

## AN ANALYTICAL STUDY OF SOILS AND SUSTAINABLE AGRICULTURE OF THE GANGA *DIARA*, BIHAR.

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**ABSTRACT :** Diara lands are essentially depositional tracts situated in between the natural levees and the course of the river Gange that get inundated during the monsoon rains (June to October). At times they are eroded at some points and aggraded at the other due to river action. This is accompanied by meandering, braiding and course changing of the river. Diara land soils are young and stratified with AC profiles. These soils occurring in alluvial fans and flooded plains are characterised by light colour, sand to sandy loam texture, single grain to massive structure and slightly alkaline reaction. They have very faint and poor pedogenic manifestations as observed in their morphology. Further, they are well to excessively drained and constituted by layered sand and silt particles in varying proportions. The soils of diara lands cover a lot of risks and hazards, which ultimately limit their usefulness for cultivation. The diara plains are generally very fertile and give promising yield, if carefully handled and scientifically managed.

### INTRODUCTION

Diara lands are riverine lands fringing along the river bank. They are formed on alluvium deposited by the river during meandering, braiding and changes of the river course. Geographically, diaralands are situated between 25° and 26° N latitudes and extends from 84° to 88° E. longitudes. The area reported under the diara tract comes to about a million hectares spread mainly along the Ganga river which flows for 462 Km. from west to east in the state of Bihar. The diara area varies from 3 to 8 km. in width along the northern as well as southern banks. The spread is more along the southern bank compared to the northern one. Other rivers, Viz., the Gandak, the Ghaghra, the Kosi and the Sone also have diaralands, but their coverage is relatively small (Fig.1). Among the diaras, the Ganga diara is the largest and more

extensive. Soils of the Ganga, diara are distributed in an area of roughly 0.50 million ha. on both sides of the Gange extending from Chausin (Buxar district) in the extreme west to Radhanagar (Sahebganj district) in the east (Singh, 1988).

The climate of the area is sub-tropical with a rainfall average of about 1250 mm. The dry seasons (February-May) and (November-January) vary from very hot to cool and have pronounced humidity during the rains (June-October). The over-all condition of the land is suitable for sustainable agricultural. The yield and intensity of crops may substantially be increased by using modern crop husbandry and technology as the soils have moderate to high potentialities. This necessitates a detailed study of the soils and the resulting agricultural land use in diara tract as the sequel will show.

## PHYSICAL SETTING

Diaras possess a monotonously plain and flat lands and at places, they display a slightly undulating topography interspersed with mara (dead) and active channels forming more or less a complex topography i. e. uplands, medium lands and lowlands.

### i) Uplands:

These lands are occasionally flooded for less than one month and that too in the years of relatively high inundation. These areas are suitable for good agricultural and horticultural crops raised all the year round.

### ii) Medium lands:

These lands remain under water for approximately a period of a month or two. The crop husbandry is very much interfered with when copious rains occur, and floods of moderate intensity visit low lying areas when waterlogging may occur for 2 to 3 months during the peak floods.

