PART 5

Cost of Loadshedding to Agriculture Sector

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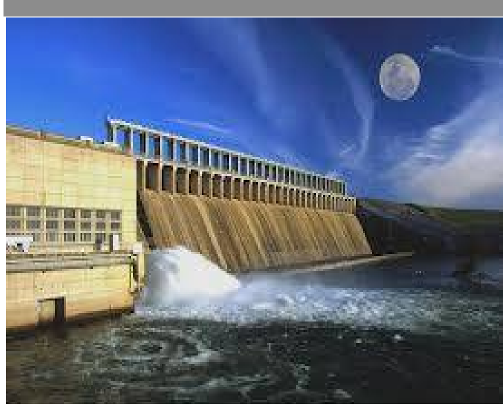

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ACRONYMS

DISCOs	Distribution Company
GST	General Sales Tax
HIES	Household Integrated Economic Survey
KESC	Karachi Electric Supply Corporation
K-PK	Khyber-Pakhtunkhwa
KWH	Kilowatt Hour
LDO	Light Diesel Oil
O & M	Operations and Maintenance
WTP	Willingness to Pay

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CHAPTER 1
INTRODUCTION

This part of the study presents the findings on costs of loadshedding to the agricultural sector of Pakistan and to rural households.

The report is organized in eight chapters. Chapter 2 presents the methodology used for quantification of costs due to outages. An estimate is also made of the cost of loadshedding on the basis of secondary data. Chapter 3 describes the survey including the sampling methodology. Chapter 4 gives the magnitude of the parameters like the incidence of outages, impact on water supply, loss of output, etc., leading to an estimate of the cost of outages in agriculture.

Chapter 5 quantifies the cost of outages in home-based economic activities and in domestic consumption. Chapter 6 presents proposals for an improved load management strategy while Chapter 7 highlights the suggestions made by sample units. Finally, Chapter 8 summarizes the key findings and the policy implications which emerge from the research.

CHAPTER2
METHODOLOGY

2.1 SECONDARY-DATA BASED METHODOLOGY AND ESTIMATES

Electricity consumers in agriculture are owners or renters of tube wells operated by electric motors, both public and private. Consumption for other purposes is shown in other categories of consumers.

Given secondary data availability, it is possible to get first estimate of the power outage costs in agriculture. These costs are designated as OC and derived on the following basis:

$$OC = q \,.\, t \,.\, e. \ell .V \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where

q = share of crop output from irrigated area in Pakistan

t = share of irrigated area that is irrigated by tube well

e = share of water from tube wells extracted by electric tube wells

ℓ = share of time lost due to loadshedding

V = share value added in the crop sector, both major and minor crops (in the absence of loadshedding)

The magnitudes of the above variables are derived below.

Estimate of q: the latest Agricultural Census of 2010 gives an estimate of the extent to which the cultivated area is irrigated, as follows:

Table 2.1
Distribution of Cultivated Area between Irrigated and Barani Area

(000 Hectares)

	Irrigated	% by Province	Barani	Province	Total	% by Province
Punjab	9425	65	1516	55	10941	63
	(86)[a]		(14)		(100)	
Sindh	2925	20	168	6	3093	18
	(95)		(5)		(100)	
K-PK	1111	8	691	25	1802	10
	(62)		(38)		(100)	
Balochistan	1016	7	397	14	1413	8
	(72)		(28)		(100)	
Pakistan	**14477**	**100**	**2771**	**100**	**17248**	**100**
	(84)		(16)		(100)	

Source: Agricultural Census, 2010

In order to derive the share of crop output of irrigated land, it is also necessary to know the difference in yield of individual crops between irrigated and barani area. This exercise has been undertaken for Punjab, where over 70 percent of the tube wells are located. Results are given in Table 2.2. It is estimated that the value added per acre in irrigated area is about 2.5 times the value added per acre in barani area. As such, about 93 percent of the value added of crops in Pakistan is generated in the irrigated areas of the country. Therefore, q = 0.93.

Table 2.2
Yield of Crops* in Irrigated and Barani Area of Punjab

Yield (tonnes per hectare)

	Irrigated	Barani	Ratio
Wheat	2.95	1.32	2.23
Maize	8.24	2.43	3.39
Gram	0.47	0.47	1.00

*Other crops like rice, sugarcane, cotton, vegetables and fruits are mostly grown on irrigated land.

