Agropedology 2010, 20 (1), 19-29

Micro-level planning for optimum land use in a coastal area of West Bengal - A case study

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Abstract : An agricultural land use plan was conceived through the integration of various factors like available land and water resources as well as socio-economic factors viz. land holding size, social acceptability and economic conditions of farmers. The study was conducted in Jeebantala village (146.42 ha) of Sagar Island (South 24 Parganas district,West Bengal) to prepare micro-level plan for optimum land use. Four soil series viz Jeebantala-1, Jeebantala-2, Jeebantala-3 and Jeebantala-4 were identified through detailed soil survey (1:4000 scale) and classified as Aeric Endoaquepts, Fluvaquentic Endoaquepts, Aeric Endoaquents and Typic Endoaquents, respectively. Soil-site suitability evaluation indicated that chilli, grass pea and Dinanath grass were highly suitable in soil of Jeebantala 1, 2 and 3 series whereas paddy, potato and sunflower were moderately suitable. The soils of Jeebantala-4 series showed limited scope for crop cultivation due to severe limitations of soil salinity and very poor drainage. Socio-economic study of the area indicated that marginal farmers (<1ha) constitute 77.25 per cent of the total population. Cropping sequences like paddy - chilli and paddy - sunflower were suggested for saline soils whereas paddy - potato and paddy -grass pea were suggested for non-saline soils. Incorporation of sunflower in the existing paddy-based cropping sequences enhanced the land utilization up to a maximum of 26.32 per cent in case of marginal farmers and 36.44 per cent in case of small farmers. The suggested land use may generate an enhanced employment option from 142 to 205 and 176 to 197 man days ha^{-1} $year^{-1}$ for the marginal and small farmers, respectively and increase their per capita income irrespective of their class.

Additional key words : *Employment generation, agricultural land use plan, marginal farmers, small farmers*

Introduction

In Coastal areas of West Bengal, agriculture is virtually managed by more than 80 per cent of marginal farmers and few small farmers (Anonymous 2003). These farmers are resource poor than their counterparts in other areas. This is primarily due to the pressure of population on finite land resources, low paddy yields and lack of alternative crops, which have resulted in widespread poverty, as distinctly witnessed in the eastern coastal tracts (Rai 2004). However, sustainable utilization of ecosystem's potential may be achieved through effective management of land resources, which requires site-specific detailed information on soils, their distribution and extent,

potentials and constraints in addition to data on climatic conditions, crop adaptability and socio-economic profile of the farmers. The present study was, therefore, carried out to formulate a micro-level agricultural land use plan of Jeebantala village of Sagar island, South 24-Parganas district, West Bengal.

Materials and Methods

The study was carried out in the village Jeebantala lying in between 88°07'37.2" to 88°08'31.2" E and 22°41'38.4" to 22°42'35.4" N, covering an area of 146.42 ha in Sagar block, South 24 Parganas district, West Bengal. Soil series were identified through detailed soil survey on 1:4000 scale (IARI 1970) and the soils were classified (Soil Survey Staff 1998). Standard laboratory techniques were used to estimate the physical and chemical properties of the soils (Jackson 1973) and fertility status (Page *et al.* 1982). Quality of irrigation water was estimated according to the procedure described (Tandon 1999). Land capability classification and land irrigability classes were done as per Klingbiel and Montgomery (1966) and Soil Survey Division Staff (20010), respectively. The soils were evaluated for their suitability to paddy, potato, chilli, sunflower, grass pea and Dinanath grass using the methods suggested by FAO (1976), Sys *et al.* (1993) and Dent and Young (1981).

The socio-economic survey was carried out using a questionnaire especially developed for this purpose (Ray and Mandal 1999). The crop experiment consisted of six paddy based cropping sequences with paddy (*Oryza sativa*) in wet season (July to October) followed by six crops in the winter season (November to February) namely, paddy (*Oryza sativa* L.), potato (*Solanum tuberosum* L.), sunflower (*Helianthus annus L.*), chilli (*Capsicum annum*), grass pea (*Lathyrus sativus* L.) and Dinanath grass (*Pennisetum pedicellatum*). Chemical fertilizers were applied during both the seasons according to the dosages recommended for the area (Bhattacharyya 1998) and the crops were raised following standard package of agro-managements (Bandyopadhyay *et al.* 2001) for respective crops. Overall employment generation for small and marginal farmers under the existing and suggested cropping systems was worked out as per the guidelines of Behera and Mahapatra (1998).