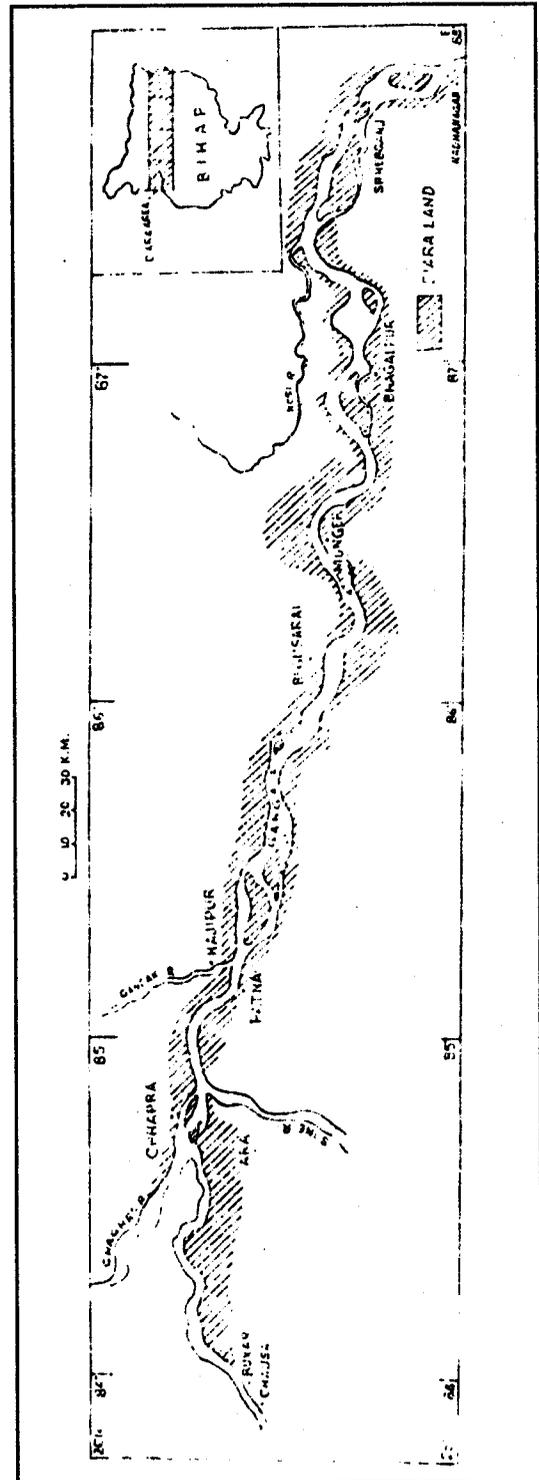
### iii) Low lands:

These lands are generally inundated for more than 3 months due to heavy rains. Farming becomes uncertain. The land is flooded almost every year whence it follows that the pre-monsoon crops are not grown in this tract.

### Soils and their properties:

The diara soils are broadly comprised mostly of recent alluvium. These are usually coarse to fine textured; the texture of surface soils changes with the distances from the stream. These soils are predominantly light textured lying in the close vicinity of the banks of the Ganga owing to an admixture of silt and sand.

The morphological properties (Table-1) of the soils indicate them to be lighter in colour (Pale olive to colourless). They are mainly influenced by the colour of sand fractions. Further, these soils are associated with alluvial fans and flood plains.



**Ganga Diara, Bihar**

Table-1

## Morphological characteristics of the soils

Horizon	Depth (cm)	Colour	Texture	Structure	Effervescence	Slope (%) & drainage	Land use	Remarks
<b>Pedon 1, Kamlakund series, Typic Ustifluent</b>								
Ap	0-42	5y 5/3(d)	SL	Sg	ev	4-6	Wheat, Caster,	No mottles
C1	42-80	5y 6/3 (d)	LS	Sg	ev	well drain-	Gram, Sweet-	
C2	80-110	5y 6/2(d)	S	Sg	ev	to exce-	potato, Water-	
C3	110-180	5y 6/3 (d)	LS	Sg	ev	ssively drained	melon etc.	
<b>Pedon 2, Milki Series, Typic Ustifluent</b>								
Ap	0-32 2.	5y 6/2 (d)	SL	abk	ev	4-6	Maize,	Annually
C1	32-63 2.	5y 5/4 (d)	L	abk	ev	well	Wheat,	flooded, few
C2	63-182 2.	5y 7/2 (d)	LS	Sg	ev	drained to excessively drained		mottles in lower horizons
<b>Pedon 3, Makra series, Typic Ustifluent</b>								
Ap	0-22	5y 7/2 (d)	SL	gr	ev	2-4	Maize, Jowar	Occasionally
C1	22-40	5y 8/2 (d)	S	Sg	ev	well drained	Barley, Water-	flooded,
C2	40-65	5y 7/2 (d)	SL	Sg	ev	to excessively drained	melon, potato,	no mottles
C3	65-185	5y 6/3 (d)	LS	Sg	ev		Sweetpotato, etc.	
<b>Pedon 4, Nauranga series, Typic Ustifluent</b>								
Ap	0-28	2.5y 4/4 (d)	SL	M	ev	2-4	Wheat, Bary,	Alluvial
C1	28-50	5y 6/2 (d)	S	Sg	ev	well drained	Gram, Maize, etc.	Fans,
C2	50-80	5y 7/1 (d)	S	Sg	ev	to excessively drained		Ferruginous nodules, mottles, presen
C3	80-95	5y 5/3 (m)	S	Sg	ev			
C4	95-120	2.5y 3/2 (m)	SL	M	ev			
C5	120-132	5y 8/1 (m)	LS	Sg	ev			

