Food and Agriculture Organization of the United Nations

International Network of Salt-Affected Soils

Case studies on crop nutrition management in salt-affected soils: with special reference to India

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OUTLINE

1. Background
2. Interventions for enhancing sustainable crop productivity in salt-affected soil
3. Conclusion
4. Way Ahead

Background

- During **Vedic period** cultivable lands were distinguished between **fertile (Urvara)** and **infertile (Anurvara)** on the basis of productivity. The **salt affected lands** were called **Usara**. Medieval scripts have used **Usar/Kallar/Reh** and other terms for salt-affected lands.

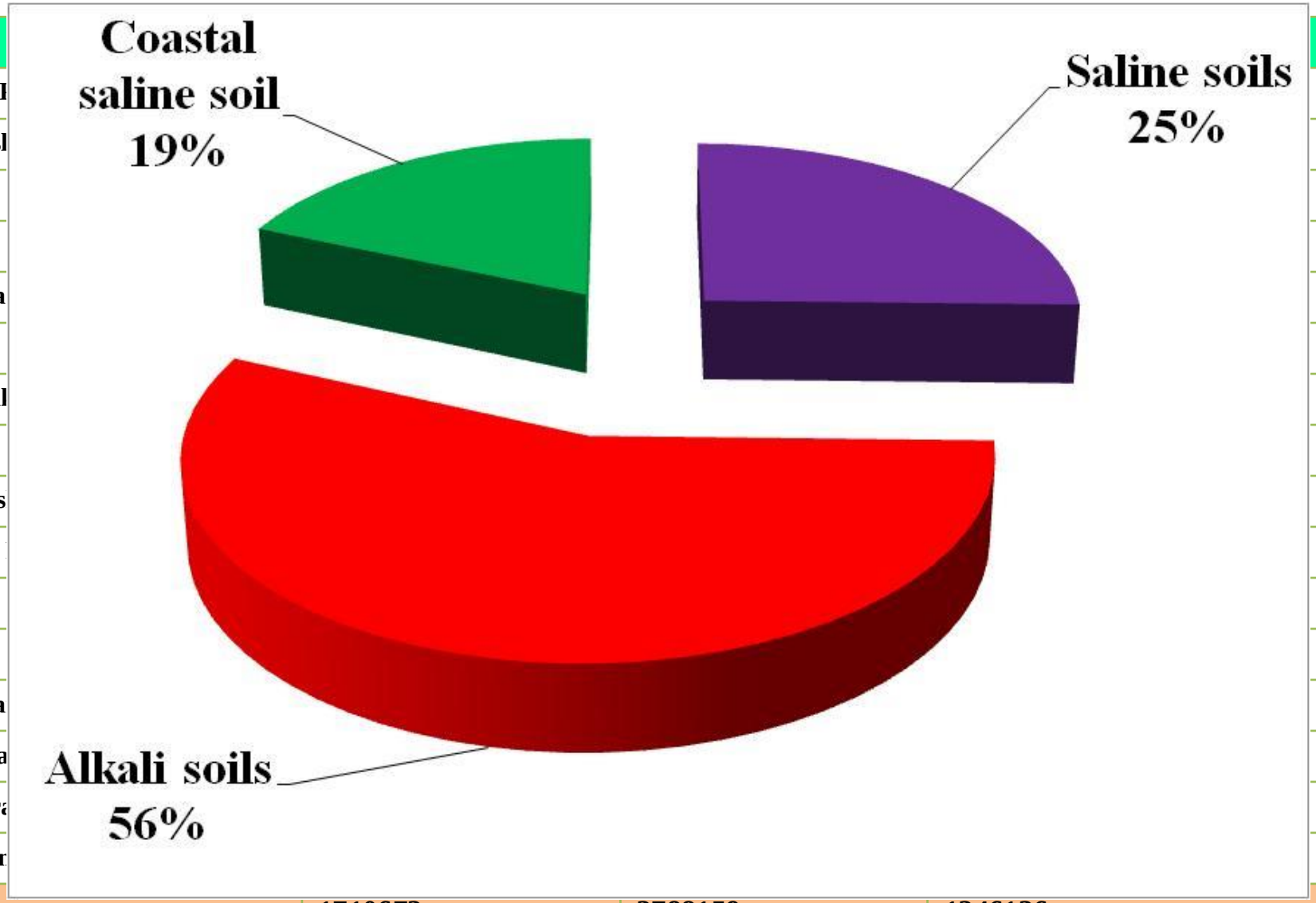
- The **first systematic attempt to study** the vagaries of the problems and the causes was initiated by an Imperial Chemist named **J.W. Leather**. **Leather (1906) recommended application of gypsum along with heavy manuring for reclamation of *Reh*.**

