

**Table II-1 Cultivated Land by Data Source**

(Unit: ha)

Gewog	RNR Statistics 2000					Land Registration					Land Cover Map				
	Wet land	Dry land	Tseri	Kitchen garden	Total	Wet land	Dry land	Tseri	Kitchen garden	Total	Wet land	Dry land	Tseri	Mixed land	Total
Lhuntse	812	1,371	1,030	49	3,262	926	1,296	1,748	105	4,075	944	2,383	3,289	6,196	12,812
L1 Gangzur	167	238	151	12	568	162	242	233	8	646	43	518	438	1,157	2,155
L2 Jaray	15	193	154	4	365	15	178	156	5	355	11	72	899	475	1,457
L3 Khoma	104	165	64	8	341	102	57	98	10	267	0	181	59	764	1,004
L4 Kurtoe	68	93	64	6	231	75	81	175	9	340	21	0	521	1,415	1,957
L5 Menbi	173	113	173	3	461	293	169	571	51	1,084	569	48	154	857	1,628
L6 Metsho	61	114	127	3	305	73	117	184	5	379	43	469	722	320	1,554
L7 Minjay	166	165	131	4	466	144	144	154	5	446	118	217	47	723	1,105
L8 Tsenkhar	59	291	165	9	524	62	307	176	11	556	139	879	450	485	1,953
Mongar	500	3,056	1,263	45	4,864	594	3,446	1,632	146	5,818	627	7,077	5,904	5,408	19,016
M1 Balam	13	136	27	1	176	8	110	18	4	140	12	205	210	0	427
M2 Chali	68	121	37	2	229	163	463	43	4	673	74	11	0	638	723
M3 Chaskhar	51	244	41	2	339	44	195	67	5	310	111	501	143	94	849
M4 Drametse	58	312	97	8	476	74	368	118	0	560	111	1,195	0	10	1,316
M5 Drepong	13	112	33	0	157	16	122	3	6	148	0	250	364	272	886
M6 Gongdue	2	178	223	2	406	1	158	172	51	382	0	330	1,192	690	2,212
M7 Jurme	0	118	90	0	208	0	116	195	4	315	0	387	651	324	1,362
M8 Kengkhar	0	183	99	0	282	0	169	218	17	404	0	603	1,379	52	2,035
M9 Mongar	41	249	53	0	344	49	425	81	9	564	86	671	132	241	1,130
M10 Ngatshang	54	181	56	0	291	47	141	62	4	254	111	478	33	63	684
M11 Saleng	42	268	153	12	475	52	308	259	3	622	86	330	99	471	986
M12 Serimuhang	69	219	57	2	346	30	127	35	0	193	12	649	66	73	800
M13 Silambi	0	201	143	1	345	0	219	98	4	321	0	899	254	1,297	2,450
M14 Thangrong	7	193	38	3	241	4	170	59	17	250	0	466	408	136	1,011
M15 Tsakaling	67	211	48	4	330	86	241	105	10	441	25	11	331	826	1,193
M16 Tsamang	15	130	67	8	219	19	115	98	7	240	0	91	640	220	951

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**Table II-2 Agricultural Land and Land Tenure in the Study Area**

	Unit	National	Lhuntse Dzongkhag										Mongar Dzongkhag															
			Lhuntse Dzongkhag	L1 Gangzur	L2 Jaray	L3 Khoma	L4 Kurtoe	L5 Menbi	L6 Metsho	L7 Minjay	L8 Tsenkha	Mongar Dzongkhag	M1 Balam	M2 Chai	M3 Chaskhar	M4 Drametse	M5 Drepung	M6 Gongdue	M7 Jurmey	M8 Kengkhar	M9 Mongar	M10 Ngatshang	M11 Saleng	M12 herimuhur	M13 Silambi	M14 Thangrong	M15 Tsakaling	M16 Tsamang
<b>1. Population</b>		700,000	19,426	3,487	1,360	2,400	1,692	3,142	2,142	2,219	2,984	44,138	1,614	1,952	3,095	4,734	1,733	3,246	2,141	3,178	4,544	2,615	2,718	2,593	2,812	2,228	3,132	1,803
Households		90,000	2,516	459	216	323	200	405	244	266	403	4,966	181	262	401	534	217	333	260	384	461	268	293	269	311	274	332	186
<b>2. Agricultural Area and Land Holdings</b>																												
<b>2.1 Operational Agricultural Areas under Various Land Use Types</b>																												
Wet Land	ha	21,861	812	167	15	104	68	173	61	166	59	499	13	68	51	58	13	2	0	0	41	54	42	69	0	7	67	15
Dry Land	ha	45,640	1,371	238	193	165	93	113	114	165	291	3,055	136	121	244	312	112	178	118	183	249	181	268	219	201	193	211	130
Tseri/Pangshing	ha	28,800	1,030	151	154	64	64	173	127	131	165	1,263	27	37	41	97	33	223	90	99	53	56	153	57	143	38	48	67
Kitchen Garden	ha	1,040	50	12	4	8	6	3	3	4	9	45	1	2	2	8	0	2	0	0	0	0	12	2	1	3	4	8
Operational Land Total	ha	97,341	3,262	568	365	341	231	461	305	466	524	4,862	176	229	339	476	157	406	208	282	344	291	475	346	345	241	330	219
<b>Average farm size</b>																												
Wet Land	ha/HH	0.24	0.32	0.36	0.07	0.32	0.34	0.43	0.25	0.62	0.15	0.10	0.07	0.26	0.13	0.11	0.06	0.01	0.00	0.00	0.09	0.20	0.14	0.26	0.00	0.03	0.20	0.08
Dry Land	ha/HH	0.51	0.54	0.52	0.89	0.51	0.46	0.28	0.47	0.62	0.72	0.62	0.75	0.46	0.61	0.59	0.51	0.54	0.45	0.48	0.54	0.68	0.91	0.81	0.65	0.70	0.64	0.70
Tseri/Pangshing	ha/HH	0.32	0.41	0.33	0.71	0.20	0.32	0.43	0.52	0.49	0.41	0.25	0.15	0.14	0.10	0.18	0.15	0.67	0.35	0.26	0.12	0.21	0.52	0.21	0.46	0.14	0.15	0.36
Kitchen Garden	ha/HH	0.01	0.02	0.03	0.02	0.03	0.03	0.01	0.01	0.01	0.02	0.01	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.01	0.01	0.05
Operational Land Total	ha/HH	1.08	1.30	1.24	1.69	1.06	1.16	1.14	1.25	1.75	1.30	0.98	0.97	0.87	0.84	0.89	0.73	1.22	0.80	0.73	0.75	1.09	1.62	1.29	1.11	0.88	0.99	1.18
<b>2.2 Wet and Dry Land Area by Land Tenancy Status</b>																												
<b>Wet Land</b>																												
Own and Operated	%	79%	80%	76%	83%	92%	85%	70%	81%	81%	83%	89%	81%	94%	95%	90%	90%	100%			76%	81%	92%	92%		100%	92%	84%
Leased in	%	6%	5%	7%	0%	2%	12%	4%	3%	4%	5%	2%	0%	0%	1%	1%	0%	0%			1%	6%	2%	2%		0%	3%	3%
Leased out	%	8%	7%	5%	8%	5%	2%	11%	3%	12%	6%	3%	13%	1%	3%	4%	0%	0%			3%	2%	3%	2%		0%	4%	5%
Left Fallow	%	7%	8%	12%	8%	1%	1%	15%	13%	3%	6%	6.1%	6%	5%	1%	6%	10%	0%			20%	11%	3%	3%		0%	2%	8%
<b>Dry Land</b>																												
Own and Operated	%	74%	79%	82%	61%	91%	82%	63%	72%	86%	84%	83%	79%	93%	97%	87%	80%	63%	81%	85%	77%	84%	81%	79%	77%	98%	81%	84%
Leased in	%	2%	2%	3%	1%	0%	3%	1%	1%	2%	2%	1%	2%	0%	0%	1%	0%	1%	1%	2%	1%	1%	4%	2%	1%	0%	1%	2%
Leased out	%	3%	2%	2%	5%	2%	0%	7%	2%	1%	1%	2%	6%	1%	0%	2%	0%	2%	7%	5%	1%	2%	2%	1%	3%	0%	2%	0%
Left Fallow	%	21%	17.3%	12%	34%	8%	14%	30%	25%	12%	13%	13.4%	12%	6%	3%	10%	19%	34%	10%	8%	21%	14%	13%	17%	18%	1%	15%	14%
<b>2.3 Percentage of Wet Land Cultivated by Holding Sizes</b>																												
< 0.4 ha	%	16	25	23	68	23	33	14	44	16	46	63	91	51	82	76	100	52			66	59	41	44		100	64	71
0.4 - 1.2	%	44	53	54	32	63	49	57	50	49	46	28	9	47	15	21		48			24	26	44	31			29	29
1.2 - 2.0	%	24	15	15		14	18	19	6	17	9	5		2	3	3					10	8	15	3			3	
2.0 - 2.8	%	9	2	2				5		3	1	1									7						5	
2.8 - 4.0	%	4	2	3				5																				
4 - 10	%	2	4	4						15																		
> 10	%	1										3																
<b>2.4 Percentage of Dry Land Cultivated by Holding Sizes</b>																												
< 0.4 ha	%	8	14	15	7	15	24	31	20	12	8	11	4	17	8	12	17	16	24	22	11	7	5	6	10	12	10	7
0.4 - 1.2	%	41	49	56	36	49	42	52	54	49	53	65	59	76	76	73	61	67	60	68	72	70	39	52	66	70	62	68
1.2 - 2.0	%	25	23	17	27	18	18	17	24	16	32	18	30	6	12	10	16	12	12	11	16	17	32	28	23	17	23	20
2.0 - 2.8	%	12	8	5	22	4	11		3	7	7	4	7	2	5	4	5	2			2	11	12	2			3	
2.8 - 4.0	%	7	2	5	2	14	5					1				1					4		5	2			2	6
4 - 10	%	6	2	3	6							1																
> 10	%	1	2							16								4				4	9					

Source: Population and households: Dzongkhag  
Others: RNR Statistics 2000

**Table II-3 Food Crop Production in the Study Area**

	Unit	National	Lhunse Dzongkhag									Mongar Dzongkhag																	
			Lhunse Dzongkhag	L1 Gangzur	L2 Jaray	L3 Khorma	L4 Kurtoe	L5 Menbi	L6 Metsho	L7 Minjay	L8 Tsenkha	Dzongkhag	M1 Balam	M2 Chali	M3 Chasknar	M4 Drametse	M5 Drepong	M6 Gongdue	M7 Jurme	M8 Kengkhar	M9 Mongar	M10 Ngatshang	M11 Saleng	M12 Jenmuan	M13 Silambi	M14 Thangrong	M15 Tsakaling	M16 Tsamang	
<b>1. Field Crop Production</b>																													
<b>1.1 Harvested Area under Cereal Crops (Acres)</b>																													
Paddy	ha	19,146	750	162	12	102	75	140	53	144	62	440	8	61	49	53	13	<1	<1	31	49	35	51	6	7	63	12		
Maize	ha	31,138	1,093	242	104	57	81	64	93	144	307	3,092	118	115	267	275	86	176	205	237	203	160	295	175	166	323	172	119	
Wheat	ha	4,688	36	5	20	5	<1	<1	4	2	39	59	<1	6	<1	6	2	3	2	3	2	<1	<1	2	11	<1	<1	3	
Barley	ha	1,498	6	<1	<1	<1	<1	<1	3	<1	297	407	3	3	28	<1	49	<1	2	2	108	64	31	4	2	0	<1		
Millet	ha	5,166	97	13	6	71	2	<1	<1	<1	40	970	<1	<1	<1	<1	12	4	2	<1	<1	4	6	3	<1	7			
Buckwheat	ha	3,529	8	<1	<1	<1	<1	<1	<1	5	84	932	2	<1	2	2	3	<1	11	9	2	<1	15	6	18	4	<1		
Total of Cereal Crops	ha	66,165	1,990	423	144	238	158	206	155	289	378	3,992	131	181	351	331	156	189	225	254	347	276	346	269	212	341	237	146	
<b>1.2 Cereal Production</b>																													
Paddy	ton	68,573	2,918	606	40	469	308	551	182	552	210	1,445	28	187	153	196	38	*	*	90	177	113	207	15	21	178	35		
Maize	ton	77,298	3,158	695	321	201	280	199	301	398	763	10,565	318	325	1,027	1,048	300	442	561	868	728	749	769	730	340	1,602	422	334	
Wheat	ton	4,352	44	6	20	10	*	*	6	2	59	59	2	1	13	*	10	2	2	4	*	*	4	14	*	*	4		
Barley	ton	1,735	6	*	*	*	*	*	3	*	407	407	2	1	42	*	81	*	1	2	134	71	64	4	4	*	*		
Millet	ton	3,793	185	19	5	153	2	*	*	*	39	970	*	*	*	*	12	1	2	*	2	3	6	1	*	8			
Buckwheat	ton	2,887	7	*	*	*	*	*	*	3	78	932	1	*	3	0	2	*	7	15	1	*	8	9	20	1	5		
Total of Cereal Crops	ton	158,638	6,318	1,325	387	833	590	750	491	950	978	12,593	349	513	1,237	1,245	432	454	573	888	956	1,000	890	1,018	400	1,629	600	385	
<b>1.3 Average Unit Yield</b>																													
Paddy	kg/ha	3,582	3,892	3,731	3,320	4,599	4,117	3,950	3,456	3,845	3,363	3,287	3,483	3,055	3,093	3,704	3,030			2,916	3,650	3,202	4,056	2,361	2,993	2,836	2,867		
Maize	kg/ha	2,482	2,890	2,867	3,079	3,524	3,456	3,086	3,230	2,759	2,489	3,417	2,696	2,819	3,851	3,808	3,502	2,519	2,736	3,660	3,585	4,684	2,604	4,176	2,052	4,954	2,449	2,815	
Wheat	kg/ha	928	1,216	1,135	1,027	1,916			1,336		891	1,493			2,233	1,560			789	696	1,491		1,678	1,236			1,144		
Barley	kg/ha	1,158	972						837			1,373	730	435	1,539	1,646			529	723	1,243	1,115	2,040	1,106	1,977				
Millet	kg/ha	615	1,908	1,490	925	2,147	970					970						1,017	355	841		850	1,002	441		1,154			
Buckwheat	kg/ha	818	831								666	932	538		1,319	299	874		642	1,590	427		549	1,563	1,117	301	1,061		
<b>1.4 Percentage of Farm Households Producing Cereals Crops</b>																													
Paddy	%	54	75	81	46	72	99	88	80	88	58	45	42	81	75	63	34	6		1	41	80	39	76	9	22	81	43	
Maize	%	69	84	84	93	58	99	72	89	83	96	94	92	95	97	91	98	91	95	96	92	92	96	88	92	99	97	96	
Wheat	%	14	5	4	28	7	0	5	2	2	3	3	4	1	3	0	14	0	1	3	1	0	0	2	14	2	0	6	
Barley	%	7	1	1	2	1			3	1	0	15	4	1	16	0	43	0	4	2	58	56	29	6	3	2	2		
Foxtail Millet	%	3	1	3	4		1		1		0	2	1	0		0	1	14	5	2		1	2	5	1	0	6		
Finger Millet	%	14	12	8	12	62	4	6	4	4	2	1	1		0	0		1	1	0	0	0	1	2	1	6			
Sweet Buckwheat	%	8	1			2	1	2	1	1	1	3	3	1	1	2	4	0	12	7	1	1	4	4	8	5	0	6	
Bitter Buckwheat	%	5	1		2		1	1	1		4	2	2		0	2	0	3	1	0	2	6	2	17	0	1			
<b>2. Other Field Crops</b>																													
<b>Mustard</b>																													
Area	ha	3,450	39	12	5			4	5	<1	13	78		12	<1		<1	<1	<1	6	30	8	8	<1	4	3	<1		
Production	ton	1,696	17	3	4			3	2	*	6	45		5	*	*	*	*	*	2	24	3	4	*	1	2	*		
Yield	kg/ha	492	440	236	819			708	335	*	432	580		418	*	*	*	*	*	300	812	307	559	*	138	597	*		
<b>Soyabean</b>																													
Production	ton	577	30	3	1	2		18	*		5	63			2	7	5	1	9	3	6	0			3	24	3		

