

**Appendix 6 Socio-Economic Situations and PV Potential
in Botswana rural Areas**

Appendix 6 Socio Economic Situations and PV Potential in Botswana Rural Area

6.1 The Population Movement in Botswana

Population and Housing census in Botswana are executed in every 10 years. Population in Botswana investigated in the past four Population and Housing Census is shown in Appendix Table 6.1-1.

“Town” in the Table indicates 6 cities/towns such as Gaborone, Francistown, Lobatse, Selbi-Phikwe, Orapa, Jwaneng and Sowa.

Appendix Table 6.1-1 Population in Botswana of the Past 4 Census

Year	Village/ Locality		Town		Total	
	Population	increase	Population	increase	Population	increase
1971	519,678	-	54,416	-	574,094	-
1981	791,006	1.52	150,021	2.76	941,027	1.64
1991	1,040,017	1.31	286,779	1.91	1,326,796	1.41
2001	1,305,086	1.25	375,777	1.31	1,680,863	1.27

(Source: 1981, 1991 and 2001 Population and Housing Census)

Appendix Table 6.1-2 shows population of Villages, Localities having population 200 or more and Localities having population less than 200 in 1991 and 2001 by each Sub-District and Town.

Appendix Table 6.1-2 Population of Botswana and its movement

District	Sub-District		1991 Pop. Census	2001 Pop. Census				Pop. Increment
				Population	Households	Ave. Family Size	No of Villages & Localities	
Southern	Ngwaketse	Village	66,252	91,539			29	1.38
		Locality(Pop. 200 over)	9,119	7,568			115	0.83
		Locality(Pop. 200 less)						
		Sub-Total	128,989	113,704	24,463	4.65	144	0.88
	Barolong	Village	30,833	37,451			49	1.21
		Locality(Pop. 200 over)	3,273	2,892			158	0.88
		Locality(Pop. 200 less)						
		Sub-Total	18,400	47,477	10,348	4.59	207	2.58
	Ngawketse West	Village	5,416	8,050			10	1.49
		Locality(Pop. 200 over)	225	473			151	2.10
		Locality(Pop. 200 less)						
		Sub-Total		10,471	2,391	4.38	161	
	Total	Village	102,501	137,040			88	1.34
		Locality(Pop. 200 over)	12,617	10,933			424	0.87
		Locality(Pop. 200 less)	32,271	23,679				0.73
		Sub-Total	147,389	171,652	37,202	4.61	512	1.16
South East	Village	37,744	51,610			5	1.37	
	Locality(Pop. 200 over)	1,047	5,919			139	5.65	
	Locality(Pop. 200 less)	4,793	3,094				0.65	
	Sub-Total	43,584	60,623	14,780	4.10	144	1.39	
Kweneng	Kweneng East	Village	91,158	149,983			25	1.65
		Locality(Pop. 200 over)	27,095	25,869			362	0.95
		Locality(Pop. 200 less)	52,184	13,921				0.27
		Sub-Total	170,437	189,773	43,812	4.33	387	1.11
	Kweneng West	Village	16,690	23,788			20	1.43
		Locality(Pop. 200 over)	5,616	6,597			413	1.17
		Locality(Pop. 200 less)						
		Sub-Total		40,562	8,766	4.63	433	
	Total	Village	107,848	173,771			45	1.61
		Locality(Pop. 200 over)	32,711	32,466			775	0.99
Locality(Pop. 200 less)		29,878	24,098				0.81	
Sub-Total		170,437	230,335	52,578	4.38	820	1.35	
Kgatleng	Village	44,951	65,452			22	1.46	
	Locality(Pop. 200 over)	2,296	1,321			215	0.58	
	Locality(Pop. 200 less)	10,523	6,734				0.64	
	Sub-Total	57,770	73,507	17,054	4.31	237	1.27	
Central	Serowe/Palapye	Village	82,530	125,675			43	1.52
		Locality(Pop. 200 over)	15,268	7,562			859	0.50
		Locality(Pop. 200 less)	30,673	19,798				0.65
		Sub-Total	128,471	153,035	33,969	4.51	902	1.19
	Mahalapye	Village	63,277	92,538			36	1.46
		Locality(Pop. 200 over)	5,881	2,656			498	0.45
		Locality(Pop. 200 less)	26,275	14,617				0.56
		Sub-Total	95,433	109,811	23,730	4.63	534	1.15
	Bobonong	Village	27,608	47,298			17	1.71
		Locality(Pop. 200 over)	8,246	4,557			408	0.55
		Locality(Pop. 200 less)	17,704	15,109				0.85
		Sub-Total	53,558	66,964	15,057	4.45	425	1.25
	Boteti	Village	21,227	33,874			15	1.60
		Locality(Pop. 200 over)	2,015	1,217			431	0.60
		Locality(Pop. 200 less)	12,217	12,966				1.06
		Sub-Total	35,459	48,057	10,363	4.64	446	1.36
	Tutume	Village	66,713	94,093			40	1.41
		Locality(Pop. 200 over)	13,560	14,964			492	1.10
		Locality(Pop. 200 less)	19,776	14,457				0.73
		Sub-Total	100,049	123,514	27,168	4.55	532	1.23
	Total	Village	261,355	393,478			151	1.51
		Locality(Pop. 200 over)	44,970	30,956			2,688	0.69
		Locality(Pop. 200 less)	106,645	76,947				0.72
		Sub-Total	412,970	501,381	110,287	4.55	2,839	1.21