Results and Discussion

Soil resources

Soils of Jeebantala-1 (Jbn-1) occurring on upland were very deep, moderately well drained silty clay loam surface texture, slightly acidic to neutral pH (6.3 to 7.3) and slightly saline (ECe: 4.1 to 4.4 dSm^{-1}) (Table 1). The soils of Jeebantala-2 (Jbn-2) were very deep, moderately drained occurring on midland and had silty clay loam surface texture, slightly acidic to neutral (pH 6.2 to 7.3) and non-saline (ECe: 2.8 to 3.4 dSm^{-1}) and classified as fine, mixed, hyperthermic, Fluvaquentic Endoaquepts. The soils of Jeebantala-3 (Jbn-3) occurring on lowland were very deep, poorly drained, neutral to slightly alkaline (pH 6.9 to 7.6), moderately saline (ECe: 8.1 to 8.8 dSm^{-1}) and had silty clay surface texture. The soils of Jeebantala-4 (Jbn-4) were very deep, very poorly drained, slightly alkaline (pH 7.7 to 8.1), strongly saline (ECe : 14.6 to 15.2 dSm^{-1}) and had silty clay loam surface texture. Organic carbon in surface horizons of all these soils was high (9.8 to 12.2 g kg^{-1}) except in Jbn-4 soils. All these soils had moderate cation exchange capacity (13.7 to 20.1 cmol (p+) kg^{-1}) and moderately high base saturation (76 to 85 per cent) in different horizons. The surface horizons were low to medium in available N (255 to 292 kg ha^{-1}) and medium in available P_2O_5 (69 to 79 kg ha^{-1}). Available K_2O was high (638 to 936 kg ha^{-1}) with a tendency to decrease with depth barring few exceptions.

Water resources

Groundwater and ponds were the only viable sources of irrigation in the area (Table 2). The saline irrigation water is the major problem of the area. Lowest EC (0.70 dSm^{-1}) was recorded for pond water, the groundwater (EC 2.52 dSm^{-1}), canal water (EC 20.10 dsm^{-1}) and river water (EC 23.71 dsm^{-1}) had higher EC. The EC of river water might be

Table 1. Physical and chemical properties and fertility status of identified soil series

Horizon	Depth (cm)	pH (H_2O)	ECe dSm^{-1}	Org. C. (%)	Clay (%)	CEC cmol (p+) kg^{-1}	B.S. (%)	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})
		Physical and chemical properties						Fertility		
Jeebantala- 1 (Jbn-1) soil series (Fine- loamy, mixed, hyperthermic Aeric Endoaquepts)										
Ap	0-17	6.3	4.1	9.8	32.1	15.9	76	262	69	638
Bwg1	17-37	7.0	4.4	4.7	34.1	14.4	85	236	63	629
Bwg2	37 - 73	7.3	4.3	3.8	40.4	16.5	85	185	31	472
Bwg3	73- 107	7.4	4.6	2.9	41.2	16.7	86	126	24	369
Bwg4	107- 138	7.4	4.6	2.0	41.6	16.6	86	93	17	357
Jeebantala-2 (Jbn-2) soil series (Fine, mixed, hyperthermic Fluvaquentic Endoaquepts)										
Ap	0-15	6.2	2.8	10.4	38.2	15.8	78	286	79	782
Bwg1	15-33	7.0	3.0	4.5	36.7	14.1	82	242	52	744
Bwg2	33-60	7.3	3.4	3.4	38.4	14.4	83	218	25	582
Bwg3	60- 94	7.1	2.9	4.3	38.0	14.0	79	115	21	428
Bwg4	94-127	7.0	3.2	2.9	38.6	14.3	81	83	15	349
Jeebantala-3 (Jbn-3) soil series (Fine, mixed, hyperthermic Aeric Endoaquents)										
Ap	0-16	6.9	8.1	12.2	48.3	20.1	86	292	78	738
A2	16-36	7.3	8.3	5.1	47.2	17.1	83	252	51	712
Ag3	36-65	7.6	8.8	3.5	38.2	14.4	82	180	31	624
Cg1	65-104	7.3	9.4	2.1	37.9	14.1	81	157	23	426
Cg2	104- 123	6.9	9.7	1.9	37.4	14.0	81	114	14	364
Jeebantala-4 (Jbn-4) soil series (Fine, mixed, hyperthermic Typic Endoaquents)										
Ap	0-15	7.7	14.6	7.8	41.2	15.6	85	255	71	936
A2	15-35	7.9	14.9	4.6	38.9	13.7	85	232	53	851
Ag3	35-71	8.1	15.2	3.9	36.4	14.0	82	174	33	735
Cg1	71- 97	8.4	16.7	1.2	36.5	13.4	81	113	21	581
Cg2	97- 141	8.4	18.3	0.9	35.9	13.2	80	78	14	489