Source: RNR Statistics 2000

**Table II-4 Horticulture in the Study Area (1/2)**

	Unit	National	Lhuntse Dzongkhag										Mongar Dzongkhag															
		Dzongkhag	L1	L2	L3	L4	L5	L6	L7	L8	Mongar Dzongkhag	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	
<b>1. Vegetable and Spice</b>																												
<b>1.1 Harvested Area, Production and Yield</b>																												
<i>Potato</i>																												
Area	ha	3,122	38	8	6	4	6	4	<1	<1	8	241	34	<1	6	97	9		5	13	36	3	11	4	<1	12	<1	6
Production	ton	35,436	332	74	42	35	48	45	*	*	62	2,132	268	*	48	878	79		47	104	353	37	92	27	*	99	*	61
Yield	kg/ha	11,350	8,629	9,625	6,459	9,624	7,927	12,320	*	*	8,064	8,854	7,798	*	7,420	9,082	8,861		8,841	8,036	9,908	13,011	8,153	7,484	*	8,120	*	9,419
<i>Chili</i>																												
Area	ha	937	57	11	8	5	6	2	<1	3	21	53	5	<1	<1	13	<1	<1	<1	<1	11	<1	2	4	<1	<1	3	6
Production	ton	2,849	151	27	10	19	13	8	*	15	44	154	14	*	43	*	*	*	*	*	30	*	9	4	*	*	9	24
Yield	kg/ha	3,039	2,652	2,381	1,303	3,946	2,306	3,456	*	4,613	2,038	2,936	2,960	*	3,324	*	*	*	*	*	2,685	*	3,746	981	*	*	2,828	3,947
<i>Radish</i>																												
Area	ha	779	14	2	3	<1	<1	2	<1	<1	4	62	<1	<1	<1	6	5	<1	<1	<1	22	<1	7	<1	<1	8	<1	2
Production	ton	3,384	55	11	13	*	10	*	*	10	4	340	*	*	33	47	*	*	*	112	*	28	*	*	*	35	*	11
Yield	kg/ha	4,341	3,909	4,515	4,111	*	4,882	*	*	2,151	5,531	5,531	*	*	5,814	8,903	*	*	*	5,023	*	3,797	*	*	*	4,506	*	4,326
Beans	ton	1,151	27	1	1	14		1	8		3	209	6	1	5	8	16	25	52	25	8	11	14	10	1	14	5	8
Brijjal	ton	197	35	*		27		*	*		*	12	2	*	1	*	*	2		1	*	*	*	*	*	*	*	2
Carrot	ton	151	*	*								6	*	*	*	*	*	2	*	*	*	*	*	*	*	*	*	313
Cassava	ton	827	*	*								40	*	*			24	9	*	*	*	*	*	*	*	*	*	*
Peas	ton	627	31	*							22	*	*	3	0			*	*	10	*	*	*	*	*	5	*	
R Beans	ton	355	15	2		8		1	*		4	61	2	2	1	23			3	1		3		2		6	11	6
Sag	ton	521	7	*	5	*	*	*	*	*	*	43	*	*	2	*	*	*	*	21	*	7	*	*	*	4	*	*
Tomato	ton	334	31	*							39	1	2		6	10	*	*	*	*	3	*	*	*	11	*	1	
Garlic	ton	430	28.6	4.5	*	10.4	1.5	3.1	*		5.2	94.1	10.9	3.1	3.1	24.3	2.0	*	2.7	*	7.6	16.1	3.9	5.5	*	6.4	7.6	
Onion	ton	285	8.9	*	*	2.3	1.5	2.8	*		1.1	65.6	4.6	1.9	*	17.3	3.3	2.5	18.3		3.6	*	*	*	*	4.3	7.6	1.5
<b>1.2 Percentage of Farm Households Growing Various Types of Vegetables</b>																												
Potato	%	20.0	20.4	38.6	19.7	10.7	60.3	14.1	9.1	3.5	15.8	25.1	57.4	8.9	11.2	59.4	39.7	0.4	11.6	12.6	63.3	10.2	29.8	9.4	1.9	11.9	9.1	39.2
Radish	%	17.1	8.9	18.1	16.1	2.4	18.4	3.0	6.4	0.5	8.0	20.5	21.3	8.9	7.6	22.1	49.5	6.3	6.8	3.7	53.4	5.3	55.5	4.0	3.0	40.1	8.8	29.8
Sag	%	8.2	1.9	3.4	5.2	0.5	0.7	1.0	1.4		2.1	9.7	16.9	0.8	1.0	17.2	36.9	0.4	2.4	0.3	21.6	0.4	24.9	1.3		19.6	2.9	5.8
Beans	%	6.2	4.5	5.9	5.7	4.9	16.3	2.3	1.8	2.0	2.4	11.6	3.3	1.3	0.3	15.1	4.7	9.8	31.6	36.8	1.8	0.8	17.1	0.3	2.6	44.6	0.7	7.0
Cabbage	%	0	1.6	3.7	0.5	1.0	4.3	1.6		0.5	0.9	4.9	7.7	3.8	0.8	2.5	24.8	0.8	2.0	0.3	8.9	1.9	15.1		2.2	10.6	1.3	4.7
Garlic	%	4.6	2.8	7.2	1.6	0.5	3.5	1.3	3.7	0.5	2.7	6.3	18.6	2.1	1.5	25.1	4.2	1.6		0.3	6.9		14.7	1.7	1.1	6.7	2.3	1.8
Onion	%	3.3	2.6	5.6	2.6	1.5	5.0	1.3	0.9	1.0	2.7	3.2	6.0	4.2	0.8	9.1	1.4	1.6	0.4		4.6		7.3			1.9	5.9	4.1
Chili	%	15.1	27.9	42.1	17.6	30.6	59.6	11.5	6.8	21.1	37.8	16.3	33.3	7.6	8.9	38.4	20.1	5.9	1.6	0.6	26.4	4.2	28.2	5.4	2.2	7.1	16.3	56.1
<b>2. Fruits and Nuts Tree crops</b>																												
<b>2.1 Production of Tree Crops</b>																												
Apple	ton	5,113	11.3	0.5	0.1		0.2	3.0	6.1	0.2	1.2	11.8	0.1		0.6	3.5	*	0.7	*	4.2	0.5	*	*	*	*	0.5	*	*
Orange	ton	29,616	60.4	15.4	0.4	0.6	1.5	3.1	9.2	22.6	7.6	594.0	3.9	23.1	9.6	19.1	1.3	180.1	66.1	63.3	18.9	33.1	78.6	20.2	19.4	19.7	16.1	21.7
Walnut	ton	235	18.1	0.2	2.5	10.6	0.0	0.0	0.0	4.8	0.0	51.4	3.6	0.0	1.6	2.8	0.0	0.0	0.7	0.4	0.0	0.0	1.2	15.3	21.7	0.0	0.0	4.3
Plum	ton	282	16.1	4.6	*	5.6	4.5	0.4	*		0.9	32.0	0.2	0.5	0.9	1.7	*			12.3	8.6	*	4.5	*	*	3.0	0.0	
Pear	ton	718	36.7	2.2	3.7	13.5	4.5	0.9	0.9	10.1	0.9	71.9	*	0.6	*	8.6	1.6		9.7	*	29.8	1.1	0.7	*	3.9	1.3	9.9	
Peach	ton	1,091	39.3	7.2	1.5	4.8	0.6	8.1	2.2	8.0	6.9	231.6	16.1	2.3	1.2	48.8	17.2	4.1	12.8	*	55.5	12.0	2.4	21.3	4.9		8.3	24.5
Guava	ton	665	15.8	2.9			*		*	3.1	9.3	98.7	*	5.7	22.8	4.1	2.4	6.0	6.2	0.0	2.9		25.0	1.5		17.9	1.5	2.8

Source: RNR Statistics 2000

**Table II-4 Horticulture in the Study Area (2/2)**

	Unit	National		Lhunse Dzongkhag								Mongar Dzongkhag																			
		Lhunse Dzongkhag	Gangzur	Jaray	L1 Khorma	L2 Kurtoe	L3 Menbi	L4 Melsho	L5 Minjay	L6 Tsenkhar	L7	L8	Mongar Dzongkhag	M1 Balam	M2 Chall	M3 Chaskhar	M4 Drametse	M5 Drepong	M6 Gongdue	M7 Jume	M8 Kengkhar	M9 Mongar	M10 Ngatshang	M11 Saleng	M12 Jerimuhan	M13 Slambi	M14 Thangrong	M15 Tsakaling	M16 Tsamang		
<b>2.2 Number of Trees, Production and Yield</b>																															
<b>Apple</b>																															
Total Tree	No.	368,388	1,286	356	30	63	26	106	476	26	202	1423	51		150	459	<25	39	<25	263	194	<25		<25	<25	66	149	<25			
Bearing Tree	No.	196,479	280	52	8		6	91	68	6	51	241	12		3	96	*	21	*	20	46	*	*	*	*	15	*	*			
Production	ton	5,113	11.3	0.5	0.1		0.2	3.0	6.1	0.2	1.2	11.8	0.1		0.6	3.5	*	0.7	*	4.2	0.5	*	*	*	0.5	*	*				
Yield	kg/tree	26	40	9	10		40	33	90	40	24	49	9		192	37	*	36	*	205	11	*	*	*	30	*	*				
<b>Orange</b>																															
Total Tree	No.	1,761,005	4,810	1,014	109	81	47	177	315	2,163	903	24,575	212	1,217	316	1,470	212	6,262	3,255	2,522	1,034	1,042	2,815	1,330	610	689	810	779			
Bearing Tree	No.	906,703	1,638	290	10	25	33	77	98	880	234	11,945	74	533	207	590	14	3,294	2,007	1,354	224	352	1,486	386	368	371	399	287			
Production	ton	29,616	60.4	15.4	0.4	0.6	1.5	3.1	9.2	22.6	7.6	594.0	3.9	23.1	9.6	19.1	1.3	180.1	66.1	63.3	18.9	33.1	78.6	20.2	19.4	19.7	16.1	21.7			
Yield	kg/tree	33	37	55	40	24	45	40	93	26	33	50	52	43	46	32	93	55	33	47	84	94	53	52	53	53	40	75			
<b>Walnut</b>																															
Total Tree	No.	36,729	1,658	65	110	385	133	105	148	532	181	7092	257	518	931	474	77	30	799	232	485	305	609	317	345	194	109	1410			
Bearing Tree	No.	5,458	408	16	9	225	0	0	0	158	0	590	14	0	26	32	0	0	31	10	0	0	48	113	251	0	0	65			
Production	ton	235	18.1	0.2	2.5	10.6	0.0	0.0	0.0	4.8	0.0	51.4	3.6	0.0	1.6	2.8	0.0	0.0	0.7	0.4	0.0	0.0	1.2	15.3	21.7	0.0	0.0	4.3			
Yield	kg/tree	43	44	13	270	47				30		87	250		60	87			23	38			24	135	86			67			
<b>Plum</b>																															
Total Tree	No.	8,922	498	146	<25	112	99	32		<25	80	1624	137	60	93	60	<25				533	264	<25	182		<25	169	65			
Bearing Tree	No.	5,343	382	126	*	64	80	32		*	70	705	11	10	31	30	*				200	234	*	97		*	85	0			
Production	ton	282	16.1	4.6	*	5.6	4.5	0.4		*	0.9	32.0	0.2	0.5	0.9	1.7	*				12.3	8.6	*	4.5		*	3.0	0.0			
Yield	kg/tree	53	42	37	*	88	56	13		*	12	45	15	50	30	55	*				61	37	*	47		*	35				
<b>Pear</b>																															
Total Tree	No.	12,580	881	131	41	235	89	32	104	158	90	1409	<25	60	<25	234	43		92	<25	515	81		55	<25	54	72	138			
Bearing Tree	No.	8,028	587	102	14	193	75	21	44	108	30	878	*	10	*	184	21		72	*	336	30		14	*	22	48	75			
Production	ton	718	36.7	2.2	3.7	13.5	4.5	0.9	0.9	10.1	0.9	71.9	*	0.6	*	8.6	1.6		9.7	*	29.8	1.1		0.7	*	3.9	1.3	9.9			
Yield	kg/tree	88	62	21	270	70	60	44	20	93	30	82	*	63	*	47	75		136	*	89	37		50	*	181	26	132			
<b>Peach</b>																															
Total Tree	No.	29,439	1439	274	174	96	60	174	195	285	181	4993	476	100	47	1460	390	115	338	<25	621	343	97	339	327		97	225			
Bearing Tree	No.	20,657	1038	263	37	96	60	124	65	222	171	3409	309	80	16	1002	206	69	174	*	398	320	77	234	231		72	201			
Production	ton	1,091	39.3	7.2	1.5	4.8	0.6	8.1	2.2	8.0	6.9	231.6	16.1	2.3	1.2	48.8	17.2	4.1	12.8	*	55.5	12.0	2.4	21.3	4.9		8.3	24.5			
Yield	kg/tree	53	38	27	40	50	10	65	33	36	40	68	52	29	80	49	83	60	74	*	139	38	31	91	21		115	122			
<b>Guava</b>																															
Total Tree	No.	26,927	500	87			<25		<25	131	241	2835	<25	179	155	207	80	241	228	40	297		870	42		323	42	118			
Bearing Tree	No.	17,950	480	87			*	*	*	131	241	1934	*	179	155	195	48	195	171	0	119		598	29		151	29	54			
Production	ton	665	15.8	2.9			*	*	*	3.1	9.3	98.7	*	5.7	22.8	4.1	2.4	6.0	6.2	0.0	2.9		25.0	1.5		17.9	1.5	2.8			
Yield	kg/tree	37	33	33			*	*	*	24	39	51	*	32	147	21	50	31	36		24		42	51		119	51	52			
<b>2.3 Percentage of Farm Households Growing Various Types of Tree Crops</b>																															
Apple	%		1	1	1	1	1	0	3		1	1	1	1	4	1	0		1	2	1		0	0	1		1	1			
Orange	%		7	17	2	2	6	3	4	12	6	20	8	13	6	15	1	45	52	39	6	13	46	17	11	27	6	25			
Walnut	%		1	2	1						0	0			1		0	0	0			3	0					1			
Plum	%		1	3			1		1	1	0	1	1		1	0					1	1	1	1		1		1			
Pear	%		2	2	7		4		2	1	1	0							1	0	0	2	1					2			
Peach	%		2	3	8		2		3		1	1	1		1	1			2	0	1	0	9	1	0	1		6			
Guava	%		1	3				0	1	1	2	2	1	0	1	1	1	0	0	1	1	0	16	0	0	3		2			

