HISTORY OF GYPSUM RESEARCH AND CURRENT USE IN SUGARCANE PRODUCTION

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Early Work

- 1946 – 1966: Application of normal super phosphate typically showed sugarcane yield increases in Louisiana.
- 25 – 40 lbs of P_2O_5 and 15 – 24 lbs of S
- Stubble cane responded better than plantcane and the response was better on heavy (clay) soils than on lighter soils. Better response was observed in those soils because of poor root penetration into the subsoil due to low oxygen content and poor root development.
- Little thought given to the effect of S

Sulfur Alone

- 38 field trials conducted separating the effects of phosphorous and sulfur as by-product gypsum
- Average annual increase was 1.71 tons/acre; the average annual increase from the heavy soil sites was 2.20 tons/acre
- Case made for both soil test and leaf tissue testing because of the mobility of S in the soil.

Status of soil/sugarcane	Extractable S[1]	Leaf-blade S[2]	
		Plant cane	Stubble cane
	ppm	%	%
Very low	<3	<.13	<.10
Low	3 - 6	.13 - .16	.10 - .13
Medium	6 - 10	.16 - .20	.13 - .17
High	10 - 15	.20 - .25	.17 - .22
Very high	>15	>.25	>.22

By-Product Gypsum

- By-product of fertilizer production by plants along the Mississippi
  - DAP and MAP
- Abundant
- Slightly radioactive
- Excellent source of sulfur
- Excellent source of calcium, especially for the peanut industry

By-Product Gypsum

- Applied to rice fields in southwest Louisiana where increase sodium content in soils had become a detriment to rice production
- Sulfur deficiency in sugarcane has been found in Louisiana and in other countries – not a new phenomena
- For sugarcane, applied once in the fallow period of the crop cycle (0.5 to 1 ton per acre)

By-Product Gypsum

– Sulfur is mobile in the soil: good and bad

Table 7.—Movement of ^{35}S from fertilizer applied to Loring-Olivier silt loam

Treatment	Radioactivity		
	First leaching	Second leaching	Total
	dpm		
Standard	6,785	45	6,830
Banded	672	1,775	2,447
Mixed	1,345	1,343	2,688

Table 8.—Movement of ^{32}P from fertilizer applied to Loring-Olivier silt loam

Treatment	Radioactivity		
	First leaching	Second leaching	Total
	cpm		
Standard	2,949	4	2,953
Banded	6	9	15
Mixed	5	10	15

By-Product Gypsum

- Trace amounts of radioactivity
- U-238 and Ra-226 are components of mined rock phosphate
- During fertilizer production, the U-238 follows the phosphoric acid and the Ra-226 follows the by-product gypsum (14-26 picocuries/gram).
- EPA has set a limit at 5 pCi/g

By-Product Gypsum

Ra-226 in the By-Product Gypsum

Gypsum Source	Background	Sample + background	Net
1	241	272	31
2	242	266	24
3	238	267	29

By-Product Gypsum

Ra-226 in the Topsoil – 1 ton gypsum/acre

Gypsum Source	Soil Type	Check	Treated
1	Baldwin sicl	6.1	5.1
2	Mhoon sicl	6.4	5.0
3	Sharkey c	4.8	5.7

Radioactivity differences between check and treated areas were not significant. There is a one thousand fold dilution effect when adding one ton of gypsum to one acre (2,000,000 lbs topsoil). The positive but very small amount of radioactivity in the soil was due to natural radioactivity existing in the soil.