due to its close proximity to the sea. The other parameters viz. Na^+, Ca^{2+}, Cl^-, CO_3^{2-} and HCO_3^- followed similar trend of EC. Considering the Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) values, both pond water and ground water samples (2.71 and 7.73 and -1.08 and 0.42,

Table 2. Irrigation water quality of different sources (Pooled data -pre monsoon, monsoon and post monsoon)

Irrigation source	Irrigation water parameters								Quality indices		
	pH	EC (dSm^{-1})	Na^+	Ca^+	Mg^+	Cl^-	CO_3^{2-}	HCO_3^-	SAR	RSC	SSP
	<---------- ($meql^{-1}$) ---------->										
Pond	7.3	0.70	2.88	1.16	1.09	2.82	0.2	0.94	2.71	-1.08	42.81
Ground water	7.4	2.52	13.72	2.96	3.19	10.90	0.6	6.00	7.73	0.42	57.96
Canal	7.3	20.10	128.59	4.57	6.89	111.78	1.6	13.24	53.39	3.38	69.99
River	7.1	23.71	158.14	5.42	8.63	135.23	1.7	15.79	59.51	3.47	70.30

Table 3. Demographic features and land characteristics

Farmers class (H. No)*	Population features			Caste		Literacy (%)	Land characteristics	
	Male	Female	Total	SC	ST		Seasonal	Perennial
Marginal (159)	502 (54.3)	422 (45.7)	924 (77.3)	84 (9.1)	69 (7.5)	592 (64.1)	55.85 (81.69)	12.52 (18.31)
Small (42)	155 (57.0)	117 (43.0)	272 (22.7)	19 (7.0)	18 (6.6)	190 (69.9)	47.12 (82.87)	9.74 (17.13)
Total (201)	657 (54.9)	539 (45.1)	1196 (100.0)	103 (8.6)	87 (7.3)	782 (65.4)	102.97 (82.22)	22.26 (17.78)

** H. No: number of house hold, Figures in parentheses indicate per centage, SC: Scheduled caste; ST: Scheduled tribe*

respectively) may be rated as safe but water of canal and river was practically unsafe for irrigation purposes (Richards 1954; Ayers and Westcot 1985).

Socio-economic conditions

On the basis of operational land holding sizes, two categories of farmers viz. marginal (< 1 ha) and small (1-2 ha) were identified in the study area (Table 3). Out of the total household (201), 79.1 per cent comprised marginal farmers and the rest 20.9 per cent belonged to small farmer's category. In general, literacy per cent and average family size showed an increasing trend with increase in operational land holding size of the farmers. Majority of scheduled caste (81.55 of their total population) and scheduled tribe populations (79.31 per cent of their total population) belonged to marginal farmer's category.