Source: RNR Statistics 2000

**Table II-5 Livestock in the Study Area**

		National	Lhuntse Dzongkhag								Mongar Dzongkhag																		
Unit			Lhuntse Dzongkhag	L1 Gangzur	L2 Jaray	L3 Khoma	L4 Kurtoe	L5 Menbi	L6 Metsho	L7 Minjay	L8 Tsenkha	Mongar Dzongkhag	M1 Balam	M2 Chali	M3 Chaskhar	M4 Drametse	M5 Drepong	M6 Gongdue	M7 Jurme	M8 Kengkhar	M9 Mongar	M10 Ngatshang	M11 Saleng	M12 Jerimuhan	M13 Silambi	M14 Thangrong	M15 Tsakalng	M16 Tsamang	
<b>1. Livestock Population</b>																													
<b>1.1 Total Livestock Population by Type</b>																													
Cattle	head	320,509	14,089	2,390	1,623	2,492	1,060	1,634	1,341	1,689	1,860	26,635	696	1,064	2,419	2,043	1,333	1,429	1,354	1,909	1,959	1,524	2,772	1,733	1,849	1,580	1,668	1,302	
Local Cattle	head	284,339	12,466	1,905	1,535	2,144	897	1,534	1,285	1,434	1,735	23,974	650	965	1,707	1,982	1,180	1,370	1,341	1,833	1,561	1,326	2,562	1,547	1,791	1,378	1,558	1,225	
Improved Cattle	head	36,171	1,622	485	88	347	164	100	56	256	125	2,660	46	98	712	61	153	59	13	76	398	198	209	186	58	202	111	78	
Adult male	head	90,827	2,789	581	251	533	285	317	164	242	417	5,616	140	243	371	534	273	376	281	400	415	321	577	275	397	319	368	327	
Adult female	head	157,791	8,230	1,248	1,034	1,402	537	983	881	1,076	1,070	15,892	424	671	1,461	1,114	805	750	812	1,176	1,203	898	1,645	1,097	1,084	966	1,050	735	
Calves	head	71,892	3,069	561	338	556	239	334	296	372	373	5,126	132	149	587	395	255	303	261	333	341	305	549	361	368	295	251	241	
Horses	head	23,329	1,768	263	85	287	211	152	121	286	363	2,123	101	82	100	320	76	231	82	104	46	78	66	154	287	82	244	68	
Mules	head	4,273	160	22	5	33	32	11	9	5	42	505	22	6	27	119	12	47	27	41	4	7	13	19	68	48	36	10	
Pigs	head	41,401	1,617	464	13	50	111	228	141	287	323	4,398	245	456	332	553	130	612	37	59	147	246	211	169	473	291	329	110	
Poultry	head	230,723	9,577	1,962	650	933	855	1,144	998	1,301	1,734	17,564	707	826	1,293	1,437	471	1,422	772	1,032	1,464	1,036	1,420	942	1,454	1,254	897	1,135	
<b>1.2 Average Number of livestock per household</b>																													
Cattle	head/HH	3.6	5.6	5.2	7.5	7.7	5.3	4.0	5.5	6.3	4.6	5.4	3.8	4.1	6.0	3.8	6.1	4.3	5.2	5.0	4.2	5.7	9.5	6.4	5.9	5.8	5.0	7.0	
Horses	head/HH	0.3	0.7	0.6	0.4	0.9	1.1	0.4	0.5	1.1	0.9	0.4	0.6	0.3	0.2	0.6	0.4	0.7	0.3	0.3	0.1	0.3	0.2	0.6	0.9	0.3	0.7	0.4	
Mules	head/HH	0.0	0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	
Pigs	head/HH	0.5	0.6	1.0	0.1	0.2	0.6	0.6	0.6	1.1	0.8	0.9	1.4	1.7	0.8	1.0	0.6	1.8	0.1	0.2	0.3	0.9	0.7	0.6	1.5	1.1	1.0	0.6	
Poultry	head/HH	2.6	3.8	4.3	3.0	2.9	4.3	2.8	4.1	4.9	4.3	3.5	3.9	3.2	3.2	2.7	2.2	4.3	3.0	2.7	3.2	3.9	4.8	3.5	4.7	4.6	2.7	6.1	
<b>2. Percentage of Farm Households Owning Different Types of Livestock</b>																													
Cattle	%	77.5	78.4	76.0	89.1	80.1	85.8	76.7	79.9	70.4	75.6	83.2	79.2	85.6	89.1	82.8	84.1	67.2	83.2	83.9	82.3	81.8	90.6	80.1	83.3	87.8	80.1	89.5	
Horses	%	23.8	41.0	27.1	25.4	47.1	58.2	26.2	38.8	49.7	62.2	34.1	41.5	25.0	21.6	52.9	29.4	57.0	30.4	23.0	7.3	25.0	13.1	38.4	71.0	31.7	51.8	28.1	
Pigs	%	37.5	40.1	48.3	4.7	14.1	44.7	49.2	34.2	58.8	51.2	46.5	60.1	76.7	52.2	52.0	45.3	80.9	10.4	7.2	23.4	53.4	43.7	33.3	75.5	53.2	58.3	38.6	
Poultry	%	65.5	78.2	84.7	71.0	71.4	88.7	76.4	77.2	77.9	78.6	72.9	77.6	73.3	75.3	68.1	61.2	82.8	62.8	56.3	71.1	79.2	87.8	65.3	84.4	85.9	62.9	87.7	
<b>3. Livestock Production</b>																													
<b>3.1 Annual Livestock Production</b>																													
Milk	ton	24,837	1,097.8	170.3	106.7	217.9	85.8	101.7	121.5	148.8	145.0	2,055.0	37.7	54.3	294.0	113.0	100.9	98.9	66.7	118.4	152.8	167.2	248.5	155.5	132.7	102.7	102.4	109.3	
Butter	ton	1,316	76.0	11.8	5.0	13.8	7.7	6.3	8.1	15.1	8.1	123.3	2.9	1.8	17.3	8.5	5.3	7.5	3.6	6.6	9.9	7.3	14.8	9.2	7.7	5.8	7.6	7.3	
Cheese	ton	2,173	115.3	20.3	8.1	20.9	10.0	14.4	9.5	21.7	10.4	178.6	3.5	3.2	25.6	10.4	7.5	10.9	4.3	8.0	13.2	11.1	25.2	13.0	12.7	6.8	11.5	11.7	
Beef	ton	1,409.7	72.6	12.8	4.5	8.4	7.0	8.3	14.6	5.7	11.3	179.8	2.2	2.2	8.6	12.9	7.4	10.7	9.9	14.5	11.5	15.2	27.6	17.6	16.5	5.6	10.6	6.6	
Pork	ton	186.6	3.1	0.5	0.2	0.2	1.0	0.4	0.6	0.4	0.4	10.9	0.1	0.1	0.9	0.2	0.6	2.4	0.2	0.3	2.1	0.7	0.9	1.8	0.3	0.2	0.1		
Chicken	ton	21.3	0.12	0.02	0.00	0.03	0.01	0.01	0.03	0.00	0.02	0.29	0.02	0.07	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.05	0.03	0.01	0.01	
Egg	1000 ps.	15,718	620.6	116.8	53.0	47.5	47.9	53.8	72.3	73.6	155.6	1,405.4	48.4	75.7	67.2	100.2	45.6	161.2	46.4	87.1	81.3	82.1	147.4	65.9	171.4	73.1	71.0	81.3	
<b>3.2 Per household production</b>																													
Milk	kg/HH	276	436	371	494	675	429	251	498	559	360	414	208	207	733	212	465	297	256	308	331	624	848	578	427	375	308	588	
Butter	kg/HH	15	30	26	23	43	39	16	33	57	20	25	16	7	43	16	24	23	14	17	22	27	51	34	25	21	23	39	
Cheese	kg/HH	24	46	44	38	65	50	36	39	82	26	36	19	12	64	19	35	33	17	21	29	41	86	48	41	25	35	63	
Egg	ps/HH	175	247	254	245	147	240	133	296	277	386	283	267	289	168	188	210	484	178	227	176	306	503	245	551	267	214	437	

**Table II-6 Crop Budget (1/2)**

Present	Paddy			(ha)	Maize			(ha)	Wheat			(ha)
	Unit	Unit price (Nu)	Quantity	Value (Nu)	Unit price (Nu)	Quantity	Value (Nu)	Unit price (Nu)	Quantity	Value (Nu)		
<b>1 Gross Income</b>												
<b>Main products</b>	kg	8.0	2,200	17,600	8.0	2,000	16,000	9.0	1,000	9,000		
By-product	kg	0.2	1,760	352	0.2	2,000	400	0.2	800	160		
<b>Total</b>				17,952			16,400			9,160		
<b>2 Production Cost</b>												
Input												
• Seed (Seedling)	kg	8.0	75	600	8.0	40	320	9.0	115	1,035		
• FYM	kg	0.5	0	0	0.5	1,000	500	0.5	0	0		
• Urea	kg	5.0	30	150	5.0	20	100	5.0	0	0		
• SSP	kg	3.6	0	0	3.6	0	0	3.6	0	0		
• MOP	kg	6.3	0	0	6.3	0	0	6.3	0	0		
• Plant protection and chemicals	kg			700			400			0		
Subtotal				1,450			1,320			1,035		
Labors		50			50							
Nursery preparation/management	m-day	0	31	0	0	0	0	0	0	0		
Land preparation	m-day		68	0	42	0	0	38	0	0		
Manuring	m-day		0	0	30	0	0	25	0	0		
Planting	m-day		61	0	7	0	0	6	0	0		
Fertilizer application	m-day		4	0	4	0	0	0	0	0		
Weeding	m-day		45	0	76	0	0	0	0	0		
Tree maintenance	m-day											
Harvesting /Carrying	m-day		68	0	53	0	0	53	0	0		
Watching/Fencing	m-day		23	0	30	0	0	15	0	0		
Subtotal	m-day		300	0	242	0	0	137	0	0		
Draught Power		100			100			100				
Land preparation	ox-day	0	8	0	0	8	0	0	8	0		
<b>Total Cost</b>				1,450			1,320			1,035		
<b>3 Net Return</b>				16,502			15,080			8,125		
Return Ratio (Income/Cost)	%			1138%			1142%			785%		
Cost Ratio	%			8%			8%			11%		
Net Return per Man-day	Nu/m-day			55			62			59		
<b>Net Return per Product</b>	Nu/ton			7,501			7,540			8,125		
<b>Production Cost per Product</b>	Nu/ton			659			660			1,035		

Proposed	Paddy			(ha)	Maize			(ha)	Wheat			(ha)
	Unit	Unit price (Nu)	Quantity	Value (Nu)	Unit price (Nu)	Quantity	Value (Nu)	Unit price (Nu)	Quantity	Value (Nu)		
<b>1 Gross Income</b>												
<b>Main products</b>	kg	8.0	2,600	20,800	8.0	2,300	18,400	9.0	1,150	10,350		
By-product	kg	0.2	2,080	416	0.2	2,300	460	0.2	920	184		
<b>Total</b>				21,216			18,860			10,534		
<b>2 Production Cost</b>												
Input												
• Seed	kg	14.0	50	700	10.0	30	300	10.0	85	850		
• FYM	kg	0.5	0	0	0.5	1,000	500	0.5	0	0		
• Urea	kg	5.0	40	200	5.0	30	150	5.0	20	100		
• SSP	kg	3.6	10	36	3.6	0	0	3.6	0	0		
• MOP	kg	6.3	10	63	6.3	0	0	6.3	0	0		
• Plant protection and chemicals	kg			700			400			0		
Subtotal				1,699			1,350			950		
Labors		50			50			50				
Nursery preparation/management	m-day		31	0	0	0	0	0	0	0		
Land preparation	m-day		68	0	42	0	0	38	0	0		
Manuring	m-day		0	0	30	0	0	0	0	0		
Planting	m-day		61	0	7	0	0	6	0	0		
Fertilizer application	m-day		6	0	6	0	0	0	0	0		
Weeding	m-day		45	0	76	0	0	0	0	0		
Tree maintenance	m-day											
Harvesting /Carrying	m-day		68	0	53	0	0	53	0	0		
Watching/Fencing	m-day		23	0	30	0	0	15	0	0		
Subtotal	m-day		302	0	244	0	0	112	0	0		
Draught Power		100			100			100				
Land preparation	ox-day	0	8	0	0	8	0	0	8	0		
<b>Total Cost</b>				1,699			1,350			950		
<b>3 Net Return</b>				19,517			17,510			9,584		
Return Ratio (Income/Cost)	%			1149%			1297%			1009%		
Cost Ratio	%			8%			7%			9%		
Net Return per Man-day	Nu/m-day			65			72			86		
<b>Net Return per Product</b>	Nu/ton			7,507			7,613			8,334		
<b>Production Cost per Product</b>	Nu/ton			653			587			826		