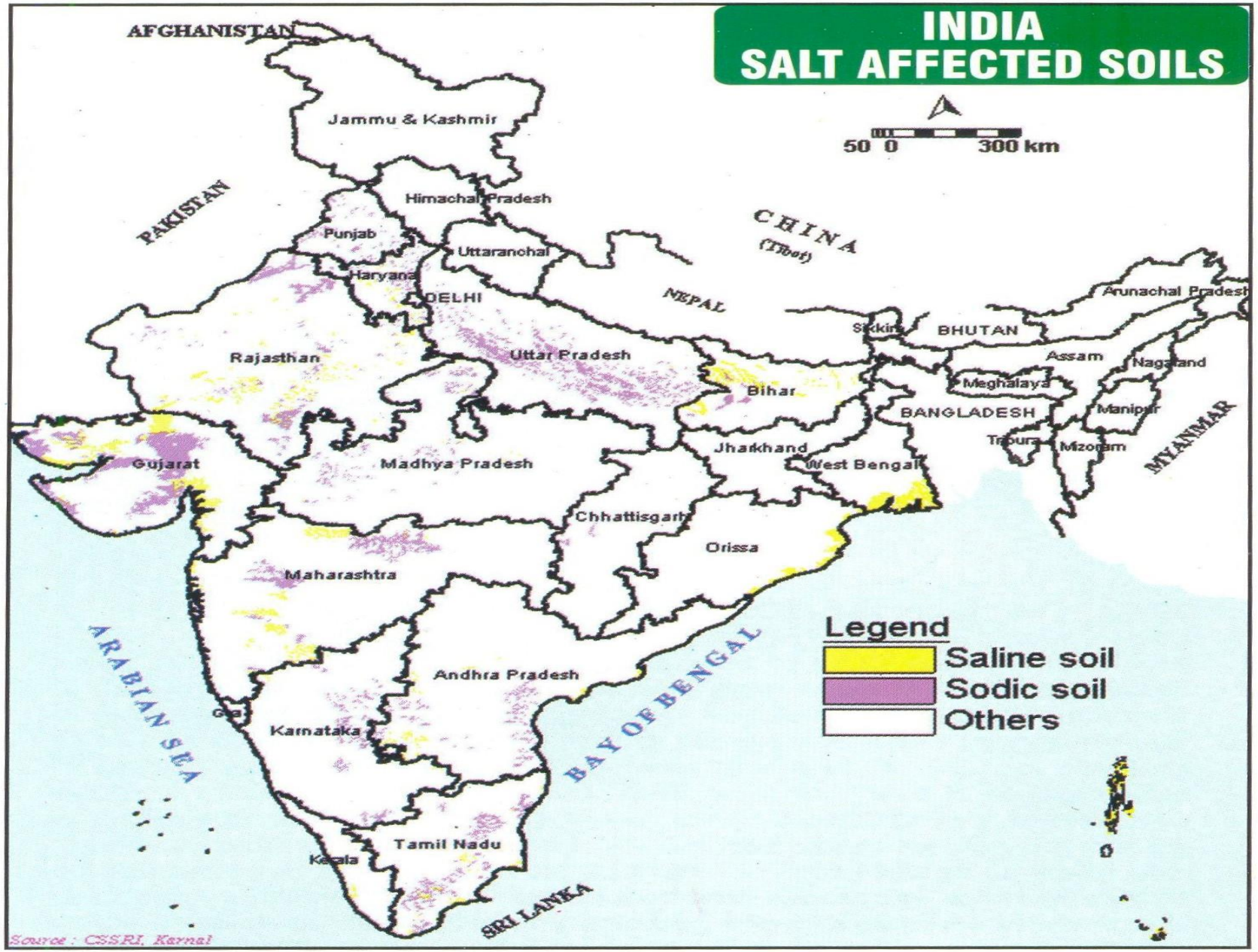
- **Soil that contains excess salts which impair crop productivity is called salt-affected.** The degree of adverse effects depends upon the type and quantity of salts, soil texture, type of crop, variety, stage of growth, cultural practices, and environmental factors (temperature, relative humidity, and rainfall).

