APPENDIX – II

UNIT COST OF SURFACE WATER

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II.1 GENERAL

One of the variables in the objective function is unit cost of surface water, which is discussed here. The unit cost of surface water consists of

Annual capital cost

For working out unit cost of surface water the capital cost of the project is converted to future value. The capital cost is then converted to annual capital cost by multiplying it with capital recovery factor (C.R.F.). The annual capital cost is divided by the culturable command area (C.C.A.) of the project, considering unit depth of application of water, to obtain the annual capital cost per ha.m. The above mentioned value is added to the

Operation, maintenance and repair (O.M.R.) cost

The annual O.M.R. cost of the project is divided by the C.C.A. of the project to obtain the O.M.R. cost per hectare meter, considering unit depth of application of water.

The above two costs obtained are summed up to obtain the unit cost of surface water.

II.2 METHODOLOGY

The water available at Kakrapar weir is the summation of the outflow of Ukai dam in the Tapi River and the flow generated between Ukai dam and Kakrapar weir. Therefore, in the present study, for working out the unit cost of surface water, the annual capital cost of Ukai dam is calculated first. Considering the live storage and outflow of Ukai dam in the Tapi River, the annual capital cost of Ukai outflow is determined. It is then added to the annual capital cost of Kakrapar weir. From the total quantity

of water available at Kakrapar weir, 60% is diverted to K.L.B.M.C., which is the area for the present study. Therefore, 60% of the total annual capital cost determined above is taken into consideration to calculate the unit cost of surface water.

For Ukai Dam

Capital cost

Yearly total expenditures are converted with respect to base year 1999-2000. The project is completed in 1974 having capital cost as Rs. 76.2183 crores.

$FV = P (i+1)^n$ .....(II.1)

Where,

FV = Future Value

P = Present Value

i = Rate of Interest

= 6.5%

n = Period, years

= 1974-1999

= 25 years

$FV = 76.2183 (0.065 + 1)^{25}$

$= Rs. 367.9590 \times 10^7$

The total capital investment in year 1999-2000

$= 36.7959 \times 10^8$ Rs.

Annual capital cost

The economic life of project	= 150 years
Year of commencement of the project	= 1974
Year of end of the project	= 2124
Base year	= 1999-2000

The remaining life of the project considering base year

$= 2124 - 1999$

$= 125$ years

Capital Recovery Factor, C.R.F. : $= \dfrac{i(i+1)^n}{(i+1)^n - 1}$ .....(II.2)

$= \dfrac{0.065\,(0.065+1)^{125}}{(0.065+1)^{125} - 1}$

$= 0.065025$

The annual capital cost of Ukai dam = C.R.F. x Total capital investment in 1999-2000

$= 0.065025 \times 36.7959 \times 10^8$

$= \text{Rs. } 23.9264 \times 10^7$

Table II-1: Monthly Outflow of Ukai Dam During 1999-2000

Year	Month	Outflow	
		Day cusecs	Mm^3
1999	June	5,530	13.52
1999	July	3,764	9.20
1999	August	8,137	19.90
1999	September	6,986	17.08
1999	October	15,885	38.84
1999	November	10,289	25.16
1999	December	5,402	13.21
1999	January	6,241	15.26
2000	February	5,903	14.43
2000	March	6,218	15.20
2000	April	8,029	19.63
2000	May	6,482	15.84
	Total	88,866	217.28

Outflow of Ukai dam $= 217.28\ Mm^3$

Gross storage of Ukai dam $= 8,511\ Mm^3$

Live storage of Ukai dam $= 7,092\ Mm^3$

Dead storage of Ukai dam $= 1,419\ Mm^3$

The annual capital cost of Ukai dam outflow

$= \dfrac{23.9264 \times 217.28}{7,092}$

$= \text{Rs. } 73,30,430$

FOR KAKRAPAR WEIR

Capital cost

Yearly total expenditures are converted with respect to base year 1999-2000.The project is completed in 1954, having the capital cost of Rs. 24.85 crores, including maintenance and repair works, labours, staff payment etc.

F.V. $= P(1+i)^n$

$= 24.85\ (1+0.065)^{45}$

$= \text{Rs. } 422.7257 \times 10^7$

Total capital investment in year, 1999 – 2000

$= \text{Rs.}42.27257 \times 10^8$

Annual capital cost

The economic life of project = 100 years

Year of commencement of the project = 1954

Year of end of the project = 2054

Base year = 1999-2000

The remaining life of the project considering base period will be

$= 2054 - 1999$

$= 55$ years

Capital recovery factor, C.R.F.

$$= \frac{i\,(i+1)^n}{(i+1)^n - 1}$$

$$= \frac{0.065\,(0.065+1)^{55}}{(0.065+1)^{55} - 1}$$

$= 0.067101$

The annual capital cost of Kakrapar weir = C.R.F. x Total capital investment in 1999-2000

$= 0.067101 \times 42.2725 \times 10^8$

$= \text{Rs. } 28,36,54,804$

The annual capital cost = Annual capital cost of Ukai dam
+ Annual capital cost of Kakrapar weir
= 73,30,430 + 28,36,54,804
= Rs. 29,09,85,234

Out of the amount of water released by Kakrapar weir into the canals 60% flows to K.L.B.M.C.

Therefore, annual capital cost of water flowing into K.L.M.B.C.

= 0.60 x 29,09,85,234

= Rs. 17,45,91,140

Culturable command area of K.L.M.B.C. = 1,45,335 ha

$$\text{The annual capital cost/ha} = \frac{17,45,91,140}{1,45,335}$$

= 1,201.30 Rs./ha

$$\text{The capital Cost / ha / season} = \frac{1,201.30}{3}$$

= 400.43 Rs./ha/season

Considering unit depth of application of water

The annual capital cost = 400.43 Rs./ha.m/season

Total OMR cost including

- Head work
- Canal System Networks
- Establishment & staff charges

= 9,18,91,000 Rs./year

Annual O.M.R. cost of water flowing into K.L.B.M.C.

= 0.60 x 9,18,91,000

= 5,51,34,600 Rs.

$$\text{Annual OMR cost/ha} = \frac{5,51,34,600}{1,45,335}$$

$$= 379.36 \text{ Rs./ha}$$

$$\text{The OMR Cost / ha / Season} = \frac{379.36}{3}$$

$$= 126.45 \text{ Rs./ha/season}$$

Considering unit depth of application of water.

The OMR Cost = 126.45 Rs./ha.m/season

Total unit cost of surface water = Capital cost + OMR cost

= 400.43 + 126.45

= 526.88 Rs./ha.m/season

Say 527 Rs./ha.m/season

Therefore, the unit cost of surface water is 527 Rs./ha.m/season