**Table II-6 Crop Budget (2/2)**

Present	Beans			(ha)	Potato			(ha)	Orange			(100 trees)
	Unit	Unit price (Nu)	Quantity	Value (Nu)	Unit price (Nu)	Quantity	Value (Nu)	Unit price (Nu)	Quantity	Value (Nu)		
<b>1 Gross Income</b>												
Main products	kg	13.0	500	6,500	3.0	12,500	37,500	3.0	5,000	15,000		
By-product	kg			0			0			0		
<b>Total</b>				<b>6,500</b>			<b>37,500</b>			<b>15,000</b>		
<b>2 Production Cost</b>												
Input												
• Seed (Seedling)	kg	12.0	25	300	10.0	300	3,000	17.0	100	1,700		
• FYM	kg	0.5	0	0	0.5	3,000	1,500	0.5	1,000	500		
• Urea	kg	5.0	0	0	5.0	20	100	5.0	0	0		
• SSP	kg	3.6	0	0	3.6	0	0	3.6	0	0		
• MOP	kg	6.3	0	0	6.3	0	0	6.3	0	0		
• Plant protection and chemicals	kg			0			0			0		
Subtotal				300			4,600				2,200	
Labors												
Nursery preparation/management	m-day		0	0		0	0		0	0		
Land preparation	m-day		38	0		30	0		0	0		
Manuring	m-day		0	0		23	0		10	0		
Planting	m-day		6	0		38	0		10	0		
Fertilizer application	m-day		2	0		8	0		6	0		
Weeding	m-day		0	0		23	0		10	0		
Tree maintenance	m-day								15	0		
Harvesting /Carrying	m-day		15	0		76	0		60	0		
Watching/Fencing	m-day		15	0		30	0		30	0		
Subtotal	m-day		76	0		228	0		141	0		
Draught Power												
Land preparation	ox-day	100	8	800	100	8	800	100	8	800		
<b>Total Cost</b>				<b>1,100</b>			<b>4,600</b>			<b>2,200</b>		
<b>3 Net Return</b>												
Return Ratio (Income/Cost)	%			491%			715%			582%		
Cost Ratio	%			17%			12%			15%		
Net Return per Man-day	Nu/m-day			71			144			91		
<b>Net Return per Product</b>	<b>Nu/ton</b>			<b>10,800</b>			<b>2,632</b>			<b>2,560</b>		
<b>Production Cost per Product</b>	<b>Nu/ton</b>			<b>2,200</b>			<b>368</b>			<b>440</b>		

Proposed	Beans			(ha)	Potato			(ha)	Orange			(100 trees)
	Unit	Unit price (Nu)	Quantity	Value (Nu)	Unit price (Nu)	Quantity	Value (Nu)	Unit price (Nu)	Quantity	Value (Nu)		
<b>1 Gross Income</b>												
Main products	kg	13.0	600	7,800	3.0	17,500	52,500	3.0	8,000	24,000		
By-product	kg			0			0			0		
<b>Total</b>				<b>7,800</b>			<b>52,500</b>			<b>24,000</b>		
<b>2 Production Cost</b>												
Input												
• Seed	kg	20.0	10	200	10.0	300	3,000	17.0	100	1,700		
• FYM	kg	0.5	0	0	0.5	3,000	1,500	0.5	1,000	500		
• Urea	kg	5.0	55	275	5.0	50	250	5.0	20	100		
• SSP	kg	3.6	150	540	3.6	50	180	3.6	20	72		
• MOP	kg	6.3	0	0	6.3	25	158	6.3	20	126		
• Plant protection and chemicals	kg			0			0			600		
Subtotal				1,015			5,088			3,098		
Labors												
Nursery preparation/management	m-day	50	0	0	50	0	0	50	0	0		
Land preparation	m-day		38	0		45	0		0	0		
Manuring	m-day		0	0		30	0		10	0		
Planting	m-day		6	0		38	0		10	0		
Fertilizer application	m-day		4	0		12	0		6	0		
Weeding	m-day		0	0		23	0		10	0		
Tree maintenance	m-day								20	0		
Harvesting /Carrying	m-day		15	0		100	0		76	0		
Watching/Fencing	m-day		15	0		30	0		30	0		
Subtotal	m-day		78	0		278	0		162	0		
Draught Power												
Land preparation	ox-day	100	8	800	100	8	800	100	8	800		
<b>Total Cost</b>				<b>1,015</b>			<b>5,088</b>			<b>3,098</b>		
<b>3 Net Return</b>												
Return Ratio (Income/Cost)	%			668%			932%			675%		
Cost Ratio	%			13%			10%			13%		
Net Return per Man-day	Nu/m-day			87			171			129		
<b>Net Return per Product</b>	<b>Nu/ton</b>			<b>11,308</b>			<b>2,709</b>			<b>2,613</b>		
<b>Production Cost per Product</b>	<b>Nu/ton</b>			<b>1,692</b>			<b>291</b>			<b>387</b>		



**Table II-7 Farm Household Economy**

**(Cash Income Expenditure)**

**(Unit: Nu.)**

	Study	Lhuntse	Mongar	Living Standard Category			Study	Lhuntse	Mongar	Living Standard Category		
	Area	Dzongkha	Dzongkha	A	B	C	Area	Dzongkha	Dzongkha	A	B	C
<b>Income</b>												
Paddy	1,918	5,573	110	6,402	514	89	7%	19%	0%	16%	2%	0%
Maize	1,455	2,104	1,130	1,701	1,436	1,345	5%	7%	4%	4%	6%	5%
Vegetables	2,661	1,346	3,301	4,679	1,941	2,001	9%	5%	12%	12%	8%	7%
Fruits	1,072	434	1,384	1,896	862	714	4%	1%	5%	5%	3%	3%
Subtotal	7,106	9,457	5,926	14,677	4,753	4,150	25%	32%	22%	37%	19%	15%
Livestock	3,501	2,612	3,929	2,985	3,057	3,014	12%	9%	14%	7%	12%	11%
Livestock production	2,594	3,541	2,120	1,788	3,405	2,475	9%	12%	8%	4%	13%	9%
Subtotal	6,095	6,153	6,049	4,773	6,462	5,489	22%	21%	22%	12%	25%	20%
Other agricultural products	887	114	1,265	1,987	231	761	3%	0%	5%	5%	1%	3%
Total of agriculture/livestock	14,087	15,724	13,239	21,438	11,446	10,400	50%	53%	49%	53%	45%	38%
Forest products	3,779	1,435	4,924	6,367	5,921	3,941	13%	5%	18%	16%	23%	14%
On farm wage	1,149	572	1,430	191	831	2,209	4%	2%	5%	0%	3%	8%
Off farm wage	2,272	1,328	2,731	1,930	1,832	3,042	8%	4%	10%	5%	7%	11%
Remittance	1,260	2,001	892	416	1,788	1,401	4%	7%	3%	1%	7%	5%
Handicraft	2,761	5,184	1,558	3,649	950	4,345	10%	17%	6%	9%	4%	16%
Business/Others	2,876	3,593	2,515	6,154	2,857	2,281	10%	12%	9%	15%	11%	8%
<b>Total Income</b>	<b>28,184</b>	<b>29,837</b>	<b>27,288</b>	<b>40,145</b>	<b>25,625</b>	<b>27,620</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
<b>Expenditure</b>												
Crop production cost	6,232	5,163	6,812	9,013	5,337	5,867	22%	17%	25%	22%	21%	21%
Livestock production cost	3,047	3,192	2,968	2,866	3,691	2,524	11%	11%	11%	7%	14%	9%
Subtotal	9,279	8,355	9,780	11,879	9,028	8,391	33%	28%	36%	30%	35%	30%
Staple food	3,197	4,818	2,319	4,862	2,459	2,656	11%	16%	8%	12%	10%	10%
Other food	2,201	2,606	1,982	4,156	2,010	2,123	8%	9%	7%	10%	8%	8%
Subtotal	5,398	7,423	4,300	9,018	4,469	4,779	19%	25%	16%	22%	17%	17%
Health	204	63	280	403	40	227	1%	0%	1%	1%	0%	1%
Education	2,149	1,578	2,459	3,969	2,002	2,782	8%	5%	9%	10%	8%	10%
Clothes	3,118	2,812	3,284	4,889	2,281	4,277	11%	9%	12%	12%	9%	15%
Energy	981	1,314	800	1,664	966	794	3%	4%	3%	4%	4%	3%
Transportation	1,157	1,423	1,012	1,279	1,249	977	4%	5%	4%	3%	5%	4%
Religious	3,002	2,373	3,343	2,759	2,363	3,822	11%	8%	12%	7%	9%	14%
Others	2,896	4,495	2,030	4,287	3,228	1,570	10%	15%	7%	11%	13%	6%
Subtotal	13,507	14,059	13,208	19,249	12,128	14,449	48%	47%	48%	48%	47%	52%
<b>Total Expenditure</b>	<b>28,184</b>	<b>29,837</b>	<b>27,288</b>	<b>40,145</b>	<b>25,625</b>	<b>27,620</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

**(Including self-consumption of own-products)**

	Study	Lhuntse	Mongar	Poverty category			Study	Lhuntse	Mongar	Poverty category		
	Area	Dzongkha	Dzongkha	A	B	C	Area	Dzongkha	Dzongkha	A	B	C
<b>Income</b>												
Staple food												
Paddy	1,918	5,573	110	6,402	514	89	4%	11%	0%	10%	1%	0%
Maize	1,455	2,104	1,130	1,701	1,436	1,345	3%	4%	2%	3%	3%	3%
Self consumption of Staple food *1	12,000	12,000	12,000	12,000	12,000	12,000	24%	23%	24%	19%	25%	24%
Subtotal	15,373	19,677	13,241	20,103	13,949	13,434	30%	37%	26%	32%	29%	27%
Horticulture												
Vegetables	2,661	1,346	3,301	4,679	1,941	2,001	5%	3%	7%	7%	4%	4%
Fruits	1,072	434	1,384	1,896	862	714	2%	1%	3%	3%	2%	1%
Self consumption of vegetables/fruits *2	3,200	3,200	3,200	3,200	3,200	3,200	6%	6%	6%	5%	7%	6%
Subtotal	6,933	4,980	7,885	9,775	6,004	5,915	44%	47%	42%	47%	41%	38%
Livestock												
Livestock	3,501	2,612	3,929	2,985	3,057	3,014	7%	5%	8%	5%	6%	6%
Livestock production	2,594	3,541	2,120	1,788	3,405	2,475	5%	7%	4%	3%	7%	5%
Self consumption of Livestock product	7,600	7,600	7,600	7,600	7,600	7,600	15%	14%	15%	12%	16%	15%
Subtotal	13,695	13,753	13,649	12,373	14,062	13,089	27%	26%	27%	20%	29%	26%
Other agricultural products	887	114	1,265	1,987	231	761	2%	0%	3%	3%	0%	2%
<b>Agriculture/Livestock Total</b>	<b>36,887</b>	<b>38,524</b>	<b>36,039</b>	<b>44,238</b>	<b>34,246</b>	<b>33,200</b>	<b>72%</b>	<b>73%</b>	<b>72%</b>	<b>70%</b>	<b>71%</b>	<b>66%</b>
Forest products	3,779	1,435	4,924	6,367	5,921	3,941	7%	3%	10%	10%	12%	8%
On-farm wage	1,149	572	1,430	191	831	2,209	2%	1%	3%	0%	2%	4%
Off-farm wage	2,272	1,328	2,731	1,930	1,832	3,042	4%	3%	5%	3%	4%	6%
Remittance	1,260	2,001	892	416	1,788	1,401	2%	4%	2%	1%	4%	3%
Handicraft	2,761	5,184	1,558	3,649	950	4,345	5%	10%	3%	6%	2%	9%
Business/Others	2,876	3,593	2,515	6,154	2,857	2,281	6%	7%	5%	10%	6%	5%
<b>Total Income</b>	<b>50,984</b>	<b>52,637</b>	<b>50,088</b>	<b>62,945</b>	<b>48,425</b>	<b>50,420</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
<b>Expenditure</b>												
Crop production cost	6,232	5,163	6,812	9,013	5,337	5,867	12%	10%	14%	14%	11%	12%
Livestock production cost	3,047	3,192	2,968	2,866	3,691	2,524	6%	6%	6%	5%	8%	5%
Production cost total	9,279	8,355	9,780	11,879	9,028	8,391	18%	16%	20%	19%	19%	17%
Staple food	3,197	4,818	2,319	4,862	2,459	2,656	6%	9%	5%	8%	5%	5%
Self produce *1	12,000	12,000	12,000	12,000	12,000	12,000	24%	23%	24%	19%	25%	24%
Other food	2,201	2,606	1,982	4,156	2,010	2,123	4%	5%	4%	7%	4%	4%
Self Produce *3	10,800	10,800	10,800	10,800	10,800	10,800	21%	21%	22%	17%	22%	21%
Food expenditure total	28,198	30,223	27,100	31,818	27,269	27,579	55%	57%	54%	51%	56%	55%
Health	204	63	280	403	40	227	0%	0%	1%	1%	0%	0%
Education	2,149	1,578	2,459	3,969	2,002	2,782	4%	3%	5%	6%	4%	6%
Clothes	3,118	2,812	3,284	4,889	2,281	4,277	6%	5%	7%	8%	5%	8%
Energy	981	1,314	800	1,664	966	794	2%	2%	2%	3%	2%	2%
Transportation	1,157	1,423	1,012	1,279	1,249	977	2%	3%	2%	2%	3%	2%
Religious expense	3,002	2,373	3,343	2,759	2,363	3,822	6%	5%	7%	4%	5%	8%
Others	2,896	4,495	2,030	4,287	3,228	1,570	6%	9%	4%	7%	7%	3%
Other expenditure total	13,507	14,059	13,208	19,249	12,128	14,449	26%	27%	26%	31%	25%	29%
<b>Total Expenditure</b>	<b>50,984</b>	<b>52,637</b>	<b>50,088</b>	<b>62,945</b>	<b>48,425</b>	<b>50,420</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Note \*1: Assumed that 250 kg per capita consumed, average family size 8 persons, and Nu.6/kg

\*2: Assumed that 50 kg per capita consumed, average family size 8 persons, and Nu.8/kg

\*3: Assumed that 80% of staple food value based on the average of interview survey

**Table II-8 Food Balance in the Study Area**

**1 Population and Households (Dzongkhag)**

	Unit	Lhuntse	L1	L2	L3	L4	L5	L6	L7	L8	Mongar	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16
		Total	Gangzur	Jaray	Khoma	Kurtoe	Menbi	Metsho	Minjay	Tsenkha	Total	Balam	Chali	Chaskhar	Drametse	Drepong	Gongdue	Jume	Kengkar	Mongar	Ngatshan	Saleng	Senmuha	Silambi	Thangron	Tsakaling	Tsamang
Population	person	19,426	3,487	1,360	2,400	1,692	3,142	2,142	2,219	2,984	44,138	1,614	1,952	3,095	4,734	1,733	3,246	2,141	3,178	4,544	2,615	2,718	2,593	2,912	2,228	3,132	1,803
Total households	HH	2,516	459	216	323	200	405	244	266	403	4,966	181	262	401	534	217	333	260	384	461	268	293	269	311	274	332	186
Average family size	psn/HH	7.7	7.6	6.3	7.4	8.5	7.8	8.8	8.3	7.4	8.9	8.9	7.5	7.7	8.9	8.0	9.7	8.2	8.3	9.9	9.8	9.3	9.6	9.0	8.1	9.4	9.7