**Note** : d = dry, m = moist, Sg = Single grained, abk = angular blocky, gr = granular, M = massive, ev = effervescence vigorous  
**Source** : Journal of the Indian Society of Soil Science (1994) with young stratified soils with AC profiles. The soils sand to sandy loam in texture and single grained to massive in structure with ochric epipedon.

The physical and chemical properties of these soils (Table-2) indicate an uneven distribution of mechanical separates indicating stratification depending upon the mode of deposition of soil particles. These soils are low in organic carbon content due to poor regeneration and high rate of organic matter decomposition under hyperthermic temperature regime (Diwakar and Singh, 1994). Further, the irregular decrease in organic carbon content also suggests these soils to be of recent origin. Recent origin of these soils was also reported by Jha (1969). They are calcareous in nature ( $\text{CaCO}_3$  - 2.0-6.0%) and show alkaline reaction (PH 7.6-8.6).

The soils of diarlalands suffer from the spell of hot and dry summer which leads to moisture stress, as a result of poor water retention capacity of the light textured soils, high permeability of sandy soils near the banks/ levees in the areas which are still in formative phases of building up. In such a situation, erosion and deposition are distinct features and go hand in hand. Elsewhere, the soils display wide variety; usually heavy-textured groups predominate-where sand particles dwindle into insingificance.

These soils are said to be moderate to high in fertility status. Since they are light textured and their organic carbon content is low to

Table : 2

## Some Physical and chemical properties of the soils

Depth (cm)	Mechanical : Separates			Org. C (%)	Caco 3 (%)	pH
	Sand (0.2-0.02) (mm)	Silt (0.02-0.002 mm)	Clay (< 0.002 mm)			
<b>Pedon 1, Kamalkund series, Typic Ustifluent</b>						
0-42	49.2	43.8	7.0	0.51	2.0	7.6
42-80	85.9	8.0	6.1	0.40	5.0	7.8
80-110	88.1	6.9	5.0	0.21	3.6	7.7
110-180	85.3	9.6	5.1	0.08	3.1	7.6
<b>Pedon 2, Milki series, Typic Ustifluent</b>						
0-32	50.9	34.0	15.1	0.31	3.1	7.6
32-63	42.1	43.9	14.0	0.25	4.6	7.9
63-182	85.0	4.8	10.2	0.28	5.1	8.0
<b>Pedon 3, Makra series, Typic Ustifluent</b>						
0-22	50.2	42.5	7.3	0.49	4.2	8.2
22-40	90.0	3.9	6.1	0.25	5.9	8.6
40-65	52.3	40.2	7.5	0.30	4.8	8.5
65-185	86.0	8.0	6.0	0.06	6.0	8.6
<b>Pedon 4, Nauranga series, Typic Ustifluent</b>						
0-28	69.8	14.0	16.2	0.52	4.0	8.0
28-50	90.0	4.0	6.0	0.41	4.1	8.0
50-80	88.0	5.8	6.2	0.32	4.9	8.2
80-95	91.1	3.9	5.0	0.10	4.8	8.2
95-120	10.0	86.0	4.0	0.21	5.0	8.2
120-132	84.7	10.1	5.2	0.25	4.2	8.0

Source: Journal of the Indian Society of soil Science 91994).

medium. Special care is needed for nitrogen management to enhance its fertility (Chandra & Tiwary, 1987).