Source: Punjab Development Statistics.

Estimate of t and e: The quantum of water provided by electric and diesel tube wells depends on their rates of capacity utilization. The average hours operated by each type of tube well are given in Table 2.3. It appears that although the number of electric tube wells is less, they are operated more intensively.

Table 2.3
Number of Hours Operated by Electric and Diesel Tube wells

	Unit	Electric	Diesel	Total
BY OWNER				
Number of Tube wells	’000	161	776	937
Hours per tube wells	Hrs	1104	625	
Total hours of use	Million hrs	**177.7**	**485.0**	**662.7**
BY RENTING				
Number of Tube wells	’000	48	142	190
Hours per tube wells	Hrs	597	316	
Total hours of Renting	Million hrs	**28.7**	**44.9**	**73.6**
Total Hours		**206.4**	**529.9**	**736.3**
Share	**%**	**28**	**72**	**100.0**

Source: Agricultural Statistics Year Book

As shown in Table 2.3, the share of electric tube wells in water extracted by tube wells is 28 percent.

Next, the share in water availability from different sources at the farm-gate is given in Table 2.4.

Table 2.4 Water Availability at Farm Gate due to Different Sources, 2010-11			
	Total Water Available (MAF)	**From Electric Tube wells (MAF)**	**Diesel Tube wells (MAF)**
Surface Water	**86.95**	**------**	**------**
Ground Water	**50.20**	**20.47**	**29.73**
Public Tube wells	8.91	8.91	--------
Private Tube wells	41.30	11.56	29.7
Total*	**137.15**	**20.47**	**29.73**
*Other sources make a very small contribution **28% as derived from table			
Source: Agricultural Statistics Year Book			

Therefore, from Table 2.4 we have that t = 0.37 and e = 0.41

Estimate of ℓ: The electricity consumption per agricultural consumer is given in Table 2.5. There has been fall after 2009-10 from 23365 kwh to 17714 kwh in 2011-12, a fall of 24 percent. As such, the magnitude of ℓ is assumed to 0.24.

Table 2.5 Electricity Consumption per Agricultural Consumer		
	Agricultural Consumers (Tube well)	**Growth Rate (%)**
2007-08	18130	
2008-09	23146	17.7
2009-10	23365	10.9
2010-11	20077	-14.1
2011-12	1714	-11.9
*Excluding Balochistan, with pre-dominantly deep water public tube wells Source: NEPRA, State of Industry Report, 2010		

Estimation of V: Net of the impact of loadshedding, the value added in the crop sector of Pakistan in 2011-12 is Rs 1574 billion. Given equation (1) we have from that q = 0.93, t = 0.37, e = 0.41 and ℓ = 0.24. **This implies that the cost of loadshedding to the agricultural sector of the country is Rs 55 billion**. This represents a production loss of 3.5 percent in the case of crops.

2.2 Primary–Data Based Methodology

The cost of outages is estimated for a farm which owns/rents an electric tube well, by first designating the following variables:

W_K = % reduction in number of rounds in kharif season due to power outages

W_R = % reduction in number of rounds in Rabi season due to power outages

O_K = % loss of output due to reduction in number of rounds in Kharif

O_R = % loss of output due to reduction in number of rounds in rabi

Then,

$O_K = f_k (w_K)$ and $O_R = f_R (w_R)$ …………………………………………… (1)

The cost of outages in the case of a farm with no stand-by generator is given by

$CO = O_K V_K + O_R V_R$ …………………………………………… (2)

Where,

V_K = value added by the farm from crops during Kharif season (in the absence of outages)

V_R = value added by the farm from crops during Rabi season (in absence of outages)

Virtually all the farms in the sample did not have a stand-by generator. Therefore, the operative methodology is given by (2).

CHAPTER 3
THE SAMPLING FRAMEWORK AND ITS DISTRIBUTION

Implementation of the methodology for estimation of the cost of power outages in agriculture requires the collection of data from a sample of farmers in Pakistan. The approach adopted to selection of the sample and the resulting sample distribution is described below.