**2 Land Resource (RNR Statistics 2000)**

RNR Statistics 2000																												
Wet land	ha	812	167	15	104	68	173	61	166	59	500	13	68	51	58	13	2	0	0	41	54	42	69	0	7	67	15	
Dry land	ha	1,371	238	193	165	93	113	114	165	291	3,056	136	121	244	312	112	178	118	183	249	181	268	219	201	193	211	130	
Tseri & Pangshing	ha	1,030	151	154	64	64	173	127	131	165	1,263	27	37	41	97	33	223	90	99	53	56	153	57	143	38	48	67	
Kitchen garden	ha	49	12	4	8	6	3	3	4	9	45	1	2	2	8	0	2	0	0	0	0	12	2	1	3	4	8	
Total	ha	3,262	568	365	341	231	461	305	466	524	4,864	176	229	339	476	157	406	208	282	344	291	475	346	345	241	330	219	

**3 Food Production (RNR Statistics 2000)**

Paddy	ton	2,918	606	40	469	308	551	182	552	210	1,445	28	187	153	196	38				90	177	113	207	15	21	178	35
Maize	ton	3,158	695	321	201	280	199	301	398	763	10,565	318	325	1,027	1,048	300	442	561	868	728	749	769	730	340	1,602	422	334
Wheat	ton	44	6	20	10			6		2	59			13		10		2	2	4		4	14			4	
Barley	ton	6						3			407	2	1	42		81		1	2	134	71		64	4	4		
Foxtail Millet	ton	5	2								30							12	1	2		2	5			5	
Finger Millet	ton	180	17	3	153					9																3	
Sweet Buckwheat	ton	2								46				3					5	15		1	8	4	1	4	
Bitter Buckwheat	ton	5								3											7	1	16				

**4 Cereal Production**

Cereal crop production (rough grain)																												
Paddy	ton	2,918	606	40	469	308	551	182	552	210	1,445	28	187	153	196	38	0	0	0	90	177	113	207	15	21	178	35	
Maize	ton	3,158	695	321	201	280	199	301	398	763	10,565	318	325	1,027	1,048	300	442	561	868	728	749	769	730	340	1,602	422	334	
Other cereals	ton	242	25	24	163	0	0	9	0	5	584	2	1	58	0	91	12	9	20	137	71	8	79	44	5	0	15	
Total	ton	6,318	1,325	385	833	588	750	491	950	978	12,593	348	513	1,237	1,244	429	454	571	888	955	997	890	1,016	399	1,628	600	384	

**Food grain (milling recovery rates are 60% for paddy, and 80% for maize and others)**

Rice	ton	1,751	363	24	281	185	331	109	331	126	867	17	112	92	118	23	0	0	0	54	106	68	124	9	12	107	21
Maize	ton	2,526	556	257	161	224	159	241	318	611	8,452	254	260	822	838	240	354	449	694	583	599	615	584	272	1,281	338	267
Other cereals	ton	193	20	19	130	0	0	7	0	4	467	2	1	46	0	73	10	7	16	110	57	7	63	35	4	0	12
Total	ton	4,470	939	300	573	409	490	357	649	740	9,785	273	373	959	956	336	364	456	711	746	762	690	771	316	1,298	445	300

**Per capita milled grain**

Rice	kg	90	104	18	117	109	105	51	149	42	20	10	57	30	25	13	0	0	0	12	41	25	48	3	6	34	12
Maize	kg	130	159	189	67	132	51	112	143	205	191	157	133	265	177	139	109	210	219	128	229	226	225	97	575	108	148
Other cereals	kg	10	6	14	54	0	0	3	0	1	11	1	1	15	0	42	3	3	5	24	22	2	24	12	2	0	7
Total	kg	230	269	221	239	242	156	166	293	248	222	169	191	310	202	194	112	213	224	164	292	254	297	113	583	142	167

**Ratio of commodities**

Rice	%	39%	39%	8%	49%	45%	68%	31%	51%	17%	9%	6%	30%	10%	12%	7%	0%	0%	0%	7%	14%	10%	16%	3%	1%	24%	7%
Maize	%	57%	59%	86%	28%	55%	32%	67%	49%	82%	86%	93%	70%	86%	72%	97%	96%	98%	78%	79%	89%	76%	86%	99%	76%	89%	
Other cereals	%	4%	2%	6%	23%	0%	0%	2%	0%	1%	5%	1%	0%	5%	0%	22%	3%	2%	2%	15%	7%	1%	8%	11%	0%	0%	4%
Total	%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

II-T10

**Table II-9 Present Condition of Gangzur Gewog (1/4)**

**1. Gewog and Gup**

Name of Gup	Yeshi Dorji	Name of Mang Ap	
Location of Gewog center	Thrimyul		
Accessibility to from Gewog Center to motor road		0 ohr	
Gup office	Not exist	Meeting facility	Health ORC
Villages in Gewog			
1. Ngar	25 hh	14. Jalamzur	11 hh
2. Gangzur	19 hh	15. Nimshong	13 hh
3. Denkaling	15 hh	16. Amchii	8 hh
4. Jang	62 hh	17. Taushing goenpa	15 hh
5. Lingabi	12 hh	18. Yongmaling	3 hh
6. Rotpa	15 hh	19. Ney	63 hh
7. Somshing	21 hh	20. Tsholing	16 hh
8. Namseygang	4 hh	21. Zhamling	32 hh
9. Kecheng	11 hh	22. Khonchung	4 hh
10. Changrey	9 hh	23. Thrima	15 hh
11. Samling	5 hh	24. Shawa	34 hh
12. Magar	26 hh	25. Chesa	5 hh
13. Tohgling	16 hh	Total	459 hh

**2. RNR Staff and Facility**

Extension agent			
Agriculture	Livestock	Forestry	
Lumglea (AAEO)	Kencho Tshering	Rib Suba	
	Singay Lham		
RNR Center	Thrimyul		

**3. General Conditions**

Total village	22	Altitude range of Gewog (m)	1,200 m - 4,800 m
Total population	3,487	Farmland (m)	1,400 m - 2,200 m
Total households	HH	Land holding size	
Agricultural households	456 HH	Average	1 - 2 acre/HH
Gewog Area	535.7 km <sup>2</sup>	Large farmer	15 - 20 acre/HH

**4. Farm Land Area**

Land Use (acre)	Land registration	Land Cover Map	RNR Statistics 2000
Wet land	401	100	412
Dry land	599	1,075	588
Tseri / Pangshing	576	925	374
Kitchen garden	0		30
Mixed land		2,800	
Subtotal	1,576	4,900	1,404
Average farm size (ac./hh)	3.5	10.7	3.1
Orchard			19
Sogshing	21		148
Pasture	100	350	237
Total	1,697	5,250	1,808

**Table II-9 Present Condition of Gangzur Gewog (2/4)**

**5. Major Field Crops/Horticulture Crops**

(Source Production: RNR Census 2000, Yield: Estimation by JICA Team)

	Production (ton)	Yield (kg/acre)	Area (acre)	
<b>Cereal crop</b>				
Rice	605.6	880	688	
Maize	695.0	800	869	
Wheat	5.5	400	14	
Barley	-	400	0	
Buckwheat	-	400	0	
Miller	19.3	400	48	
Cereal total	1,325.4	819	1,619	
<b>Oil seed/Pulses</b>				
Mustard	2.8	160	18	
Soybean	3.2	200	16	
Rajma bean				
<b>Horticulture</b>				
Potato	74.0	2,400	31	
Chili	27.0	800	34	
Radish	11.0	1,600	7	
Other vegetables	3.2	2,000	2	
Total			1,727	

**6. Fruits/Tree crop**

	Nos. of trees	Bearing trees	Production (ton)	Potential area (acre) /village
Orange	1,014	280	15.4	
Mango	510	Nil	-	
Pear	131	102	2.2	
Peach	275	263	7.2	3.62 ac.
Apple	356	52	0.5	12.6 ac.
Walnut	65	16	0.2	9.6 ac.
Plum	1,461	126	4.6	
Total	3,812	839	30.1	

**7. Farm Machinery**

Power tiller		Sprayer	
Wheel tractor		Thresher	

**8. Rearing Livestock (Number of animals)**

	Improved	Local	Total
Cattle			
(Male)	127	454	581
(Female)	248	1,000	1,248
(Calf)	110	451	561
(Total)	485	1,905	2,390
Horse	21	242	263
Mule	0	22	22
Pig	63	401	464
Sheep	1	6	7
Goat	0	6	6
Chicken	3	851	854

**Table II-9 Present Condition of Gangzur Gewog (3/4)**

**9. Priority / Potential Crops and Livestock in the Gewog**

Field crop	1. Paddy rice/Maize, 2. Wheat, Potential: Barley
Fruit / Tree crop	1. Orange, 2. Mango, Potential 1: Apple
Other horticulture crop	1. Chili, 2. Potato, 3. Cardamom
Medical/Aromatic plant	
Livestock	1. Cattle, 2. Pig, 3. Poultry

**10. Off-farm Activity for Income Generation (Please mark, if active in the Gewog)**

Lemon grass extraction		Forest vegetable collection	
Resin tapping		Wage labor	
Weaving		Others ( )	

**11. Farm Road**

Starting point	End point	Length (km)	No. of beneficiaries (HH)	Condition
<b>Existing</b>				
1. Lhuntse	Themshueng			
2. Thymyul	Zhamling	6	50	
<b>Proposed</b>				
2. Zhamling	Jangchuling	5	50	
3. Jangchuling	Ney	10	60	
4. Ney	Shawa	5	25	
5. Shawa	Jay	5	60	

**12. Irrigation Facilities**

Name of irrigation system/village	Irrigated area (acre)	No. of beneficiaries (HH)	Water source (river name)	Canal length (km)	Activity of WUA	Condition of facilities
<b>Existing</b>						
1. Somshing	100	50	Stream	4		Not good
2. Ney	150	60	Stream	5		-
3. Tsholing	30	14	Stream	5		Damaged
4. Shawa	45	30	River	2		
5. Jang	50	45	Stream	3		
6. Nimshong	100	40	Stream	6	-	On-going
<b>Proposed (New)</b>						
1. Maggar	100	48	Stream	5	-	-
2. Ney	50	60	River	5	-	-
3. Shawa	10	30	River	3	-	-
4. Denkaling	30	18	River	4	-	-

**13. Marketing Facility (Weekly market, Collection point of products, Storage, etc.)**

Kind of Facilities	Location	Capacity	Operating organization
<b>Existing</b>			
<b>Proposed</b>			

**14. Agro-processing Facilities**

Facility	Number	Capacity	Remarks
<b>Existing</b>			
Flour mill (Atta Chaki)			
Rice mill			
Lemmon grass oil extractor			
Tengma mill			
Oil expeller			

**Table II-9 Present Condition of Gangzur Gewog (4/4)**

**15. Farmers Organizations** (Irrigation Water Users Association, Credit group, Drinking water users group, Farmers cooperative)

Name of organizations	Name of village	No. of members	Activity

**16. Priority Project** (Priority order of the Project Approaches identified at the Workshop)

Order	Project Approach	Note
1	Farm road	
2	Irrigation	
3	Farmers training	
4		

**Table II-10 Present Condition of Chaskhar Gewog (1/4)**

**1. Gewog and Gup**

<b>Name of Gup</b>	Chador Drukpo	<b>Name of Mang Ap</b>	
Location of Gewog center	Zalungkhasor		
Accessibility from Gewog Center to motor road	0 hour		
Gup office	Existing	Meeting facility	Gup office, Open area
Villages in Gewog			
1. Pam	71 HH	5. Kharmang Lamtag	48 HH
2. Dungsingma	64 HH	6. Karmang Lamwog	46 HH
3. Yetomg	64 HH	7. Yangraphusing	39 HH
4. Goenpa	69 HH	Total	401 HH

**2. RNR Staff and Facility**

<b>Extension agent</b>			
Agriculture	Livestock	Forestry	
Chimi Wanghcuk (AAE)	N. B. Thapa (AHS)	Pandril Zangpo (FEA)	
<b>RNR facilities</b>			
RNR Center	Zalungkhasor	AI Center	Zalungkhasor

**3. General Conditions**

Number of villages	7 (35)	Altitude range of Gewog	600 m - 2,600 m
Total population	3,095	Farmland	900 m - 2,300 m
Total households	409 HH	Land holding size	
Agricultural households	401 hh	Average	acre/HH
Gewog area	53 km <sup>2</sup>	Large farmer	acre/HH

**4. Farm Land Area**

Land Use (acre)	Land Registration	Land Cover Map	RNR Statistics 2000
Wet land	109	<b>225</b>	127
Dry land	481	<b>1,100</b>	603
Tseri/Pangshing	165	<b>325</b>	102
Kitchen garden			5
Mixed land		<b>225</b>	
Subtotal	755	<b>1,875</b>	837
Average farm size (acre/hh)	1.88	<b>4.68</b>	2.09
Orchard	0	<b>0</b>	8
Sogshing	159		188
Pasture	28	<b>0</b>	14
Lac plantation	28		
Total	970	<b>1,875</b>	1,047

**Table II-10 Present Condition of Chaskhar Gewog (2/4)**

**5. Major Field Crops/Horticulture Crops**

(Source: Production: RNR Census 2000, Yield: Estimation by JICA Team)

	Production (ton)	Yield (kg/acre)	Planted area (acre)	Potential area (acre) /village
<b>Cereal crops</b>				
Wet land rice	152.7	880	174	
Maize	1,026.9	800	1,284	
Wheat	12.7	400	32	
Barley	42.4	400	106	
Buckwheat	2.7	400	7	
Cereal total	1,237.4	772	1,603	
<b>Oil seed /Pulses</b>				
Mustard seed	0	160	0	
Soybean	2.3	200	11.5	
Rajma bean				
<b>Horticulture</b>				
Potato	48.0	2,400	20.0	
Chili	0	800	0	
Other vegetables	6.4	2,000	3.2	
Total			1,638	

**6 Fruits/Tree crop**

	Nos. of trees	Bearing trees	Production (ton)	Potential area (acre) /village
Orange	316	207	9.6	
Mango				
Pear	-			
Peach	47	16	1.2	
Apple	150	3	0.6	
Walnut	931	26	1.6	
Guava	155	155	22.8	
Plum	93	31	0.9	
Total	1,692	438	36.7	

**7 Farm Machinery**

Power tiller		Sprayer	
Wheel tractor		Rice Hauler	

**8 Rearing Livestock (Number of animals)**

	Gewog RNR Data			RNR Statistics 2000		
	Improved	Local	Total	Improved	Local	Total
Cattle						
(male)				54	317	371
(female)				482	979	1,461
(calf)				176	411	587
(Total)	2,012	344	2,356	712	1,707	2,419
Horse				1	99	100
Mule/Donkey				2	28	30
Pig				51	281	332
Sheep				0	2	2
Goat				0	4	4
Chicken				23	748	771