Table 4. Present land use

Farmers' category	Land position	Total cropped area (ha)	OLH[1] (ha)	Crop sequence	Rice equivalent yield ($t\ ha^{-1}$)	Land use efficiency (%)	Cropping intensity (%)
Marginal	Upland	28.63	33.07	WSP[2] - fallow WSP - WP[3] WSP - potato	2.95 - 10.50	41.1 - 65.8	120.34
	Midland	33.28	41.28	WSP - fallow WSP - WP WSP - grass pea WSP - potato	2.80 - 9.85	41.1 - 74.0	127.05
	Lowland	6.46	6.46	WSP - fallow	1.98 - 2.10	0 - 41.1	96.91
Small	Upland	24.06	27.21	WSP - fallow WSP - WP WSP - potato	2.81 - 9.85	41.1 - 74.0	117.27
	Midland	23.68	29.27	WSP - fallow WSP - WP WSP - grasspea WSP - potato	2.65 - 9.31	41.1 - 74.0	123.60
	Lowland	9.13	9.13	WSP - fallow	1.87 - 1.98	0 - 41.1	99.70

[1]OLH: Operational land holding; [2]WSP: Wet season paddy; [3]WP: Winter season paddy

Table 5. Land capability, land irrigability and soil site suitability for different crops

Soil series	Land capability class	Land irrigability class	Soil site suitability class						
			WSP[1]	WP[2]	Potato	Chilli	Sunflower	Grass Pea	Dinanath grass
Jbn-1	IIs	2s	S2	S2	S2	S1	S2	S1	S1
Jbn-2	IIws	2d	S2	S2	S2	S1	S2	S2	S1
Jbn-3	IVws	4ds	S2	S3	N1	S2	N1	S3	S2
Jbn-4	IVws	4ds	S3	N1	N2	N1	N2	N1	S3

[1]*WSP: Wet season paddy;* [2]*WP: Winter season paddy*

Present land use

Wet season paddy - winter season paddy cropping sequence is principally followed in the area with vegetables and oilseeds in some pockets of upland and midland. Marginal farmers owned the major share of total cropped area (68.87 ha) than the small farmers (56.87 ha). Both the categories of farmers obtained maximum yield from upland (2.95 - 10.50 ton ha^{-1}) whereas the minimum yield was recorded from lowland (1.87 - 2.10 ton ha^{-1}) (Table 4). Cropping intensity was maximum in midland followed by upland and lowland. The marginal farmers cultivated grass pea mainly as utera crop of lathyrus (relay crops grown by broadcasting the seeds 15-20 days prior to harvest of rice crop) in the midland. Lowland areas were mostly monocropped except for few patches that remained fallow during the winter season.

Soil-site suitability for different crops

The soil site suitability evaluation (Table 5) indicated that chilli, grass pea and Dinanath grass were highly suitable in soils of Jbn-1 series whereas paddy (wet season and winter season), potato and sunflower were moderately suitable. The soils of Jbn-2 series were highly suitable for chilli and Dinanath grass, however, paddy (wet season and winter season) may also be grown successfully in these soils after improvement in soil fertility. Similarly, the soils of Jbn-3 series were rated as moderately suitable for wet season paddy, chilli and Dinanath grass, but soils of Jbn-4 series offered limited scope for crop cultivation due to severe limitations of soil salinity and very poor drainage (Seal *et al.* 2005).

Yield and economics of paddy-based cropping sequences under different salinity levels

Average productivity of different cropping sequences varied with salinity level and the production efficiency went down with increase in soil salinity. In general, wet season paddy - chilli cropping sequence recorded the highest productivity (average rice equivalent yield 10,600 kg ha^{-1}) with few exceptions (Table 6). In the non-saline and slightly saline soils, rice equivalent yield of WSP-potato cropping sequence was the highest. However, net income was the highest from WSP-chilli cropping sequence except in the non-saline soils. Hence, in non-saline and slightly saline soils, all the cropping sequences were profitable in terms of net returns and benefit cost ratio. However, in these soils, WSP-chilli and WSP-potato cropping sequences were distinctly better than others. Capital investment was much higher for WSP-potato (Rs. 48,462 ha^{-1}) and WSP-chilli (Rs. 30,655 ha^{-1}) cropping sequences and, therefore, most suited for small farmers with better economic status. On the other hand, cultivation cost for WSP-sunflower (Rs. 20615 ha^{-1}) cropping sequence was much lower whereas the income per rupee invested (1.66 to 1.22 except in strongly saline soils) was compatible, even higher in some cases than the other cropping sequences, making it suitable for the resource poor marginal farmers.