By-Product Gypsum

Ra-226 in the Juice – 1 ton gypsum/acre

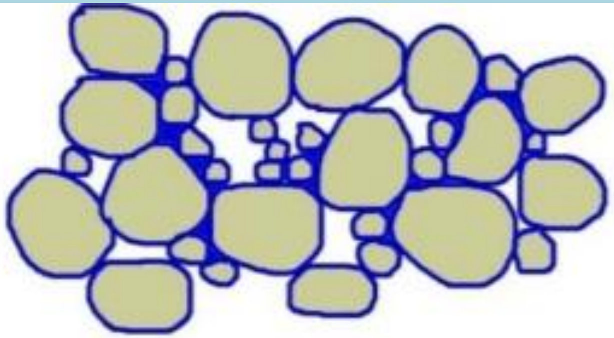
Gypsum Source	Soil Type	Check	Treated
1	Baldwin sicl	0.1	0.1
2	Mhoon sicl	-0.7	-0.5
3	Sharkey c	0.0	0.3

Radioactivity determinations in juice resulted in no counts that differed significantly from background nor that differed significantly when comparing samples from check and treated areas.

Gypsum

- There are many benefits to adding gypsum to the soil
  - Sulfur
  - Improving soil tilth – the soil’s general overall suitability to support plant growth, more specifically to support root growth. Ease of tillage/cultivation, germination of seed (buds in our case), and root penetration.
  - A soil with good tilth has large pore spaces for adequate air movement and water movement
  - Sodium tends to disperse soil particles; calcium promotes flocculation and structure development
  - Good soil tilth (health) is in balance with a healthy population of living soil organisms

Figure 3. The size of pore spaces between soil particles plays a key role in plant growth. Pore spaces are a function of soil texture and structure.

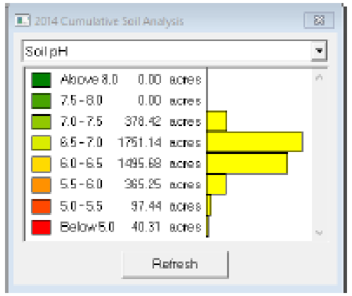


Gypsum

- There are many benefits to adding gypsum to the soil
  - Calcium is useful for displacing sodium in situations such as storm surge events.
  - In 29-B situations, displaced sodium must have a means of exit such as tile drainage or physical removal by the plant.
  - Reducing Sodium Adsorption Ratio

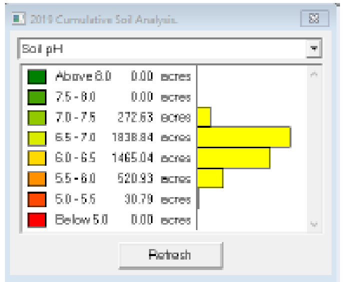
$$\mathrm{SAR} = \frac{Na^+}{\sqrt{\frac{1}{2}(Ca^{2+} + Mg^{2+})}}$$