**Table II-10 Present Condition of Chaskhar Gewog (3/4)**

**9. Priority / Potential Crops and Livestock in the Gewog**

Field crop	1. Maize, 2. Wetland rice, 3: Wheat, Potential: Mustard
Fruit / Tree crop	1. Orange, 2. Mango, 3: Plum, Potential l: Walnut, Apple
Other horticulture crop	1. Potato, 2: Chili, 2. Vegetables (Cabbage, Radish)
Medical/Aromatic plant	1: Lemongrass, 2: Lac
Livestock	1. Cattle, 2. Poultry, 3: Pig
Constraints:	

**10. Off-farm Activity**

Lemon grass extraction		Forest vegetable collection	
Resin trapping		Wage labor	
Weaving			

**11. Farm Road (Existing)**

Starting point	End point	Length (km)	No. of beneficiaries	Condition
<b>Proposed</b>				
1. Kadam - Dungsingma - Brabang - Pam		6	105	For citrus marketing (890 ton)
2. Panglen - Goenpa		1.5	73	For horticulture crop Marketing

**12. Irrigation Facilities (Existing)**

Name of irrigation system/village	Irrigated area (acre)	No. of beneficiaries (HH)	Water source (river name)	Canal length (km)	Condition of facilities	Activity of WUA
<b>Existing</b>						
1. Chaskhar	110	250	Gudari	7	No good	active
2. Kharawang			Gudarijucke	25	Good	
<b>Proposed</b>						
3. Phakhdang	50	30	Phakhdang	4		

**13. Marketing Facility (Existing)**

	Location	Capacity
<b>Existing</b>		
<b>Proposed</b>		
Weekly market for horticulture crops		

**14. Agro-processing Facilities (Existing)**

Facility	Number	Capacity
Flour mill (Atta Chaki)	10	
Rice mill		
Lemmon grass oil extractor	20	
Tengma mill		
Oil expeller		

**Table II-10 Present Condition of Chaskhar Gewog (4/4)**

**15. Farmers Organizations** (Irrigation Water Users Association, Credit group, Drinking water users group, Farmers cooperative)

Name of organizations	Name of village	No. of members	Activity
<b>Existing</b>			
WUA	Gudari, Kharnang		Rotation irrigation
Drinking water users group	Whole Gewog		
Credit group			
<b>Proposed</b>			

**16. Priority Project** (Priority order of the Project Approaches identified at the Workshop)

Order	Project Approach	Note
1	Farm road (new)	
2	Construction of Irrigation facilities	
3	Land Slide Protection	
4	Cooperative Shipping	
5	Quality Control of Products	
6	Agro-processing support	
7	RNR Extension Service (Additional Staff)	

**Table II-11 Present Condition of Drepong Gewog (1/3)**

**1. Gewog and Gup**

<b>Name of Gup</b>	Pema Tshewang	<b>Name of Mang Ap</b>	
Location of Gewog center	Bumpajor		
Accessibility from Gewog Center to motor road	5 hrs on foot to Mongar		
Gup office	Not exist	Meeting facility	Health ORC
<b>Villages in Gewog</b>			
1. Drepong	66 HH	4. Chaksuzor	12 HH
2. Labtsa	64 HH	5. Tshangkhar	17 HH
3. Zungleon	58 HH	Total	217 HH

**2. RNR Staff and Facility**

<b>Extension agent</b>		
Agriculture	Livestock	Forestry
Karma Tenzing (AAEO)	Chandor Bdr. Mongar (AHA)	
<b>RNR facilities</b>		
RNR Center	Bumpajor	

**3. General Conditions**

Number of villages	5, (8)	Altitude range of Gewog	600 m -2,500 m
Total population	1,733	Farmland	700 m -2,200 m
Total households	217 HH	Land holding size	
Agricultural households	217 HH	Average	1 - 3 acre/HH
Gewog area	51 km <sup>2</sup>	Large farmer	acre/HH

**4. Farm Land Area**

Land Use (acre)	Land Registration	Land Cover Map	RNR Statistics 2000
Wet land	40	0	31
Dry land	302	550	276
Tseri	8	825	82
Kitchen garden	15		-
Mixed land		650	
Sub-total	365	2,025	389
Average farm size (ac./hh)	1.68	9.33	1.79
Orchard		0	3
Sogshing			37
Pasture/Tsamdrop		0	60
Total	365	2,025	489

**5. Major Field Crops/Horticulture Crops**

(Source: Production: RNR Census 2000, Yield: Estimation by JICA Team)

	Production (ton)	Yield (kg/acre)	Harvested area (acre)	Potential area (acre) /village
<b>Cereal crops</b>				
Wet land rice	38.0	880	43	Depong, Tsangkhar
Maize	300.5	800	376	Whole Gewogs
Wheat	10.1	400	25	
Barley	80.6	400	201	
Buckwheat	2.5	400	6	Zunglane, Depong, Tsangkhar
Millet		400		
Cereal crop total	431.7	660	651	
<b>Oil crops/Pulses</b>				
Mustard seed	-	160		
Soybean	4.5	200	22.5	
Rajma bean				

**Table II-11 Present Condition of Drepong Gewog (2/3)**

<b>Horticulture</b>				
Potato	78.9	2,400	32.9	Whole Gewogs
Chili	-	800		
Radish	46.8	1,600	29.3	
Other vegetables	31.4	2,000	15.7	Chakzor, Laptsa, Zunglane
Total			751	

**6. Fruits/Tree crop**

	Nos. of trees	Bearing tree	Production (ton)	Potential area (acre) /village
Orange	212	14	1.3	Gomcheri, Tsangkhar
Mango	581	70	7.5	Gomcheri, Tsangkhar
Pear	43	21	1.6	
Peach	390	206	17.2	
Apple	-			
Walnut	77	0	-	
Guava	80	48	2.4	
Total	1,383		30.0	

**7. Farm Machinery**

Power tiller	-	Sprayer	-
Wheel tractor 359	-	Thresher	-

**8. Rearing Livestock (Number of animals)**

Data Source	Gewog RNR Data			RNR Statistics 2000		
	Improved	Local	Total	Improved	Local	Total
Cattle						
(male)				13	260	273
(female)				100	705	805
(calf)				40	215	255
(Total)	589	819	1,408	153	1,180	1,333
Horse			73	3	73	76
Mule/Donkey			15	1	12	13
Pig			106	0	130	130
Sheep						0
Goat				0	53	53
Chicken			707	22	804	826

**9. Priority / Potential Crops and Livestock in the Gewog**

Field crop	1. Maize, 2. Barley, 3: Rice, Potential: Wheat, Mustard, Soybean
Fruit / Tree crop	1. Orange/ Walnut, 2. Mango, Potential 1: Apple
Other horticulture crop	1. Potato, 2: Cabbage/Radish, 3Chili, Potential: Ginger
Medical/Aromatic plant	Lemongrass oil
Livestock	1. Cattle, 2. Pig, 3. Poultry

**10. Off-farm Activity**

Lemon grass extraction	Low	Forest vegetable collection	
Resin tapping	Stopped	Wage labor	
Weaving			

**11. Farm Road (Existing)**

Starting point	End point	Length (km)	No. of beneficiaries	Condition
<b>Proposed</b>				
Gyelposhing	Caplsa	10 -15	Direct: 131 HH, indirect: 84 HH	

**Table II-11 Present Condition of Drepong Gewog (3/3)**

**12. Irrigation Facilities (Existing)**

Name of irrigation system/village	Irrigated area (acre)	No. of beneficiaries (HH)	Water source (river name)	Canal length (km)	Condition of facilities	Activity of WUA
<b>Existing</b>						
1. Drepong	40.48	60	Spring	1.3	good	Drepong
<b>Proposed</b>						
2. Bachheri	5	15	Hay karia	1		

**13. Marketing Facility (Existing)**

	Location	Capacity	Operating organization
Weekly market	Weekly market to Gyelposhing and sometime in Mongar		
Collection point			
Storage			

**14. Agro-processing Facilities(Existing)**

Facility	Number	Capacity
Flour mill (Atta Chaki)/Rice mill	2	
Lemmon grass oil extractor		
Tengma mill		
Oil expeller		

**15. Farmers Organizations (Irrigation Water Users Association, Credit group, Drinking water users group, Farmers cooperative)**

Name of organizations	Name of village	No. of members	Activity
<b>Existing</b>			
Drinking Water Users Group			By Dzonghag Public Health Engineering
WUA			By Dzonghag
Plant Protection Association			
<b>Proposed</b>			

**16. Priority Project (Priority order of the Project Approaches identified at the Workshop)**

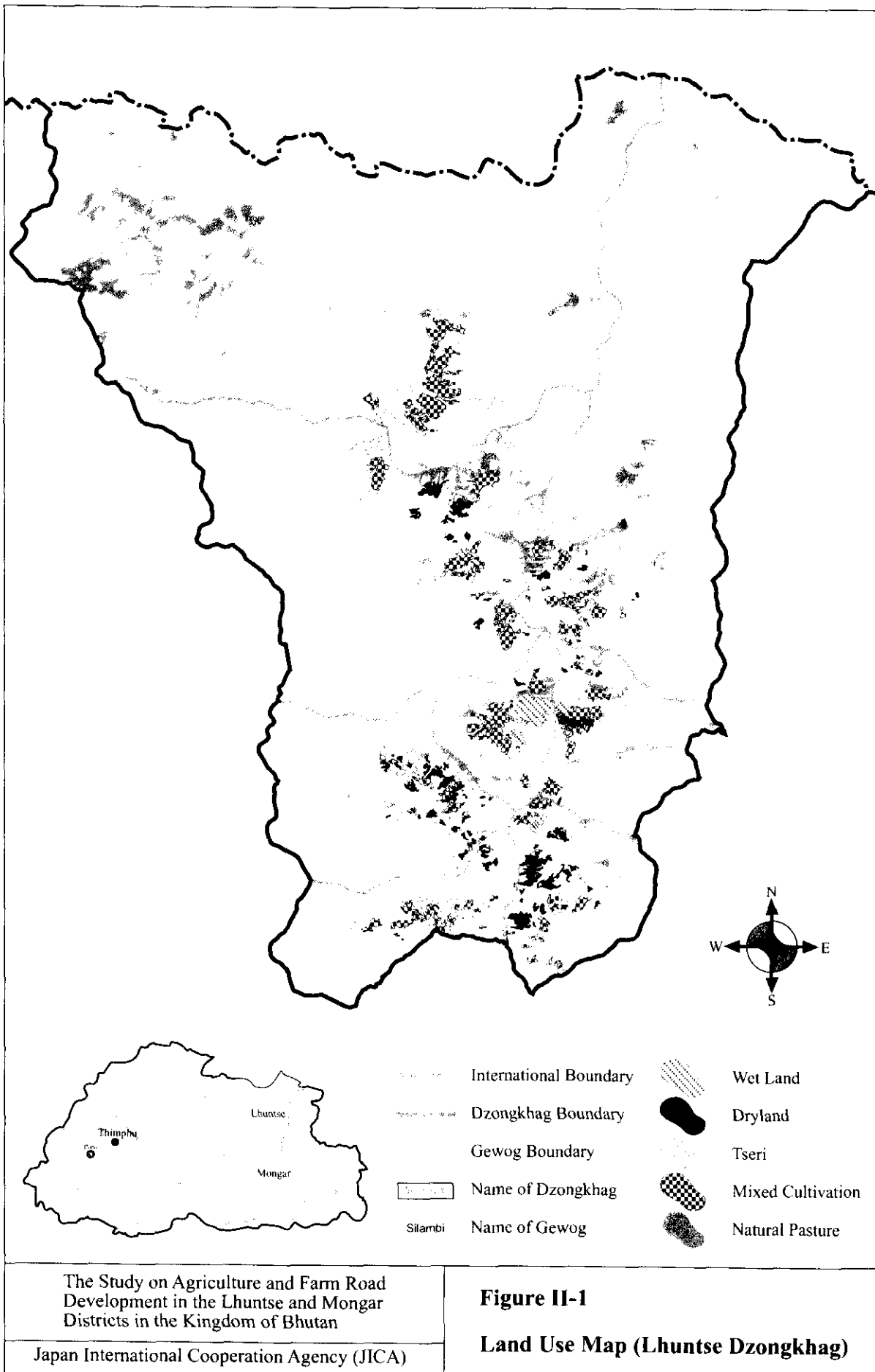
Order	Project Approach	Note
1	Farm road Construction	
2	Construction of Irrigation facilities	
3	Supply of Agri. Inputs	
4	Agro-processing Support	
5	Land Slide Protection	
6	Construction of Cooperative Storage	
7	Agri. / Livestock Extension Services (Included Training of EAs)	
8	Watershed Management	

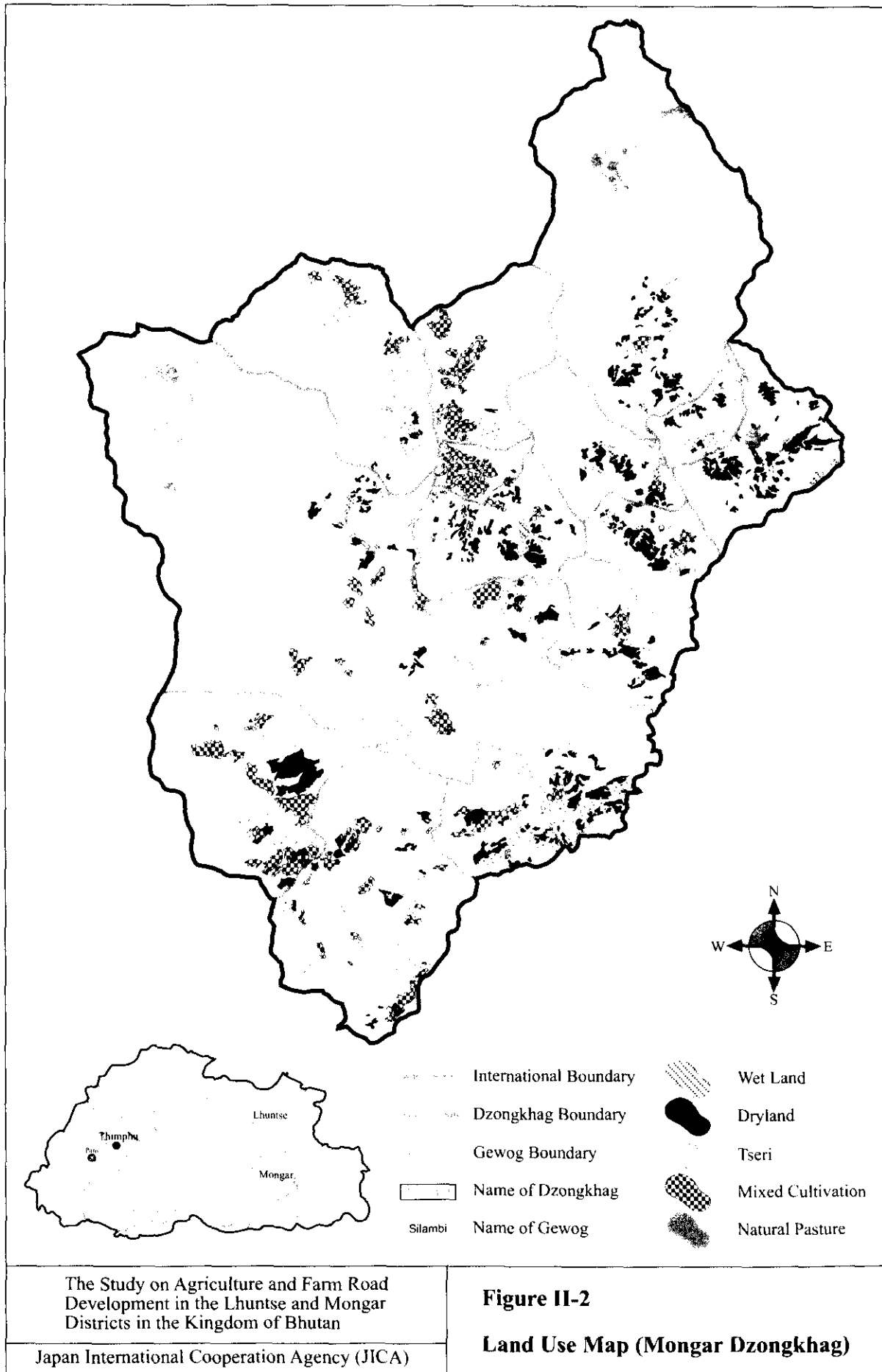


## *Figures*













***ANNEX-III***

***HORTICULTURE***



## ANNEX-III

### Horticulture

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## ANNEX-III

### HORTICULTURE

#### CHAPTER III-1 PRESENT SITUATION OF HORTICULTURE IN THE STUDY AREA

Horticulture crops are widely recognized as important cash crops for farmers in the Study Area, Lhuntse and Mongar Dzongkhags. Cash income by horticulture crops occupies a certain percentage of the farm household economy (refer to table below). There are some differences between Lhuntse and Mongar about gravity of horticultural crop. The ratio of cash income from the horticulture in Mongar is higher than that in Lhuntse. It is estimated around 60% of horticulture products in Lhuntse is consumed by farmers themselves.