District	Sub-District		1991 Pop. Census	2001 Pop. Census				Pop. Increment	
				Population	Households	Ave. Family Size	No of Villages & Localities		
North East		Village	39,265	45,476			42	1.16	
		Locality(Pop. 200 over)	1,420	870				0.61	
		Locality(Pop. 200 less)	2,669	3,053			163	1.14	
		Sub-Total	43,354	49,399	10,834	4.56	205	1.14	
North West	Ngamiland East	Village	34,400	53,276			18	1.55	
		Locality(Pop. 200 over)	7,677	8,347				1.09	
		Locality(Pop. 200 less)	13,392	10,759			334	0.80	
		Sub-Total	55,469	72,382	15,615	4.64	352	1.30	
	Ngamiland West	Village	16,157	30,537			24	1.89	
		Locality(Pop. 200 over)	12,001	13,275				1.11	
		Locality(Pop. 200 less)	8,565	5,830			180	0.68	
		Sub-Total	36,723	49,642	10,184	4.87	204	1.35	
	Chobe	Village	9,427	14,890			9	1.58	
		Locality(Pop. 200 over)	568	812				1.43	
		Locality(Pop. 200 less)	4,131	2,556			91	0.62	
		Sub-Total	14,126	18,258	4,600	3.97	100	1.29	
	Delta	Village	1,134	1,004			6	0.89	
		Locality(Pop. 200 over)							
		Locality(Pop. 200 less)	1,208	1,684			61	1.39	
		Sub-Total	2,342	2,688	514	5.23	67	1.15	
	Total	Village	61,118	99,707			57	1.63	
		Locality(Pop. 200 over)	20,246	22,434				1.11	
		Locality(Pop. 200 less)	27,296	20,829			666	0.76	
		Sub-Total	108,660	142,970	30,913	4.62	723	1.32	
	Ghanzi	Ghanzi	Village					17	
			Locality(Pop. 200 over)						
			Locality(Pop. 200 less)	23,725	32,481			391	1.37
			Sub-Total	23,725	32,481	7,666	4.24	408	1.37
CKGR		Village					0		
		Locality(Pop. 200 over)							
		Locality(Pop. 200 less)	994	689			8	0.69	
Sub-Total		994	689	110	6.26	8	0.69		
Total		Village	14,082	22,230			17	1.58	
		Locality(Pop. 200 over)	1,132	1,022				0.90	
	Locality(Pop. 200 less)	9,505	9,918			399	1.04		
	Sub-Total	24,719	33,170	7,776	4.27	416	1.34		
Kgalagadi	Kgalagadi South	Village	14,485	20,589			21	1.42	
		Locality(Pop. 200 over)	380	781				2.06	
		Locality(Pop. 200 less)	4,929	4,568			121	0.93	
		Sub-Total	19,794	25,938	5,679	4.57	142	1.31	
	Kgalagadi North	Village	9,574	14,525			14	1.52	
		Locality(Pop. 200 over)	237	4				0.02	
		Locality(Pop. 200 less)	1,529	1,582			70	1.03	
		Sub-Total	11,340	16,111	3,984	4.04	84	1.42	
	Total	Village	24,059	35,114			35	1.46	
		Locality(Pop. 200 over)	617	785				1.27	
		Locality(Pop. 200 less)	6,458	6,150			191	0.95	
		Sub-Total	31,134	42,049	9,663	4.35	226	1.35	
	Total	Village	692,923	1,023,878			462	1.48	
		Locality(Pop. 200 over)	117,056	106,706				0.91	
Locality(Pop. 200 less)		230,038	174,502			5,660	0.76		
Sub-Total		1,040,017	1,305,086	291,087	4.48	6,122	1.25		
Town	Gaborone		133,468	186,007	58,476	3.18		1.39	
	Francistown		65,244	83,023	23,124	3.59		1.27	
	Lobatse		26,052	29,689	8,523	3.48		1.14	
	Selibe Phikwe		39,772	49,849	15,258	3.27		1.25	
	Orapa		8,827	9,151	2,578	3.55		1.04	
	Jwaneng		11,188	15,179	4,681	3.24		1.36	
	Sowa		2,228	2,879	979	2.94		1.29	
	Town Total		286,779	375,777	113,619	3.31		1.31	
Grand Total			1,326,796	1,680,863	404,706	4.15		1.27	

(Source: 1991, 2001 Population and Housing Census)

6.2 General Situations

(1) Chief and Kgotla

A Chief is a traditional leader of villages and whose position is inherited by his eldest son as a rule. As a head of the village, the chief enjoys exalted authority, respect and privilege among his people.

The Chief is responsible to his people in maintaining law and order in the village. The chief is expected to be modest, compassionate, diligent, lead an exemplary life, respect and follow tribal customs and practices.

The chief having a highest authority is called "Paramount Chief" as a head of the tribe. A chief in a village is assigned and approved by the paramount chief. Paramount Chiefs are now existing in a large village such as Serowe, Kanye, Maun, Hantsi, Morepolore, Romotwa and Masunga.

The most important and unique institution in the Chief's administration is called "the Kgotla", an assembly courtyard at which issues in a village are discussed and major decisions taken. The kgotla is the seat of traditional government and a forum for free exchange of views in a village democratic system. Any member of the community has the opportunity and privilege to address the Chief directly in the kgotla. A Chief calls a meeting at the kgotla whenever there are important matters to be discussed and decisions taken. On a regular basis, the kgotla is playing a role as a tribal court, an administrative center to determine property rights, and consult on general village community projects.

At present time in Botswana, there are modern style courts (headed by magistrates) besides customary courts (headed by the chief) as places where law and order and dispute resolution are administered. Parties to a dispute have the option of using the modern system or the traditional structures. Serious cases such as homicide and rape are reserved for the modern courts.

In the case of crimes, particularly those against the person and property, there are settlements out of court allowed by traditional way in Botswana. When someone else's cattle stray into a ploughed field and destroy the crops, for example, the owner of the field is entitled to forfeit one of the cattle which destroyed his crops.

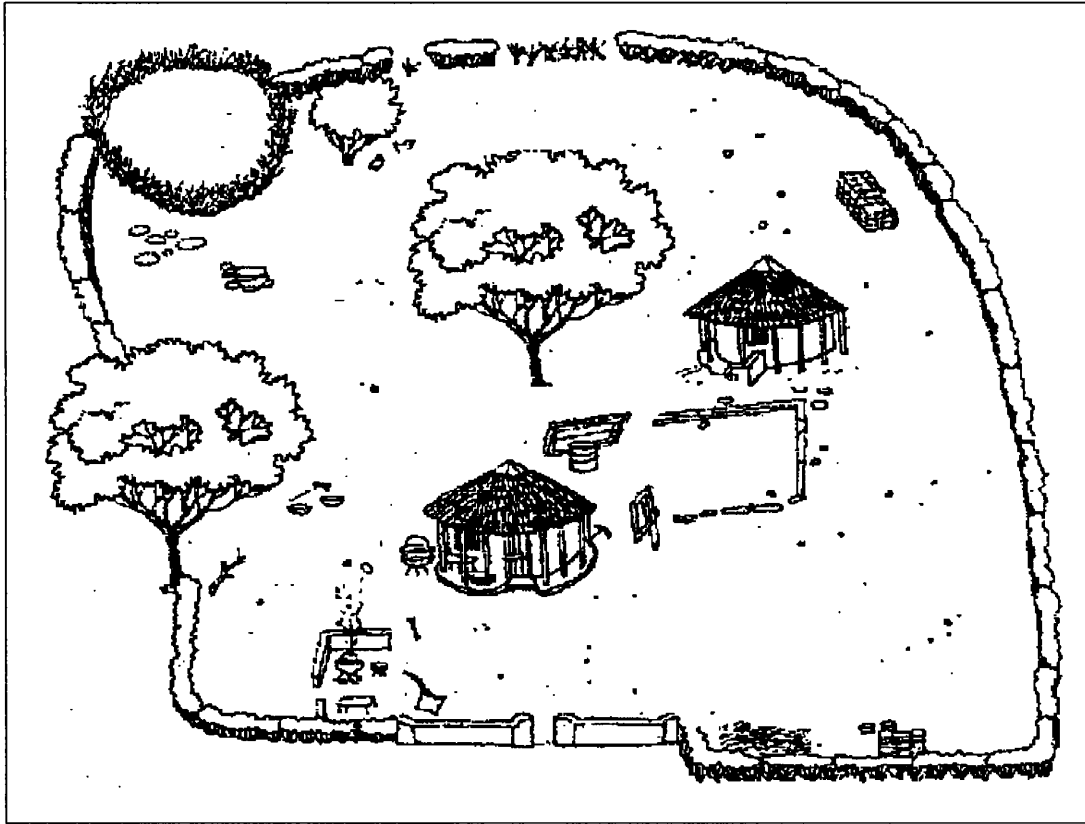
In cases where a boy seduces an unmarried girl and impregnates her, the parents on both sides can settle the matter by negotiation and payment of a traditionally established fine (usually several cattle).

