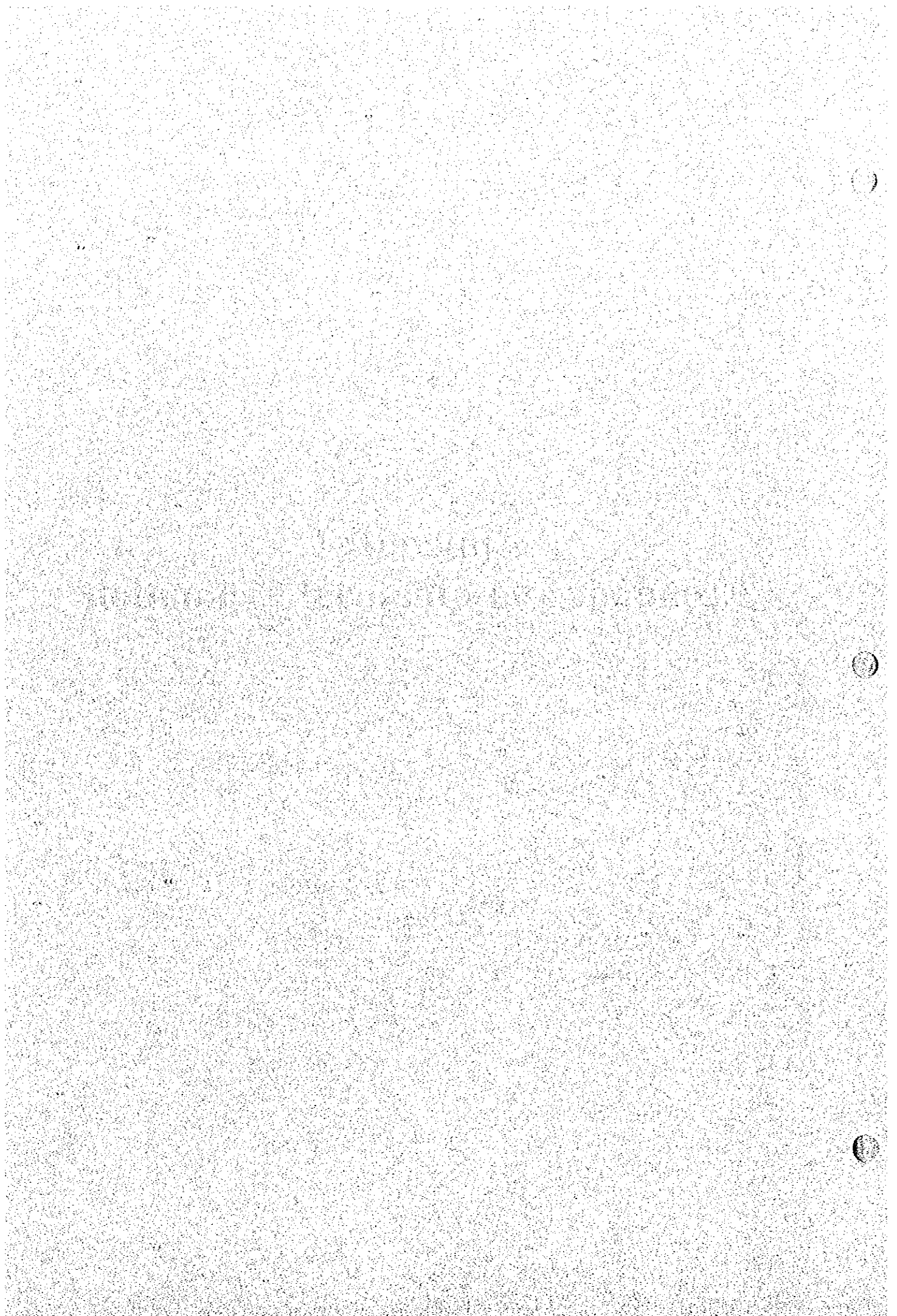


Appendix I
Economic and Financial Evaluation



**FEASIBILITY STUDY
ON
THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT
IN
ISLAMIC REPUBLIC OF PAKISTAN**

**FINAL REPORT
VOLUME III
SUPPORTING REPORT**

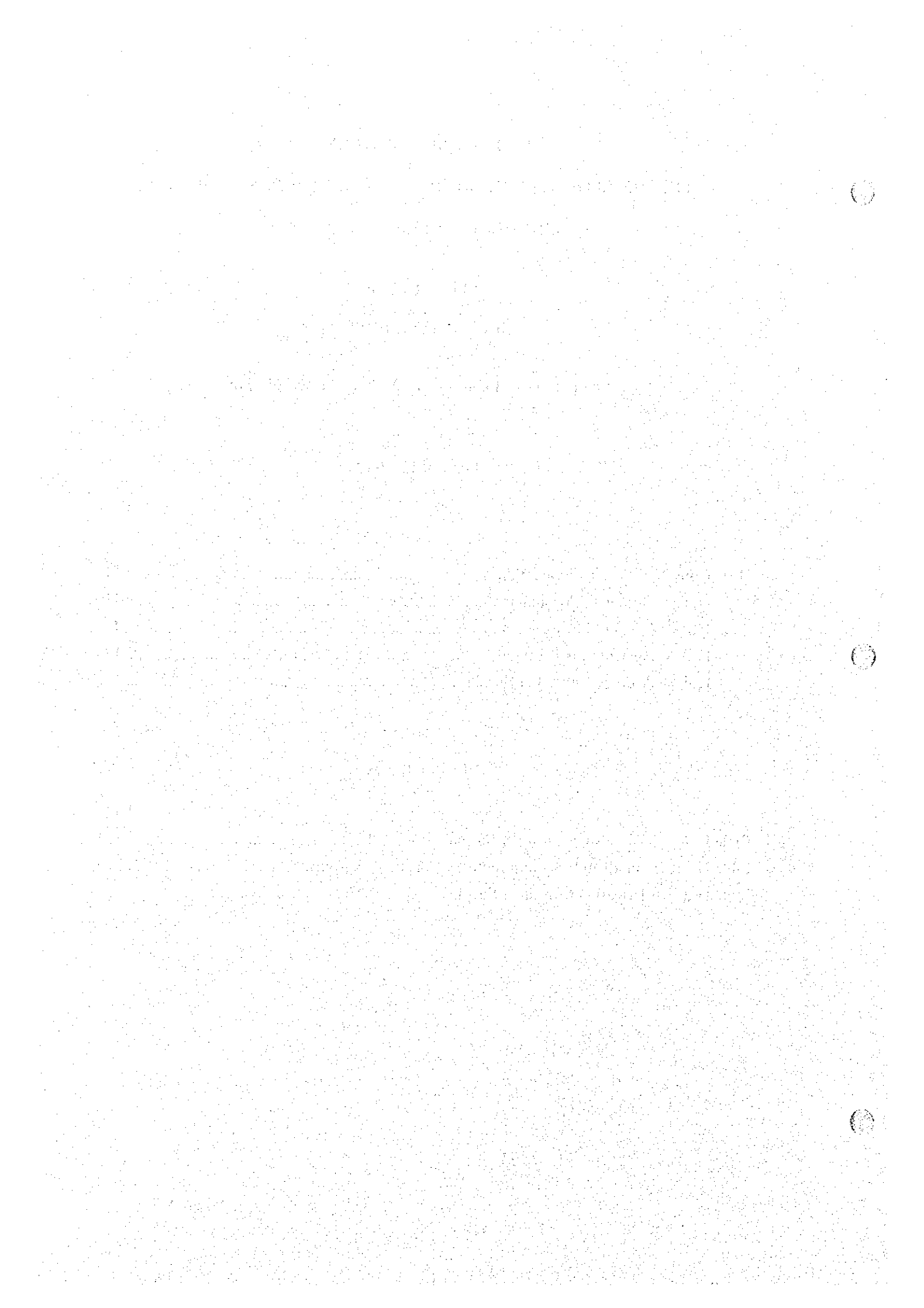
Appendix I : Economic and Financial Evaluation

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APPENDIX I ECONOMIC AND FINANCIAL EVALUATION

II Consumer Surplus Evaluation

In a power shortage situation, the consumption of electricity implies benefits to consumers, in excess of the price paid under WAPDA tariffs. The concept of consumer surplus as a measurement of the consumers' willing to pay is used in various economic analysis for determining power benefits in Pakistan.

Selective surveys have been taken to obtain data for making an assessment of consumer surplus for a hydropower project in the Northwest Frontier Province. During the Matiltan Hydropower Project Feasibility Study, the consultants collected field data and conducted typical case studies in selected area. The following major consumer categories were investigated.

- domestic consumers
- small industries and medium industries
- agriculture tubewells

The consumer surplus calculated savings in the cost of lighting and motor power provided by electricity generated from Munda rather than from alternative sources, such as kerosene oil lamps and diesel generation. Considering the shape of the demand curve for electricity with a negative slope, only 50 percent of the consumer surplus is usually used in the benefit evaluation, including the aforementioned project study. Given the fact that the tariff has been substantially increased in recent years, and based on a more realistic projection of long term economic development, a conservative 1/3 of the consumer surplus is used in Munda study.