- ICAR-Central Soil Salinity Research Institute, Karnal (1969).

Extent and distribution of salt-affected soils (ha) in India

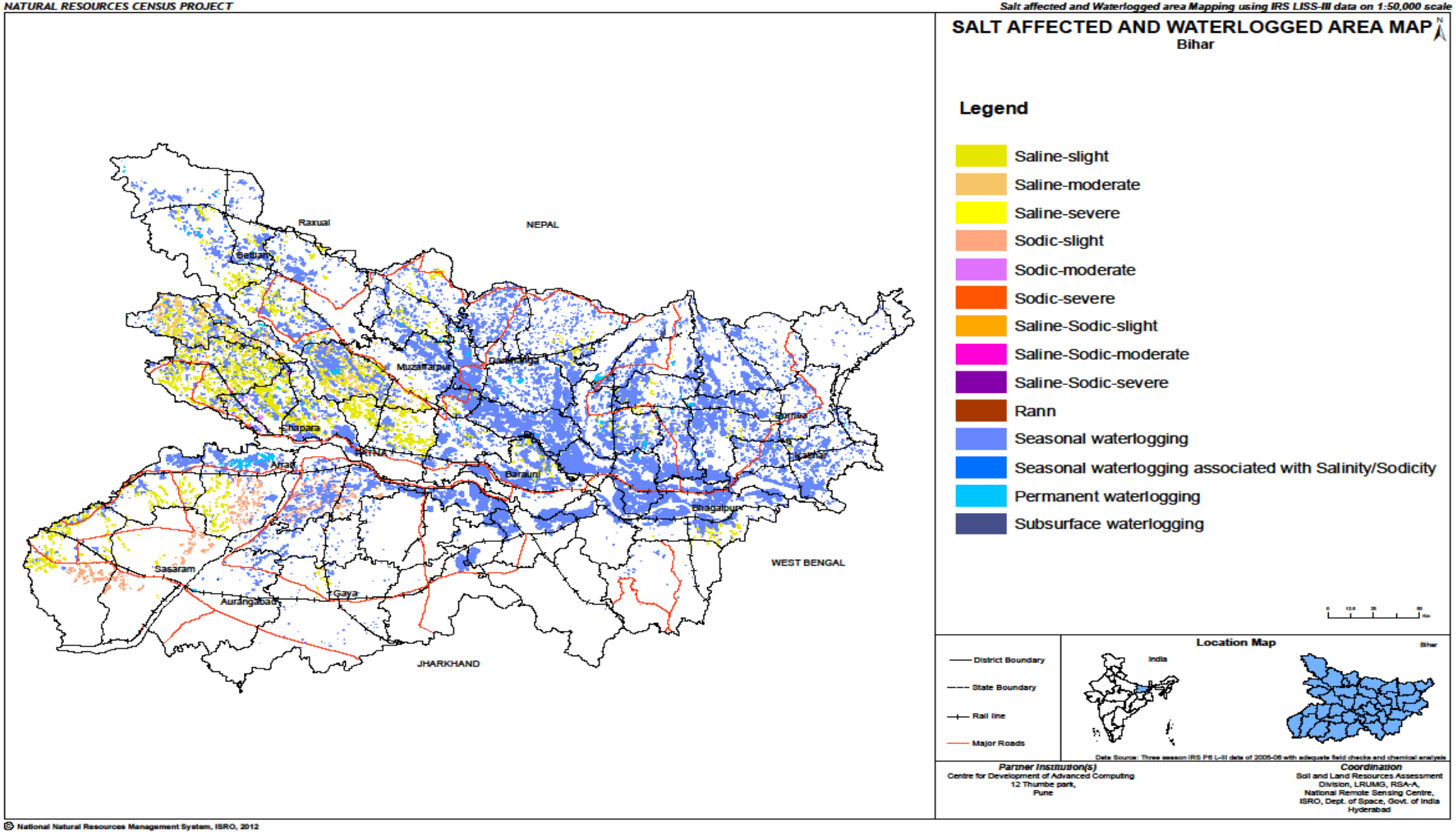
S. N.	State				Total
1	Andhra I				274207
2	A & N isl				77000
3	Bihar				153153
4	Gujarat				2222000
5	Haryana				232556
6	J & K				17500
7	Karnatal				150029
8	Kerala				20000
9	Maharas				606759
10	Madhya				139720
11	Orissa				147138
12	Punjab				151717
13	Rajastha				374942
14	Tamil Na				368015
15	Uttar Pra				1368960
16	West Ber				441272
	Total	1710673	3788159	1246136	6744968




