Field scale manure born animal waste management in small beef cattle backgrounding site - GIS application

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Beef Industry in United States

- Cow-calf production

- Backgrounding/stockering

- Feedlot finishing

SLAUGHTER

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Beef Cattle Backgrounding

KEY FEATURES

- Receive weaned calves from cow-calf operations
- Raise them for conditions ready for feedlot finishing

MANAGEMENT

- Feed: grazing and compound feed supplements
- Provide intensive health care management
- Use of growth promoter feed additives(antibiotics)

Beef Cattle Backgrounding site (2 ha.)

120 steers

Feeder Area : Intense manure deposition

Grazing Area

Environmental Risks Associated with beef cattle backgrounding

- **Excessive soil nutrients**
  - Soil quality degradation
  - Surface and ground water quality deterioration

- **Veterinary pharmaceuticals in soil**
  - Antibiotic resistant bacteria
  - Human and animal health concerns

- **Pathogenic bacteria populations**
  - Water and food contamination
  - Public heath concerns

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Experiment Phase 1: Assessment of contaminant concentrations & distribution across the site

Netthisinghe, A.M.P., K.L. Cook, C. Rice, R.A.Gilfillen, and K.R.Sistani. Soil nutrients, bacteria populations, and veterinary pharmaceuticals across a backgrounding beef feedlot. J. Environ. Qual. 42:532-544 (2013)

- Soil nutrients

  Soil organic matter / NH_4^+-N /NO_3^- -N / Soil P

- Veterinary pharmaceuticals

  Doramectin / Monensin / Lasalocid

- Pathogenic bacteria populations

  Total bacteria / E. coli / Enterococcus

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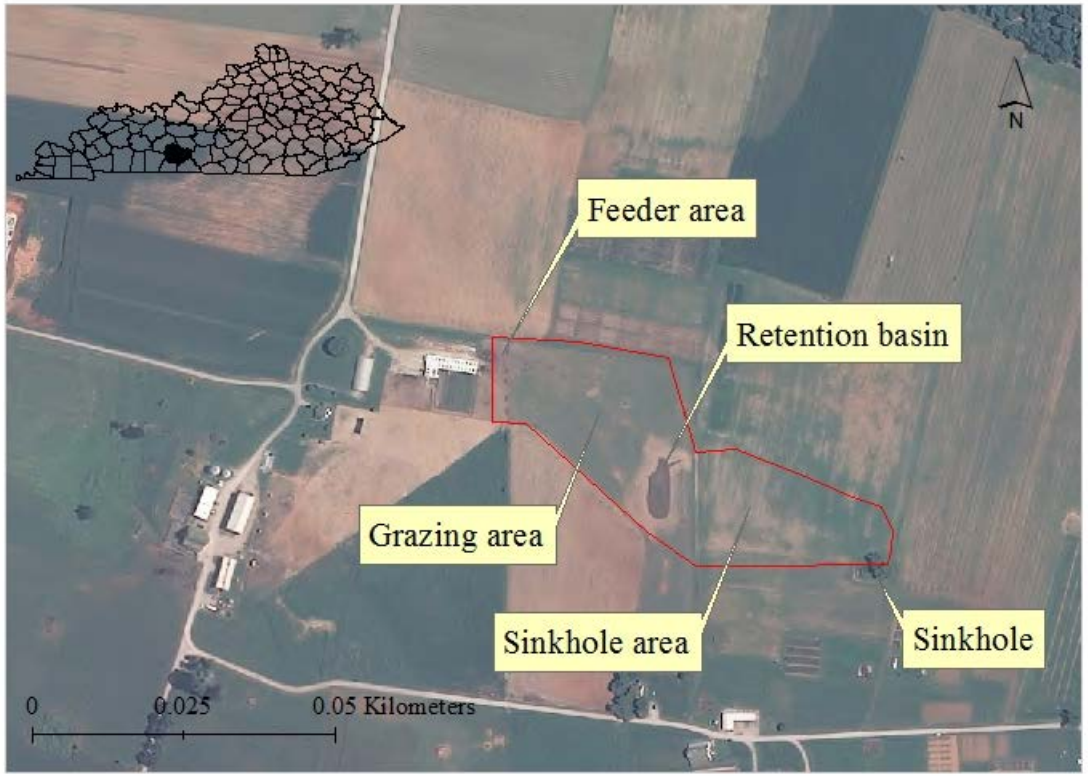
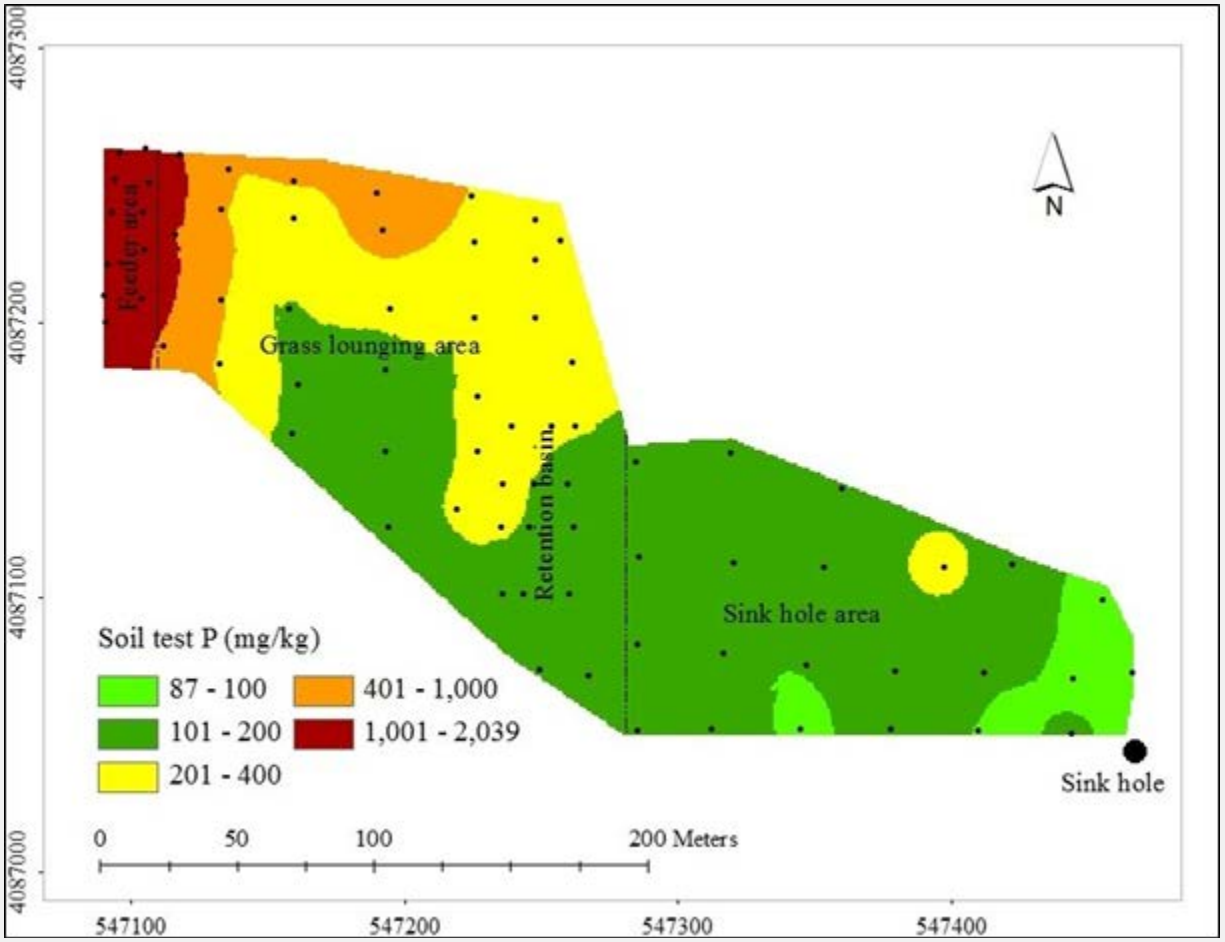
Study Location