Table 6. Comparative analysis of the yield and economics of different paddy- based cropping sequences in the trial plots

Crop sequence	Trial plot Yield & Economics	Upland			Midland				Lowland		
		< ---------- Salinity level ---------- >									
		S1	S2	S3	S0	S1	S2	S3	S1	S2	S3
WSP - WP	REY (kg ha^{-1})	7982	6946	4652	8482	8122	6972	4787	7848	6642	4284
	Gross return (Rs ha^{-1})	31928	27784	18608	33928	32488	27888	19148	31392	26568	17136
	Net return (Rs ha^{-1})	7295	3151	-6025	9295	7855	3255	-5485	6759	1935	-7497
	B : C ratio	1.30	1.13	0.76	1.38	1.32	1.13	0.78	1.27	1.08	0.70
WSP - potato	REY (kg ha^{-1})	13840	9780	4219	17738	13319	9171	3502	12213	7276	2056
	Gross return (Rs ha^{-1})	55360	39120	16876	70952	53276	36684	14008	48852	29104	8224
	Net return (Rs ha^{-1})	6898	-9342	-31586	22490	4818	-11778	-34454	390	-19358	-39329
	B : C ratio	1.14	0.81	0.35	1.46	1.10	0.76	0.29	1.01	0.60	0.17
WSP - sunflower	REY (kg ha^{-1})	8545	7463	4382	8898	8296	7100	4099	7652	6284	3364
	Gross return (Rs ha^{-1})	34180	29852	17528	35592	33184	28400	16396	30608	25136	13456
	Net return (Rs ha^{-1})	13565	9237	-3087	14977	12569	7785	-4219	9993	4521	-7159
	B : C ratio	1.66	1.45	0.85	1.73	1.61	1.38	0.80	1.48	1.22	0.65
WSP - grass pea	REY (kg ha^{-1})	4765	3771	2554	5100	4748	3674	2541	4394	3346	2056
	Gross return (Rs ha^{-1})	19060	15084	10216	20400	18992	14696	10164	17576	13384	8224
	Net return (Rs ha^{-1})	5415	1439	-3429	6755	5347	1051	-3481	3931	-261	-5121
	B : C ratio	1.40	1.11	0.75	1.50	1.39	1.08	0.74	1.29	0.98	0.62
WSP - chilli	REY (kg ha^{-1})	13811	12200	6544	14168	13526	11571	5788	13066	10890	4438
	Gross return (Rs ha^{-1})	55244	48800	26176	56672	54104	46284	23152	52264	43560	17752
	Net return (Rs ha^{-1})	24589	18145	-4479	26017	23449	15629	-7503	21609	12905	-12903
	B : C ratio	1.80	1.59	0.85	1.85	1.76	1.51	0.76	1.70	1.42	0.58
WSP - Dinanath grass	REY (kg ha^{-1})	4706	4236	3159	4943	4746	4161	3176	4600	3921	2671
	Gross return (Rs ha^{-1})	18824	16944	12636	19772	18984	16644	12704	18400	15684	10684
	Net return (Rs ha^{-1})	4305	2425	-1883	5253	4465	2125	-1815	3881	1165	-3835
	B : C ratio	1.30	1.17	0.87	1.36	1.31	1.15	0.88	1.27	1.08	0.74

REY - Rice Equivalent Yield

Similar interpretation was made by Gangwar and Katyal (2001) working on different paddy based cropping sequences in West Bengal and Orissa. On similar basis, WSP-chilli and WSP-sunflower may be the first choice of small and marginal farmers, respectively in the moderately saline soils. In the strongly saline soils, no cropping sequence proved to be profitable. However, WSP-Dinanath grass (labour cost was 64.5 % of total cost) or WSP-fallow (labour cost was 77.2 % of total cost) cropping sequence may be applicable in limited cases as family members contributed a considerable portion of the farm labour, which curtails the total cost of cultivation.