Many kinds of horticulture crops are grown in the Study Area under each climate conditions. Products of a few horticulture crops like potato, chili, mandarin orange, and lemongrass have been commercially established, but most of the other horticulture crops have not been established commercially in the present condition. They are grown or cultivated only in a small scale, or for non-commercial use like as their kitchen vegetables. Marketing of these products is limited in local market such as weekly market, school dormitory and hospital.

**Farm Income and the Percentage (Cash Income)**

	Lhuntse		Mongar		Study Area	
Food crop	7,700	48.7 %	3,400	24.1 %	1,200	9.1 %
Horticulture crop	1,900	12.0 %	4,600	32.6 %	5,900	44.6 %
Livestock	6,200	39.2 %	6,100	43.3 %	6,000	45.5 %
Total farm income	15,800	100 %	14,100	100 %	13,200	100 %

**Farm Household Income (Including self consumption of own-products)**

	Lhuntse		Mongar		Study Area	
Food crop	19,700	51.2 %	15,400	41.7 %	13,200	36.7 %
Horticulture crop	5,100	13.2 %	7,800	21.1 %	9,100	25.3 %
Livestock	13,800	35.8 %	13,700	37.1 %	13,600	37.8 %
Total farm income	38,500	100 %	36,900	100 %	36,000	100 %

#### III-1.1 Production of Horticultural Crops

##### III-1.1.1 Fruits

Major fruits including nut trees in the Study Area are mandarin orange, and followed by mango, walnut, apple, peach, pear, plum, guava, apricot, etc. Temperate and sub-tropical fruits are grown under the conditions of the tropical highland. As for the fruit production in the Study Area, some data sources are available, however, accurate statistics have not prepared.

### Current Production of Major Fruits Crops

	Lhuntse		Mongar		Study Area	
	Area (ha)	Production (ton)	Area (ha)	Production (ton)	Area (ha)	Production (ton)
Citrus	27	197	107	364	134	561
Apple	13	45	-	-	13	45
Mango	23	83	47	118	70	201
Walnut	1	10	31	0	32	10
Total	64	335	185	482	249	817

Source: (IHDP-II, MOA 2001)

In Mongar Dzongkhag, area of orchard is estimated at 185 ha in total according to IHDP-II (Integrated Horticulture Development Project, Second Phase, based on the data submitted by Dzongkhag), as shown in above table. Most of the fruit trees, however, are planted as scattered trees around farmlands. RNR Statistics 2000 (Table III-1; Agricultural Census Survey at 2000) and RNR sector of the Dzongkhag (Table III-2) reported that around 44,000, and 50,000 fruits trees are grown in the Dzongkhag in total, respectively. Production of fruits also is estimated at 600 – 1,100 ton in total, and production of orange occupies more than 50 % of the total. Characteristics of fruits production in the Mongar Dzongkhag are summarized below:

- About 40,00 to 50,000 of fruits trees are grown in Mongar Dzongkhag,
- Average number of the fruits trees grown is estimated to be 8 – 9 trees per household,
- About 60 % of the trees are occupied by orange, and followed by walnut and mango,
- Ratio of bearing trees is still less than 50 %,
- Total production of fruits is estimated around 600 – 1,100 ton,
- About 55 % - 60 % of the fruits production are occupied by orange,
- Major production areas of mandarin are located in southern Gewogs in Mongar (Gongdue, Jurme, Kengkhar and Saleng).

Fruits development in Lhuntse Dzongkhag is low stage comparing with in Mongar. Based on the above data sources, characteristics of fruit production in the Lhuntse Dzongkhag are summarized below:

- Around 11,000 of fruit trees are grown in the Dzongkhag,
- Average number of the fruits trees grown is estimated to be around 4 trees per household,
- About 40 % of the trees are occupied by orange, and followed by walnut and mango, walnut and apple,
- Ratio of bearing trees is around 50 %,
- Total production of fruits is estimated around 200 – 300 ton,
- About 55 % - 60 % of the fruits production are occupied by orange.

In both Dzongkhag, high ratio of non-bearing or young trees are planted, especially orange, mango and walnut are promising rapid increase in their production in the near future.

#### **III-1.1.2 Vegetables**

Major vegetables including spice crops produced in the Study Area are potato and chili, and followed by radish, garlic, onion, turnip, eggplant, cabbage and vegetable bean. Most of farm households are operating kitchen garden for self-consume vegetables. Besides kitchen garden,

certain portion of potato and chili are planted in dry land as cash crops. Chili, which is a traditional and indispensable vegetable / spice for Bhutanese, is cultured widely and it is dealt to broad market. Potato has increased during last 20 years, and is exported to India.

In Mongar, planted area of vegetables is estimated at about 600 – 700 ha in total according to the RNR Statistics 2000 (Table III-3). Production of the vegetable 3.200 ton in total, and average production per household is about 650 kg. Major vegetables are potato, chili and turnip. Also, onion, carrot, cabbage, cauliflower, leaf greens, kidney beans, peas, eggplant, etc. are cultivated mainly in kitchen garden. Other vegetables are dealt in local market only, and little in distant market.

### III-1.1.3 Special Plant Products

Mushroom contributes considerable opportunities for raising farm incomes in some Gewogs. Shiitake (oak mushroom) cultivation has brought income increase to the farmers. The seed-fungus is supplied from Mushroom Center in Thimphu. The wood material for mushroom culture is from oak or related trees or their branches. Wild mushrooms like *matsutake* are collected in the mountains, and shipped not only to local market, but also to international market.

Medicinal and aromatic plants like lemongrass or spice plants have been mainly collected in the wild fields as natural resources, and are contributing to increase the farm income.

### III-1.2 Agro-climatic Distribution of Horticultural Crops

The altitude in Lhuntse and Mongar Dzongkhags ranges between 200 m and 5,500 m. According agro-ecological classification in Bhutan, there are 6 zones classified with the altitude and rainfall: Alpine zone, Cool temperate, Warm temperate, Dry sub-tropical, Humid-subtropical, and Wet-subtropical zones. Altitude is the key of the climate, forming agro-climatic condition. On the other side, latitude, ranging from N 26.9° to N 28.3°, shows little effect on the distribution of crops. Many kinds of horticulture crops or plants are grown under each climate condition. According to RNR Sector, agro-ecological zones in Bhutan is classified, and priority horticultural crops in the zones are as follows.

**Agro-ecological Zones of Bhutan and the Priority Horticultural Crops**

Agro-ecological Zone	Altitude Range (m)	Annual Rainfall (mm)	Annual Mean Air Temp. (°C)	Priority Horticultural Crops
Alpine	3,600 - 4,600	< 650	5.5	Medicinal and Aromatic Crops
Cool Temperature	2,600 - 3,600	650 - 850	9.9	Apple, Potato, Vegetables in summer
Warm Temperature	1,800 - 2,600	650 - 850	12.5	Apple, Potato, Vegetables in summer, Walnut
Dry Subtropical	1,200 - 1,800	850 - 1,200	17.2	Mandarin, Potato, Chili, Vegetables in winter, Pear
Humid Subtropical	600 - 1,200	1,200 - 2,500	19.5	Mandarin, Mango, Vegetables in winter, Cardamom
Wet Subtropical	150 - 600	2,500 - 5,500	23.6	Mango, Litchi, Ginger, Arecanut, Chili in winter

Source: RNR 9th FYP (2002-2007)

Most of the Study Area is located in Cool Temperate, Warm Temperate, Dry Subtropical, and Humid Subtropical zones. But high mountain areas include Alpine Zone, and part of lowland along the Kuri Chhu River belongs to some Wet Subtropical Zone.

In the Study Area, Lhuntse and Mongar, it may that rainfall in the summer season is much more than the precipitation record presented by MOSA. Some kinds of fruit and vegetable are inhibited to grow by the high humidity in the summer. For instance, apples grow well in Paro

and Thimphu, but not good in the Study Area, because diseases might be caused by high humidity in the summer season.

### **III-1.2.1 Alpine Zone**

Common horticultural crops are difficult to grow in the cold condition in Alpine Zone. Medicinal and aromatic plants have become important cash crops in this zone.

### **III-1.2.2 Cool Temperate Zone**

Potato is a major horticultural crop in this zone. Vegetables in summer are increasing. Apple is a priority fruit in Bhutan, but not so adaptable in the East Area because of much rainfall in the summer season.

### **III-1.2.3 Warm Temperate Zone**

The most of productive horticultural crops are grown in this zone. Fruit and nut such as walnuts, apples, pears, peaches, and plums are produced in the zone. Vegetables like chili, cabbage, cauliflower, broccoli, tomatoes and many others are cultivated not only for home consumption but also for the marketing.

### **III-1.2.4 Dry Subtropical Zone**

Citrus fruit trees such as mandarin orange, and some vegetables are grown in the winter, but the production is small. Oil extraction of lemongrass, which is typical natural vegetation in this zone, is an important income source of farmers.

### **III-1.2.5 Humid Subtropical Zone**

Mustard, pulses and vegetables are grown in rotation cropping with rice. Vegetables are grown even in the autumn or early spring. Sub-tropical fruits like mandarin, guava, and ginger are grown in this zone.

### **III-1.2.6 Wet Subtropical Zone**

As the annual mean temperature shows higher than 20°C, this zone must belong to 'Tropical Zone' in meteorological standard.

Specific land of Lingmithang and along the Khuri-chuu River, tropical fruits like mango, papaya, pineapple, and banana, ginger, arecanut, and chili can be grown in winter.

## **III-1.3 Yield of Horticultural Crops**

Yield of crops is one of the most important factors of cash income for farmers.

Average yield is estimated based on the production and planted area. The yields of major horticultural crops in the Study Area are shown in the following table.

**Average yield of Major Horticultural Crops**

(Unit: kg/ha)

	Lhuntse	Mongar	Bhutan Average
Citrus	7,250	3,395	10,149
Apple	3,375		6,104
Mango	3,625	2,533	2,040
Walnut	2,172		3,167
Potato	6,250	18,413	14,230

According to another data, yield of orange, mango, apple and walnut in Mongar are estimated as 40 kg, 30 kg, 30 - 40 kg, and 3 - 4 kg per tree respectively. Assuming that the planted density is 200 trees/ha, the yields of them are estimated at 8 ton/ha, 6 ton/ha, 6 - 8 ton/ha, and 600 - 800 kg/ha, respectively.

Considering these data, the productivity of orange, mango, and apple are extremely low. It might be caused mainly by the fact that most of trees are still in young stage. The average yields will be increased smoothly during the several years.

Yield of horticultural crops are fluctuating year-by-year, and not stable. Climatic condition is a main cause, and low cultivation technique may be another cause of the instability of yield.

#### **III-1.4 Quality of Horticultural Products**

Quality of products is another important factor to affect on farm income. Quality of fruits and vegetables in the Study Area could not be evaluated correctly. Horticulture products at weekly market in Thimphu and Mongar are shown in Table III-4 and III-5. Through the observing at the market in Mongar, it could be concluded as follows:

- Size is generally very small,
- Form is irregular,
- Appearance is poor caused by bruise and decay,
- Quality is medium,
- Period of quality keeping is short, and
- Price is reasonable, but it is about half of the same products from India.

For instance, apple (cv. Delicious) fruit sold in market shows fairly good color, but irregular form, and as small as less than 100 g per piece, seed content number per fruit is only 1 - 2. This is caused by insufficient pollination, and by no-thinning fruit. Fruit appearance is no good caused by mechanical bruise, disease, and insect bite. These might be easily prevented and improved by suitable cultivation practice and careful handling.

Low quality fruits or vegetable can be sold in local market, but are low value or no value in the international market. Improved quality and grading of products are required to get more income for farmers.

#### **III-1.5 Variety or Cultivars**

Variety or cultivar of horticulture crops is an important factor to produce fruits and vegetables. Native or traditional varieties have occupied a large part of horticulture crops. For instance, native banana variety of which fruit contains many seeds, are still grown. Improved varieties are introduced and developing in some species of fruits / nuts, and some kinds of vegetables.

The leading variety of apple in Bhutan is "Delicious". The fruits of the classic variety is not only favorite of the people but also is exported to India. The fruit produced in the Study Area is very small and low quality as described above, and the period of keeping-quality is short. It is said that Indian people like small size fruit, and do not like large size fruit to be cut with knife. But it is doubtful, because larger fruit is sold at higher price in market, and people select larger ones as possible. "Delicious" is a good variety, of cause, but the short period of keeping-quality is a problem in Bhutan because of the difficult transportation, and also the juice quality of this variety is not suitable for juice-processing.

Many wild pear trees are grown in field. The fruit is very small, and the taste is sweet but astringent. The trees resemble Japanese wild species *Pyrus serotina* Rheder.

Persimmon tree grown in the Study Area is astringent variety. It seems like "*Hiratanenashi*" from Japan but has small seeds. The fruit is fairly large, and has good color appearance. People eat this fruit in over-ripened condition. De-astringent treatment would be useful to get better taste. Sweet cultivars of Japan are not grown yet in the Study Area.