Soil nutrients: phosphorus (P) mg/kg soil



Feeder (12)	Grazing (30)	Retn. Basin (12)	Sinkhole (22)
2002 ±136.7	272.9±30.9	196.7±6.4	120.7±13.5

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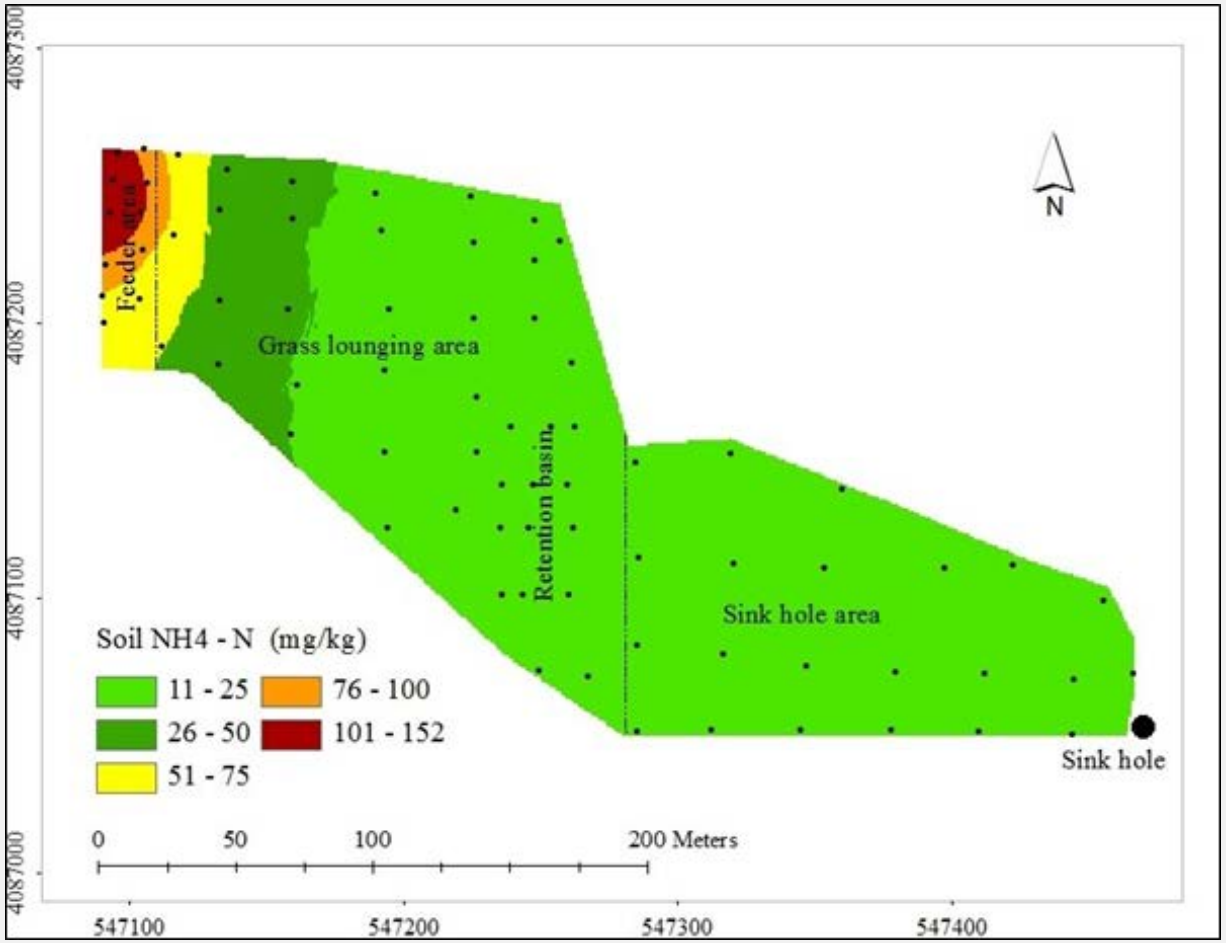
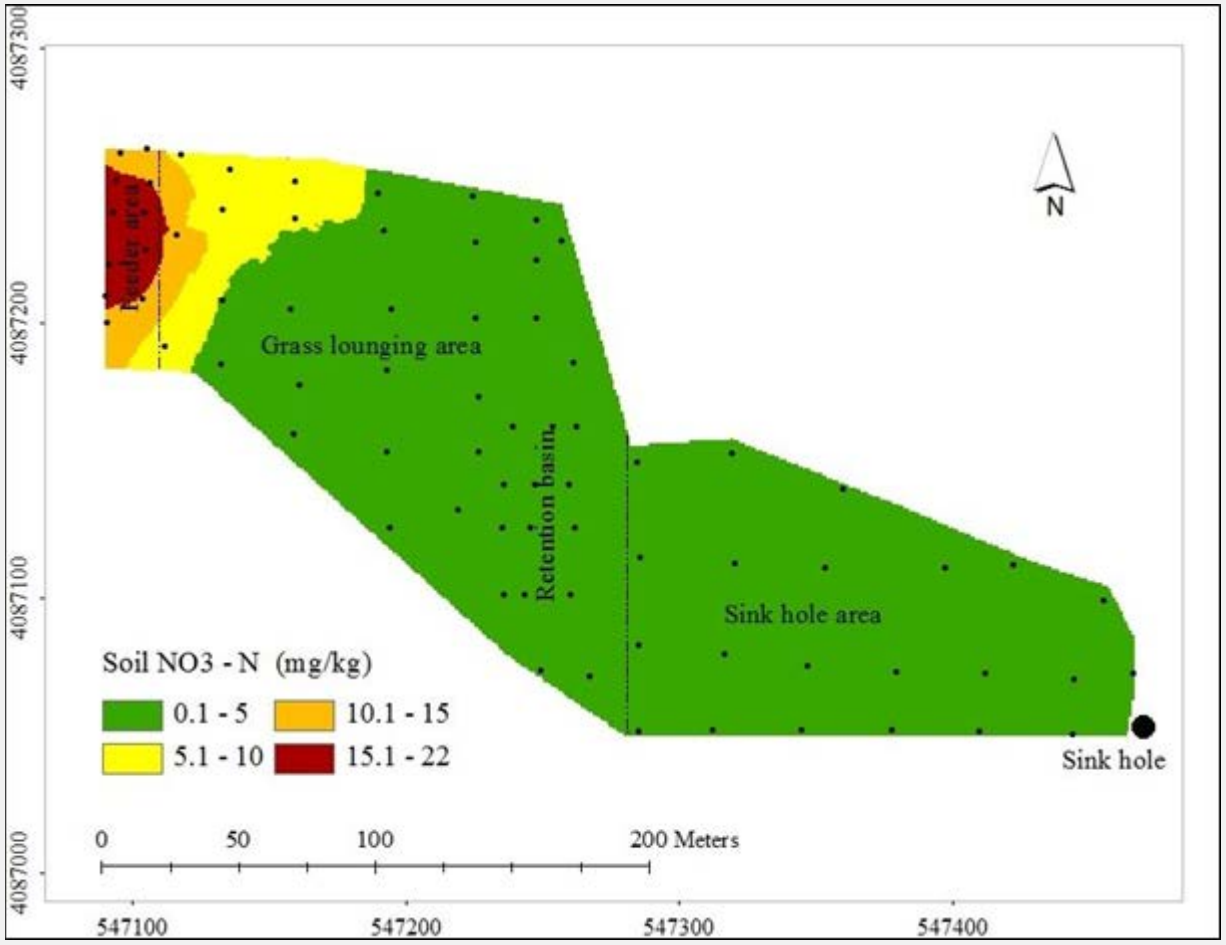
Soil nutrients: NH_4 -N mg/kg soil