Suggested land use for marginal farmers

The wet season paddy may be cultivated in the wet season without choice to fulfil the requirement for family consumption. However, in the winter season, sunflower and grass pea were suggested as alternate crops in non-saline, slightly saline and moderately saline soils of upland and midland. Chilli was not suggested for marginal farmers due to comparatively high cost (Rs. 20,160/- ha^{-1}) of cultivation. Grass pea its cultivation was suited for the marginal farmers due to its low cultivation cost (Rs. 3,150/- ha^{-1}) and was suggested in slightly saline / moderately saline soils of upland and non-saline / slightly saline soils of midland. In addition, grass pea may be cultivated as utera crop after WSP utilizing the residual soil moisture in the areas where irrigation facility is not available.

Large scale potato cultivation may not be suggested for marginal farmers due to high cultivation cost (Rs. 37,967/- ha^{-1}) involved as well as risk and uncertainty associated with potato yield in saline soils. However, small scale cultivation may be taken up in the non-saline soils of midland to cater to the requirement for family consumption. In moderately saline soils, sunflower and in lowland, winter season paddy cultivation may be suggested with assured irrigation. Adoption of the suggested cropping sequences may increase the operational land holdings size up to a maximum of 26.32 per cent in the slightly saline soils of midland (Table 7).

Suggested land use for small farmers

Rice is the staple food of the locals and hence mono-crop paddy cultivation is the only choice during wet season. However, during winter season chilli; sunflower and potato cultivation may be practiced by the small farmers in non-saline and slightly saline soils of upland and midland. Though the net profit of potato was lower than that of sunflower in slightly saline soil, its inclusion as winter crop was solely due to its wide social acceptability. In moderately saline soils, chilli could be the first choice due to its higher net income. In strongly saline soils, no crop seemed to be profitable from economic point of view, but WSP-Dinanath grass cropping sequence may be suggested in limited areas where irrigation was assured, considering involvement of family labour (labour cost was 64.5% of total cost) which curtailed the actual cost of cultivation in farmer's field. Adoption of suggested cropping sequences by small farmers may increase operational land holdings size up to a maximum of 36.44 per cent in the slightly saline soils of lowland (Table 7).

Employment generation and per capita income

The employment potential assessed in terms of human labour requirement under different cropping systems indicated that wet season paddy - potato cropping sequence had highest labour requirement (339 man days ha^{-1} $year^{-1}$) followed by wet season paddy - chilli (312 man days ha^{-1} $year^{-1}$), wet season paddy - winter season paddy (259 man days ha^{-1} $year^{-1}$), wet season paddy - sunflower (219 man days ha^{-1} $year^{-1}$), wet season paddy - grass pea (163 man days ha^{-1} $year^{-1}$) and wet season paddy - Dinanath grass (156 man days ha^{-1} $year^{-1}$) cropping sequence, respectively. Very high labour requirement during crop season under sequential cropping indicates the potential for employment (Lynam *et al.* 1986; Newaj and Yadav 1992). Adoption of suggested land use may generate highest employment in the non-saline soils, which figured out as 163 to 339 and 312 to 339 man days ha^{-1} $year^{-1}$ in case of marginal and small farmers, respectively (Table 8). Employment generation decreased with increase in soil salinity due to restricted