The original survey was conducted in FY 1996, but the datum were updated during a survey in Peshawar in June 1999. The results of the updated survey, although with somewhat different input prices, correspond to those of the previously survey.

II.1 Domestic Consumers

The main alternative to electricity for domestic consumers for lighting is the kerosene oil lamp. The estimated data are given in table following this text. The estimated average tariff for domestic consumers is estimated at Rs.1.96/kWh for April 1999. The consumer surplus for domestic consumers has been calculated as 168 percent of the average tariff as tabulated in Table I1.1.

II.2 Industrial Consumers

In the survey of small and medium industrial consumers covered fourteen industrial units. The industries use high speed engines and electricity-driven motors. The data are updated in Peshawar as possible. The basic assumptions built into the calculations of industrial consumers are given below:

Economic Life

Electric Motor	20 years
High speed diesel engine	10 years
Electricity wiring	15 years
Electric connection	30 years

Prices (Updated)

High speed diesel	Rs. 11/Litre
Mobil oil	Rs. 45/Litre

Energy Tariff

Industrial consumers	Rs. 5.23 /kWh
----------------------	---------------

The data and calculation results are shown in Table I1.2.

The consumer surplus analysis favors diesel units and this may imply that the level of tariff for industrial users is now higher than the long-run marginal cost. However, given the fact that the consumers are actually using the electricity even at such high level and considering the convenience associated with electricity, it can be reasonably assumed that electricity is the chosen option for most industrial consumers, at current tariff level. Therefore no "negative surplus" is deducted from the overall consumer surplus calculations.

I1.3 Agricultural Tubewells

The basic assumptions used for agricultural irrigation consumers are as follows:

Economic life

Electric motor	20 years
High speed diesel engine	10 years
Electricity wiring	15 years
Power connection	30 years

Energy Tariff

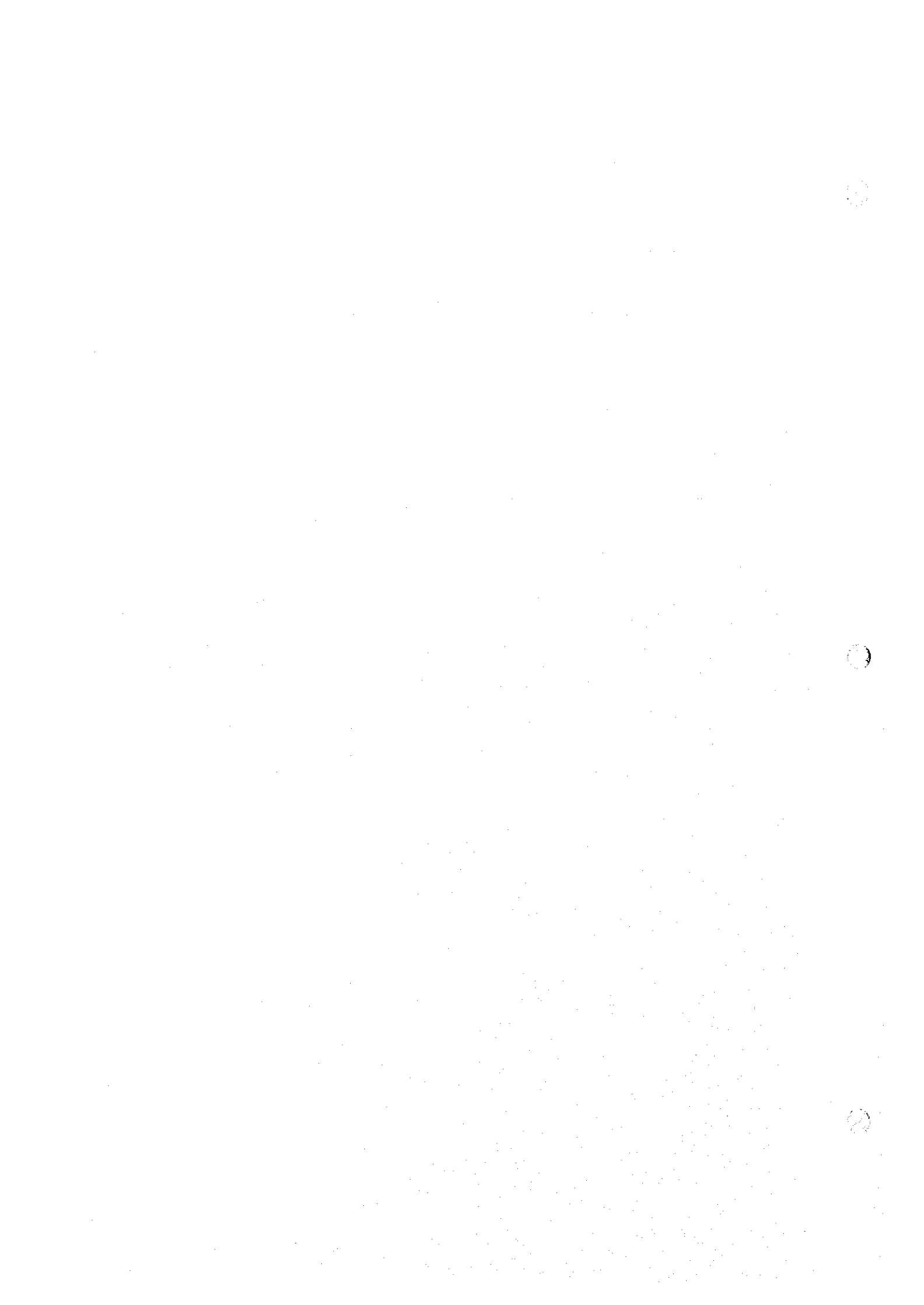
Average tubewell tariff: Rs. 2.74 kWh and the average weighted value of the consumer surplus is 102 percent of the average tariff as shown in Table I1.3.