In case the accused person objects the judgment or fine imposed on him, he has a right of appeal.

(2) Village Layout and Villagers Housing

The kgotla is arranged in the center of the village. Offices of the chief, policemen and VDC stand in a line near the kgotla. Villagers are given the land of about 40m x 40m at free cost by Land Board, and they build their houses within their premises. Their traditional house is called "Randaval", which has a round soil wall with a thatched roof.

A square shaped house with a tin roof is recently being built in a village. Housing with 2 bed rooms is popular at present in a village while the big housing with 4 to 5 bed rooms is seen as well.



Appendix Figure 6.2-1 Standard Dwell

(3) Public Facilities in a Village

A village has usually public facilities such as a kgotla, an elementary school, a medical institution, the police, VDC (Village Development Committee) and a veterinary office. Botswana has more than 600 elementary schools and 170 secondary schools in whole country. Most villages have an elementary school while a secondary school is built in comparatively big village.

A village has a medical facility called Health Post, having a consulting room where a nurse is stationed, a treatment room and a store room, or Mobile Clinic, where a doctor's round visit is done once or twice a month from the near clinic, depending on the population of village.

A village has a police station where 1 or 2 policemen are stationed. The policeman is transferred to the different village after staying several years in the village.

VDC is a committee consisting of villagers and executes a development plan for the village under the ministry of local government.

(4) Communication measures in villages

A post office is placed in the area with 20-40km² or population 3000-6000 or where the economic growth and the potential business can be anticipated. There were more than 85 post offices in the year of 1997. But a post office isn't located in a target village for PV rural electrification so far.

As for the telecommunication, BTC (Botswana Telecommunication Corporation) undertakes a business. Telephone lines are extended even to a non-electrified village. For example, a telephone line has already been extended to Motlhabaneng, where the Dissemination project is carried out, though a grid is not extended to the village. A short wave radio is used in non-telephone village in an emergency.

6.3 Socio Economic Survey

6.3.1 Selection Criteria for 10 Villages

- 1) Master plan for PV dissemination in rural areas in Botswana will cover entire country. Accordingly, locations of surveyed villages should be widely dispersed in the country, not concentrated in specific areas.

- 2) Surveyed villages should not currently be grid-electrified, and are expected not to be grid electrified at least within a few years. Accordingly distance from nearest existing grid (preferably more than 30km) is taken into account.
- 3) Approximately 50 samples (households and small business) will be taken in one village. Therefore, population of the village should be also considered. Number of households should be more than 100 (i.e. twice of number of samples)

6.3.2 Surveyed Method

Local consultant company EECG formed two teams, which were composed of one supervisor and four enumerators each. EECG started their survey at Oliphant's Drift on the 2nd of November 2000 to test the adequacy of the questionnaire since this was the nearest village to Gaborone. Two survey teams visited together Oliphant's Drift and Lorlwana in order to consolidate their understandings of data collection procedure. After that, each survey team visited and surveyed the following villages. The field survey was completed by the last week of November 2000 as scheduled.

Team No. 1: Motlhabaneng, Parakarungu, Makalamabedi, Kule, Khawa

Team No. 2: Dutlwe, Kudumatse, Gojwane

Appendix Table 6.3-1 Number of Respondents Interviewed

Village	Non-PV Electrified Households	PV-Electrified Households	PV-Electrified Public Facilities	Non-PV Electrified Public Facilities	Informal Interviews
Dutlwe	49		2	2	1
Gojwane	51	5	1	3	3
Khawa	50	4		5	3
Kudumatse	55	2	2	2	1
Kule	48	5		4	2
Lorolwana	54		2	4	1
Makalamabedi	52	4		2	2
Motlhabaneng	51	4	1	5	2
Oliphant's Drift	59	2	1	3	3
Parakarungu	51	5		2	2
Manyana		5			
Metsimotlhaba		6			
District/Subdistrict					11
Total Sample	520	42	9	32	31

Since the number of households in each village was small (250 households at most) and the village samples ranged between 20% and 60% of the village households, cluster sampling was the method used to select the households to interview in the field. This sampling method entails interviewing suitable respondents from one household to the next until the allocated village sample is achieved. Some households did not have people at home and others did not have suitable candidates to interview (e.g. those where only small children were found), so some households were skipped thus allowing a more representative survey coverage of the villages.

6.3.3 Socio-Economic Status

6.3.3.1 Non-PV Electrified Households

(1) Households Status

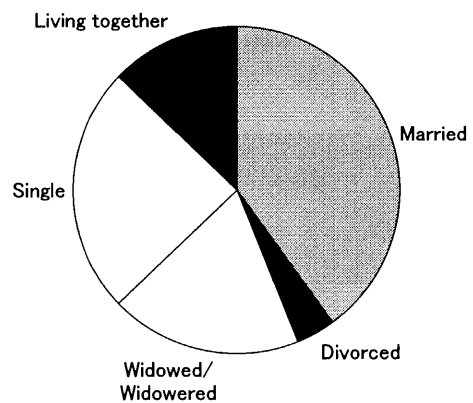
Sex of households head

Male: 52%
 Female: 48%

Often female heads are single, divorced or widowed.