INDIA
SALT AFFECTED SOILS
50 0 300 km
AFGHANISTAN
Jammu & Kashmir
PAKISTAN
Himachal Pradesh
Punjab
Uttaranchal
Haryana
DELHI
CHINA
(Tibet)
NEPAL
Arunachal Pradesh
Sikkim
BHUTAN
Assam
Nagaland
Meghalaya
Rajasthan
Uttar Pradesh
Bihar
BANGLADESH
Manipur
Tripura
Mizoram
MYANMAR
Jhakhand
West Bengal
Gujarat
Madhya Pradesh
Chhattisgarh
Orissa
Maharashtra
ARABIAN SEA
BAY OF BENGAL
Andhra Pradesh
Karnataka
Tamil Nadu
Kerala
SRI LANKA
Legend
Saline soil
Sodic soil
Others
Source : CSSRI, Karnal

NATURAL RESOURCES CENSUS PROJECT

Salt affected and Waterlogged area Mapping using IRS LISS-III data on 1:50,000 scale



- **In India, the area under salt-affected soils is about 6.73 million ha and accounting for almost 75% of saline and sodic soils in the country. In Bihar, a state of India, out of total 92.83 lakh hectares, about 4.0 lakh ha arable area falls under salt-affected soils.**
- **This case highlights the management of calcareous sodic soils for which pyrites are superior chemical amendment over gypsum both in respect of yield and improved soil properties.**
- **Owing to the less/non availability of pyrite in the state Bihar, gypsum can be used as a source of sulphur to reclaim the sodicity by the farmers.**
- **Application of gypsum provides soluble calcium and sulphur. Use of gypsum not only directly supplies soluble calcium but also results in greater solublization of calcium carbonate of soils. Also, the reclamation efficiency enhanced by application organic amendments.**

1. Gypsum

$CaSO_4 \longleftrightarrow Ca^{+2} + SO_4^{2-}$

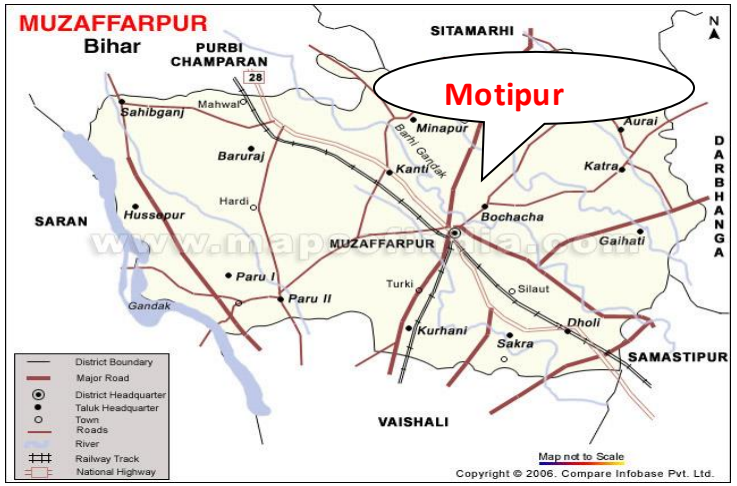
Soil Na^+ $Na^+ + CaSO_4$ $\longrightarrow$ Soil Ca^{++} $+ Na_2SO_4$

2. Pyrites

$2FeS_2 + 7O_2 + 2H_2O \longrightarrow 2FeSO_4 + 2H_2SO_4$

$H_2SO_4 + CaCO_3 \longrightarrow CaSO_4 + H_2O + CO_2$

Location and beneficiary farmers



S.No	Village	Area (ha)	No. of farmers
1.	Birahima	2	22
2.	Babutola	2	11
3.	Tajpur	2	09
4.	Mathaiya	2	06
5.	Sirsia	2	01
Total	**Five**	**10**	**49**

Field view

Collection of soil samples

Treatments and Methodology

T_1 = Control (RDF)

T_2 = 50% of GR + RDF

T_3 = SPM @10t/ha + RDF

T_4 = 50% of GR + SPM @10t/ha + RDF

T_5 = 50% of GR + *Dhaincha* + RDF

T_6 = 50% of GR + SPM @10t/ha + *Dhaincha* + RDF

Cropping sequence:

Rice – wheat – moong

Replications: Five (No. of villages)