3.1 THE SAMPLING APPROACH

The limitation of funds for the study restricted the national sample size to only 250 farmers. Random sampling would have severely limited the number of farmers with electric tube wells. Therefore, a purposive sampling approach was adopted. An attempt was made to ensure that at least one-third of the farmers sampled had electric tube wells. This involved more search for the appropriate farmers in the villages covered during the survey. The resulting sample is given in Table 3.1.

Following edit checks, 240 sample farms have been analyzed to determine costs of outages. A comparison of the population and sample size distribution is given in Table 3.2.

Table 3.1
Sample Size and Distribution

	Number of sample Farms	% of Sample	Number of Farms with electric Tube wells	% Sample Farms
Province				
Punjab	125	50	43	34
Sindh	60	24	23	38
K-PK	40	16	13	32
Balochistan	25	10	15	60
Size of Farm (Cropped Area)				
0-10	18	7	1	6
10-25	70	28	24	34
25-50	87	35	36	41
50-100	53	21	27	51
100^+	22	9	6	27
Total	**250**	**100**	**94**	**38**

Table 3.2
Comparison of the Population and Sample Size Distribution of Farms

(%)

	Population Distribution	Sample Distribution
Farm Size (Cropped Area)		
0-10	78	1
10-25	18	23
25-50	3	40
50-100	0.8	30
100^+	0.2	6
Total	**100.0**	**100**

Therefore, the sample is concentrated in medium-sized and large farms who are more likely to own tube wells.

The distribution of the original sample by districts within a province is given in Table 3.3. Surveyors were instructed to select villages which were near or for away from the district road network.

Table 3.3
Distribution of Sample by Districts

Province/District	Sample Size	Province/District	Sample Size
Punjab	**125**	Sukkur	25
Lahore	40	**K-PK**	**40**
Faisalabad	20	Peshawer	20
Sialkot	10	Mardan	10
Gujranwala	10	Abbottabad	6
Multan	30	Bannu	4
Rawalpindi	15	**Balochistan**	**25**
Sindh	**60**	Quetta	25
Karachi	10	**-**	**-**
Hyderabad	25	**Total**	**250**

CHAPTER 4
COST OF OUTAGES IN AGRICULTURE

The primary cost of outages in agriculture is the impact on output of crops due to reduction in water availability arising from a reduction in the number of hours operated by electric tube wells. The methodology of estimating accordingly the cost of outages is given in chapter 2 and is applied below.

4.1 SOURCE OF IRRIGATION

For the total sample of 240 farms, the distribution of sources of irrigation is given below:

The analysis has not been conducted by province because of the small number of tube well owners in the provinces of Sindh, K-PK and Balochistan. The share of tube wells is higher because of the purposive nature of the sample chosen.

Table 4.1
Distribution of Sample Farms by Sources of irrigation

(%)

	Kharif	Rabi
Canal	47	46
Tube well + Canal Tube well	38	38
Other	15	16
Total	**100**	**100**

4.2 TYPE OF TUBE WELLS

Table 4.2 gives the presence of owning or renting of electric tube wells in farms of different sizes. The incidence of use of electric tube wells is the highest in the case of farms between 25 and 100 acres of cropped area. This group of farmers is generally considered as 'progressive' in terms of use of inputs and agricultural practices.

Table 4.2
Incidence of Use of Electric Tube wells

Cropped Area (Acres)	Sample Size	Using Tube wells (Electric)	(%)
0-10	18	1	6
10-25	65	21	32
25-50	82	36	44
50-100	53	27	51
100 +	22	6	27
Total	**240**	**91**	**38**

4.3 INCIDENCE OF LOADSHEDDING

The incidence of loadshedding during working hours on farm is given in Table 4.3. It appears that farms using electric tube wells lose about 27 percent of the working hours in outages.

Table 4.3
Incidence of Loadshedding during Working Hours on Farm

Cropped Area (Acres)	(farms with electric tube wells)	(hours annually)	
0-10	674	2441	28
10-25	664	2240	30
25-50	669	2702	25
50-100	901	3182	28
100 +	1011	4012	25
Total	**716**	**2693**	**27**

The incidence of loadshedding appears to be the highest in Balochistan al almost 62 percent, followed by the other three provinces at close to 23 percent.