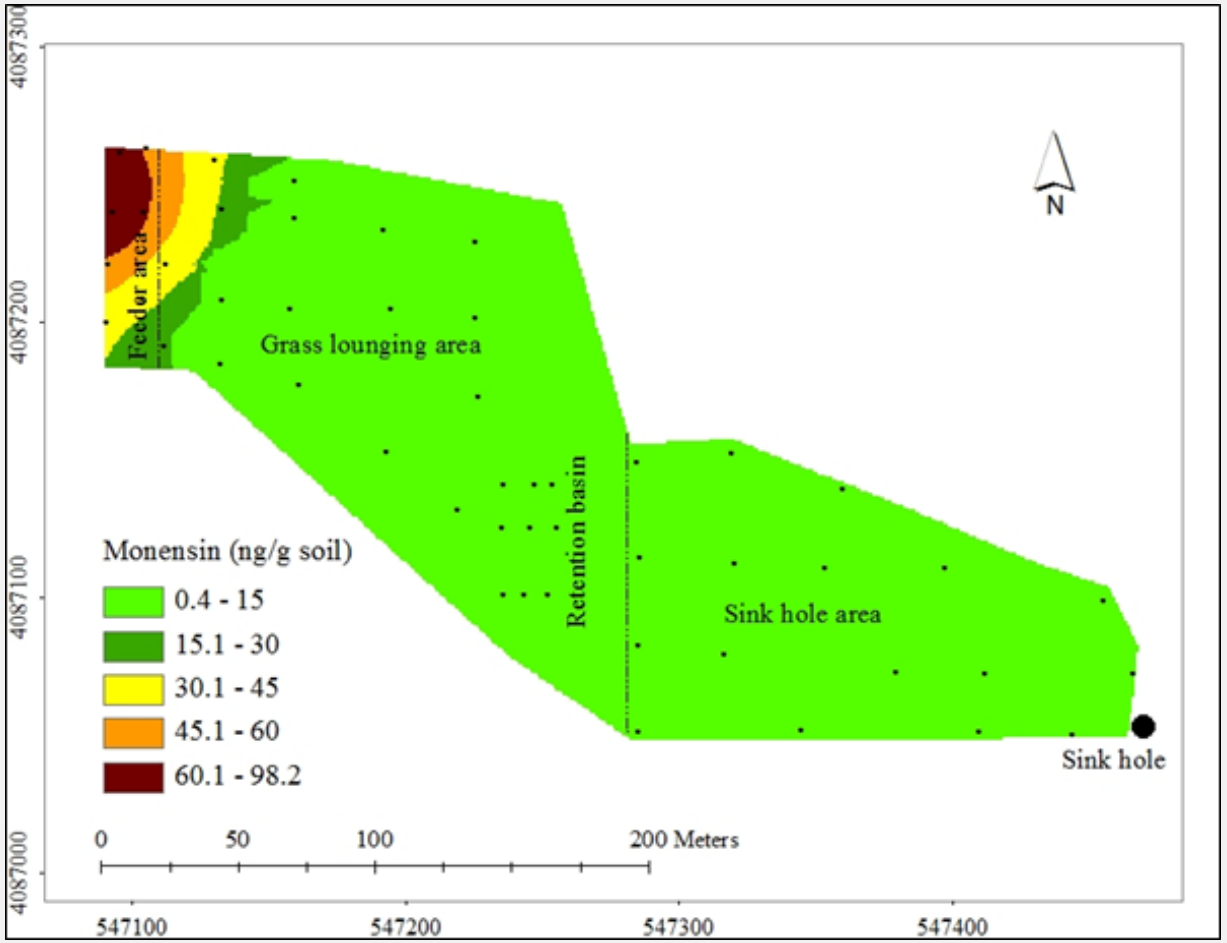
Feeder (12)	Grazing (30)	Retn. Basin (12)	Sinkhole (22)
99.7±25.3	272.9±30.9	21.5±2.9	17.6±2.8