Table 7. Suggested land use for marginal and small farmers

Land	Salinity level	Marginal farmers				Small farmers			
		Suggested land use	Total area (ha)	LUE[1] (%)	% increase in OLH[2]	Suggested land use	Total area (ha)	LUE (%)	% increase in OLH
Upland	Slightly Saline	WSP - grass pea WSP - sunflower	18.10	65.8 - 68.5	15.16	WSP - chilli WSP - sunflower WSP - potato	13.61	65.8 - 82.2	26.74
	Moderately Saline	WSP - sunflower WSP - grass pea	8.38	65.8 - 68.5	22.62	WSP - chilli WSP - sunflower	6.84	68.5 - 82.2	24.92
	Strongly saline	WSP - sunflower	2.15	68.5	26.00	WSP -Dinanath grass	3.61	82.2	17.49
Midland	Non saline	WSP - potato WSP - grass pea WSP - sunflower	7.47	65.8 - 68.5	10.0	WSP - chilli WSP - potato	5.59	65.8 - 82.2	13.32
	Slightly Saline	WSP - grass pea WSP - sunflower	5.51	65.8 - 68.5	26.32	WSP - chilli WSP - sunflower	5.81	68.5 - 82.2	36.23
	Moderately Saline	WSP - sunflower	16.30	68.5	21.01	WSP - chilli WSP - sunflower	7.66	68.5 - 82.2	22.92
	Strongly saline	WSP - fallow	4.00	41.1	0.00	WSP - Dinanath grass	4.62	82.2	14.25
Lowland	Slightly Saline	WSP - WP WSP - sunflower	0.40	68.5 - 74.0	25.00	WSP - WP WSP - chilli	0.61	74.0 - 82.2	36.44
	Moderately Saline	WSP - WP WSP - Dinanath grass	0.82	74.0 - 82.2	19.75	WSP - WP WSP - Dinanath grass	0.50	74.0 - 82.2	7.79
	Strongly saline	WSP - fallow	5.25	41.1	0.00	WSP -fallow	8.01	41.1	0.00

[1]LUE: Land use efficiency; [2]OLH: Operational land holdings; [3]WSP: Wet season paddy; [4]WP: Winter season paddy.

Table 8. Employment generation and per capita income under the present and suggested land use.

Farmers class	Soil salinity							
	Non saline		Slightly saline		Moderately saline		Strongly saline	
	EG* (mandays)	PCI** (Rs person^{-1} year^{-1})	EG (mandays)	PCI (Rs person^{-1} year^{-1})	EG (mandays)	PCI (Rs person^{-1} year^{-1})	EG (mandays)	PCI (Rs person^{-1} year^{-1})
Based on present land use								
Overall [1]	211	3221	165	2207	137	1297	125	1042
Based on suggested land use								
Marginal	163 [2] -339	1509 [3] - 5248	142 - 205	1133 - 1805	137 - 150	1116 - 1354	131	690
Small	312 - 339	11485 - 14690	176 - 197	5145 - 6142	147 - 157	3338 - 3696	127	1875
Average#	227 - 339	1191 - 7239	157 - 201	2043 - 2788	141 - 153	1500 - 1758	129	1283

*Note: *EG (mandays): Employment generation; **PCI (Rs person^{-1} year^{-1}): Per capita income (income calculated on expected gross income basis)*

Employment generation and per capita income under present land use was calculated as per data obtained from socio-economic survey. Range values were given under suggested land use as selection of cropping sequences depended upon farmer's choice.

[1] EG and PCI from present land use were calculated on overall basis as there wasn't much variation in the cropping pattern followed by the small and marginal farmers (as given in Table 4.).

 # Weighted average was taken for calculation of average per capita income.

[2] Employment generation and [3]per capita income from suggested land use was based on the area suggested for specific crop, which was calculated as per the availability of irrigation water.

agricultural activity under increasing salinity hazards. Per cent increase in employment opportunities associated with suggested crop plan indicated that adoption of alternative paddy-based cropping sequences might assist in improving the socio-economic status of the local farming community.

Per capita income followed similar trend as employment generation was the highest (average Rs. 1191 to 7239 person^{-1} year^{-1}) in non-saline soils irrespective of farmer's class. This is of special significance in case of small and marginal farmers, where a major portion of the farm labour was contributed by the family members. Therefore, any improvement in crop performance through the introduction of new cropping sequences may supplement the present income status of the farmers in the study area.

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Received : June 2008 *Accepted : April 2010*