4.4 REDUCTION IN OUTPUT

The reduction in number of water rounds and the consequent loss of output in farms using electric tube wells is given in Tables 4.4 and 4.5 respectively.

The extent of production losses correspond closely to the incidence of loadshedding as hardly any sample farm has a standby generator/motor.

Table 4.4
Reduction in Number of Water Rounds due to Power Outages
(Farms using Electric Tube wells)

	Kharif			Rabi		
Farm Cropped Area (Acres)	**Average Number of Rounds (actual)**	**Reduction in Number of Rounds due to Outages (actual)**	**% (Reduction)**	**Average Number of Rounds (actual)**	**Reduction in Number of Rounds due to Outages (actual)**	**% (Reduction)**
0-10	4.00	2.00	33.3	9.00	2.00	18.2
10-25	6.29	2.71	30.1	8.19	3.62	30.6
25-50	5.11	1.94	27.5	7.97	2.83	26.2
50-100	5.37	1.81	25.2	8.44	3.11	26.9
100 +	5.00	1.83	26.8	10.83	5.17	32.3
Total	**5.44**	**2.08**	**27.7**	**8.36**	**3.24**	**27.9**

Table 4.5
Extent of Production Loss* due to Reduction in Water Rounds
(Farms using Electric Tube wells)

(%)

Farm Cropped (Acres)	Kharif	Rabi
0-10	30.0	30.0
10-25	28.6	25.6
25-50	26.1	23.4
50-100	25.3	23.6
100 +	31.6	23.8
Total	27.0	24.1

4.5 COST OF OUTAGES

The resulting loss of value added from cultivation of crops, both major and minor, is given in Table 4.6. There does not appear to be much variation by from size in the percentage of crop value added lost due to outages.

Table 4.6 Loss of Value Added due to Outages (Farms using Electric Tube wells) (000 Rs per farm)			
Farm Cropped (Acres)	**Loss of Value Added**	**Value Added (in the absence of outages)**	**% Loss**
0-10	37	153	24
10-25	113	453	25
25-50	89	386	23
50-100	146	620	24
100 +	264	1023	26
Total	**122**	**510**	**24**

It appears that almost one-fourth of crop output is lost by farms using electric tube wells. This is a high percentage of loss. On the average, the outage cost per acre of cropped area is estimated at approximately Rs 2650.

4.6 NATIONAL ESTIMATE OF OUTAGE COSTS

The sample has been adjusted in Table 4.7 to reflect the population distribution of farms by size on the basis of the Agricultural Census of 2010. It is estimated that there are approximately 1 million farms in the country which either own or rent an electric tube well. This implies that on average over four farmers use an electric tube well.

Table 4.7 Cost of Loadshedding in Agriculture					
Cropped Area* (Acres)	**Number of Farms (000)**	**% using Electric Tube wells**	**Number using Electric Tube well (000)**	**Loadshedding Cost per Tube well ('000)**	**Loadshedding Cost (Rs in Billion)**
0-10	6446	6	387	37	14.3
10-25	1240	32	397	113	44.9
25-50	372	44	164	89	14.6
50-100	165	51	84	146	12.2
100 +	41	27	11	264	2.9
Total	**8264**		**1043**		**88.9**
*On average farm size is 75 % of cropped area (both seasons combines) Source: Agricultural census, 2010					

Almost 75 percent of farms using tube wells are relatively small, with cropped area upto 25 acres, and account for two-third of the national cost of outages in the agricultural sector. **Overall, the national outage in agriculture cost is Rs 89 billion** in 2011-12. This is significantly higher than the magnitude estimated from secondary data of Rs 55 billion. The estimated amount of electricity not supplied is 3066 kwh. This implies from the former estimate that the outage cost per kwh is Rs 29 (29 cent).

CHAPTER 5
OTHER COSTS OF OUTAGES

The survey carried out of farmers has also enabled determination of outages costs in home-based activities and in domestic consumption of electricity.

5.1 HOME-BASED ECONOMIC ACTIVITIES

The incidence of home-based economic activities in the sample households is given in Table 5.1 along with the nature of adjustment of these activities to outages. It appears that the only activity which is significant impacted by loadshedding is milking of animals.