Soil nutrients: NO_3- N mg/kg soil



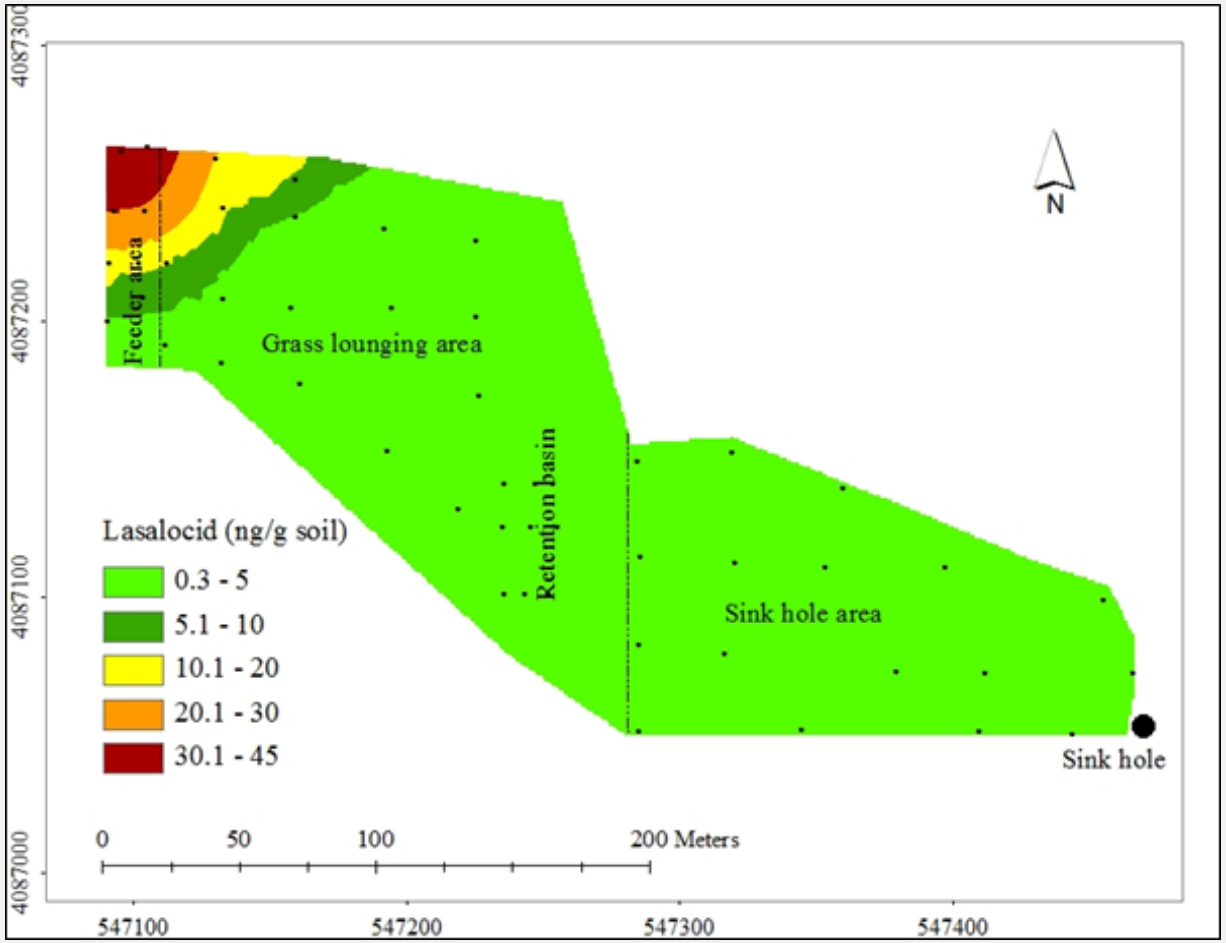
Feeder (12)	Grazing (30)	Retn. Basin (12)	Sinkhole (22)
18.3±4.4	2.0±0.6	0.6±0.2	0.6±0.2

Pharmaceutical: Monensin (ng/g soil)



Feeder (11)	Grazing (16)	Retn. Basin (9)	Sinkhole (17)
94.16 ±123.59	1.89 ±2.48	2.11 ±0.59	0.96 ±1.07

Pharmaceutical: Lasalocid (ng/g soil)



Feeder (11)	Grazing (16)	Retn. Basin (9)	Sinkhole (17)
27.60 ±33.68	2.27 ±2.16	2.11 ±0.59	0.63 ±0.98

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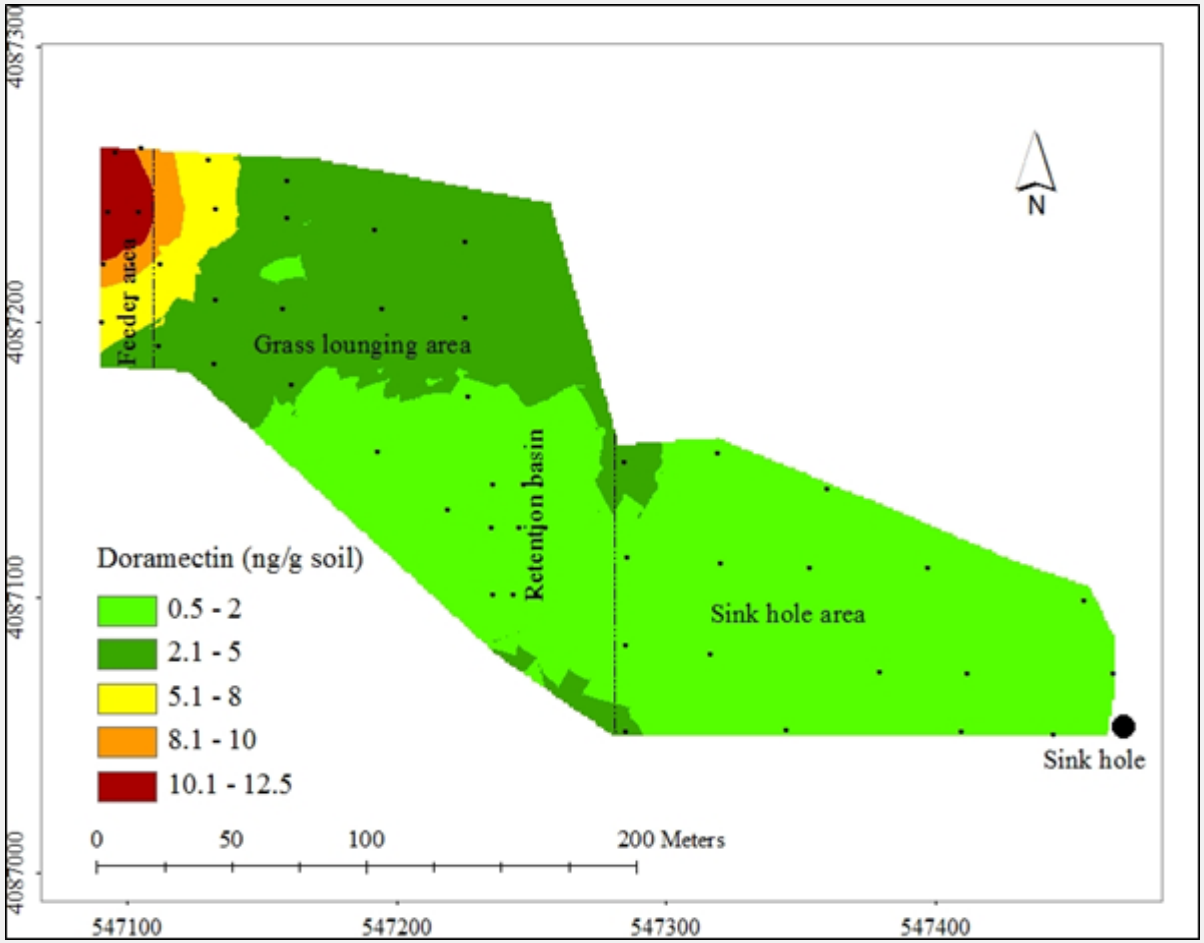
Pharmaceutical: Doramectin (ng/g soil)



Feeder (11)	Grazing (16)	Retn. Basin (9)	Sinkhole (17)
11.37 ±8.61	1.81 ±2.03	1.68 ±0.88	1.21 ±1.47

