

Land resource inventory (LRI) based agro-technology transfer in delta and plains of West Bengal

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Land resource inventory (LRI) based agro-technology transfer has been employed in lower Gangetic delta and Coastal plains of West Bengal. Acid saline soils occurred in 41.6% of the study area soils with severe salinity hazards. About 44.0% of area was best suited for crop diversification, while, 19.4% area was marked marginally suitable for majority of crops. LRI based best management practices (BMP) resulted in average annual benefit to cost ratio of 2.62 and average annual net returns from crops of ₹1,51,495, showing beneficial impact of 63.8 and 112%, respectively with average yield gain of crops by 42.0% over the existing or conventional management practices made by the farmers previously.

Keywords: Agro-technology transfer, Benefit to cost ratio, Land resource inventory, Land use plan

LAND resource inventory based agro-technology transfer involves land suitability assessment for crops and other allied enterprises through interpretative grouping of important physical and chemical parameters of soil to choose appropriate crop for cultivation. The present endeavour will guide the land use planners and policy makers as a land resource decision support tool for suitable crop planning and healthy livestock development in the lower Gangetic delta and coastal plains of West Bengal.

Majherpara village of Canning II block, South 24 Parganas district of West Bengal has been showcased for the implementation of agricultural land use plan. The study area represents lower Gangetic delta and coastal alluvial plains of West Bengal (agro ecological sub region of 18.5). The total geographical area (TGA) of the village is 46.12 hectare. The climate is hot, moist, sub-humid, sub-tropical with annual rainfall of 1796 mm. About 87% of the population of the village belongs to Scheduled Caste (SC) categories. Flooding and salinity hazards are most common constraints affecting

crop growth. Agriculture is the chief source of livelihood in the village with 70% of the working population being employed in agriculture either as cultivators or as agricultural labours. The major sources of irrigation in the village are farm ponds, bore well and tube well. The area is by and large cropped with rice in *kharif* season, jute and cucurbits during pre-*kharif* and pea and bitter gourds during *rabi* season.

Land resource inventory (LRI) technology

Land resource inventory is an assessment of the status and changing conditions of soil, water, land use, land covers and related resources in a landscape at the field level at large scale. The present endeavour deals with farm level land use plan and therefore, it employs 1: 4,000 scale of mapping i.e., at cadastral level. Detailed soil survey was performed during 2020-21 through intensive traversing of the field. Soil series were identified and mapped after detailed investigation of morphological, physical and chemical properties of representative soil profiles. Land suitability evaluation for crops was

assessed following FAO guidelines.

Soil resources and land suitability assessment

The study area was mapped in 4 soil series in 6 phases as mapping units (at 1: 4,000 scale) (Table 1). Majherpara-I has been classified as *Fine silty (cal.) Fluventic Endoaquepts*, whereas, Majherpara-II as *Fine silty (cal.) Typic Halaquepts*. Majherpara-III soils were classified as *Fine silty Fluvaquentic Endoaquepts*, whereas, Majherpara-IV as *Fine silty (cal.) Typic Endoaquepts*. Moderately acidic soils (pH 5.6-6.0) occupied 52.3% of total geographical area (TGA), whereas, soils of 47.7% of TGA were neutral (pH 6.6-7.3). Soil organic carbon was high (0.86-1.48%) in all soil series as influenced by age old natural farming practices adopted in the village. A significant part of Majherpara-I, II and III are potentially acid saline soils with high electrical conductivity (7.80-9.85 dS/m), coupled with Zn deficiency (0.52-0.58 mg/kg) occupying about 41.6% of TGA. These soils (acid saline soils) require special attention on drainage and salinity improvement through proper agronomic and