Benefits of Gypsum

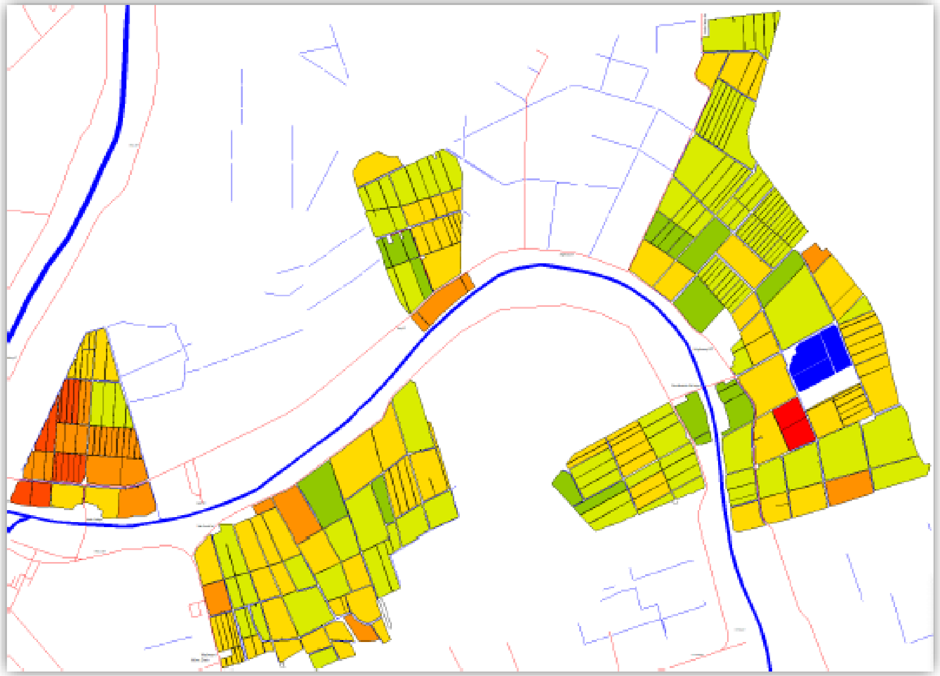


Effects of Gypsum on Soil pH

Change: + 0.11

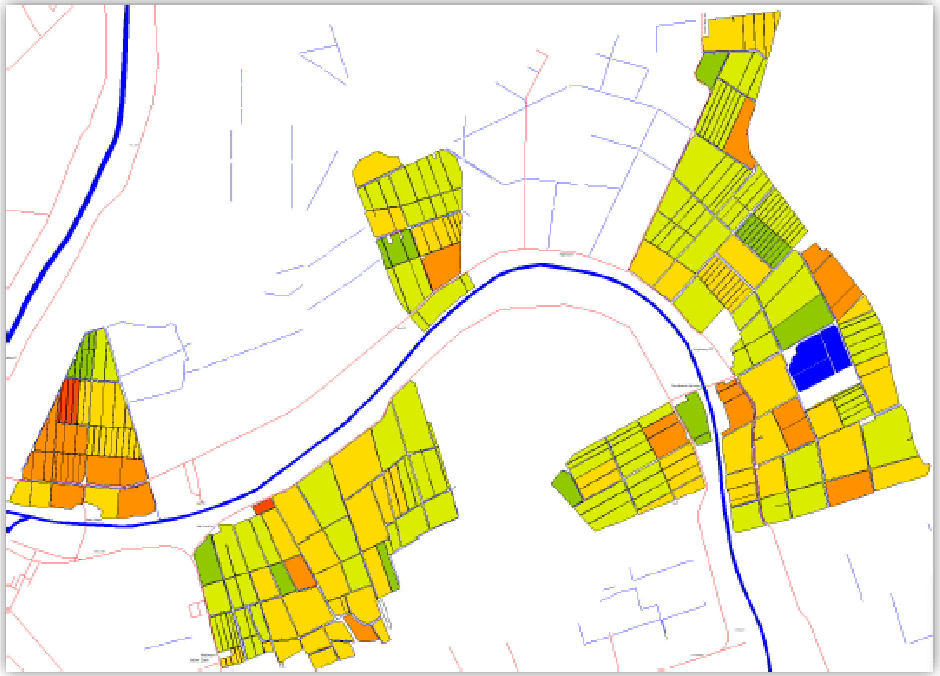


2014



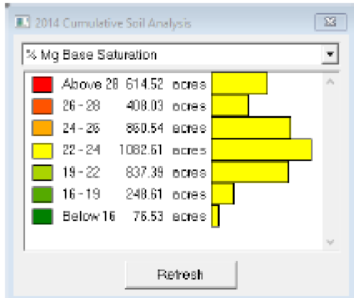
Average: 6.33

2019



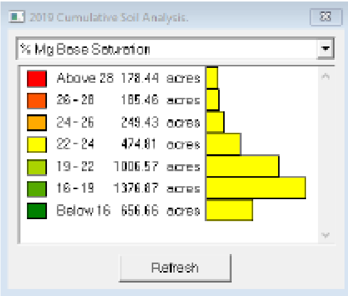
Average: 6.44

Benefits of Gypsum

