from the national treasury a large additional amount (see Tab. 13.45).

* "5%" of the Category 1 Budget would raise the total RDA budget (given the national treasury approval base) in the "Without project" case by around 2.4% per annum. The RDA expects that this increase of 2.4% per annum is possible for the national treasury.

b. Adopting the above formula and the forecasted budget (Category 1), the following maximum amount is estimated:

A_M^{MAX} : 400.1 millions Rs at current prices

B. Evaluation of Possibility of Raising Funds

The OCH maintenance cost for 2010 is estimated to be 67.8 million Rs in current prices. The national treasury will be able to supply this fund.