RDF (Recommended dose of fertilizer)-120:60:40, N:P_2O_5:K_2O
25 kg Zinc sulphate was applied in the treatment T_2 to T_6.
SPM: Sulphitation Pres Mud

Operation	Month
Apply amendment & start leaching	Mid April to Mid June
Sowing of *Dhaincha*	End of April
Incorporation of green manure	Mid June
Rice transplanting	Mid June to Mid July
Harvesting of Rice	Last weeks of October
Sowing of Wheat	Mid Nov.
Harvesting of Wheat	Mid April

Application of gypsum and pressmud

Incorporation of *dhaincha* in the field

Rice transplanting

Status of Rice

Status of wheat

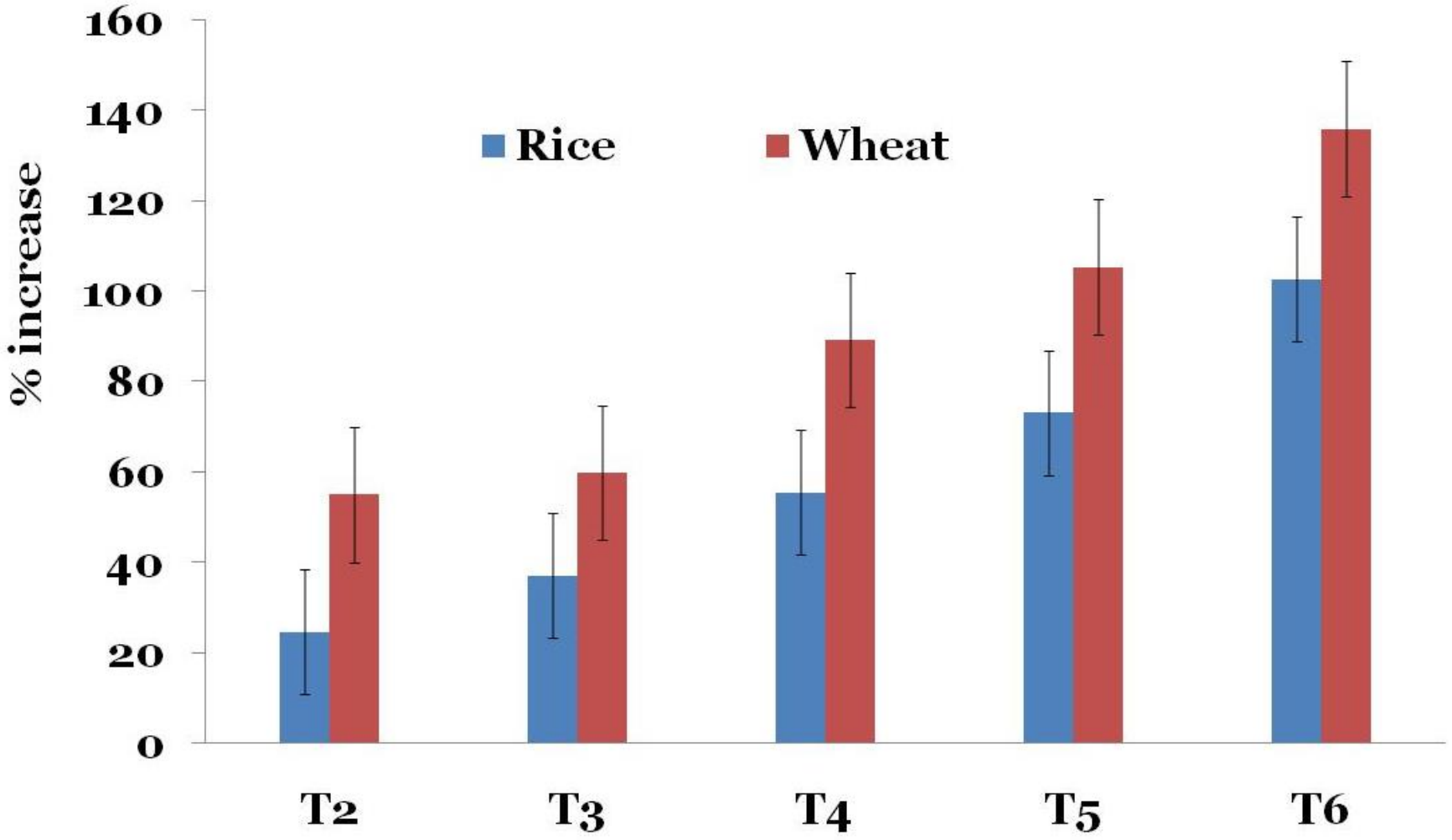
Yield (q/ha) of rice crop

Treatments	Grain yield				Straw yield			
	I year	II year	III year	Mean	I year	II year	III year	Mean
Control (Only NPK)	19.8	18.8	17.5	**18.7**	37.4	33.39	32.06	**34.3**
50% of GR	23.4	24.7	21.8	**23.3**	43.8	42.01	39.87	**41.9**
SPM @10t/ha	25.7	27.0	24.0	**25.6**	48.0	45.67	43.75	**45.8**
50% of GR + SPM @10t/ha	28.1	31.6	27.4	**29.0**	51.7	47.78	45.27	**48.3**