Marital status of households head

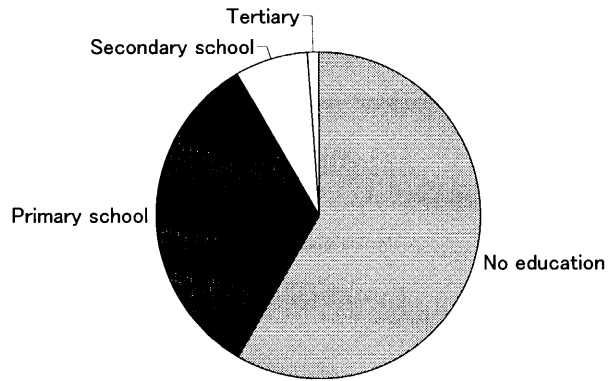
Married: 39.6%
 Divorced: 3.8%
 Widowed/ Widowed: 18.8%
 Single: 24.2%
 Living together: 12.5%



Appendix Figure 6.3-1 Households

Educational level

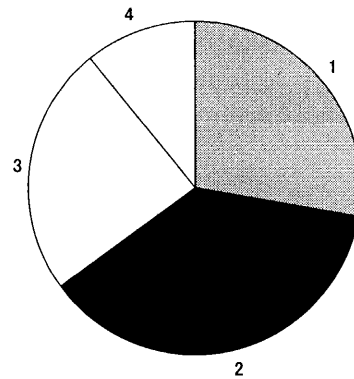
No education:	57.5%
Primary school:	32.9%
Secondary school:	6.9%
Tertiary:	1.2%



Appendix Figure 6.3-2 Educational Level

Number of bed rooms

One:	25.4%
Two:	33.8%
Three:	22.2%
Four:	9.8%



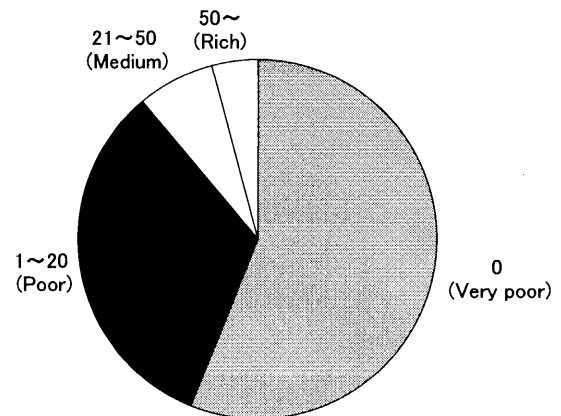
Appendix Figure 6.3-3 No. of Bedrooms

Number of all rooms including living rooms, kitchens

1~4 rooms:	60%
5~6 rooms:	30%

Number of cattle

0 (Very poor):	56%
1~20 (Poor):	32.8%
21~50 (Medium):	6.9%
50~ (Rich):	4.3%



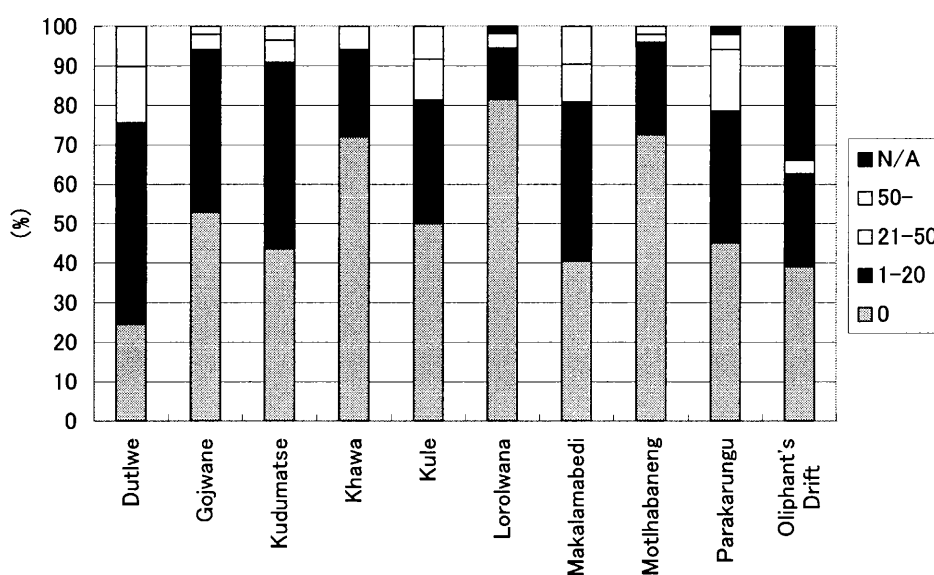
Appendix Figure 6.3-4 Number of Cattle

Cattle have considerable value in Botswana fetching anything from P500~1,500 on the market which could boost investment capacity of households.

Number of cattle by village is shown in Appendix Table 6.3-2 and Appendix Figure 6.3-5. Households with no cattle or less than 20 cattle have been classified to be rather poor, which are outstanding in Lorolwana, Motlhabaneng, and Khawa. On the contrary Dutlwe, Makalamabedi, Parakarungu had 18% or more of households with cattle in the middle categories.

Appendix Table 6.3-2 Number of Cattle by Village

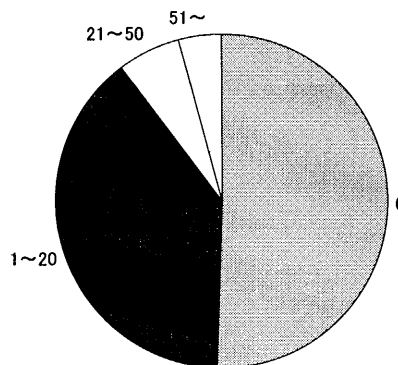
Village	Number of cattle				N/A	Total village sample (%)
	0	1-20	21-50	51-		
Dutlwe	24.5	51.0	14.3	10.2		49
Gojwane	52.9	41.2	3.9	2.0		51
Kudumatse	43.6	47.3	5.5	3.6		55
Khawa	72.0	22.0	6.0	0.0		50
Kule	50.0	31.3	10.4	8.3		48
Lorolwana	81.5	13.0	0.0	3.7	1.9	54
Makalamabedi	40.4	40.4	9.6	9.6		52
Motlhabaneng	72.5	23.5	2.0	2.0		51
Parakarungu	45.1	33.3	15.7	3.9	2.0	51
Oliphant's Drift	39.0	23.7	3.4	0.0	33.9	59



Appendix Figure 6.3-5 Number of Cattle by Village

Number of small livestock

0:	50.6%
1~20:	39.2%
21~50:	6.2%
51~:	4.1%



Appendix Figure 6.3-6 Number of Small Livestock

(2) Cash income (not including any income in kind)

Cash income distribution

Total cash income for households has three modes with peaks at below P50/month, at P200/month and a P1000/month. This pattern is similar to the results of HIES 1994.

Average cash income, median and maximum cash income in this survey were as follows.