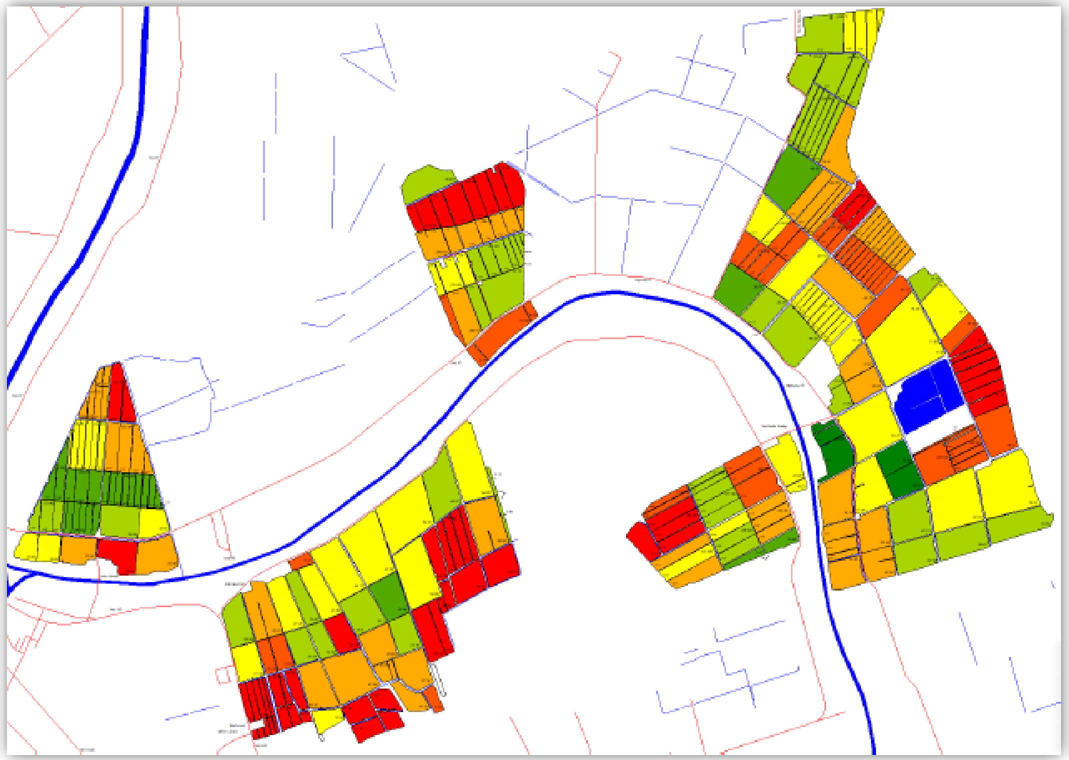


Effects of Gypsum on Mg % Base Saturation

Change: - 3.84%



2014



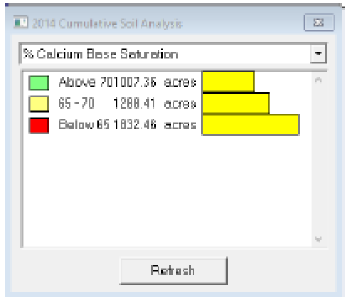
Average: 24.45%

2019

Average: 20.61%

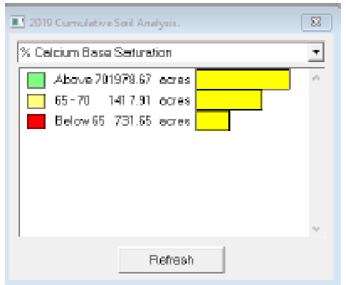
Magnesium tends to disperse soil particles; calcium promotes flocculation and structure development