50% of GR + Dhaincha	31.3	33.9	31.8	**32.3**	56.6	50.23	47.77	**51.5**
50% of GR + SPM @10t/ha + Dhaincha	36.3	40.5	36.8	**37.9**	63.5	56.38	53.37	**57.7**
S.Em±	**0.8**	**0.9**	**1.0**	**0.7**	**1.1**	**0.9**	**1.3**	**0.86**
CD (P =0.05)	**2.2**	**2.8**	**2.8**	**2.1**	**3.1**	**2.7**	**4.0**	**2.5**

Yield (q/ha) of rice crop

Treatment	Grain				Straw			
	I year	II year	III year	Mean	I year	II year	III year	Mean
Control (Only NPK)	19.5	18.8	18.3	18.9	32.2	31.0	30.1	31.1
50% of GR	30.3	29.1	29.0	29.5	49.3	47.3	45.5	47.4
SPM @10t/ha	31.0	30.2	30.4	30.5	50.1	48.7	46.8	48.5
50% of GR + PM @10t/ha	36.9	35.6	35.4	36.0	58.5	56.5	57.0	57.3
50% of GR + *Dhaincha*	39.6	39.1	39.7	39.5	61.4	60.6	58.2	60.1
50% of GR + PM @10t/ha + *Dhaincha*	45.4	45.0	45.9	45.4	67.0	66.3	68.8	67.3
S.Em±	1.5	1.3	1.3	0.9	2.3	2.2	1.7	1.7
CD (5%)	4.3	3.9	4.0	2.7	6.7	6.5	5.0	5.0

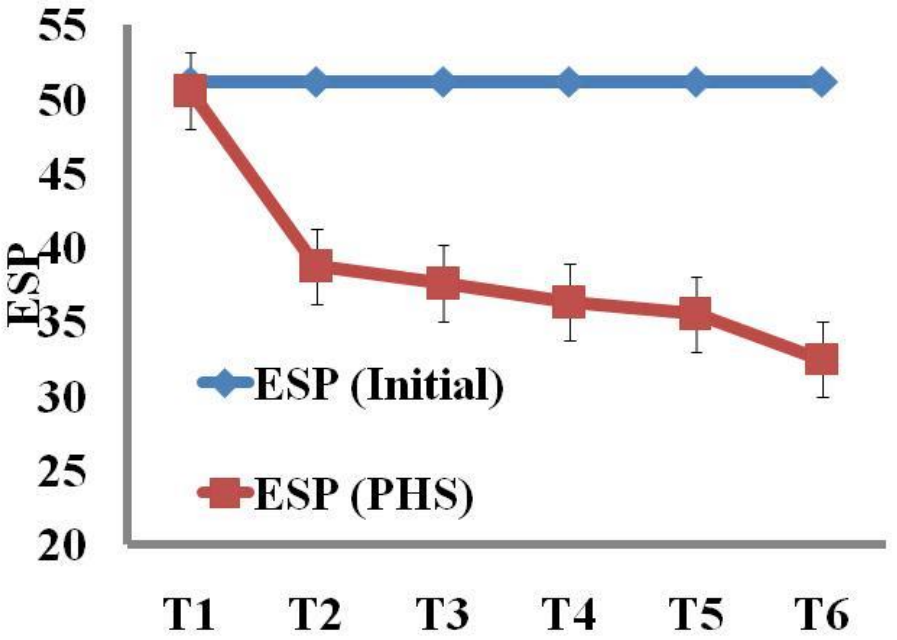
Percent increase in grain yield of rice and wheat



