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Energy data collection by survey and its comparison with bill data

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ABSTRACT

In the Implementation of any electrical power generation project, the basic requirement is the total electrical energy demand estimation. In order to estimate the total electrical energy demand, various methods can be used but neither of those methods can give the exact demand. Therefore approximate analysis of energy demand is always taken in to the consideration. In this study three villages are selected in Rajasthan state and electrical energy demand of those villages is estimated. For the estimation of energy demands two sources of data are taken in to consideration. i.e. survey data and bill data. Survey data is collected by a quessionaire based survey and bill data are taken from electricity Distribution Company for the three selected village. On the basis of these two data, energy consumption parameters such as Energy consumption of village in MWh/annum, Energy consumption of family in kWh/annum, Per capita Energy consumption in kWh/annum, Energy consumption of village in MWh/month, Energy consumption of family in kWh/month, Per capita Energy consumption in kWh/month and Average Power in kW/month are calculated for each village .these energy consumption parameters are calculated in both the cases i.e. by using survey data and by using bill data, and comparison has made in tabular manner as well as graphical manner in order to observe deviation between the parameters properly.

1. INTRODUCTION

Jhar, Mansarkheri and Khijooriya jatan are the three selected villages for the study which are located in Bassi sub division of Jaipur district in Rajasthan (latitude **26˚83'N**, longitude **76˚05'E,** altitude **351 m**).

Prasad et al. [1] showed an overview about the different facets of planning of energy with the help of various literatures. They showed the uncertainties, errors and risks which are involved in very well manner with the energy planning and continuously affecting the planning results. **Urmee et al. [2]** presented a study in which they showed the reasons of slow progress of renewable energy technologies based electrification. They suggested on the basis of literature reviewed on renewable energy based electrification that better coordination is very much required between the national level agencies and regional agencies which are actively involved in the development and the implementation of renewable energy based electrification program. **Kautto and Peck [3]** examined the potential of Biomass planning at regional level to support the Biomass planning at national level, European Union target achievement and addressing the concerns which are involved with increased bio energy production. **Singh [4]** presented a study which investigated the commercial availability of the biomass from the agricultural activities in Punjab in order to generate power from distributed power generation facilities. He estimated the total production of crop generated residues which is 55.396 Mt. Out of this total crop residue around 40.17% which is 22.315 Mt is found to be surplus which can be used as biomass in power plants for the generation of electricity

Bhandari and Jana [5] presented the impacts of characteristics of individual rural households on the priority of electrical energy from solar energy based system. This study is based upon the rural energy survey which is conducted in a coastal village of Indian sundarban. **Ishan and Pallav [6]** evaluated the solar power generation based on concentrating technology (CSP), technically as well as financially in India. They concluded that CSP based power generation facilities are financial feasible for selected part of India like north-western part especially Rajasthan and Gujarat states.

2. DATA COLLECTION AND COMPARISION

Energy consumption data of the villages Jhar, Mansarkheri and Khi.Jatan is collected by questionnaire based survey. In each village 50 households are selected in equal proportion of lower income group, moderate income group and higher income group in order to maintain reliability of the study and for better analysis and data is collected. The population related data of villages is also collected from Census Authority of the Rajasthan in which the population of the three villages is mentioned and tabulated in **table-1.**

Table-1: Population data

Particulars/Village	Jhar	Mansarkheri	Khi. Jatan
Households	757	513	198
Population	4683	3662	943