### SALIENT FEATURES OF DIARA FARMING

Natural risks and flood hazards are common phenomena in diara farming. Generally speaking, crop failures are more common than the growth of bumper crops which occur in years when flood fury is relatively low. Floods normally occur during peak monsoon storms, i.e. July and August, and may continue upto first week of October i.e. the close of

'hasta' nakshtra. Floods inundate the entire elongated tract with turbid water. They also interfere with the provision and use of irrigation facilities. More than 80 per cent of diara farming is rainfed as irrigation has touched only the fringe of the crop husbandry. The productivity in diaralands is often marred due to an unpredictable and erratic behavior of the monsoon rains, fury of the floods and occasional occurrence of droughts in the hot weather season (March to May). Three distinct crop seasons have been identified in diara areas (Prasad, 1995).

- i) Pre-flood/Garma crops (March-May):  
Maize, vegetables
- ii) Post-flood/kharif crops (mid-June-mid-November); Urad, tori, etc
- iii) Rabi crops - flood immune (November-March); Wheat, gram. lentil, tori, etc.

The rabi crops are pre-dominantly grown on a large scale due to congenial climatic and favourable edaphic conditions. The rabi seasons, sowing to harvesting, i.e. october to March, is the hectic period for agricultural operations for the farmers of diaraland. As these crops are mostly rainfed with residual soil moisture left out by the receding floods, they usually suffer due to soil moisture stress. The yields of rainfed rabi crops are medium to low (Table-3) but the production of agricultural crops may be enhanced if the soils are scientifically managed.

The uplands and medium lowlands are given to vegetable and a great variety of seasonal vegetables are raised as cash crops. In the river beds which have deposition of very thin layer of silt during seasonal floods (July-August) the soils receive renewed fertility and

make vegetable a commercial proposition. To name a few, pointed gourd, bottle gourd, lady finger, bitter gourd, water melons and a great variety of edible amaranthus are grown in plenty (Thakur, 1991).

### THE SOCIAL PROBLEM

The diaraland suffers from many social problems. The risk in diara farming is inherent and inevitable (Table-4). Barely 50-60 per cent people are engaged in agriculture, rest are either unemployed or get seasonal farm work. In fact, agriculture is the only pursuit of the diara people as other resources are wanting for them to fall back upon. Joblessness is predominant and it often encourages criminality. The family feuds as also the land disputes create law and order situation in the entire area. Transport and communication facilities are awfully poor and scanty. Hence agro-service agencies and development organisations take little interest in these areas.

The area needs tangible steps to be taken to improve and stabilize the level of agricultural production and the employment potential in

**Table 3**

**Production of Some Important crops in Ganga Diara**

S. N.	Name of the crops	Production (Q/ha)	Period of maturity (days)	Remarks
1.	Wheat (Rabi)	16-50	117-130	Irrigated and unirrigated
2.	Maize (Rabi)	47-58	160-162	Irrigated
3.	Maize (Garma)	25-47	85-105	Irrigated and unirrigated
4.	Pea (Rabi)	13-14	90-105	Unirrigated
5.	Tori (Rabi)	8-14	85-99	Irrigated and unirrigated
6.	Rai (Rabi)	13-20	107-117	Irrigated and unirrigated
7.	Linseed (Rabi)	10	124	Unirrigated
8.	Urad (Kharif)	11	80	Unirrigated
9.	A host of horticultural crops and vegetables are ubiquitous diara products			

*Source:* Technical Bulletin, K. V. K., Munger, 1999.