I1.4 Average Consumer Surplus

The weighted average consumer surplus has been calculated as 91 percent of the average tariff. To avoid overestimate the willingness to pay, most analyses use 50 percent of the difference between the cost of private generation and the consumers' prevailing tariff. Given the current high level tariff in Pakistan, in some sector, we used a conservative 1/3 of the difference, which gives a value of US\$ 9.8/kWh.

Consumer Surplus Calculation

		Consumer Surplus, %	Weighting Factor
Domestic	167.52%	50%	
Agriculture	0%	8%	
Industrial	102%	7%	
Overall surplus benefits		91%	
US\$=Rs. in 1999			50
Average Price in April, 99	Consumer Surplus Factor	WTP in Rupees	In US\$
3.76	30%	4.899	0.098



TABLES

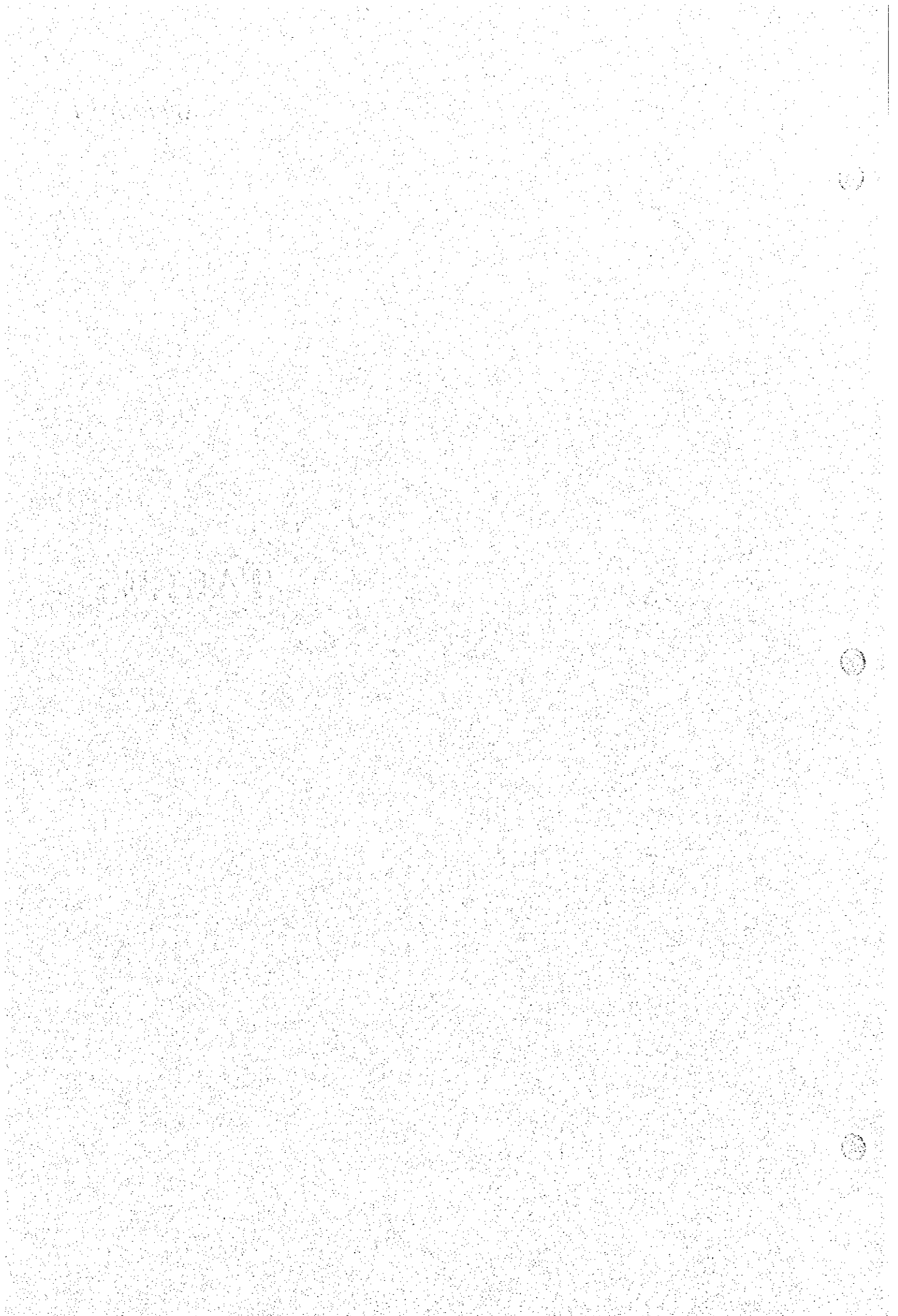


Table II.1 Domestic Consumer Surplus

No.	Domestic Unit	Unit	Value
1	Average light points per domestic consumer	Numbers	4
2	Average number of lanterns per domestic consumer	Numbers	4
3	Average annual consumption of kerosene oil for lighting (@ 28 cc per hour per lantern for 1827 hours)	Litres	205