Table-2: Energy data collected by Survey

Village	Jhar			Mansarkheri			Khi. Jatan		
Household No.	Bi-monthly Avg	Monthly Avg	Annual	Bi-monthly Avg	Monthly Avg	Annual	Bi-monthly Avg	Monthly Avg	Annual
1	100	50	600	100	50	600	100	50	600
2	50	25	300	300	150	1800	100	50	600
3	100	50	600	100	50	600	200	100	1200
4	100	50	600	500	250	3000	100	50	600
5	200	100	1200	200	100	1200	100	50	600
6	30	15	180	200	100	1200	400	200	2400
7	100	50	600	100	50	600	100	50	600
8	100	50	600	300	150	1800	150	75	900
9	300	150	1800	150	75	900	100	50	600
10	100	50	600	200	100	1200	100	50	600
11	100	50	600	500	250	3000	100	50	600
12	50	25	300	100	50	600	100	50	600
13	200	100	1200	200	100	1200	100	50	600
14	200	100	1200	100	50	600	300	150	1800
15	100	50	600	500	250	3000	50	25	300
16	50	25	300	200	100	1200	100	50	600
17	100	50	600	150	75	900	100	50	600
18	300	150	1800	500	250	3000	100	50	600
19	150	75	900	100	50	600	100	50	600
20	200	100	1200	200	100	1200	100	50	600
21	100	50	600	500	250	3000	50	25	300
22	100	50	600	50	25	300	100	50	600
23	250	125	1500	50	25	300	100	50	600
24	100	50	600	100	50	600	100	50	600
25	100	50	600	100	50	600	200	100	1200
26	200	100	1200	100	50	600	100	50	600
27	500	250	3000	100	50	600	150	75	900
28	300	150	1800	50	25	300	150	75	900

29	50	25	300	100	50	600	100	50	600
30	100	50	600	100	50	600	150	75	900
31	50	25	300	100	50	600	100	50	600
32	50	25	300	50	25	300	150	75	900
33	150	75	900	50	25	300	300	150	1800
34	100	50	600	300	150	1800	100	50	600
35	150	75	900	150	75	900	400	200	2400
36	150	75	900	50	25	300	300	150	1800
37	350	175	2100	150	75	900	200	100	1200
38	400	200	2400	100	50	600	100	50	600
39	500	250	3000	400	200	2400	50	25	300
40	350	175	2100	50	25	300	100	50	600
41	250	125	1500	150	75	900	100	50	600
42	500	250	3000	1000	500	6000	50	25	300
43	100	50	600	100	50	600	100	50	600
44	300	150	1800	100	50	600	100	50	600
45	150	75	900	50	25	300	100	50	600
46	200	100	1200	50	25	300	100	50	600
47	100	50	600	50	25	300	100	50	600
48	200	100	1200	50	25	300	100	50	600
49	50	25	300	100	50	600	100	50	600
50	100	50	600	50	25	300	100	50	600
P	8630	4315	51780	9050	4525	54300	6550	3275	39300
Q	172.6	86.3	1035.6	181	90.5	1086	131	65.5	786
R	130.66	65.33	783.95	92.85	46.43	557.12	25.94	12.97	155.63
S	27.90	13.95	167.40	25.36	12.68	152.13	27.51	13.75	165.03

P-Consumptions of 50 households in kWh, Q-kWh per family, R-Total consumption of village in MWh, S-Per capita consumption in kWh

Table-3: Bill data for village Jhar

Household No.	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec	Annual	Monthly Avg
1	96	95	98	17	100	100	506	42.17
2	43	28	74	32	40	52	269	22.42
3	40	30	79	100	100	100	449	37.42
4	80	89	122	105	215	401	1012	84.33
5	237	104	393	92	192	279	1297	108.08
6	6	12	10	30	22	17	97	8.08
7	100	100	100	100	100	100	600	50.00
8	100	100	100	100	100	100	600	50.00
9	276	189	440	333	248	549	2035	169.58
10	30	82	55	45	67	826	1105	92.08
11	61	48	142	173	84	237	745	62.08
12	0	0	0	100	100	1	201	16.75
13	241	61	227	423	198	274	1424	118.67
14	209	512	223	48	233	408	1633	136.08
15	100	100	100	100	100	100	600	50.00
16	100	51	32	8	33	40	264	22.00
17	109	101	51	98	72	150	581	48.42