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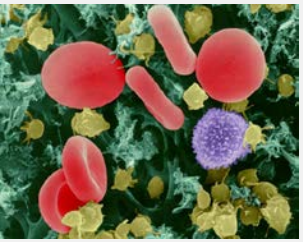
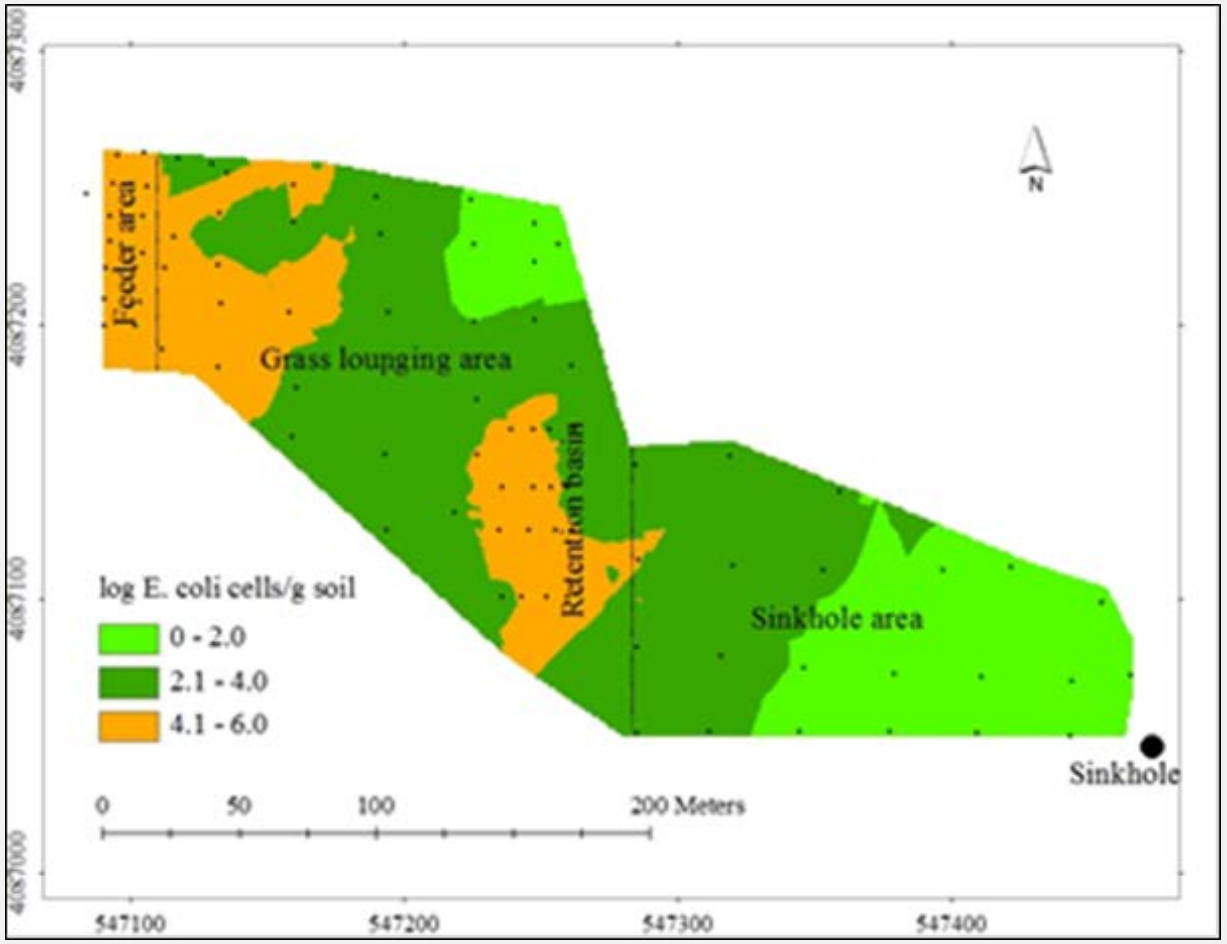
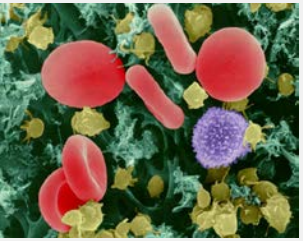
Pathogenic bacteria : *E. coli* (x10 ^{5} cells /g soil)

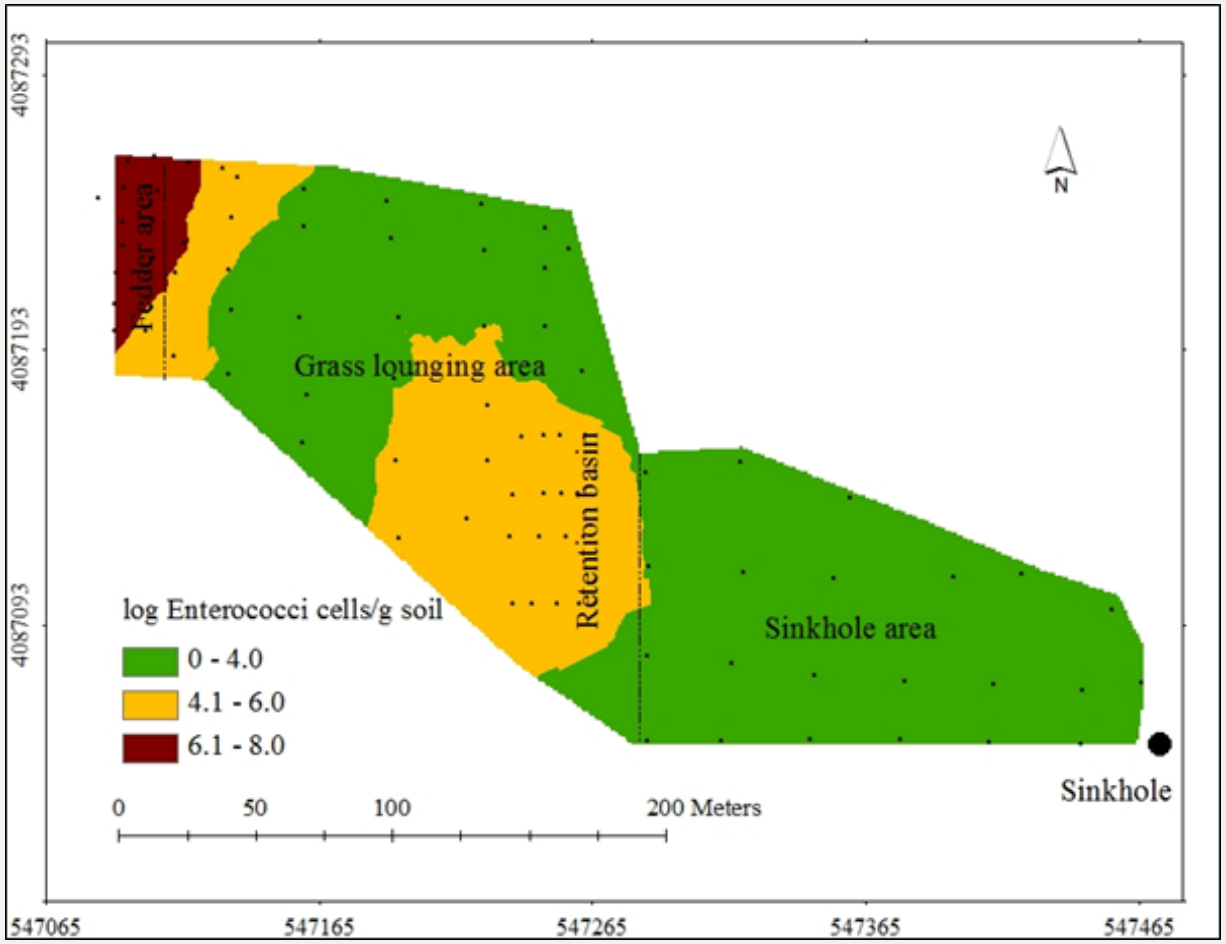




Feeder (11)	Grazing (16)	Retn. Basin (9)	Sinkhole (17)
4.50 ±3.19	0.88 ±1.03	2.09 ±2.02	0.76 ±0.50

Pathogenic bact: *Enterococcus* sp. (x10 ^{5} cells /g soil)





Feeder (11)	Grazing (16)	Retn. Basin (9)	Sinkhole (17)
2910 ±7380	0.53 ±0.69	0.53 ±0.69	0.76 ±0.50

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Conclusions

- All containments are concentrated in feeder area (FD) and nearby grazing areas (GR).
- Grazing area (GR) acts as a buffer to control contaminant movement on the landscape.
- Further waste management activities should focus feeder and nearby grazing areas.