Appendix Table 6.3-3 Average, Median, Maximum Cash Income Surveyed

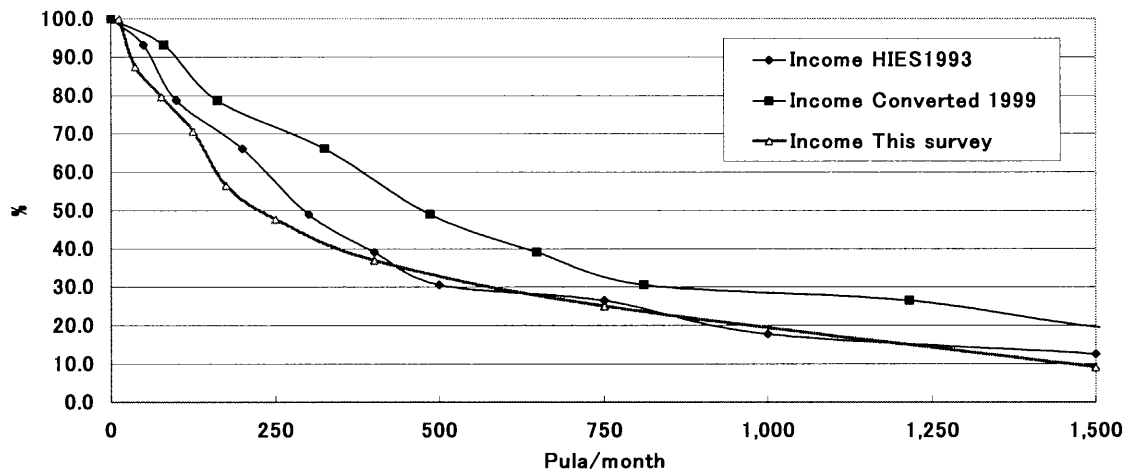
Income source	Cash Income		
	Average	Median	Maximum
Salary Wage	652.5	750	1750
Remittance	151.6	50	750
Self Employment	194.6	50	250
Rentals	125	100	750
Pensions	156.2	150	750
Livestock sales	74.3	62.5	750
Agricultural products	54.7	33.3	750
Others	102	16.7	750

Comparison with HIES survey

Cash distribution curves obtained in this survey are to be compared to that of HIES (Household Income and Expenditure Survey in 1993 and 1994).

Appendix Figure 6.3-7 shows its comparison between this survey and cash income distribution in 1993 and in 1999 based on HIES results. Since HIES was carried out in 1993 and 1994, cash income should be modified in current

year basis, using living cost index of 1993 and latest available data in 1999. Presumed cash income distribution in 1999 is based on the assumption that cash income level would increase in proportion to rise of living index. According to the figure, cash income distribution of this survey is very close to that of HIES in 1993 even though living index increased by 62% between 1993 and 1999, which means income level would not rise since 1993 in rural villages.



HIES 1999: Converting to year of 1999 using cost living index
 1991=100, 1993=132.6, 1999=214.9

**Appendix Figure 6.3-7 Cash Income Distribution
 (HIES and this survey)**

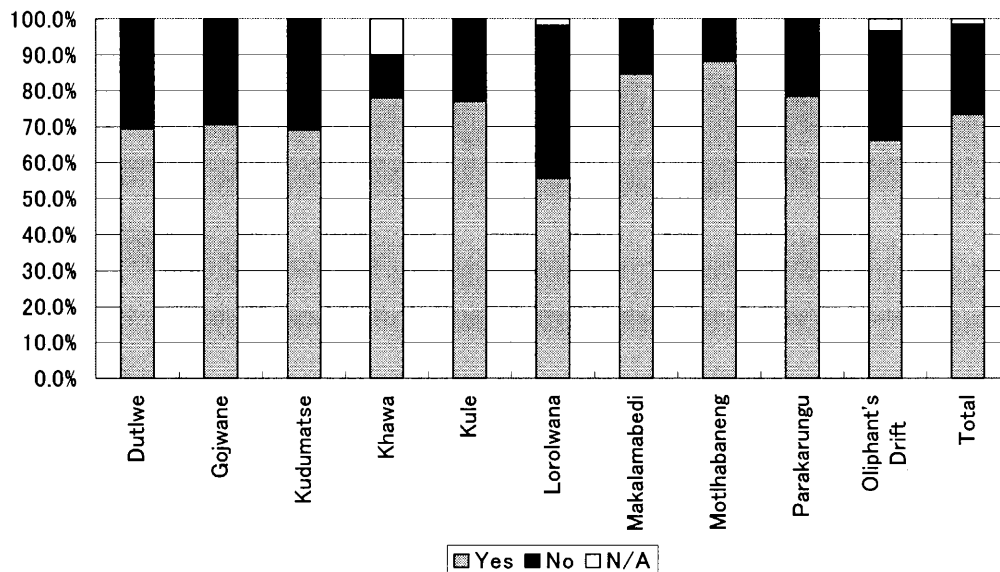
(3) Awareness on PV system

Awareness of PV system

Appendix Table 6.3-4 suggests that awareness on solar PV is highest in Motlhabaneng, Khawa and Makalamabedi and is lowest in Lorolwana followed by Kudumatse and Dutlwe. It is surprising that the villages with the lowest level of awareness are some of the villages nearest to Gaborone where most of the solar PV suppliers are based.

Appendix Table 6.3-4 Level of Awareness by Village

Village	Total sample number	YES		NO	
		Count	(%)	Count	(%)
Dutlwe	49	34	69.4	15	30.6
Gojwane	51	36	70.6	15	29.4
Kudumatse	55	38	69.1	17	30.9
Khawa	50	39	86.7	6	13.3
Kule	48	37	77.1	11	22.9
Lorolwana	54	30	56.6	23	43.4
Makalamabedi	52	44	84.6	8	15.4
Motlhabaneng	51	45	88.2	6	11.8
Parakarungu	51	40	78.4	11	21.6
Oliphant's Drift	59	39	68.4	18	31.6
Total	520	382	73.5	130	25.0



Appendix Figure 6.3-8 Awareness on PV System

Demonstration was considered by 37% of all households to be the best way of providing sufficient information to enable people to buy solar PV systems, making it to be the most popular option. This was followed by kgotla meeting which was the option favored by 28% of households while 17% favored a combination of the two options. Radio broadcasting was only favored by 4% of the households.

Number of Required Lighting Point

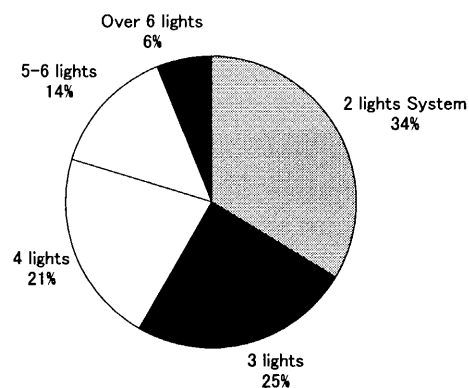
Those who showed willingness to use PV system want PV system for both lighting and powering appliances (32% of total households, 48% of those willing to use). Number of required lighting points: 2 light systems are predominant.