18	100	134	100	400	947	350	2031	169.25
19	97	33	40	186	186	216	758	63.17
20	42	15	117	198	617	54	1043	86.92
21	117	100	117	117	117	117	685	57.08
22	9	75	100	100	100	100	484	40.33
23	193	132	524	211	412	406	1878	156.50
24	31	150	108	9	208	84	590	49.17
25	109	149	164	41	123	153	739	61.58
26	88	52	324	303	206	141	1114	92.83
27	254	208	1170	873	1124	713	4342	361.83
28	228	32	434	233	150	1075	2152	179.33
29	32	100	84	27	52	34	329	27.42
30	100	100	100	100	100	100	600	50.00
31	5	30	39	3	35	98	210	17.50
32	36	75	46	33	134	143	467	38.92
33	137	150	150	150	150	150	887	73.92
34	0	200	100	115	99	107	621	51.75
35	100	49	152	299	225	87	912	76.00
36	114	167	129	127	150	150	837	69.75
37	253	120	673	242	597	756	2641	220.08
38	126	260	912	586	391	391	2666	222.17
39	79	121	101	111	100	2400	2912	242.67
40	174	87	704	470	219	462	2116	176.33
41	105	105	375	387	339	257	1568	130.67
42	403	364	651	339	1065	411	3233	269.42
43	82	88	150	47	171	210	748	62.33
44	219	87	342	80	394	237	1359	113.25
45	100	100	100	255	146	108	809	67.42
46	343	447	756	97	79	117	1839	153.25
47	100	100	100	75	100	100	575	47.92
48	63	80	69	82	100	1050	1444	120.33
49	68	18	51	45	62	37	281	23.42
50	44	52	38	100	100	390	724	60.33
P	5779	5682	11266	8345	11002	14938	57012	4751
Q	115.58	113.64	225.32	166.9	220.04	298.76	1140.2	95.02
R	87.49	86.03	170.57	126.34	166.57	226.16	**863.16**	71.93
S	18.68	18.37	36.42	26.98	35.57	48.29	184.32	15.36

Table-4: Bill data for village Mansarkheri

Household No.	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec	Annual	Monthly Avg
1	99	99	90	99	67	100	554	46.17
2	192	131	58	504	275	777	1937	161.42
3	69	149	39	142	102	19	520	43.33
4	280	282	202	654	706	979	3103	258.58
5	106	123	152	354	116	488	1339	111.58
6	411	214	272	80	414	336	1727	143.92
7	145	79	73	274	125	124	820	68.33
8	243	152	71	612	490	466	2034	169.50
9	114	92	99	176	116	206	803	66.92
10	204	183	90	209	422	274	1382	115.17
11	185	596	390	625	900	878	3574	297.83
12	33	10	11	73	97	138	362	30.17
13	98	459	35	295	139	226	1252	104.33
14	172	31	40	150	150	233	776	64.67
15	1494	187	70	683	608	316	3358	279.83
16	128	133	158	510	94	302	1325	110.42
17	302	240	255	0	300	150	1247	103.92
18	583	312	257	508	754	588	3002	250.17
19	100	100	100	135	66	206	707	58.92
20	251	178	154	222	105	300	1210	100.83
21	395	121	282	887	409	930	3024	252.00
22	92	47	71	62	88	52	412	34.33
23	52	35	30	100	68	82	367	30.58
24	96	65	15	119	83	129	507	42.25
25	87	66	74	100	96	56	479	39.92
26	152	19	18	94	100	175	558	46.50
27	63	23	37	191	227	166	707	58.92
28	91	100	35	36	2	49	313	26.08
29	27	118	15	119	46	68	393	32.75
30	65	47	46	266	104	147	675	56.25
31	150	150	100	127	8	150	685	57.08
32	42	21	7	16	10	10	106	8.83
33	28	37	20	18	9	22	134	11.17
34	379	186	54	578	242	583	2022	168.50
35	80	71	44	292	91	270	848	70.67
36	5	13	6	62	18	7	111	9.25
37	180	179	122	99	121	167	868	72.33
38	15	100	100	100	100	100	515	42.92
39	380	888	387	820	238	134	2847	237.25
40	74	81	27	47	6	39	274	22.83
41	156	115	58	206	145	204	884	73.67
42	85	3630	1858	90	15	49	5727	477.25
43	95	68	53	100	62	332	710	59.17
44	82	60	83	91	8	201	525	43.75
45	23	39	64	138	59	82	405	33.75
46	95	1	69	213	29	121	528	44.00
47	42	10	26	23	72	21	194	16.17