Table 5.1
Incidence of Home-based Economic Activities in Sample Farms and Nature of Adjustment (with use of electricity)

Activity	% of household	% making alternative arrangements*
Stitching	11	60
Embroidery	5	65
Milking	33	46
Grinding	2	100
Crushing	10	100
Churning	7	100
Poultry	9	100
Others	2	100

*Primarily changing timing of activities

The estimated value added in milk production on average per farm is Rs 10,000 per month. Sample farms have reported that they lost 17 percent of their milk output due to outages. Given there are **83** million farms in the country, the cost of outages in milking activity, COML, is given by

$$COML = 0.33 \times 0.54 \times 0.17 \times 10000 \times 12 \times 8.3 \quad \text{million Rs}$$

$$COML = 30172 \text{ million rupees}$$

That is, $COML \cong 30$ billion rupees

5.2 DOMESTIC CONSUMPTION OF ELECTRICITY

The survey of households in the rural areas of Pakistan revealed that there is little or no use of generators. As such, we have relied on the willingness to-pay approach to estimate the costs of loadshedding in domestic consumption.

On the average, the sample households revealed that they are willing to pay an extra **50** percent to avoid outages.

The estimated number of rural households in Pakistan in 2011-12 is domestic consumption in the country. This implies that the average annual electric consumption per rural household is **436** kwh annually. At this level, the power tariff is approximately Rs --- per kwh. As such the cost of outages in domestic consumption by households is given by CODC where

$$CODC = 0.27 \times 436 \times 15.4 \times 8.00 \times = 14314 \text{ million Rs}$$

That is, $CODC \cong$ Rs 14 billion

This is based on the incidence of outages at 27 percent of the time and that 88 percent of rural households have access to electricity.

Table 5.2
Total Outage Cost

	(Rs in Billion)
Cost of Outages in: Agriculture	89
Home-based economic activities	30
Domestic consumption	14
Total	**133**

5.3 TOTAL COST OF OUTAGES

In summary, the total cost of power outages in the rural areas of Pakistan are given in Table 5.2. **The outage costs aggregate to Rs 133 billion in the rural areas of the country.**

CHAPTER 6
LOAD MANAGEMENT STRATEGY

The questionnaire contains a module to solicit consumer preferences regarding timing of loadshedding which can reduce the costs and disruptions due to the outages. These can provide guidance to the load management strategy by DISCOs, the formulation of which should be a priority since loadshedding is likely to persist over the next few years.

6.1 LEVEL OF SATISFACTION WITH CURRENT LEVEL OF SERVICE

The survey teams enquired from the respondents if they were satisfied with the current level of service by the DISCOs/KESC. Almost two-thirds of the respondents ranked their satisfaction level as very low while more than one-quarter ranked it as low (see Table 6.1) while almost one-third of the respondents in Sindh appear moderately satisfied with the service level, the proportion is much lower in the other provinces. Also, there are indication of a decline with the level of satisfaction with the economic well-being of the respondent.

Table 6.1
Level of Satisfaction with Current quality of Service by DISCOs/KESC

(%)

	High	Medium	Low	Very Low
By Province				
Punjab	0	4	26	70
Sindh	0	32	44	24
KPK	3	0	15	83
Balochistan	0	0	16	84
Total	**0**	**9**	**27**	**64**
By Farm Size				
0-10	6	6	6	83
10-25	0	9	22	69
25-50	0	6	27	67
50-100	0	13	32	55
100 +	0	9	50	41
Total	**0**	**9**	**27**	**64**

The sample for respondents was also asked how much lower tariff should they be paying for the existing level of service, with loadshedding. This provides the first estimate of the respondent's perception of the cost of loadshedding. On an average, respondents felt that they should pay 28 percent less than what they currently are for the existing quality of service with interrupted power supply as revealed by Table 6.2. The highest reduction is suggested in Punjab, 38 percent, and the large landlords, 40 percent.