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Experiment Phase 2: Contaminant management through site management practices

Netthisinghe, A.M.P., K.L. Cook, R.A. Gilfillen, K.R. Sistani, and P.B. Woosley. Management practices impacts soil nutrients and bacteria populations in backgrounding beef feedlot. Accepted J. Environ. Qual.(June 10 , 2015)

- Management strategy with 4 site management practices (2010-2012)

- 12 m backgrounding **(BG)**
- Manure harvesting in the feeder area **(MR)**
- 12 m destocking **(DS)**
- 12 m grass hay harvesting **(H)**

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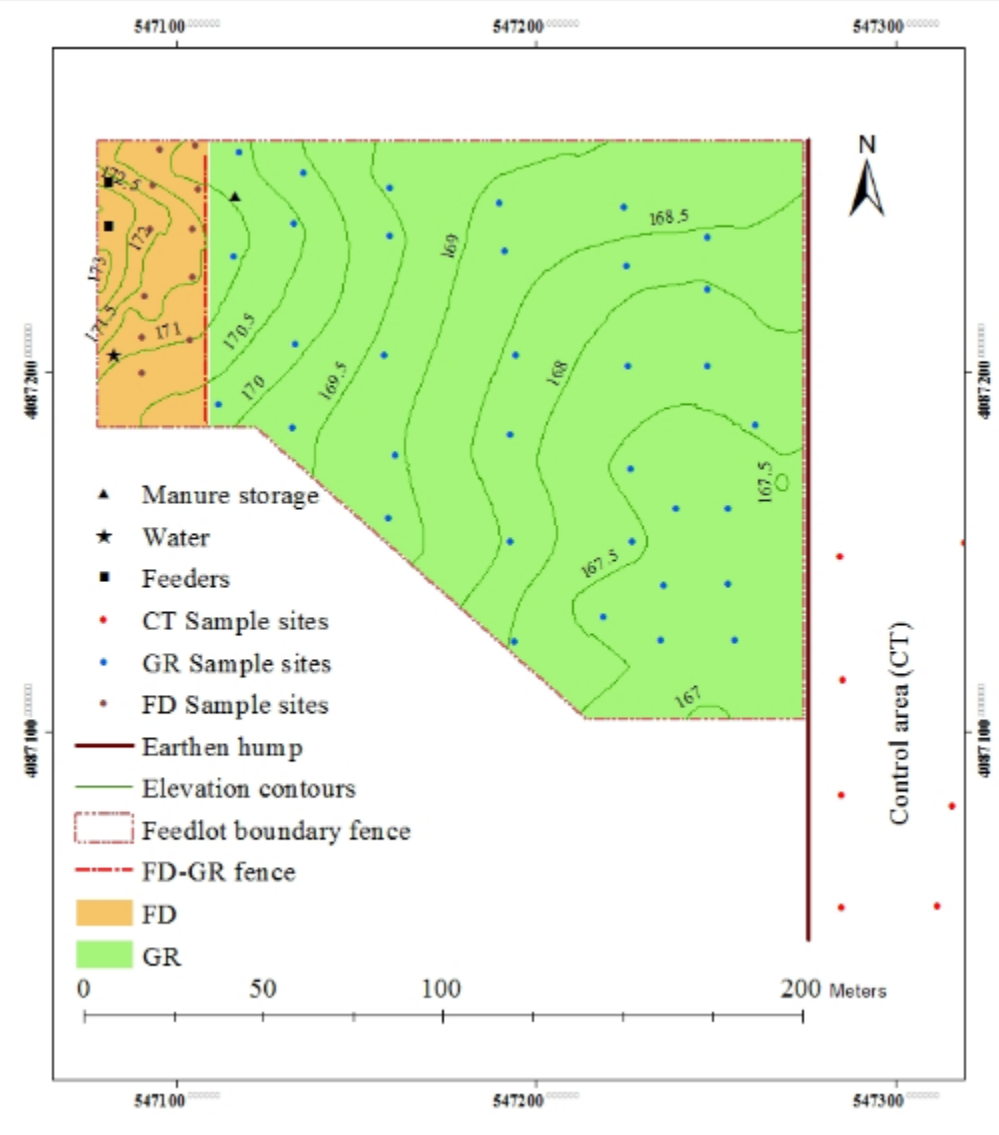
SITE MAP

Management Strategy

1. BG
2. MR
3. DS
4. H



Four site management practices

1. 12 m Backgrounding

2. Feeder area manure harvesting

3. 12 m destocking

4. 12 m hay harvesting

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Management Practice	Feeder Area	Grazing Area	Control Locations
n	20	30	22
	---------- mg kg-1 ----------		
Soil test P			
BG	3296.0[a] ± 1082.1	263.8[a] ± 142.6	99.6[a] ± 24.4
MR	1997.3[b] ± 602.1	-	-
DS	1748.2[b] ± 1033.2	225.8[a] ± 104.6	97.1[a] ± 17.2
H	1637.9[b] ± 656.9	247.3[a] ± 114.2	106.1[a] ± 25.3
Soil NH4-N			
BG	91.7[a] ± 21.3	22.7[a] ± 14.6	13.3[ab] ± 9.5
MR	48.8[b] ± 15.1	-	-
DS	20.3[bc] ± 12.2	11.9[b] ± 4.0	9.4[b] ± 2.5
H	12.1[c] ± 114.2	7.8[b] ± 1.8	13.4[ab] ± 7.5
Soil Zn			
BG	49.0[a] ± 14.4	12.0[a] ± 5.1	4.0[a] ± 1.1
MR	35.5[b] ± 8.2	-	-
DS	38.5[b] ± 14.6	10.1[b] ± 4.7	3.3[a] ± 0.6
H	35.3[b] ± 9.7	10.4[b] ± 25.3	3.4[a] ± 1.2