48	99	72	29	90	33	13	336	28.00
49	16	58	55	100	100	100	429	35.75
50	36	150	7	65	43	63	364	30.33
P	8391	10320	6408	11554	8678	11628	56979	4748
Q	167.82	206.4	128.16	231.08	173.56	232.56	1139.6	94.97
R	86.09	105.88	65.75	118.54	89.04	119.30	**584.60**	48.72
S	23.51	28.91	17.95	32.37	24.31	32.58	159.64	13.30

Table-5: Bill data for village Khijooriya jatan

Household No.	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec	Annual	Monthly Avg
1	152	66	59	93	172	126	668	55.67
2	295	65	48	63	65	82	618	51.50
3	100	100	100	178	1012	236	1726	143.83
4	100	100	100	100	100	100	600	50.00
5	100	225	26	55	381	218	1005	83.75
6	887	38	1009	487	537	423	3381	281.75
7	1	278	322	87	130	108	926	77.17
8	95	43	305	174	134	52	803	66.92
9	1	9	100	100	100	100	410	34.17
10	100	100	100	100	100	100	600	50.00
11	100	100	100	100	177	138	715	59.58
12	100	100	100	50	100	79	529	44.08
13	146	150	36	150	98	80	660	55.00
14	888	74	436	171	213	257	2039	169.92
15	100	100	250	1	1	1	453	37.75
16	150	100	100	100	100	100	650	54.17
17	1	33	100	100	100	100	434	36.17
18	100	100	100	100	100	100	600	50.00
19	100	100	100	100	100	100	600	50.00
20	150	84	117	111	111	111	684	57.00
21	100	94	100	9	47	64	414	34.50
22	100	100	100	100	100	100	600	50.00
23	100	100	2	100	100	100	502	41.83
24	100	100	100	100	100	100	600	50.00
25	478	62	391	77	80	83	1171	97.58
26	100	100	0	242	59	52	553	46.08
27	100	100	100	100	453	127	980	81.67
28	61	48	100	230	172	172	783	65.25
29	60	43	150	279	86	84	702	58.50
30	100	100	444	162	48	78	932	77.67
31	100	100	100	100	100	100	600	50.00
32	150	153	152	124	124	124	827	68.92
33	100	100	1404	79	45	74	1802	150.17
34	100	100	100	45	68	50	463	38.58
35	1034	91	770	415	98	58	2466	205.50
36	1146	69	289	179	150	150	1983	165.25
37	722	83	402	0	88	103	1398	116.50
38	100	150	90	32	76	27	475	39.58

39	1	21	41	26	64	47	200	16.67
40	131	50	223	69	54	86	613	51.08
41	100	100	100	100	100	143	643	53.58
42	100	0	0	0	0	100	200	16.67
43	46	42	63	100	100	100	451	37.58
44	100	100	0	100	100	100	500	41.67
45	100	150	150	150	122	1	673	56.08
46	60	84	87	150	110	30	521	43.42
47	95	59	78	92	128	62	514	42.83
48	100	100	91	33	44	139	507	42.25
49	100	100	100	100	100	100	600	50.00
50	100	150	39	26	66	16	397	33.08
P	9450	4614	9374	5739	6813	5181	41171	3431
Q	189	92.28	187.48	114.78	136.26	103.62	823.42	68.62
R	37.42	18.27	37.12	22.73	26.98	20.52	**163.04**	13.59
S	39.68	19.38	39.36	24.10	28.61	21.76	172.89	14.41

The data collected by the survey is the primary data of energy consumption of villages and approximate also therefore energy consumption data is also collected from electricity bills provided by the local electricity distribution company. The data collected by survey is tabulated in Table-2 and bill data are tabulated in table-3 to table-5. Sample calculation for Jhar Village is as follows-