Appendix Table 6.3-5

Number of Required Lighting Points

No. of light	No. of Households	Ration of those willing to light
2 lights System	110	33.6
3 lights	81	24.8
4 lights	70	21.4
5-6 lights	46	14.1
Over 6 lights	20	6.1
TOTAL	327	100

Lighting time: less than 4 hours 8 1%
more than 10 hours 9%



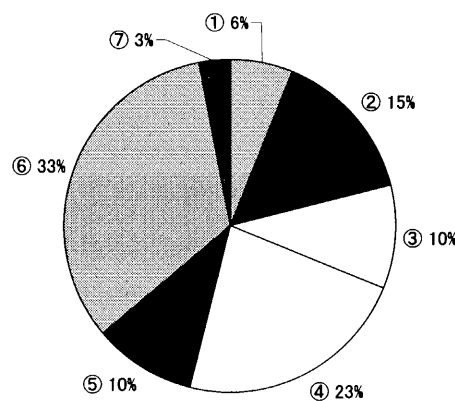
Appendix Figure 6.3-9 No. of Req. Lighting Points

Income generating activities by using PV system

- ① Battery Charger
- ② Cooling of Drink

Reason why currently not using PV system

- ① Still saving for the system: 6%
- ② Don't know where to buy it: 15%
- ③ Don't know how much it costs: 10%
- ④ Don't know about the system: 23%
- ⑤ Need to see it working: 10%
- ⑥ Others: 33%
- ⑦ N/A: 3%



Appendix Figure 6.3-10 Reason why currently not using PV System

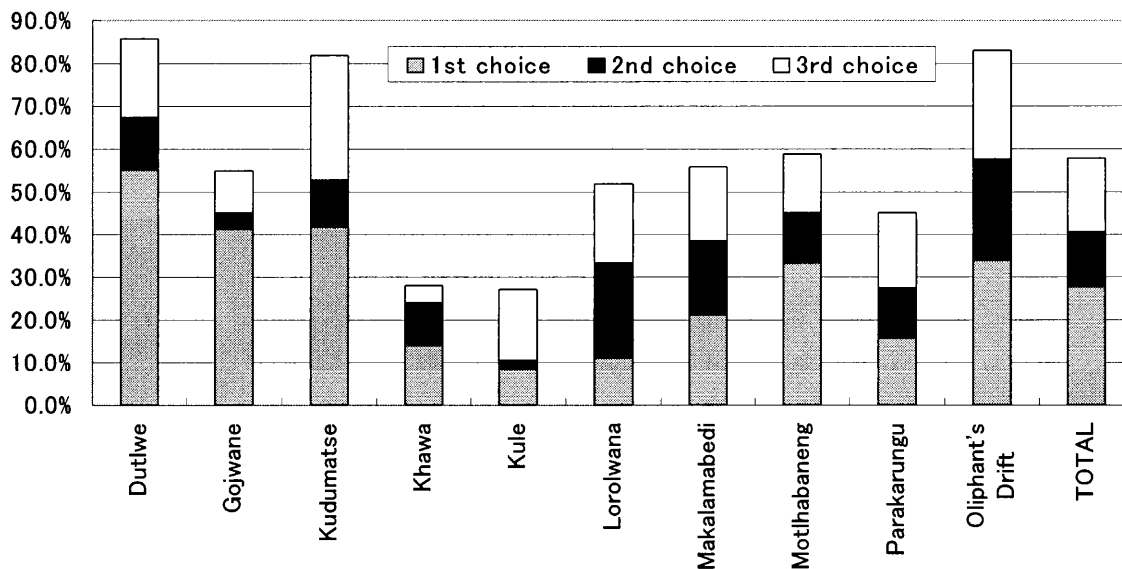
Priority to opt for PV system

Priority to opt for PV system against other equipment or potential investments

like cattle and boreholes was surveyed. This is low in Kule, Lorolwana, Khawa. On the contrary Dutlwe, Kudumatse and Gojwane shows high priority, all of which are close to Gaborone where the influence of accessing cleaner energy sources is likely to be high.

Appendix Table 6.3-6 Priority to Opt for PV System

Village	No. of sample	1 st choice	2 nd choice	3 rd choice
Dutlwe	49	27(55%)	6(12%)	9(18%)
Gojwane	51	21(41%)	2(4%)	5(10%)
Kudumatse	55	23(42%)	6(11%)	16(29%)
Khawa	50	7(14%)	5(10%)	2(4%)
Kule	48	4(8%)	1(2%)	8(17%)
Lorolwana	54	6(11%)	12(22%)	10(19%)
Makalamabedi	52	11(21%)	9(17%)	9(17%)
Motlhabaneng	51	17(33%)	6(12%)	7(14%)
Parakarungu	51	8(16%)	6(12%)	9(18%)
Oliphant's Drift	59	20(34%)	14(23%)	15(25%)
Total	520	144(28%)	67(13%)	90(17%)



Appendix Figure 6.3-11 Priority to Opt for PV System

Sixty percent (60%) of the total households surveyed are willing to shift to PV system use if their current fuel (light and appliance) budget can be enough for that.

(4) Payment source of PV system

43.1% of the 332 able to pay will use salary/wage

25.3% of the 332 able to pay will use remittance

8.7% of the 332 able to pay will use pensions

Most (88%) of those able to pay prefer to pay in installments rather than cash

70% of the 332 can make such installment monthly

11% of the 332 want to pay in every three month

39% of the 332 indicate that they can even sell cattle to pay PV system

98% of the 332 indicate that they can pay within 5 years

(5) Preferred scheme and willingness to participate in the Dissemination Project

The respondents were split in equal proportions with 49% preferring scheme A and 51% opting for Scheme B.

Scheme A : End user will owe PV system like NPVREP. Because the ownership is in the end-user, end-user will have a responsibility to maintain PV system.

Scheme B : “Fee for Service” scheme. Because the ownership is in the Implementation Body, Implementation Body will have a responsibility to maintain PV system.

This scheme will be applied in the Dissemination Project

A large number of respondents (303) are interested to participate in the dissemination Project. This share is 58% of total households, 88% of those willing to participate and 91% of those able to pay. Higher share of those wanting to participate in the Dissemination Project were found in Oliphant’s Drift, Kudumatse, Motlhabaneng.

6.2.3.2 Non-PV Electrified Public Facilities

(1) Preferred scheme and willingness to participate in the Dissemination Project

The public facilities are in favor of Scheme B (fee for service) instead of Scheme A (owning systems), probably due to fear of providing the required maintenance infrastructure.

All those opting for either Scheme A or B are willing to participate in the Dissemination Project and are 93.8% in total.

(2) Other relevant information from the survey

Primary school

They indicated that the best time for any purchasing decision to be made was at the end/ beginning of the financial year.

Since primary schools do not receive cash from the council, it was indicated by the head teachers that the best way for council to pay any attention to their request for solar systems is to have at least 5 schools submitting a requisition requesting the same product.

In council schools which had solar systems, there were complaints that the PV systems were faulty and that even after reporting the fault it could take as long as 6 months before someone was sent to maintain the system emphasizing the lack of maintenance infrastructure in the villages.

Most (if not all) of the schools are provided with two light systems and would like to upgrade to more powerful systems which can power appliances as well. There is a wish to power other appliances like radio and television for the benefit of pupils during listening programs. It was indicated that at times Councils took too long to supply them with batteries for the radios and so had to purchase their own using PTA funds and that was very costly. For that reason, they believe PV system would be more appropriate.