Table 1. LRI based suggested alternate land use advisories of the study area

Soil series	Suggested land use plan
Majherpara-I (Fine silty, moderately acidic soils with occasional flooding hazards) (<i>Fluventic Endoaquepts</i>)	Coconut plantation + Multi-tier horticulture (pre- <i>kharif</i> vegetables-F ₁ hybrids) + Homestead backyard poultry (Kaberi breed)/ duckery (Khaki Campbell breed)/ goatery (Black Bengal breed) + Integrated paddy-cum-backyard pond fishery (Indian Major Carp) <i>Best Management Practices</i> : Land shaping with ridge and furrow for drainage improvement / conservation tillage with 30% crop residue management/ Gypsum application/ Zn application @ 5 kg/ha + Recommended NPK dosages/ FYM @ 2-5 t/ha/ Vermicomposting @ 1-2 t/ha.
Majherpara-II (Poorly drained, fine silty, strongly saline soils with occasional flooding hazards) (<i>Typic Halaquepts</i>)	Coconut plantation + Multi-tier horticulture (pre- <i>kharif</i> vegetables-F ₁ hybrids) + Homestead backyard poultry (Kaberi breed)/ duckery (Khaki Campbell breed)/ goatery (Black Bengal breed) + Integrated paddy-cum-backyard pond fishery (Indian Major Carp) <i>Best Management Practices</i> : Land shaping with ridge and furrow for drainage improvement / conservation tillage with 30% crop residue management/ Gypsum application/ Zn application @ 5 kg/ha + Recommended NPK dosages/ FYM @ 2-5 t/ha/ Vermicomposting @ 1-2 t/ha.
Majherpara-III (Fine silty, moderately saline, soils with frequent flooding hazards) (<i>Fluvaquentic Endoaquepts</i>)	Coconut plantation + Multi-tier horticulture (pre- <i>kharif</i> and <i>rabi</i> Vegetables-F ₁ hybrids) + Homestead backyard poultry (Kaberi Breed)/ duckery (Khaki Campbell breed)/ goatery (Black Bengal breed) + Integrated paddy-cum-backyard pond fishery (Indian Major Carp) + Sub-tropical fruit plantation (mango, guava, sapota, etc.) (elevated zone) + Paddy (<i>kharif</i>)-Jute (JRO 524/ 529) (pre- <i>Kharif</i>) <i>Best Management Practices</i> : Conservation tillage with 30% crop residue management/ Gypsum application/ Zn application @ 5 kg/ha + Recommended NPK dosages/ FYM @ 2-5 t/ha/ Vermicomposting @ 1-2 t/ha.
Majherpara-IV (Fine silty, neutral, non saline, slightly calcareous soils with frequent flooding hazards) (<i>Typic Endoaquepts</i>)	Vegetables/ Cucurbits/ Colocasia/ Jute (pre- <i>kharif</i>)-Paddy/ Black gram (<i>Kharif</i>)-Maize/ Vegetables/ Pulses (<i>Rabi</i>) + Backyard homestead goatery (Black Bengal/ dairy (Crossed Jersey) + plantation (mango, guava, sapota, etc.) (elevated zone) <i>Best Management Practices</i> : Line sowing/ Reduced tillage (1-rotarvator)/ Recommended NPK dosages/ FYM @ 5-10 t/ha (orchards)/ Vermicomposting @ 2.5 t/ha (orchards)/ low lifting pump sets with shallow tube well as micro-irrigation for <i>rabi</i> and pre- <i>kharif</i> crops