Annual electricity consumption of 50 households = 51780 kWh. Therefore annual electricity consumption per family $=\frac{51780}{50}$ **=1035.60 kWh**

Total number of families = 757

Therefore annual electricity consumption of whole village=1035.60 x 757 = 783949.20 kWh = 783.95 MWh

Total population = 4683

Therefore annual per capita electricity consumption = $\frac{783.95}{4683}$ = **167.40 kWh**

Some deviation is observed between collected data by the survey and collected data from electricity bills. To observe that deviation the consolidated data of electricity consumption both by electricity bills and survey are arranged in tabulated format in **Table-6.**

Table-6: Consolidated electricity consumption data of villages

Particulars	X Bill	X survey	Y Bill	Y Survey	Z Bill	Z Survey
A	863.16	783.95	584.60	557.12	163.04	155.63
B	1140.20	1035.60	1139.58	1086	823.42	786
C	184.32	167.40	159.64	152.13	172.89	165.03
D	71.93	65.33	48.72	46.43	13.59	12.97
E	95.02	86.30	94.97	90.50	68.62	65.50
F	15.36	13.95	13.30	12.68	14.41	13.75
G	337.83	306.83	228.81	218.06	63.81	60.91

A-Energy consumption of villages in MWh/annum, B-Energy consumption of family in kWh/annum, C-Per capita Energy consumption in kWh/annum, D-Energy consumption of villages in MWh/month, E-Energy consumption of family in kWh/month, F- Per capita Energy consumption in kWh/month, G-Average Power in kW/month, X- Jhar, Y-Mansarkheri and Z-Khijooriya jatan