Mandarins like *Ponkan* are widely grown in lowland. The fruits are small, but of fairly good quality, and are exported to India. Satsuma mandarin, sweet oranges, grapefruit, or pomelo are little or not grown. The reason is unknown.

Banana and pineapple are grown in hotter areas, but are not productive, and the fruits are small, and of poor quality, some of them contain many large seeds. The varieties seem native, and no good quality.

Hard-shell walnut tree is being changed to soft-shell variety. Variety selection is being experimented at RNR Research Center East.

*It is supposed that variety improvement is the shortest way to increase farmer's income.*

### **III-1.6 Cultivation Practices**

Cultivation practices, or growing techniques of fruit trees and vegetable crops are widely different by regions and by individual farmers. Generally speaking, cultivation, fertilizing, and weed-control are fairly good, but training and pruning trees, pollination, pest control etc. are inadequate, or neglected at all. Fruit trees like mandarin have been usually propagated by seedling, and non-grafted trees are planted yet. It may cause the low-yield and low quality.

### **III-1.7 Supply of Seeds and Seedlings**

Vegetable seeds and seedlings are supplied generally by "Druk Seed Corporation (DSC)" under MOA. It has five (5) regional centers and three (3) production farms in the country. DSC produces and distributes seeds and seedlings to whole country. Seeds of about 50 genuine varieties of 24 species of vegetables as well as cereals, oil seeds, and pulses, and 26 species of fruit nursery plants were supplied in 2001. The prices of these seeds and fruit tree nurseries are same in whole country by subsidy of the Government.

There are also some private nurseries. The number of private nurseries is increasing recently. Seed production is a profitable industry in Bhutan because of the clean, isolated, and varied agro-ecological diversity.

### **III-1.8 Research and Extension**

Institutional structure for agriculture is designed rationally by the agro-ecological diversity. According to 9<sup>th</sup> FYP, RNR-RC East (Research Center East) will be the lead center for horticulture research in Bhutan. The RNR-RC East, Wengkhar with two sub-centers at Khangma and Lingmithang, cover major agro-ecological zones of the country in the context of horticulture development.

The RNR-RC East, Wengkhar is located in Mongar City, 1,620 m ~ 1,800 m in altitude, is under-construction yet as in Phase I, but is starting active research works on temperate fruits, citrus and vegetables. The Khangma Sub-center located near Trashigang, 2,200 m in altitude,

is in charge of research of horticulture in temperate zone. Lingmithang Sub-center, 640 m in altitude, is in charge of researches in subtropical zone, as on citrus, mango, banana, medicinal and aromatic plants, vegetable crops in winter, and also ornamental plants like orchid.

## CHAPTER III-2 POPENENTIAL OF HORTICULTURE DEVELOPMENT

Potentialities of horticulture development in Lhuntse and Mongar Districts seem to be very high. Many species of horticulture crops could be grown in their adaptable agro-climatic condition. The yield and quality could be enhanced with improved varieties and cultivation techniques. There are, of course, many problems to be solved, or not be able to solve. But it would be certainly possible that horticultural crop, as cash crop, contribute to increase farmers income in the Study Area.

### III-2.1 Potentials from Viewpoint of Natural Conditions

The agro-ecological conditions varied from alpine to tropic zones by the altitude and rainfall. This climatic diversity allows growing of various species in these regions. Using highland or sub-tropical conditions, out-of-season cultivation, e.g. vegetable cultivation in winter or in mid-summer is possible. Harvesting fruits in early or late season is also possible. These off-season fruits and vegetables have advantage benefits in the market.

Priority horticultural crops and potential crops in each agro-ecological zone are summarized in the following table. The priority horticultural crops are proposed by RNR-RC-East. In addition, here are potential horticultural crops, considering foreign examples under similar condition. Potential crops have only possibility of growing in these climate zones. Establishment of these crops depends on the productivity and quality of them that will be proved after experimental culture by RNR-RC and also by some farmers in practical fields.

**Priority and Potential Horticultural Crops by Agro-ecological Zone**

Agro-Ecological Zone	Priority Horticultural Crops	Potential Horticultural Crops
Alpine	Medicinal and Aromatic Herbs	
Cool Temperate	Apple, Potato, Vegetable in summer	Apricot, European Pear, Quince, Walnut, Asparagus, Cabbage, Lettuce,
Warm Temperate	Apple, Walnut, Potato, Vegetable in summer	Japanese Pear, Chinese Pear, Apricot, Peach, Plum, Grape, Chestnut, Strawberry, Tomato, Chinese Cabbage, Spinach,
Dry Sub-Tropical	Satsuma orange, Pear, Potato, Chili, Vegetable in winter	Japanese pear, Persimmon, Kiwifruit, Ponkan mandarin, Figs, Sweet orange, Water melon, Melon, Pumpkin, Sweet potato, Eggplant, Bell pepper, Tea
Humid Sub-Tropical	Mandarin orange, Mango, Cardamom, Vegetables in Winter	Sweet orange, Grapefruit, Pomelo, Lemon and Lime, Passion-fruit, Sweet potato, Spices, Tea
Wet Sub-Tropical	Mango, Litchi, Arecanut, Ginger, Chili as winter crop	Banana, Papaya, Pineapple, Guava, Pepper, Tropical, Medicinal Plants, Orchid, Ornamental plants

Priority Horticultural Crops: Horticulture. Research Program, Policy, Strategy, and Plan. 9th Five-Year Plan (2002 - 2007).

### III-2.2 Potentials from Viewpoint of Growing of Wild and/or Native Plants

Many species of plants grow wildly in the field or in the mountains. Some species of them like mushrooms, fern, lemongrass etc. are collected from field or mountain and utilized as vegetable or material of processing. Some wild species or relative species are botanically as same as the cultured species. Natural growing of these wild species would promise the success in culture of cultivars of the same species, because both wild and cultivated crop are suitable under similar condition. The success cases in asparagus and walnuts have been proved in this principle. Growing of chestnut, pears, grapes, stone fruits, eggplant, cucumber, many species of vegetables, mushrooms, ornamental plants, and medicinal and aromatic plants have the same potentials.



### **III-2.3 Potentials for Introduction of New Horticulture Crops**

Introduction of new crops to a new region brings out sometimes a large benefit if the crop is adaptable to the natural condition. In Bhutan, apples, radish, watermelon etc. have been shown a little success so far. Many attempts to new horticulture crops are being experimented by RNR Research Centers. There are many and much potentials to be grown new crops, and to be developed new agricultural industry in the Study Artea. Trial and practical experimental culture is necessary.

### **III-2.4 Potentials for Improvement of Yield and Quality by Variety Renewal**

Improved varieties bring out more yield and higher quality as well as resistance to disease or stress. Renewal of native hard-shell walnut to the soft-shell varieties is a good example.

As for apple, it is recommendable to renewal to varieties of longer period keeping-quality such as 'Fuji' or 'Gara' for table use, and of better juice quality, more acid-type cultivars such as 'Jonathan' for processing use.

Japanese pear cultivars and Chinese pear would have high potential to grow instead of wild trees. Resistant cultivars to diseases are recommendable.

Sweet persimmon cultivars, of which fruit become sweet even in firm-flesh stage, would take place instead of astringent varieties. Japanese cultivars such as 'Fuji' and 'Jiro' and also pollinator cultivars may be profitable.

Native or old variety of banana and other tropical fruits should be replaced to better cultivars from India or other countries.

Many varieties of vegetable crops, both native and foreign varieties, are grown. But adaptable varieties to climate conditions should be selected. Variety selection and evaluation are necessary.

### **III-2.5 Potentials for Improvement of Yield and Quality by Cultivation Techniques**

Good plant management would bring out higher yield and better quality, and conclusively more income to the farmer. In fruit trees, planting pollinator tree, pruning tree and thinning fruit is the minimum practices to get high yield and good quality fruit. As for vegetable crop production, fertilization, pollination, post-harvest treatment, etc. are important. There are much possibilities to increase yield and quality of vegetables and fruits.

### **III-2.6 Potentials for Processing of Horticulture Crops**

Long distance of carriage way, bad road conditions, and difficult access to market are the most problem in the Study Area. Processing of horticulture crops would be one of solution to the transportation problem. Small volume and high unit price is desirable. Good keeping-quality is also important. Nuts like walnut are desirable in this sense. In contrast, perishable fruits like peach or grape are undesirable.

Dried fruits, such as apricot, persimmon, or prune, some vegetables, and mushrooms can be processed easily, and have high potential in the dry condition areas. The other processing methods are also available, and would bring benefits to farmers.

Freeze-dried procedure is one of the potential of processing. Drying without quality-down is a useful process for fruit juice, medicinal plants etc. It might have possibility to solve the

transportation handicaps.

## **Chapter III-3 Problems of Horticulture Development**

### **III-3.1 Geographical Features**

Lhuntse and Mongar Dzongkhags are located in mountainous area. The lands are surrounded by high mountains. People are living on small flatland or gentle slope. Farms are on mountainous slopes or terrace made up on steep slope. Consequently, orchard and farm land areas are small, labor-efficiency is low, and mechanization is difficult. As farm households and villages are scattered, their cooperation of farming practices makes difficult. The roads are narrow and steep, vehicle use is limited, and marketing is inactive. Difficulty in transportation of horticultural products has suppressed farmer's volition to produce fruit and vegetable crops commercially. Steep slopes cause erosion of farm land frequently, that most of the fields is not fertile.

### **III-3.2 Diseases and Pests**

Complicated geographical features, as well as climatic diversity of the land allow propagation of many kinds of fungus and pest insects. Rainfall is not necessary so much in annual, but most of it falls in the summer, growing season of plants. Mist or cloud formed on the valley-side wets leaves, and they accelerate the fungus and bacterial diseases.

Apple scab, citrus cancer, potato late blight, chili blight, chili wilt, cardamom wilt, ginger bacterial wilt and soft-rot, etc. are common diseases. Additionally, virus and virus-like diseases are observed. Citrus greening disease, potato virus disease, and cyst-nematode, and cardamom virus disease have to be paid attention. Use of fungicide and pesticide are not common. Only resistant crops or varieties are cultivated. As fruit-fly attack young fruits and some fruit vegetables like melon, these crops have to be harvested before June. It caused one limiting factor to grow them.

New diseases and pests also may threaten to invade from other countries accompanied by introduction of new variety of horticulture crops. Careless private introduction of plants from foreign countries must be forbidden. Plant certification is important.

### **III-3.3 Post-harvest Problems**

Horticultural crops could not be harvested all year round. The products should be kept good condition for some period. Cold storage is desirable, but the cost of maintenance is a problem. Some fruits such as European pear or astringent persimmon require post-harvest procedure. Astringent persimmon fruit is de-astringent by non-oxygen respiration with alcohol. The procedure is not so difficult for farmers. Drying process of fruits or vegetables is widely known, dried apricot, persimmon fruit, mushroom, etc., there seem little problems on them but a little techniques are necessary to produce quality goods.

### **III-3.4 Market Mechanism**

Because of the difficult transportation between farms and town, and small scale consumers in the town, market system or mechanism has not developed in the Study Area. Farmers carry their products on horse-back or on their own back to the local market, and sell it themselves. Activities of middlemen and farmers group have not developed. On the other hand, Indian products of horticultural crops are carried into the same market by merchant tracks directly. This disadvantage or handicaps discourages the horticultural production in the Study Area.

### III-3.5 Insufficiency of Manpower in Research

Government systems and framework concerning to agricultural research and development seem fairly good, and fulfill their function (Fig. III-1).

However, manpower is insufficient definitely. The 9<sup>th</sup> FYP and the other plans seem splendid: description of background, analysis of problems, assembling of frameworks, and programs. But realization of these plans depends on manpower that works practically. For instance, requirement of researchers of RNR Research Center of Eastern Region is 29 persons in total, but the existing number of researchers is only 15 persons.

**Qualifications of Technical Staff of RNR-RC East (as of June 2002)**

	M. Sc.	B.Sc.	Diploma	Certificate	Total
Khangma	5	5	14	2	26
Lingmithang	0	0	5	0	5
Wengkhar	0	1 (Dr.)	5	2	8
Pemagatshel	0	0	1	0	1
Total	5	6	25	4	40
Average years Present posting	3.8 (0 ~ 9)	3.2 (1 ~ 8)	5.5 (0 ~ 13)	4.5 (1 ~ 12)	4.8

### III-3.6 Insufficiency of Facilities in Research Center

Facilities of the Research Centers are poor unbelievably, in spite of their importance in horticulture development. Even a simple analyzing instruments and tools, or processing units they have not. Instillation and improvement of laboratory, greenhouse, and their equipment are necessary to develop the research activities.

**Primarily Required Equipments of the Research Center and the Sub-Centers**

	Building	Equipments
Laboratory	5 rooms with necessaries	Distil water making unit, Hot air oven, Autoclave, Seed germinator, Freeze dryer, Deep freezer, Physical balance, Electric balance, pH meter, Soil analysis tools, general analysis tools
Greenhouse	Isolation greenhouse, Propagation greenhouse, Screen House	Watering unit, Heating unit, Bench, etc.
Experimental Farm		Irrigation system (pump, tank, pipe, sprinkler), Meteorological system, Tractor, Power sprayer, Truck, Dryer

## CHAPTER III-4 CONCLUSION

Considering the situation in Bhutan, horticulture development is essential to increase income of farmers. Natural conditions allow many kinds of horticultural crops to grow, or there are high potential to produce fruit, vegetable, and the other specific products such as medicinal, aromatic, and spicy materials etc. in each adaptable agro-ecological condition.

Presently, commercial horticulture in Gewogs of Lhuntse and Mongar Dzongkhags are undeveloped yet. There are many problems in the area for horticulture development. These problems and difficulties in horticulture development might be hard to solve in a short time, but there might be some good ways to solve them.

Research seems most important works to solve the problems, to develop horticulture, and to increase cash income in these districts. Researches on development of new crops or new good varieties, establishment of cultivation technology, pest control, and improvement of yield and quality are most important.

The function of the Research Centers, though the organization and plans such as 9<sup>th</sup> Five Year Plan seem splendid, are not enough to correspond to horticultural development. Manpower of the research centers is insufficient, and the establishments or equipment are too poor to comparing with other countries, even with other developing countries in Asia.

Strengthening and modernization of research works with new establishments and equipment is essential to improve horticultural crops and cultivation technology, for horticulture development, to increase cash income, and to level up living of farmers. It is the indirect but short way to develop cash crops.

Long-term training of freshmen in research centers is desirable to make specialist of horticulture. The trainees expand new technology with their experiences in the research center. They will be very useful to develop horticulture, and will be responsible to develop the agriculture of Bhutan in the future.

Horticulture development plan has formulated in the Program for Cash Crop Production Strengthening (PCCPS) as mentioned in Annex-II.