T_1 = RDF
T_2 = 50% of GR + RDF
T_3 = PM @10t/ha + RDF
T_4 = 50% of GR + PM @10t/ha + RDF
T_5 = 50% of GR + *Dhaincha* + RDF
T_6 = 50% of GR + PM @10t/ha + *Dhaincha* + RDF

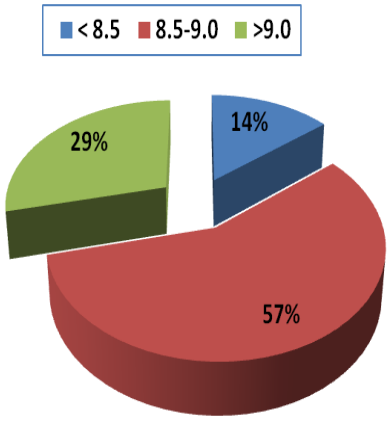
Status of soil properties in initial and post harvest soil (PHS)

Treatment	pH	EC (dS/m)	OC (%)	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
T_1 = RDF	8.93	1.96	0.41	115.0	20.9	184.7
T_2 = 50% of GR + RDF	8.60	0.97	0.48	121.8	27.4	193.9
T_3 = PM @10t/ha + RDF	8.62	0.96	0.51	126.4	28.9	199.3
T_4 = 50% of GR + PM @10t/ha + RDF	8.54	0.93	0.51	130.3	31.9	202.5
T_5 = 50% of GR + Dhaincha + RDF	8.55	0.91	0.51	140.0	34.0	205.0
T_6 = 50% of GR + PM @10t/ha + Dhaincha + RDF	8.48	0.88	0.53	144.9	41.0	209.3
S.Em±	**0.02**	**0.05**	**0.01**	**4.9**	**2.1**	**6.1**
CD (P =0.05)	**0.07**	**0.13**	**0.02**	**14.4**	**6.1**	**17.9**
Initial values	9.02	2.14	0.46	116.6	22.15	189.0

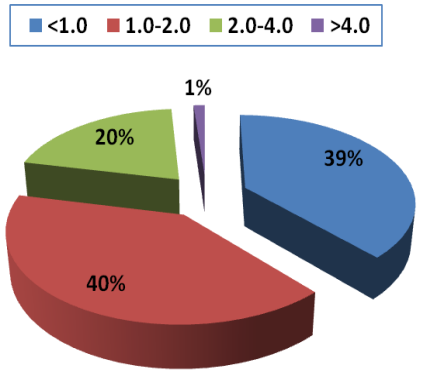


Changes in ESP in post harvest soil (PHS)

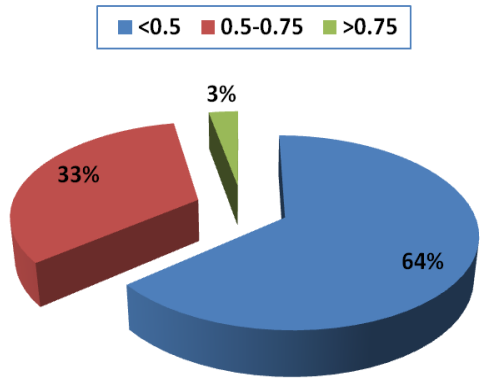
Soil properties surrounding areas of the experimental locations (500 surface soil samples)