Teachers have experience of children who are not able to do their homework at home and the excuse given is that parents cannot afford paraffin or do not allow them to “waste” paraffin/candles. Teachers expressed that if classrooms are solar electrified then such children could benefit from studying at school. Children have a better opportunity of studying at night especially standard 7 pupils who have to write a passing examination. Teachers can also have a better chance of preparing for the next days’ lessons and can also hold teachers meetings in the school at night rather than take daytime when children are to be taught.

Teachers are willing to bring their own appliances like radios to the classroom if electricity for such appliances is made available to benefit pupils in their lessons.

Other opportunities which can be provided by PV electrification in schools are being able to hold adult education lessons to educate villagers and to show, on video, awareness programs on issues like AIDS/HIV pandemic.

Teachers have mentioned dedication to start poultry projects if PV lighting can be available. Schools have also indicated that they can hold concerts and,

sell cool drinks as a way of raising funds for the school if electricity can be provided.

Clinics

Being under the Council, clinics also do not receive cash from the council directly and like the schools have to make a requisition for their needs to the Council which then supplies their requirements.

In most villages where clinics are PV electrified, staff indicated that the systems were working well.

Poor PV system performance is experienced during cloudy days since batteries cannot be fully charged. Clinics are keen to power their refrigerators using PV energy if it can be available at the clinic. The gas (LPG), which they are using at the moment, is at times not delivered on time by the Council and this causes operational complications. Public facilities would like to know if PV systems will be able to power refrigerators under all weather conditions for 24 hours a day without any failure. A hybrid refrigerator types which can take both LPG and electricity should be considered in the case of clinics.

6.3.3.3 PV Electrifies Households

(1) Household status

Sex of households head

Male : 66%

Female : 34%

Marital status of households head

Married : 48%

Widowed/widower : 10%

Single : 26%

Living together : 6%

Educational level

No education : 12%

Primary education : 34%

Secondary education : 16%

Tertiary education : 28%

Number of rooms

Households generally have about 4 rooms

Number of required lighting points

2~8 : 84%

Number of Cattle and Small Livestock

Cattle or small livestock ownership is not a critical determinant as 40% of those with the systems did not have any cattle and 42% did not have any small livestock.

(2) Size of PV system

The majority of PV systems owned are mainly for 2-lights and 3 to 4 lights in the PV electrified households/premises. PV system use has been limited to lighting and it is not surprising that the majority want to upgrade their systems (76%) to cater for appliances and more lighting (44% of households). For the others, the present load is heavier (10%) or they need a longer period of supply (14%).

Appendix Table 6.3-7 PV System Size Owned by PV Electrified Households/Premised

Size of System	No. of households	Ratio (%)
2 light	16	32
3-4 light	12	24
6 light + radio	4	8
3-4 lights + B&W TV	1	2
3-4 lights + color TV	6	12
3-4 lights + refrigerator	7	14
N/R	4	8
Total	50	100

Only 16% of the PV electrified households want to dispose their systems because they cannot afford repayments.

(3) Past payment arrangement and affordability

Apart from the 8 (16%) council PV electrified premises, the majority paid cash (48%, 20/42) for their PV systems and another 29% (12/42) paid through

hire purchase and only 5% (2/42) could not indicate. For the 29% who paid through hire purchase, nearly all paid within 4 years and only one paid in 10 years. Most of pensioner prefers to opt for hire purchase.

Appendix Table 6.3-8 Method of Payment and Income Source

Source of Income	Cash		Hire purchase	
	H/Hs	Ratio (%)	H/Hs	Ratio (%)
Salary/wage	10	20	5	10
Remittance	4	8	2	4
Self employment	10	20	5	10
Pensions	1	2	4	8
Livestock sales	7	14	4	8
Agricultural Sales	4	8	2	4
Other	2	4		

The maintenance costs varied in the case of the 6% who indicated their costs. The range was P60 to P400/year and may mean some of the households/premises had replaced their batteries in the year.

Appendix Table 6.3-9 shows that those with salary/wage own the largest number of systems followed by those who are self-employed and those who sell livestock. It is of interest to note that a larger number of households who afforded large PV systems also depend on livestock sales and sale of agricultural produce. Those on salary/wage (61.5% of them), self employment (66.7%) and with livestock for sale (81.8%) are the ones aspiring to upgrade their systems to power lights and refrigerators.

Appendix Table 6.3-9 Income –System Size Matrix for PV Electrified Households

Source of income	2-light	3-4 light	6 light + radio	3-4light + B&W TV	3-4light + Color TV	3-4light + refrigerator	Total
Salary/wage	5(3)	3(3)	2(2)		5(5)	3(3)	18(16)
Remittance	4(2)	0	0			2	6
Self employment	7(2)	3(2)	1	1	1(1)	3(3)	16(8)
Pensions	2	3	2				7
Livestock sales	2(2)	5(4)	1(1)		2(2)	5(5)	15(14)
Agricultural Sales	2	2				4(4)	8(4)
Other	2(2)	2(1)	1		2(1)		7(4)

(4) Systems technical constraints and preferred scheme

Voltage fluctuation was indicated by 48% of the PV electrified households and premises and insufficient sunshine by 30% as the main technical constraints of PV systems. Only 6% indicated damage to panel and panel support as their past technical faults. The technical constraints and maintenance problems have probably prompted current PV system owners to prefer the fee-for-service scheme. Fifty-eight percent (58%) of the PV electrified households and premises indicated that the fee-for-service scheme is better than purchasing own systems which was supported by 30% of those interviewed. The rest did not indicate their preference.

Appendix Table 6.3-10 Income Sources and Preferred Schemes

Source of Income	Scheme A- Owning system		Scheme B - Fee-for-service	
	H/Hs	Ratio (%)	H/Hs	Ratio (%)
Salary/wage	3	6	15	30
Remittance	3	6	3	6
Self employment	10	20	6	12
Pensions	4	8	2	4
Livestock sales	4	8	9	18
Agricultural Sales	1	2	6	12
Other			5	10

(5) Benefit from PV system

Over 70% of the PV electrified households have enjoyed the various benefit. Only 26% were dissatisfied with their PV system. Those who are not satisfied indicated failure of system to take certain loads, technical faults being experienced and delays in repairs, failure to work when cloudy or for long periods at night as their reasons for being dissatisfied.

Appendix Table 6.3-11 Benefits Realized through PV Electrification

Benefit	No. of Households	% of Households
Useful for homework	31	62
Entertainment increased	24	48
Knowledge of world deepened	18	36
Work became easy	27	54
Time of supper became happy	22	44
Night security improved	23	46
No change	2	4
Family became idle	3	6
All marked	15	30

6.3.3.4 Lessons from Informal Survey

(1) Opinion on PV dissemination Policy

Village authorities suggested that PV electrified schools and clinics be used as centers of PV demonstration and information dissemination through school children and patients respectively. However, in some instances, the benefits of the PV systems have not been well represented as some systems installed at these institutions have not functioned properly soon after installation.