4	Cost of kerosene oil	Rs./Litre	15
5	Cost of lantern	Rs./Unit	125
6	Cost of chimney	Rs./Unit	30
7	Cost of wick	Rs./Wick	5
8	Cost of electric bulb (100 watt)	Rs./Bulb	15
9	Cost of electric wiring	Rupees	1,500
10	Average life of lantern	Years	4
11	Average life of chimney	Months	2
12	Average life of wick	Months	1
13	Average life of electric bulb	Months	6
14	Average life of electric wiring	Years	10
A.	Annual Cost with Kerosene oil		
	cost of kerosene oil	Rs./Year	3,075
	Amortised cost of lantern @ 12%	Rs./Year	165
	Cost of chimneys	Rs./Year	720
	Cost of wick	Rs./Year	240
	Matches: one box per lantern per month	Rs./Year	24
	Total Annual Cost:	Rs./Year	4,224
B.	Annual Cost with Electricity		
	Energy consumption (1827 hours per year)	kWh/month	61
	Cost of electricity, Rs. 1.96/kWh	Rs./Month	120
	Cost of electricity per year	Rs./Year	1,435
	Bulb replacement	Rs./Year	120
	House wiring cost (amortised @ 12% & 10 years)	Rs./Year	265
	Total Annual Cost:	Rs./Year	1,820
	Annual Surplus Benefits	Rs./Year	2,403
	Percentage of electricity cost		167.52%