Table 6.2 How much lower Tariff for existing level of Service	
	Percentage
By Province	
Punjab	38.4
Sindh	21.3
KPK	15.5
Balochistan	12.0
Total	**28.3**
By Farm Size	
0-10	16.4
10-25	24.6
25-50	30.3
50-100	29.0
100 +	40.2
Total	**28.3**

6.2 PREFERRED CHANGES IN TIMINGS OF LOADSHEDDING

One-thirds of the sample units prefer midnight to 6:00 am for loadshedding, probably because though it impacts sleep but does not affect the economic activities. Loadshedding during 6 pm to midnight is preferred by 28 percent of the respondents while 22 percent prefer loadshedding in morning hours. The preference pattern in the smaller provinces appears different from Punjab and Sindh. In Balochistan and K-PK, loadshedding unambiguously is preferred in the morning hours (see Table 6.3). Also, preferences differ with the economic well being. While respondents

Table 6.3
Preference of Loadshedding Time
(%)

	Rank				
	6am-12 Noon	**12Noon-6:00pm**	**6 pm-Midnights**	**Midnight-6am**	**Total**
By Province					
Punjab	6	19	36	37	100
Sindh	12	14	32	42	100
KPK	45	3	15	38	100
Balochistan	84	4	4	8	100
Total	**22**	**14**	**28**	**35**	**100**
By Farm Size					
0-10	50	17	11	22	100
10-25	43	17	11	29	100
25-50	15	10	33	40	100
50-100	4	11	38	47	100
100 +	9	23	55	14	
Total	**22**	**14**	**28**	**35**	**100**

cultivating smaller area prefer loadshedding in morning hours, respondents with large cultivated areas prefer it in evenings or night.

Respondents were equally divided when enquired about the preferred type of loadshedding. Half preferred longer but fewer outages each time and half preferred shorter each time but more outages (see Table 6.4). It appears that in Punjab and Balochistan longer but fewer outages are preferred while in Sindh and K-PK the opposite holds. Likewise, while medium sized cultivators prefer longer but fewer outages, the small and large cultivators prefer shorter but more frequent outages.

Table 6.4.
Preference for the Type of Loadshedding

(%)

	Longer each time but fewer outages	**Shorter each time but more outages**	**Total**
By Province			
Punjab	63	37	100
Sindh	38	62	100
KPK	18	83	100
Balochistan	52	48	100
By Farm Size			
0-10	44	56	100
10-25	43	57	100
25-50	56	44	100
50-100	53	47	100
100 +	36	64	100
Total	**49**	**51**	**100**

Around one-third of the respondents indicate that it will be helpful if the power companies provided more information relating to the scheduling of the outage; methods to lower the electricity- intensity of operations; monthly fixation of schedule of loadshedding to better manage the outages and how to work more efficiently under the circumstances (see Table 6.5). Clearly, these should be focused upon in the load management strategy of the distribution companies.

Table 6.5
Information that can be provided by Distribution companies

	Percentage
Information regarding loadshedding schedule	65
Use media to minimize consumption at peak timing	61
Fixed schedule for one month at least for better management	40
Awareness about outage adjustment system	7
Use energy saver instead of heavy bulbs	2

CHAPTER 7
SUGGESTIONS BY THE SAMPLE UNITS

The questionnaire at the end solicited the respondent's views/ suggestions to help handle the loadshedding problem in the country. Specifically, the open ended question asked for "suggestions to reduce the costs of loadshedding". A number of interesting suggestions emanate from the survey responses. These can be categorized as relating to the following:

- Enhancing the supply of electricity
- Alternative sources of energy/ fuel use
- Improving governance or management
- Changes in pricing policy, and
- Alternate sources of water

Enhancing the Supply of Electricity: The highest numbers of respondents, 15 percent are of the view that new dams, including Kala Bagh Dam, should be constructed to permanently enhance the production of electricity in the country at lower cost (see Table 7.1). Building new power plants is the other significant suggestion to curb power shortages in Pakistan.