Benefits of Gypsum

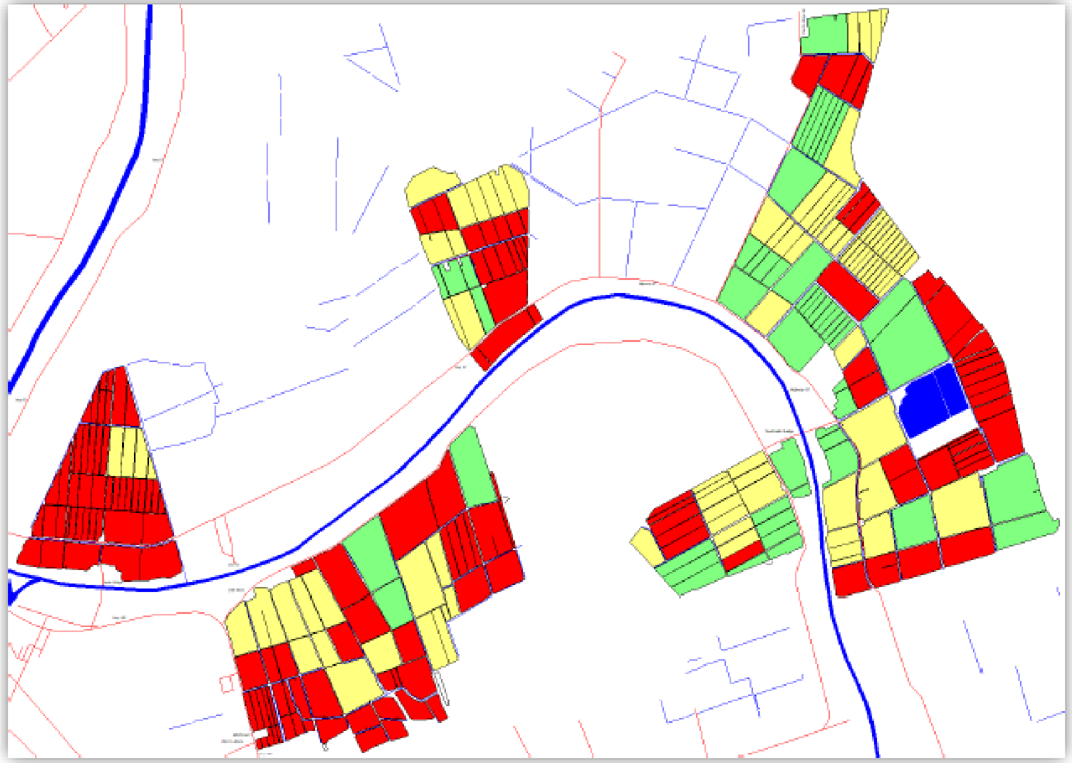


Effects of Gypsum on Ca % Base Saturation

Change: + 5.98%

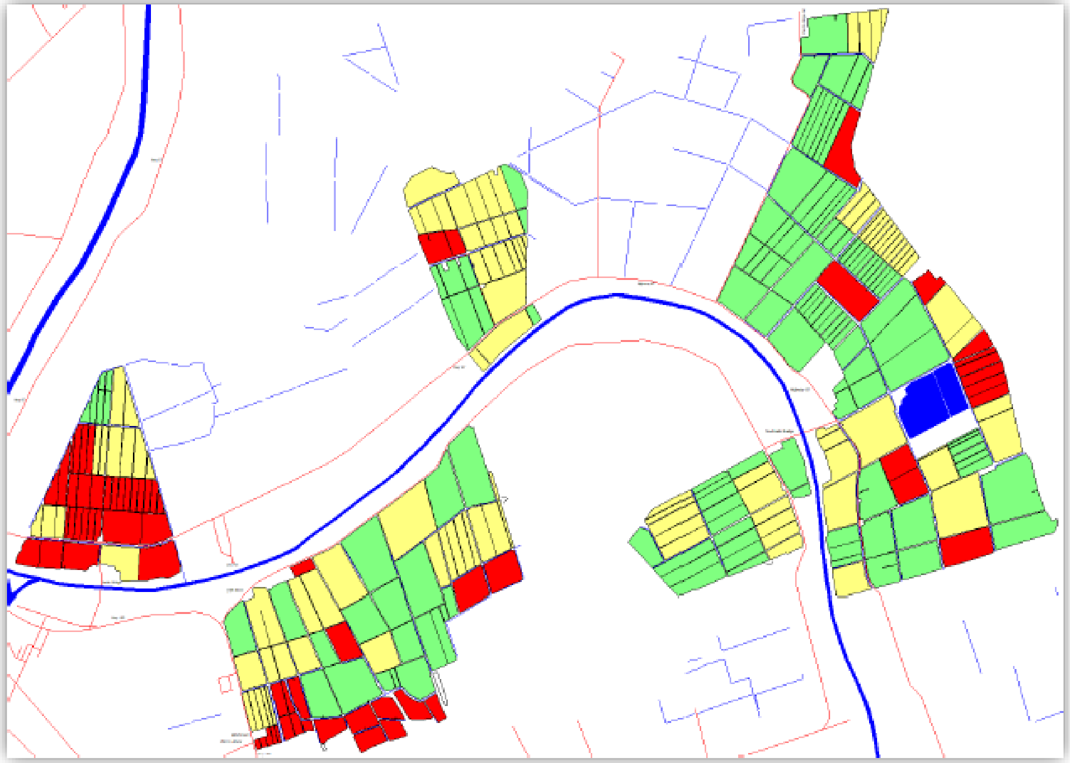