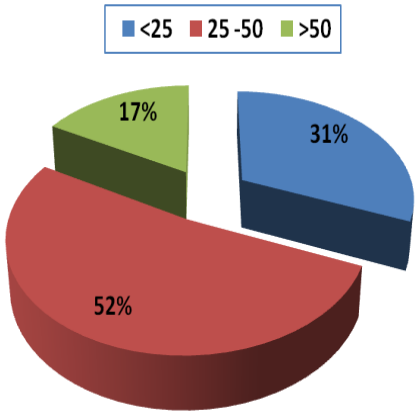
pH



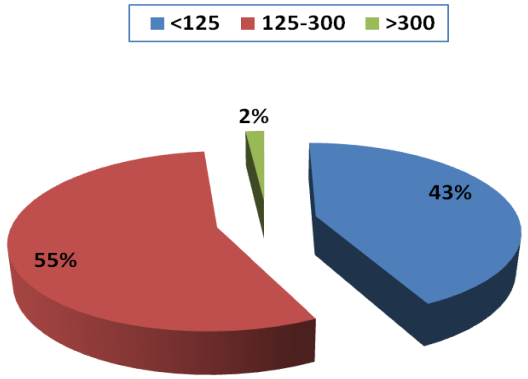
Electrical Conductivity



Organic carbon



Phosphate



Potash

Farmers awareness programme

मुजफ्फरपुर जागरण | दैनिक जागरण मुजफ्फरपुर, 15 अप्रैल 2011

ऊसर भूमि में फसलें देख खिल उठे चेहरे

मुजफ्फरपुर/ मोतीपुर, जाटी : जिले के मोतीपुर प्रखंड की पांच गांवों की ऊसर भूमि में कृषि वैज्ञानिकों की मेहनत से गेहूं की फसल लहलहा रही है। गुरुवार को राजेन्द्र कृषि विश्वविद्यालय पूसा के कृषि वैज्ञानिकों का दल मथिना चबूरबन, एवं बाबू टोला पहुंचा। इस दौरान उपचारित और गैर उपचारित भूमि में लगी गेहूं की फसलों का अवलोकन किया गया। इस दौरान महसूस किया गया कि उपचारित तरीके से लगी गेहूं में ज्यादा बाली आयी है। किसानों ने उसी पद्धति से धान की खेती करने का संकल्प लिया।

कृषि वैज्ञानिक एसपी सिंह ने बताया कि राजेन्द्र कृषि विश्वविद्यालय के कुलपति डा.मेवालाल चौधरी के नेतृत्व में राष्ट्रीय कृषि नवअनुवेशी परियोजना तथा एफसीआई और अरावली जिप्सम के ऊसर भूमि सुधार पर प्रभाव स्कीम के तहत मोतीपुर के बरहिमा, मथिना, ताजपुर, बाबू टोला, श्रीसिया का चयन किया गया है। इन गांवों में दो-दो हेक्टेयर भूमि यानी कुल 10 हेक्टेयर भूमि का चयन किया गया है। चयनित गांवों में ऊसर भूमि सुधार परियोजना के तहत जिप्सम तथा हरी व कार्बनिक खाद डालकर उर्वर बनाया जा रहा है। इसके साथ ही उन गांवों में अच्छे प्रभेद का प्रत्यक्षण, गन्ना आधारित फसल प्रणाली, बकरी पालन, मूंग बीज उत्पादन, बीज ग्राम परिकल्पना, हरी खाद एवं जिप्सम प्रयोग के उपरांत मक्का फसल प्रणाली, केंचुआ खाद उत्पादन, मत्स्य उत्पादन शुरू किया गया है। टीम में मृदा विभाग के डा.एसपी सिंह,

खुशी की लहर

- सबने देखा उपचारित और गैर उपचारित भूमि में खेती का नजारा
- राजेन्द्र कृषि विवि के वैज्ञानिकों की मेहनत लाई रंग
- मॉडल के रूप में इलाके के पांच गांवों का हुआ चयन

गोष्ठी में उपस्थित कृषि वैज्ञानिक

मुख्य अन्वेषक डा.एसएस प्रसाद एवं डा.वाई सिंह शामिल थे। गोष्ठी में वरीय कृषि वैज्ञानिक डा.जेपी सिंह, डा. दयाराम, डा.एके सिंह, डा.एलएन यादव, डा. सुमन, डा.एसके सिंह, डा. पंकज सिंह, डा. संजय तिवारी, डा.एसपी सिंह, डा. के यादव, डा.एलएन सिंह, डा.गौड़, डा.शंकर झा, डा.सीके झा आदि प्रमुख रूप से उपस्थित थे।

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Conclusion

- The reclamation efficiency of gypsum was more when applied with *dhaincha* as green manure in comparison to *sulphitation press mud*.
- The reclamation efficiency of organic amendments (*dhaincha*/*sulphitation pressmud*) was more than the chemical amendment (gypsum).
- Integration of gypsum along with *sulphitation press mud* and/or *dhaincha* showed best result with respect to improvement in nutrient availability, physico-chemical properties of calcareous sodic soil and crop yield.
- Thus, the farmers could opt for integrated application of gypsum as an alternate to pyrite along with *dhaincha* and/or *sulphitation pressmud*.

Way ahead

1. Awareness among beneficiaries/farmers
2. Availability of inputs in time
3. Site specific nutrient management
4. Development of nutrient decision tools

Food and Agriculture Organization of the United Nations

Thank you all….

International Network of Salt-Affected Soils

Crop nutrition in salt-affected soils

24 April, 2024

GLOBAL SOIL PARTNERSHIP

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