Table 11.2 Small and Medium Industry Consumer Surplus

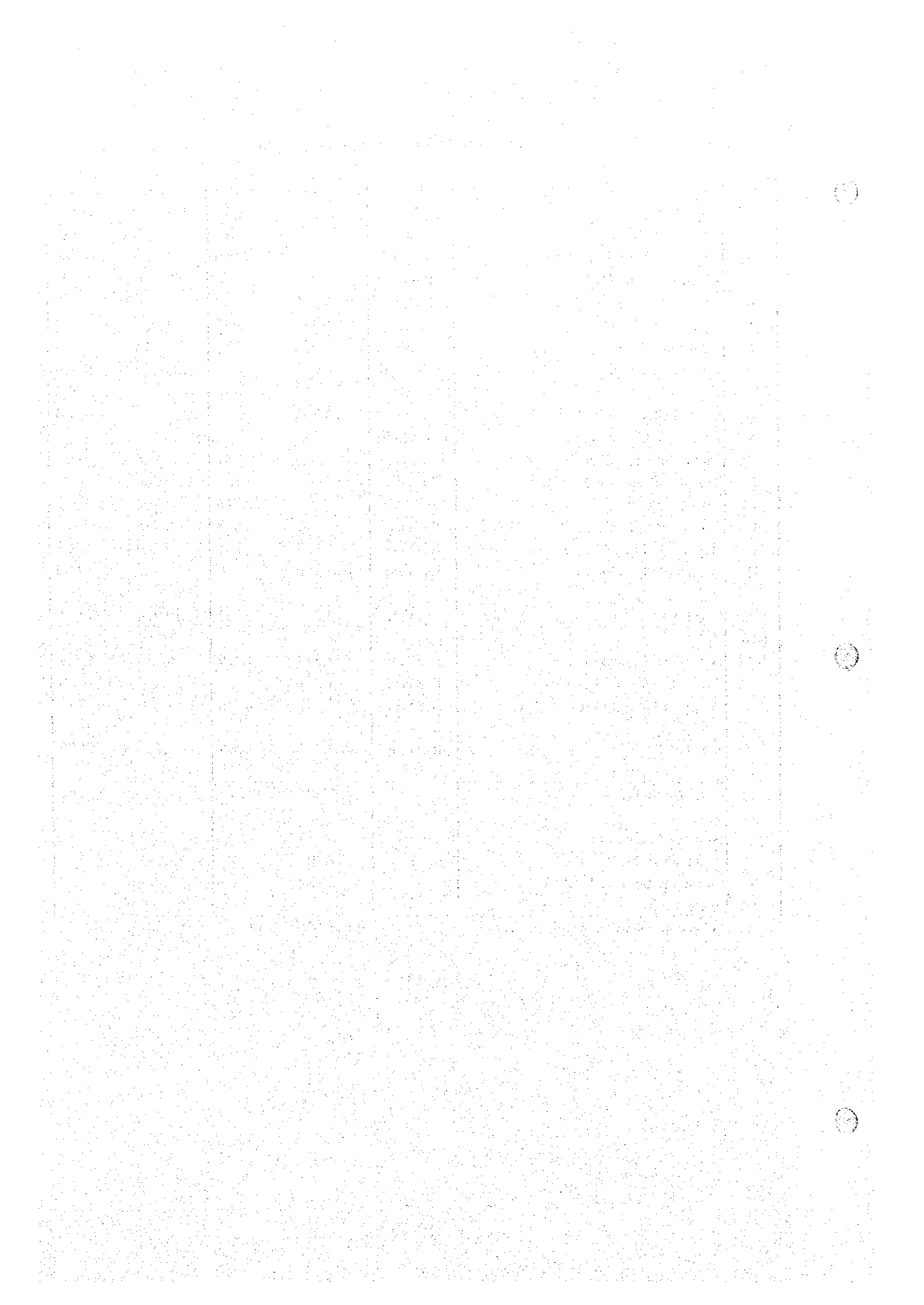
No.	Description	Unit	Electric	Equivalent Diesel	Average Diesel	Equivalent Electric
1	Average rating	hp	31	45	21	15
2	Capital Cost of the system	Rupees	45,429	131,250	61,250	21,982
3	Electric Wiring Cost	Rupees	11,857	0	0	5,929
4	Electric Connection Cost	Rupees	47,857	0	0	0
5	Operational Time	Hours	2,211	2,122	1,146	1,146
6	Utilization Factor	Percent	25	25	13	13
7	Energy Consumption	kWh/Year	54,579			12,824
		KWh/Month	4,548			1,069
8	Cost of Electricity at 5.23	Rs./Year	285,448			67,070
9	Diesel Oil Consumption	Litre/Hours		5	3	
10	Mobil Oil Consumption	Litre/Year		118	96	
11	Transportation Cost of Oils	Rs./Year		755	466	
12	Cost of Diesel, Rs. 11/Litre	Rs./Year		116,710	37,818	
13	Cost of Mobil Oil, Rs. 45/Litre	Rs./Year		5,310	4,320	
14	Repair & Maint. Charge	Rs./Year	7,671	11,507	2,150	5,753
15	Wages of Operator	Rs./Year	1,600	3,200	2,600	1,600
	Sub-total	Rs./Year	294,719	137,482	47,354	74,423
NPV 0.12	Amortised Capital Cost	Rs./Year	6,082	23,229	10,840	2,943
	Amortized Connection Costs	Rs./Year	5,941		0	0
	Amortised Wiring Cost	Rs./Year	1,741		0	871
	Sub Total	Rs./Year	13,764	23,229	10,840	3,814
	Total Annual Cost		308,483	160,711	58,194	78,236
	Number of Case Studies		10		4	
	Annual Surplus Benefits	Rs./Year	-147,772		-20,042	
	Surplus Benefits as % of Cost of electricity		-48%		-34%	