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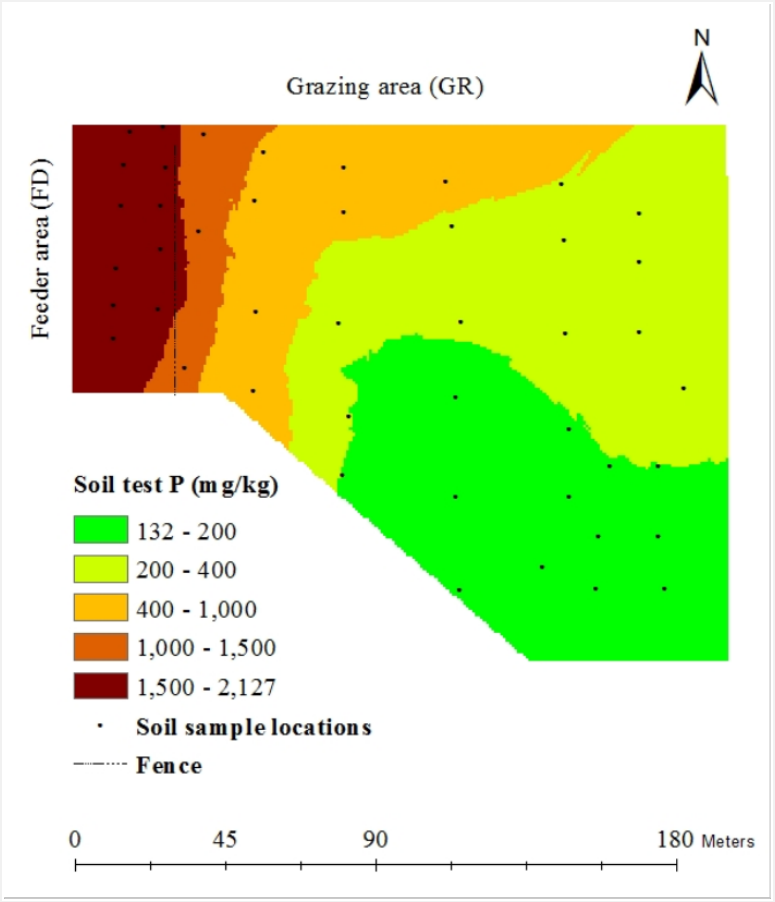
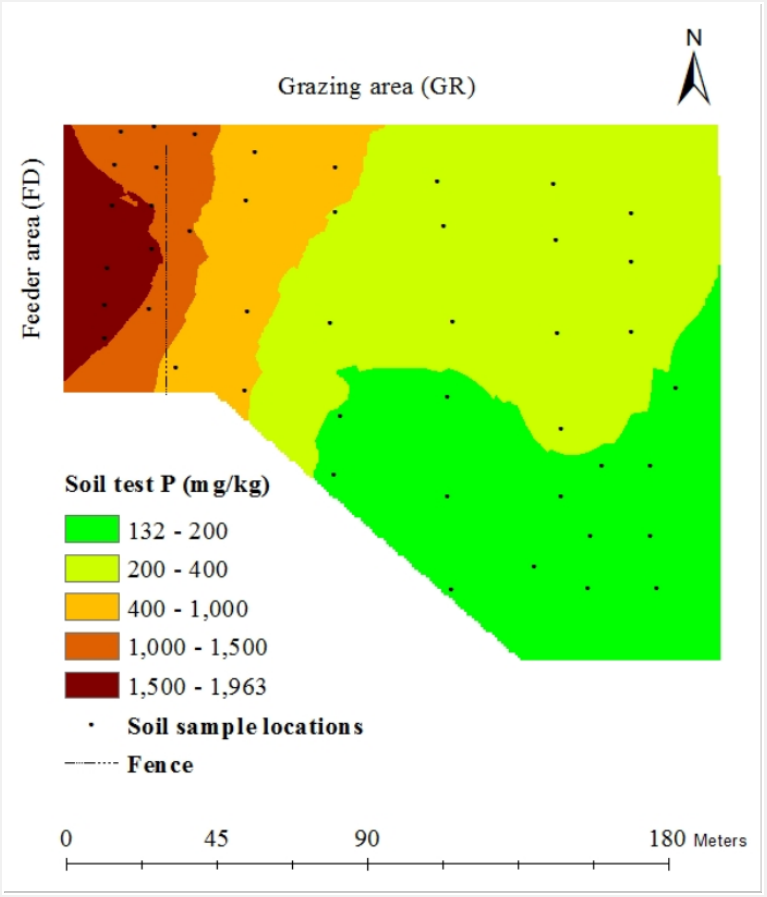
Soil phosphorus (P) content spatial/temporal change



After 12m backgrounding 2010



Following 12 m hay harvesting 2012

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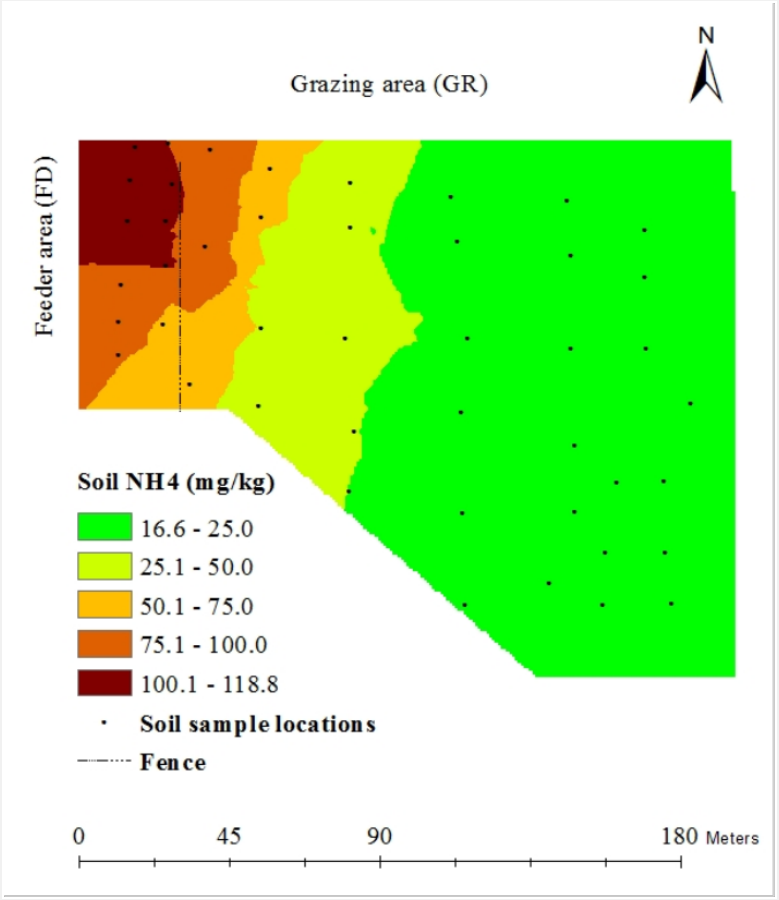
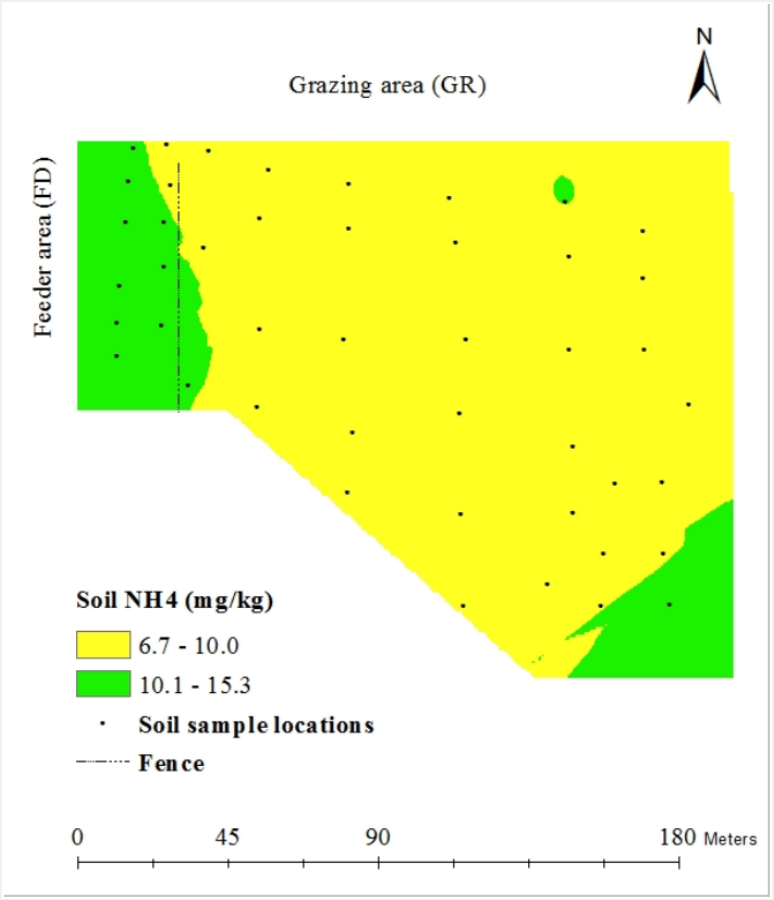
Soil NH_4-N content spatial/temporal change