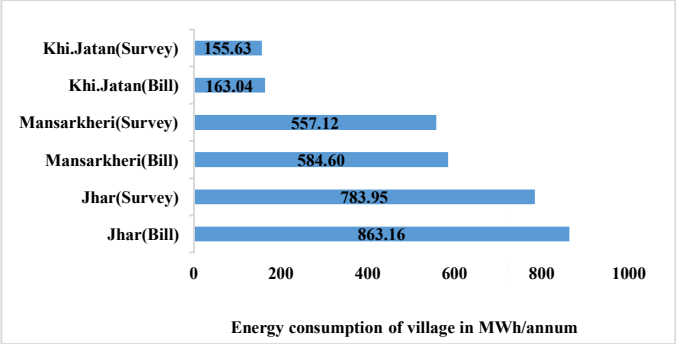

Figure -1: Energy consumption of village in MWh/annum

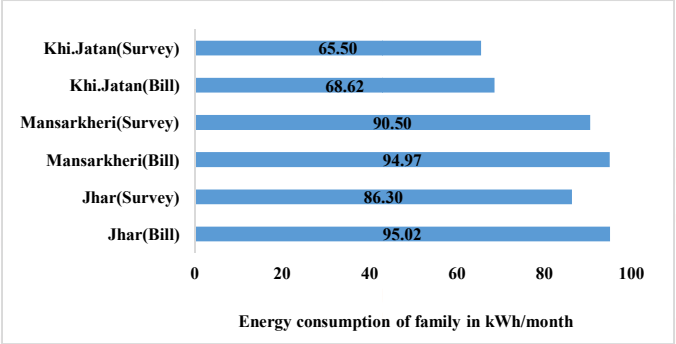

Figure -5 Energy consumption of family in kWh/month

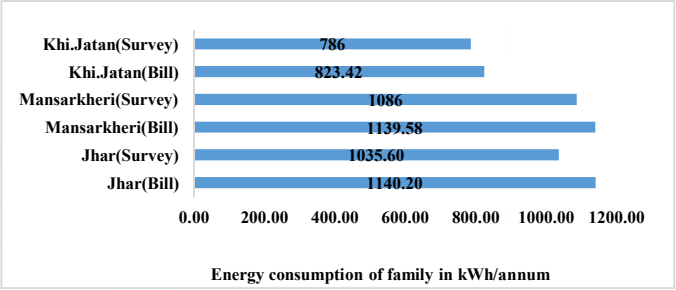

Figure-2: Energy consumption of family in kWh/annum

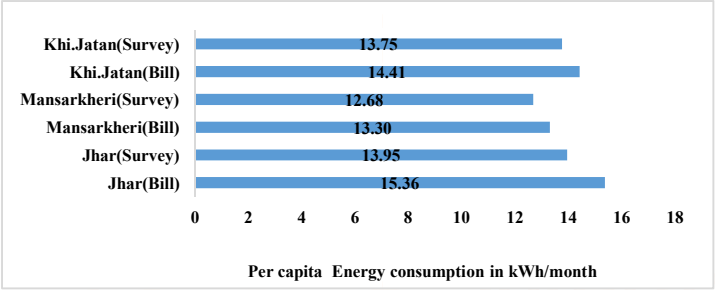

Figure-6: Per capita energy consumption in kWh/month

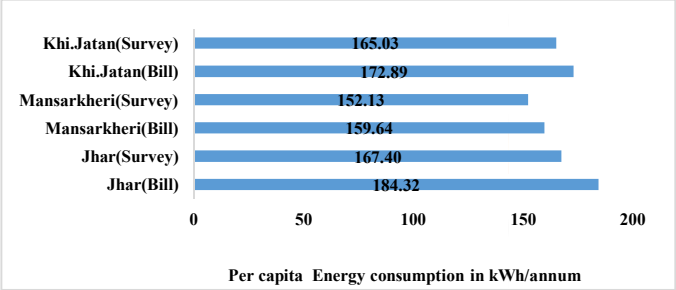

Figure-3: Per capita energy consumption in kWh/annum

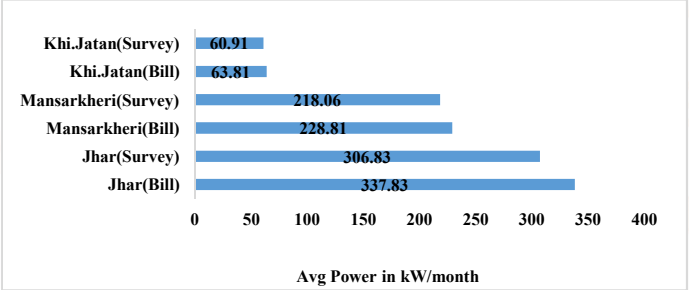

Figure-7: **Average power requirement in kW/month**

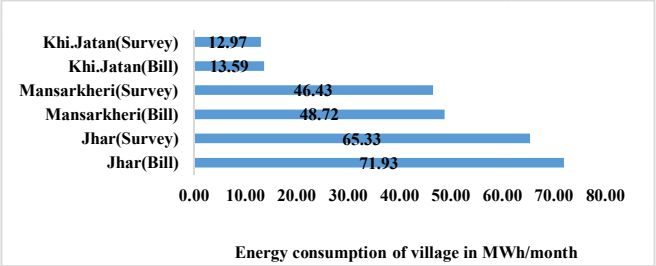

Figure-4: Energy consumption of village in MWh/month

The plots between survey data and bill data have also been plotted for each energy consumption parameters and shown in figures-1 to figure-7.

3. CONCLUSIONS

In this study electricity consumption data is collected by survey as well as local electricity Distribution Company. On the basis of these data, energy consumption parameters i.e. A-Energy consumption of villages in MWh/annum, B-Energy consumption of family in kWh/annum, C-Per capita Energy consumption in kWh/annum, D-Energy consumption of villages in MWh/month, E- Energy consumption of family in kWh/month, F- Per capita Energy consumption in kWh/month, G-Average Power in kW/month, have been calculated. Graphical representations also have been plotted between survey data and bill data for the purpose of comparative view. By viewing the graphical plots of energy consumption parameters it can be concluded that

Energy consumption parameters A, B, C, D, E, F, G calculated by survey data are found to be less for each village as compared to energy consumption parameters calculated by bill data. Bill data therefore should be taken as reference data for designing any electrical power generation facility for the villages, instead of survey data because bill data are based on the meter readings of the individual households which shows the actual electricity consumed by the household.

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