2014



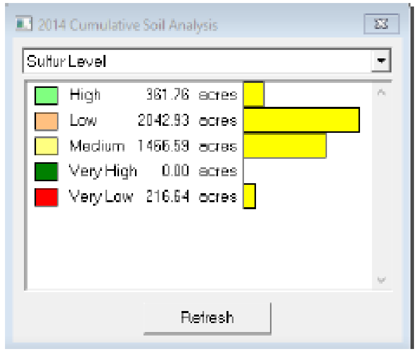
Average: 63.26%

2019

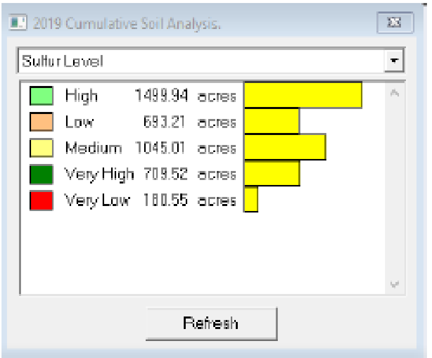


Average: 69.24%

Benefits of Gypsum

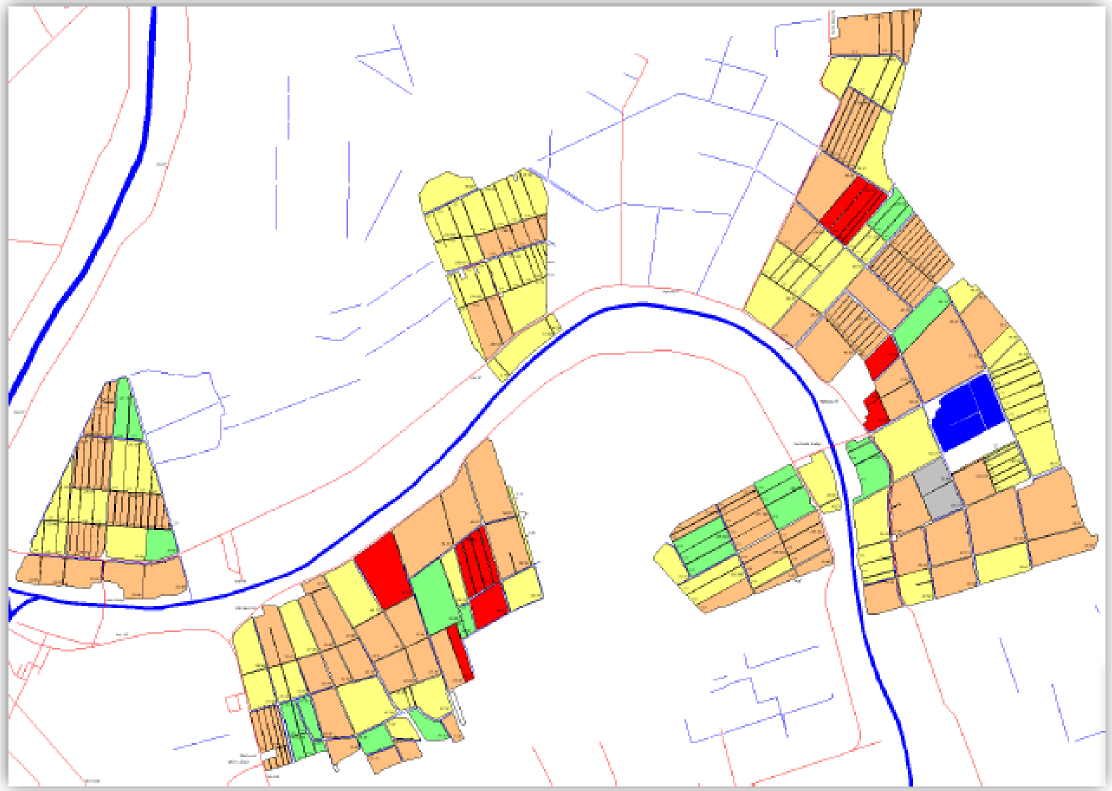


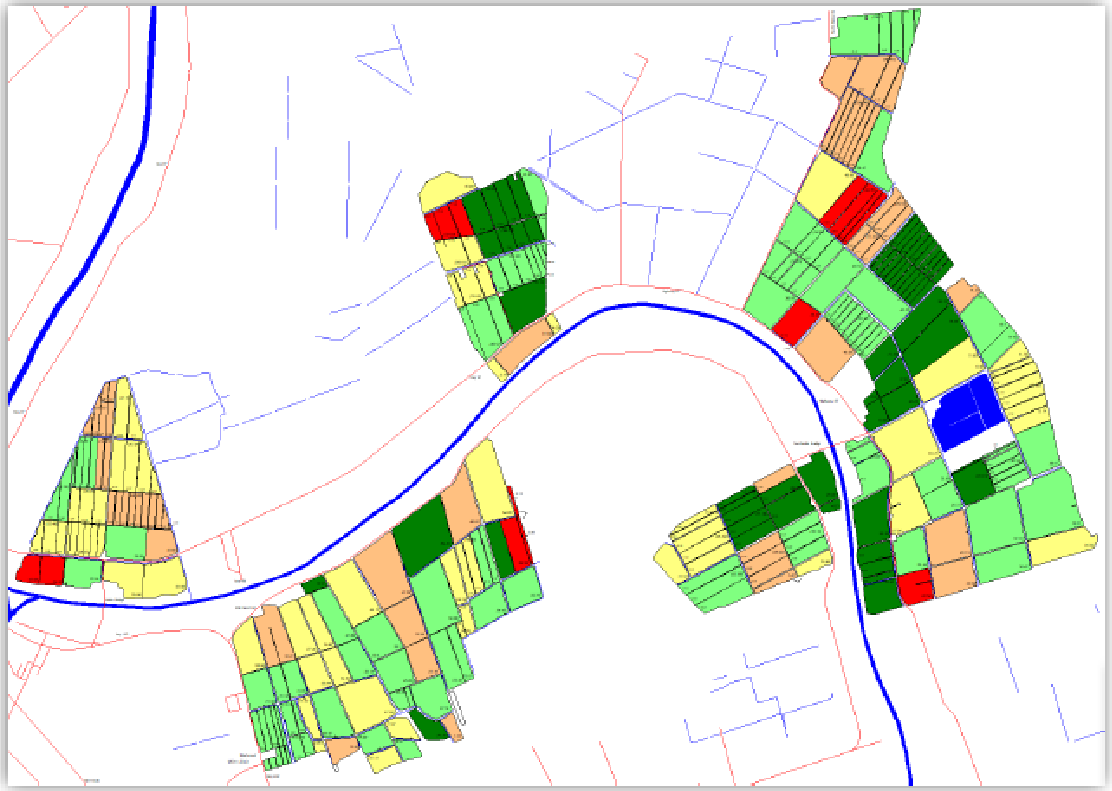
Effects of Gypsum on Sulfur Level



2014

2019





Sources of Gypsum