Table 4

**Agro-ecological situations in diaralands and risks and hazards in Farming**

Situations	Risks involved	Benefits derived
<b>I. Time of onset of monsoon :</b>		
(a) Early (Early June) Followed by good showers	-	Timely sowing of early maize/milletts followed by good showers
(b) Early (Early June) but break in monsoon for a fortnight	The early maize suffers due to drought-crop may fail	Timely sowing of early maize/milletts
(c) Timely (Mid June)	-	Good for early kharif maize/milletts
(d) Late (Early July)	Early kharif maize (unsown) fails completely	--
<b>II. Pattern of monsoon showers:</b>		
(a) Normal	--	Excellent for standing early kharif crops
(b) Erratic	Early kharif crop may fail. Drying and processing of produce difficult	--
<b>III. Time of withdrawal of monsoon:</b>		
(a) Too early (timely recession of flood)	--	Early flood recede, sowing in time, better crops.
(b) In time (timely recession of flood)	--	Early flood recede, showing in time better crops.
(c) Too late	Heavy soil saturated with water, sowing difficult.	--
<b>IV. Flood occurrence:</b>		
(a) Too early (end-July)	Damage the standing early kharif maize it fails completely	--
(b) In time (Mid-Aug.)	--	Early-kharif crop may be safe
(c) Too late (end-Aug./ Early-Sept.)	--	Early kharif maize crop is excellent
(d) In repeated flashes	Damage the early kharif crop	Heavy deposition of silts and sediments in the cropped area.
(e) No flood	Water table goes down. Summer cucurbitaceous crops suffer, Rabi crops suffer due to paucity of soil moisture.	Early kharif crops, tori, gram may be successful if rains are good

Situations	Risks involved	Benefits derived
<b>V. Recession of floods:</b>		
(a) Early recession	Chance of failure of late rabi crops due to paucity of moisture.	The prospect of late kharif (post-flood) blackgram crops bright. Timely sowing of all rabi crops.
(b) Timely recession	--	Timely sowing of late kharif and also rabi crop due to adequate moisture.
(c) Late recession	Late kharif crop fails, Too wet soil, land preparation delayed. Main rabi crops may not be sown in time.	Little useful for summer cucurbitaceous crop. Ample moisture for late rabi crops of wheat, barley, etc.
(d) Late recession and late heavy rains	Late kharif crop not possible. Rabi crop (Oct.-Nov.) sowing too much delayed due to too wet conditions of the soil. Only very late rabi sowing (Dec.-Jan.) possible.	Useful for summer cucurbitaceous crops
<b>VI. Floods preceded by failure of rains</b>		
	Very much damaging for early kharif crop at around maturity and repening.	
<b>VII. Floods and heavy rains combined</b>		
	Very wet, humid environment, heavy attack of pests and diseases, very much damaging if early floods combined with heavy rains.	
<b>VIII. Late floods and late heavy rains</b>		
	Late kharif crops fail, early as well as timely rabi crops sowing delayed, water table remains very near the surface.	Due to high water table during rabi season, rabi crops excellent heavy fertilizer response expected.

the *diara* tract on long term basis. Marketing and storage facilities for the surplus agricultural produce are very much lacking in the entire area and warehouses are practically absent

### MANAGEMENT OF DIARA FARMING AND SUGGESTIONS

The major limitations of the soils in diaraland are light texture, weak structure, inundation and occasional flooding. Therefore, it is desirable that sufficient organic matter is regularly applied to the soils for improving physical conditions and nutrient supply to the crop plants. Over and above, the provision of irrigation water through shallow tube-wells (Bamboo-borings) is also suggested. Since the area also lacks improved technology, use of improved seeds, timely sowing, compaction to conserve moisture and proper doses of

fertilizers depending upon soil test value are essential for sustainable agricultural production. Moreover, the problem of fast erosion and sometimes bank cutting becomes detrimental for the farmers. Therefore, a suitable planning must be made to ensure the stability of the land in the interest of the farmers.

### CONCLUSION

The twin problems of diara are natural hazards of recurrent floods and periodic droughts, and these could be controlled with planned farm management. The diaraland provides a challenging task before the Government and the farming community to tide over the crisis, both on the natural as well as socio-economic fronts to develop a promising and self-sustaining farming system.

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