The village authorities expressed willingness to provide the necessary assistance for these demonstrations to take place.

Respondents indicated that often after such socio-economic surveys are done, there is no feedback or follow-up to capture the potential market and delays would obviously discourage potential users from getting involved later, hence this has a tendency of lowering the demand for the product being promoted.

The interest to participate in Dissemination Projects has also been enthusiastically expressed in all the villages/Districts by these authorities.

Village authorities and District officials will be effective in creation of village markets for PV electrification.

In some villages, Village Development Committees (VDC) generate income from providing accommodation and other facilities. These institutions could be sensitized to initiate fee-for-service PV electrification model using their financial resources. This would be a viable and sustainable institutional arrangement for PV commercialization and can also build technical support systems in the villages through proper training. It will be easier to identify

potential technicians who can be trained under the auspices of local authorities than sustaining such technical support with individuals.

(2) Implementation Body

Opinion on institutions considered for an Implementation Body for PV dissemination in rural Botswana.

BPC:	3 (9.6%)
EAD:	10 (32.3%)
Local Authority:	3 (9.6%)
Local authority & EAD:	1 (3.2%)
Other:	1 (3.2%)
Private Sector:	4 (12.9%)
Private Sector & Government:	1 (3.2%)
RIIC:	8 (25.8%)

Local authorities are not favored to be the Implementation Body but 21 out of 31 informal respondents indicated that it is good to involve them in the dissemination process. Some respondents indicated that local authorities (10 out of 31) are already overloaded and have no knowledge/experience in solar activities. If that is the case, it will therefore be crucial to equip them with the necessary skills to function in their new role.

The formation of a National Committee to steer the solar electrification program was favored by the majority of the respondents (28 out of 31), but combinations of whom should be in the committee differed. The Energy Affairs Division (EAD), the Rural Industries Innovation Center (RIIC), the Botswana Power Corporation (BPC), the Department of Electrical and Mechanical Services (DEMS), the Rural Development Unit (RDU) in the Ministry of Finance and Development Planning (MFDP), the Botswana Technology Center (BOTEC) and the Ministry of Agriculture (MOA) have been consistently mentioned.

Creation of District and Village committees and who should be the members in these committees were also proposed. Respondents suggested that District Committees should consist of members from the District Commissioner, including some key District Officers, the Land Board and Tribal Authority representatives. The idea of having particularly village committees is

considered to be important as landing ‘pads’ in sensitizing the village potential users. The proposed village institution, although with some variations, was basically to include the chiefs, VDC chairpersons and other Government departments operating in the villages.

(3) Subsidy

Both District and village authorities indicated that affording PV systems is hampered by lack of money, as many people are not employed. There is a strong proposition that the systems be subsidized.

This is an idea which often comes up but government policy seems to be against direct or cross-subsidies. Particular reference is made for Khawa in Kgalagadi South, where a significant subsidy is already being given to communities through the Council by providing cattle to cooperatives, food to the elderly and the destitute, and free schooling (fees and uniforms) to poor households. In such a village where the people are used to subsidies, they would probably not be willing to pay for PV systems.

(4) Risk of PV system theft

There would be certain risk of PV system theft. Local /traditional authorities believe that the threat of PV system theft can only be perpetrated by people originating outside the villages otherwise local villagers would not know what to do with the systems or rather where to sell them. Village authorities see a counter effect in introduction of PV electrification in that it will benefit the village by frightening thieves away since thieves would be afraid to steal were there are lights especially in small villages as there would be fear of being identified.

6.4 Socio-Economic Survey for Participants in the Dissemination Project

(1) Household status

The distribution of SHS users shows the similar results as the Socio-economic Survey. However, that of BCS user indicates larger values in “Single” and “Living together”, which suggests the cash income level of BCS user is rather low as mentioned later.

Appendix Table 6.4-1 Marital Status of Household Head

	Socio-economic Survey (Average of 10 villages)	SHS user	BCS user
Married	39.6%	42%	5%
Divorced	3.8%	0%	0%
Widowed/Widower	18.8%	12%	5%
Single	24.2%	18%	50%
Living together	12.5%	28%	40%

(2) Educational level of household head

No significant difference exists in three groups.

Appendix Table 6.4-2 Educational level of Households Head

	Socio-economic Survey (Average of 10 villages)	SHS user	BCS user
No education	57.5%	58%	55%
Primary school	32.9%	28%	30%
Secondary school	6.9%	10%	15%
Tertiary	1.2%	4%	0%

(3) Number of cattle (Parameter of judging income level)

It is likely that the fact that the ratio of salary earners in SHS users is more than that in the average of 10 villages, results in lower distribution of number of cattle in SHS users. On the other hand, there is no salary earner in BCS users and they own rather few cattle.

This is telling that rather poor villagers join the BCS scheme in the Dissemination Project.

Appendix Table 6.4-3 Number of Cattle

	Socio-economic Survey (Average of 10 villages)	SHS user	BCS user
0 (Very poor)	56%	41%	80%
1~20 (Poor)	32.8%	47%	15%
21~50 (Medium)	6.9%	8%	5%
50~ (Rich)	4.3%	4%	0%

(4) Number of small livestock

The same tendency is found in “Number of cattle”.

Appendix Table 6.4-4 Number of Small Livestock

	Socio-economic Survey (Average of 10 villages)	SHS user	BCS user
0	50.6%	29%	55%
1~20	39.2%	55%	40%
21~50	6.2%	8%	0%
50~	4.1%	8%	5%

(5) Number of required lighting points

3 light system is predominant in SHS user and 2 light system is predominant in BCS user.

Appendix Table 6.4-5 Number of Required Lighting Points

No. of lights	Socio-economic Survey (Average of 10 villages)	SHS user	BCS user
2 lights System	33.6%	13%	83%
3 lights	24.8%	43%	11%
4 lights	21.4%	13%	6%
5-6 lights	14.1%	26%	
Over 6 lights	6.1%	6%	
TOTAL	100%	100%	100%

(6) Reason why currently not using PV system

Appendix Table 6.4-6 Reason why Currently not using PV System

	Socio-economic Survey (Average of 10 villages)	SHS user	BCS user
Still saving for the system	6%	6%	
Don't know where to buy it	15%	51%	89%
Don't know how much it costs	10%	9%	
Don't know about the system	23%	17%	
Need to see it working	10%	2%	
Others	33%	15%	
N/A	3%		11%

(7) Who decide and pay for PV system

Appendix Table 6.4-7 Who Decide and Pay for PV System

	Socio-economic Survey (Average of 10 villages)	SHS user	BCS user
Household head	64%	82%	94%
Spouse	11%	4%	
Working sons/daughters	17%	8%	
Family contributions	17%	4%	6%
Relatives	2%	2%	