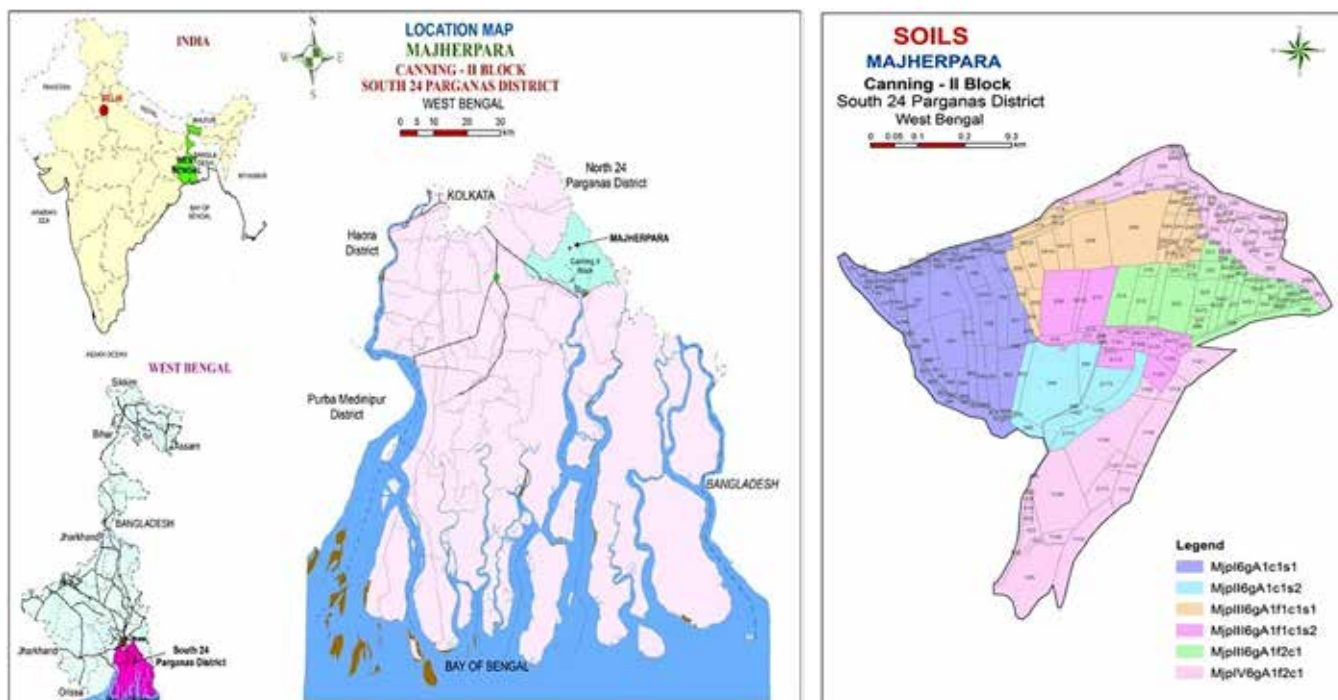
soil conservation measures. Nearly 23.8% of TGA comprise slightly to moderately saline (1.09-3.27 dS/m), moderately acidic soils. On the other hand, about 44.0% of TGA of the study area comprises neutral, non-saline soils (parts of Majherpara-III and Majherpara-IV), which, appears to be best suited soils for crop diversification with maize, pulses and vegetables in *rabi* season

and jute, cucurbits, colocasia in pre-*kharif* seasons. It was also observed that 77.8% of TGA has been found moderately suitable for sub tropical fruit plantations (guava, mango, sapota, etc.). Only, 19.4% of TGA has been marked as marginally suitable for most of the *rabi* and *kharif* crops due to severe salinity and drainage problems. These soils were recommended for multi-tier

horticulture, integrated paddy-fishery cum backyard livestock and coconut plantation.

Suggested alternate land use advisories

Based on LRI database, land suitability evaluation and socio-economic interpretation through participatory rural appraisal (PRA) technique, agro-technology has been transferred to the stake-holders



Soil map of the study area



Vermicomposting programme

through farm level alternate land use advisories were developed for each soil series. The present endeavour will help the land use planners to make decision on alternate land use options at farm level for each land parcel (at 1: 4,000 scale) (Table 2).

Implementation of land use planning programme

Land use plan has been implemented in the study area by providing necessary agricultural and allied inputs to 250 beneficiary farm families of the village including vermicomposting units (25 farm families), multi-tier horticultural units (25 farm families), pre-kharif and rabi crop planning (providing improved variety seeds to 82 farm families), livestock components (100 farm families), fishery (25 farm families) and horticultural plantation programme (plant saplings of sub tropical fruits to 250 farm families).