Table 7.1
Suggestions by Sample Units by Province
(% of Respondents)

Reasons	Punjab	Sindh	KPK	Balochistan	Total
Enhancing Supply of Electricity					
Construct new Dams (including Kala Bagh Dam)	20	12	5	16	**15**
Build new power plants	17	6	0	0	**10**
Alternative Energy Fuel Sources					
Use nuclear technology for generation	17	8	0	8	**11**
Introduce solar energy System	45	50	58	56	**49**
Introduce Wind Energy	24	4	0	8	**14**
Governance/Management					
Privatize Electric department	10	0	0	0	**5**
Minimize electric theft	1	0	0	0	**0**
Stop Corruption	5	12	13	8	**8**
Pricing Policy					
Government give subsidy on electricity	42	24	25	48	**36**
Fixed minimum price for water	19	10	15	8	**15**
Give subsidy on water	31	24	35	32	**30**
Alternative Supply of Water					
Need proper canal water system	22	26	40	32	**27**
Provide minimum water for irrigation	28	38	40	20	**31**

Alternative sources of Energy Fuel for Energy: A number of suggestions have been given regarding resort to alternative energy and fuel sources by the respondents. Almost half the respondents suggested the introduction of solar energy systems while 14 percent and 11 percent respectively suggested the use of wind energy and nuclear energy.

Improving Governance/Management. Recommendations in this category include: privatization of DISCOs; curb corruption, and; minimization of electricity theft.

Pricing Policy: A number of recommendations emanate in this category. Over one-third of the respondents requested for subsidy for electricity from the government, while 30 percent of the respondents suggested that there should be a subsidy on water. 15 percent suggested a fixed minimum price for irrigation water.

Alternative Supply of Water: Over one-quarter of the respondents recorded the request for proper supply of timely canal water so that their dependence on tube wells is correspondingly reduced. Almost 31 percent have also demanded minimum water for cultivation purposes.

To conclude, the top five suggestions emanating from the respondents of the survey are as following:

First: Introduce solar energy
Second: Government subsidy on electricity
Third: Ensure minimum water for irrigation
Fourth: Subsidy on water
Fifth: Ensure proper supply of canal water.

CHAPTER 8
CONCLUSIONS AND POLICY IMPLICATIONS

8.1 CONCLUSIONS

The research has yielded the following results:

i. Application of a methodology based on secondary data yields an estimate of the costs of power loadshedding in agriculture of Rs 55 billion, equivalent to a loss in value added by crops of 3.5 percent.
ii. The survey of 250 farmers indicates that 27 percent of the working hours on farm are lost due to outages in the case of farms owning/renting electric tube wells.
iii. The cost of outages, as quantified from the survey is Rs 89 billion, equivalent to over 5.5 percent of crop value added. This is significantly higher than the estimate from secondary data.
iv. The outage cost is estimated at Rs 29 (29 cents) per kwh in agriculture
v. The home-based economic activity impacted significantly by outages is milking of animals. The estimated cost is Rs 30 billion. The cost of outages in terms of domestic consumption in rural areas is Rs 14 billion.
vi. Overall, the total cost of power loadshedding in rural areas of Pakistan in 2011-12 is Rs 133 billion.

8.2 POLICY IMPLICATIONS

A number of policy implications emerge from the research as follows:

Development of Alternate Technology: A large number of respondents have emphasized on the access to solar and wind energy for operating tube wells. This makes eminent sense given the dispersal of villages, especially in Balochistan. As an incentive all equipment for solar or wind energy should be both duty free and exempted from GST.

Improvement of Irrigation System: Many farmers have highlighted the need for improvement in canal water supplies in order to reduce the dependence on underground water. Provincial governments must attach greater priority to regular and proper O & M of the irrigation network and lining of canals to reduce water losses.

Substitution by Diesel Tube wells: In 2007-08, the share of electric tube wells in private tube wells was 14 percent, with the remainder, 86 percent, being operated by diesel. This has increased to 17 percent by 2010-11 despite the high incidence of outages. The reason for this is the upsurge in the price of LDO which was 60 percent of the price of motor spirit in 2008. Now the price is almost the same. It is necessary to reduce the price of the LDO to make the operation of diesel tube wells more economic.

Incentive for Self-Generation: It has been observed in the survey that hardly any farm has self-generation. As recommended elsewhere the purchase of small generators should also be exempted from GST.

Moratorium on Village Electrification: Despite the severe shortage in availability of electricity in rural areas, the program of village electrification continues unabated. Between 2007-08 and 2010-11 power has been supplied to an additional 36,606 villages/sub-villages. This is exacerbating the problem of loadshedding.