After 12m backgrounding 2010



Following 12 m hay harvesting 2012

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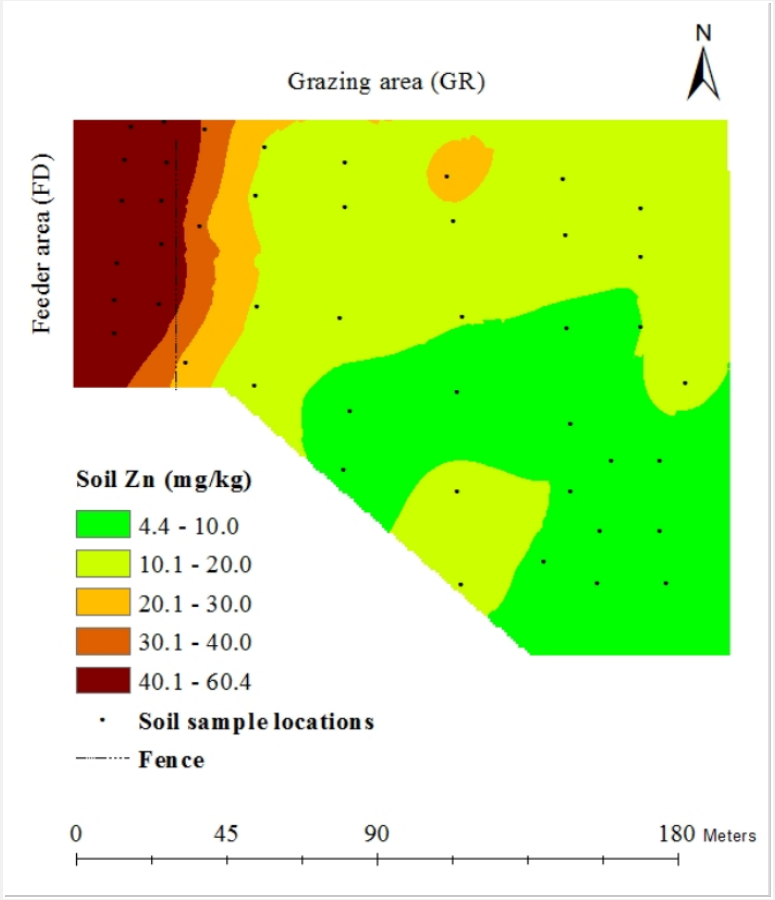
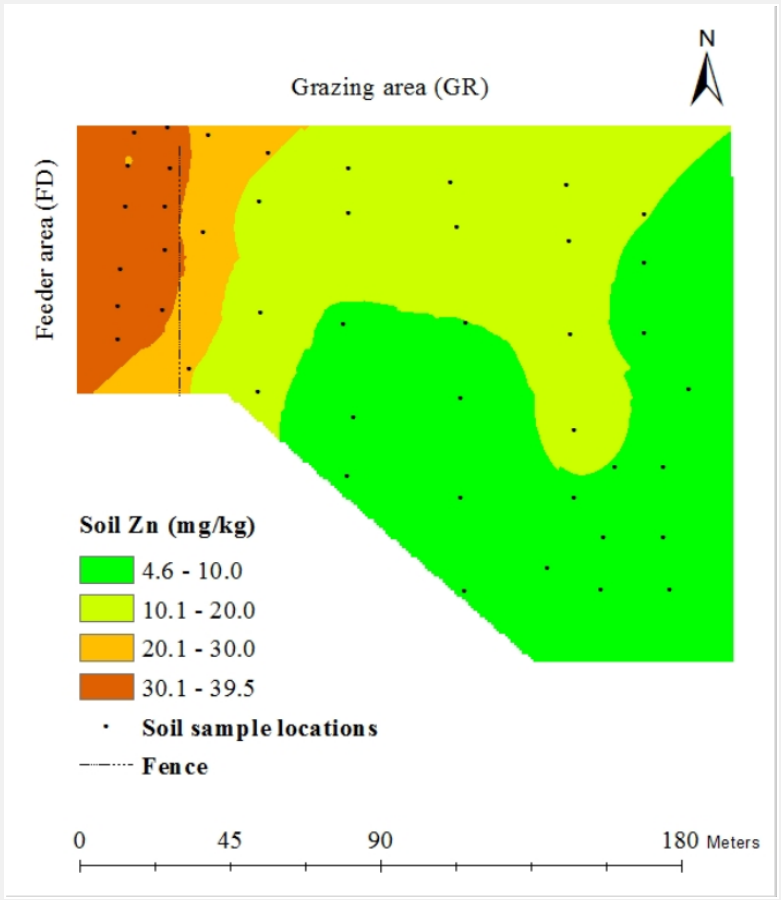
Soil Zn content spatial/temporal change



After 12m backgrounding 2010



Following 12 m hay harvesting 2012

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Phase 2 conclusions

- Manure removal from the feeder area (FD) was effective in reducing all soil nutrient concentrations
- Destocking helped lowering NH4-N and Zn levels in the grazing area (GR).
- Hay harvesting (H) has marginal benefits in reducing soil nutrients in the feeder (FD) and grazing (GR) areas.
- The management strategy has ability to control further soil nutrient build up and reduce highly nutrient concentrated area extents.

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Experiment phase 3: Contaminant management by soil amendment

Treatments

- Biochar
- Alum
- Lime
- Control

THANK YOU.