Horticultural plantation programme

Horticultural plantation programme bestows both short term and long term benefits to farmers. The short term benefits lies in multi-tier horticultural units, whereas, for long term benefits, farmers will get a secured annual income from sub-tropical fruit crops after 4-5 years of plantation on regular basis. Moreover, this will also enhance the livelihood security for the landless labours through formation of women self-help groups or beneficiary landless farming community in the village.

INM approach through vermicomposting

The vermicomposting beneficiaries have started producing vermicompost @ 4.0 quintal per unit (8ft × 4ft × 2ft pit size) annually. They have received net returns of

Table 2. LRI-agro-technology based best management practices (BMP) of the study area

Crops (Variety)	Existing yield (t/ha)	Yield after LRI based BMP (t/ha)	B-C Ratio after LRI based BMP	Yield gain (%) in LRI based BMP	Estimated annual net returns after LRI based BMP (₹/ha/year)
Kharif crops					
Paddy	2.50	3.10	1.49	24.0	57,350/-
Pre-Kharif crops					
Jute	1.50	1.88	2.22	25.3	59,300/-
Turmeric	7.2	15.0	3.13	108.0	3,40,000/-
Cucumber	8.0	15.0	2.44	87.5	1,33,000/-
Ridge gourd	3.0	4.5	2.10	50.0	76,200/-
E. Foot yams	22.5	26.3	2.70	16.9	4,53,000/-
Rabi crops					
Baby corn	1.5	2.3	3.83	53.3	1,18,000/-
Hybrid maize	7.5	8.3	2.37	10.7	1,16,700/-
Pea	0.8	1.0	2.58	25.0	22,500/-
Bitter gourd	18.8	22.5	3.38	19.7	138,900/-
Impact on crop performances		Average annual B-C ratio		Average annual net returns	
Existing System		1.60		₹ 71,556	
After LRI (Agro-technology)		2.62		₹1,51,495	
Impact on B-C Ratio over existing = 63.8%			Impact on net returns over existing = 112%		

₹ 4,800-6,000 per unit by selling the same @ ₹ 12 per kg. On an average, the vermin-wash has been produced 135-150 liters per unit, annually, from which the beneficiaries may gain a monetary benefit of ₹ 2,700 to 3,000 per unit per year. The cumulative estimated benefit for all 25 vermicomposting beneficiaries has been derived between ₹ 1,87,500 to ₹ 2,25,000 approximately.

Doubling farmers income through LRI based crop performances

Based on PRA technique of socio-economic survey among the farmers, it has been assessed that the farmers could get an approximate annual net returns from crops of ₹ 71,556 with average annual benefit to cost ratio of 1.60 only (Table 2) from existing low input management. LRI technology offered the land use managers the options for right crops. Moreover, it bestows crop

diversification in previously mono-cropped zones. Improved/ high yielding variety of crops along with best management practices (BMP) appears to increase yield, benefit to cost ratio (B-C) ratio and net returns by many-folds. The average yield gain has been estimated by 42.0% in LRI technology based crop performances. The average B-C ratio was 2.62 with an beneficial impact of 63.8% over existing system, while, the agro-technology conferred an average annual net returns of ₹1,51,495 with an enhanced impact of 112% over the existing sets of management (Table 2).

SUMMARY

Henceforth, LRI based agro-technology transfer appears to be superior over the conventional farming approach earlier adopted by the farmers in the lower Gangetic delta region. Considering fragility of the coastal ecosystem in West Bengal, the present endeavour will help the land use policy makers as a standard agricultural land use planning guide under similar climatic and physiographic situation in the elsewhere of the country.



Crop performances (baby corn and pea) after LRI based agro-technology transfer

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