Consumer surplus (weighted average): -44% of Electricity Cost

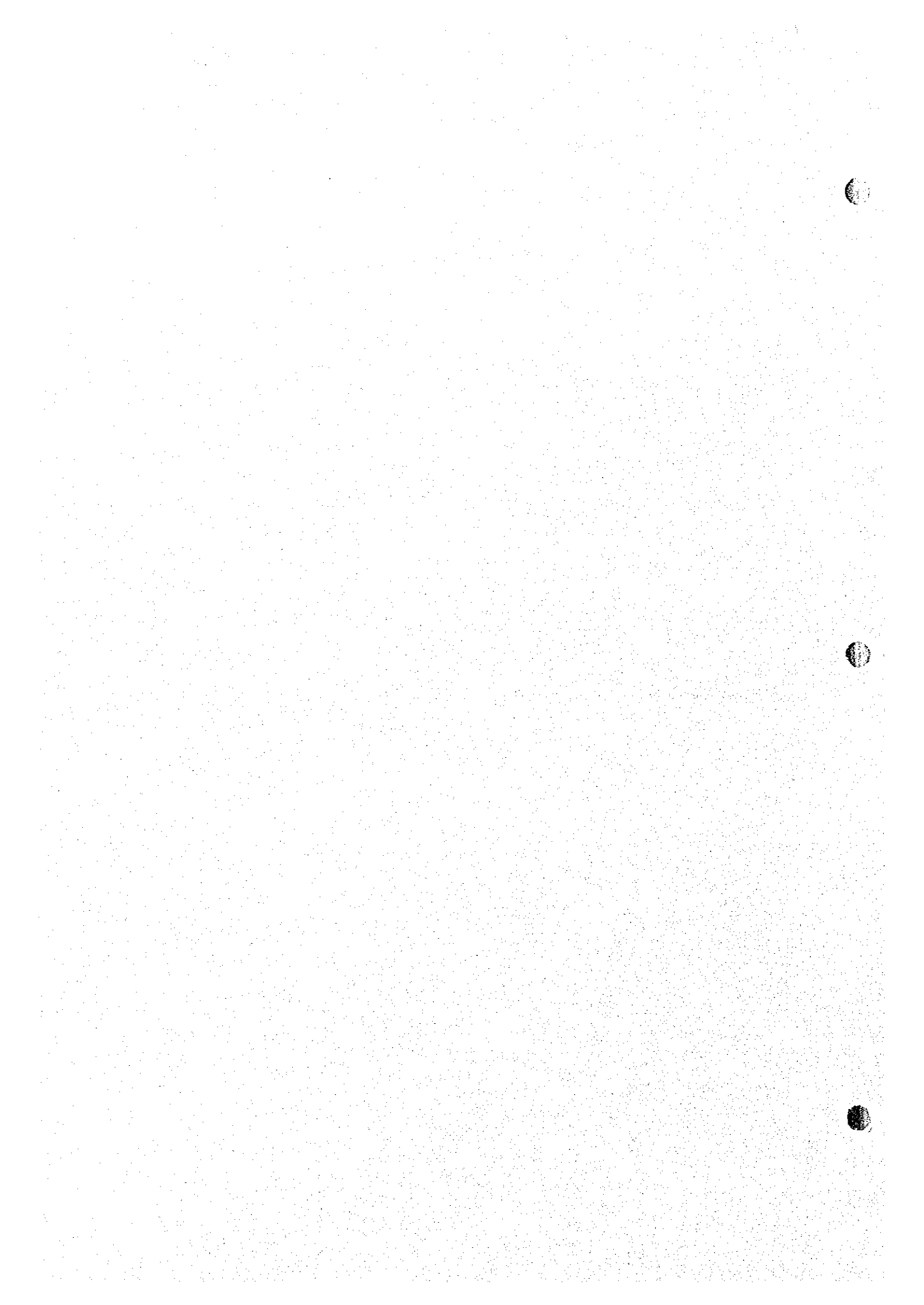
Table 11.3 Irrigation Consumer Surplus

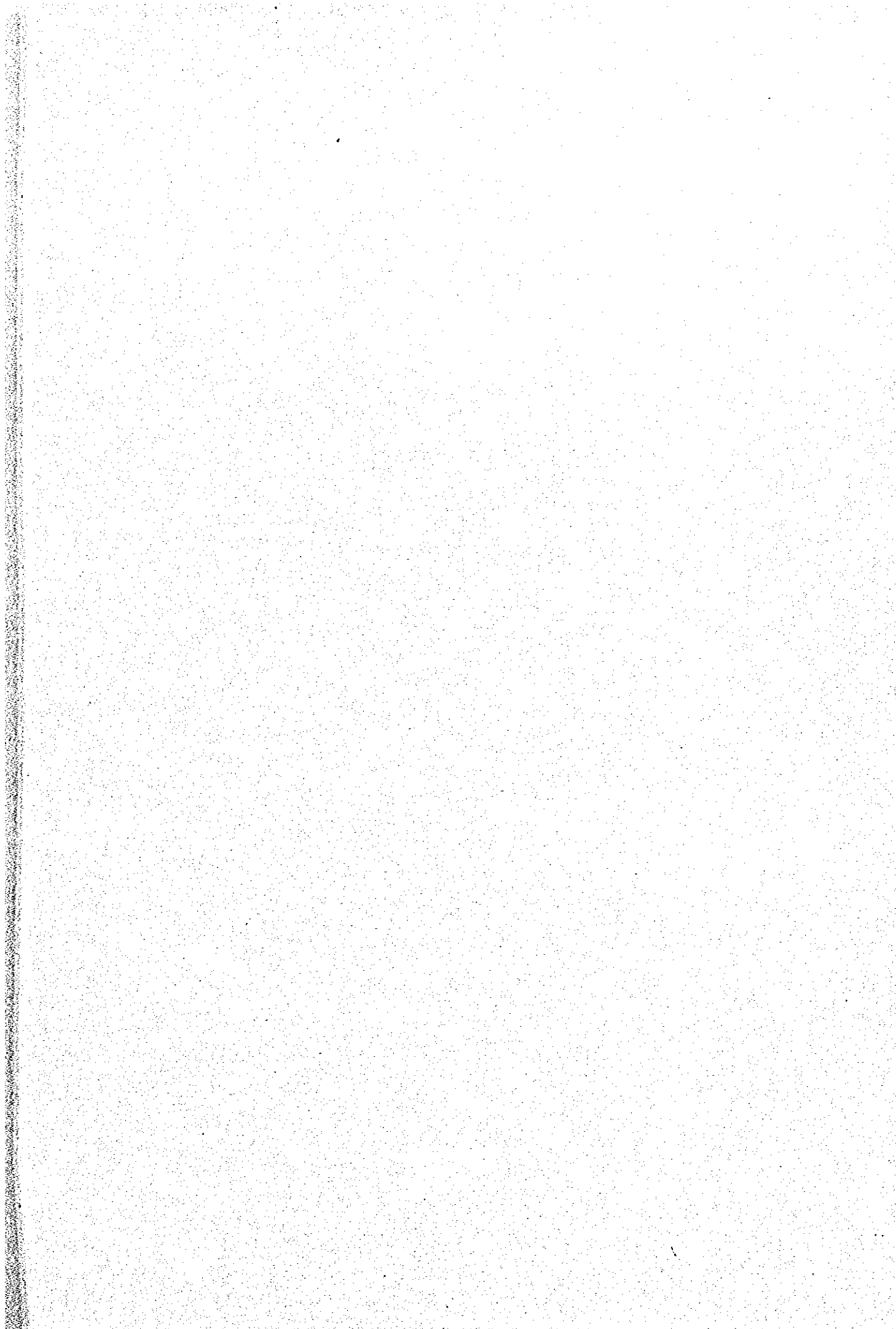
No.	Description	Unit	Electric	Equivalent Diesel	Average Diesel	Equivalent Electric
1	Average rating	hp	5	10	14	10
2	Capital Cost of the system	Rupees	17,500	27,000	38,000	31,500
3	Electric Wiring Cost	Rupees	1,000	0	0	500
4	Electric Connection Cost	Rupees	10,000	0	0	0
5	Operational Time	Hours	1,432	1,432	1,284	1,284
6	Utilization Factor	Percent	16	16	15	15
7	Energy Consumption	kWh/Year	5,001			9,579
		KWh/Month	417			798
8	Cost of Electricity at 2.74	Rs./Year	13,703			26,246
9	Diesel Oil Consumption	Litre/Hours		2	2	
10	Mobil Oil Consumption	Litre/Year		57	128	
11	Transportation Cost of Oils	Rs./Year		187	200	
12	Cost of Diesel	Rs./Year		27,716	34,792	
13	Cost of Mobil Oil	Rs./Year		2,578	5,778	
14	Repair & Maint. Charge	Rs./Year	167	251	200	125
15	Wages of Operator	Rs./Year	0	0	0	1,600
	Sub-total	Rs./Year	13,870	30,731	40,970	27,971
NPV						
0.12	Amortised Capital Cost	Rs./Year	2,343	4,779	6,725	4,217
	Amortized Connection Costs	Rs./Year	1,241		0	0
	Amortised Wiring Cost	Rs./Year	147		0	73
	Sub Total	Rs./Year	3,731	4,779	6,725	4,290
	Total Annual Cost		17,601	35,510	47,695	32,262
	Number of Case Studies		3		2	
	Annual Surplus Benefits	Rs./Year	17,909		15,433	
	Surplus Benefits as % of Cost of electricity		131%		59%	

Consumer surplus (weighted average): 102% of Electricity Cost









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