

Location-allocation in Nigeria

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Technical Content

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Understanding the problem

Objective

A fertilizer company wants to **maximize coverage and sales** through a distribution network in Nigeria.

Data available

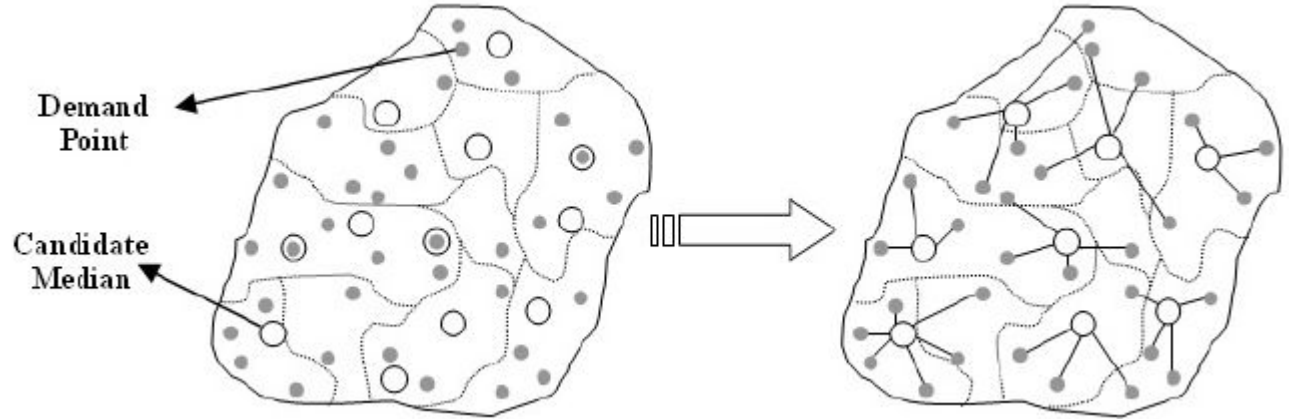
Poverty percentage
NDVI
Aridity
Farm locations
Livelihood
Population Density
Road Network
More

Problem statement

Allocate 20 stores considering farmer's demand.

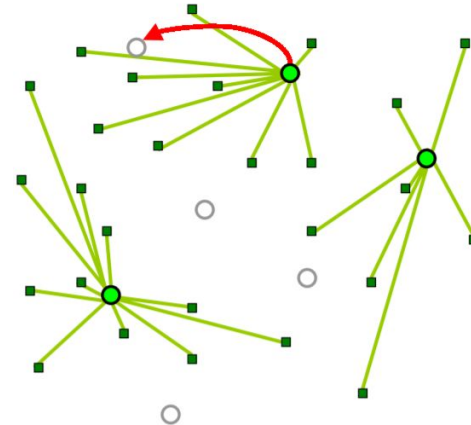
Understanding the problem

- P-median



- Teitz and Bart's p-Median Algorithm

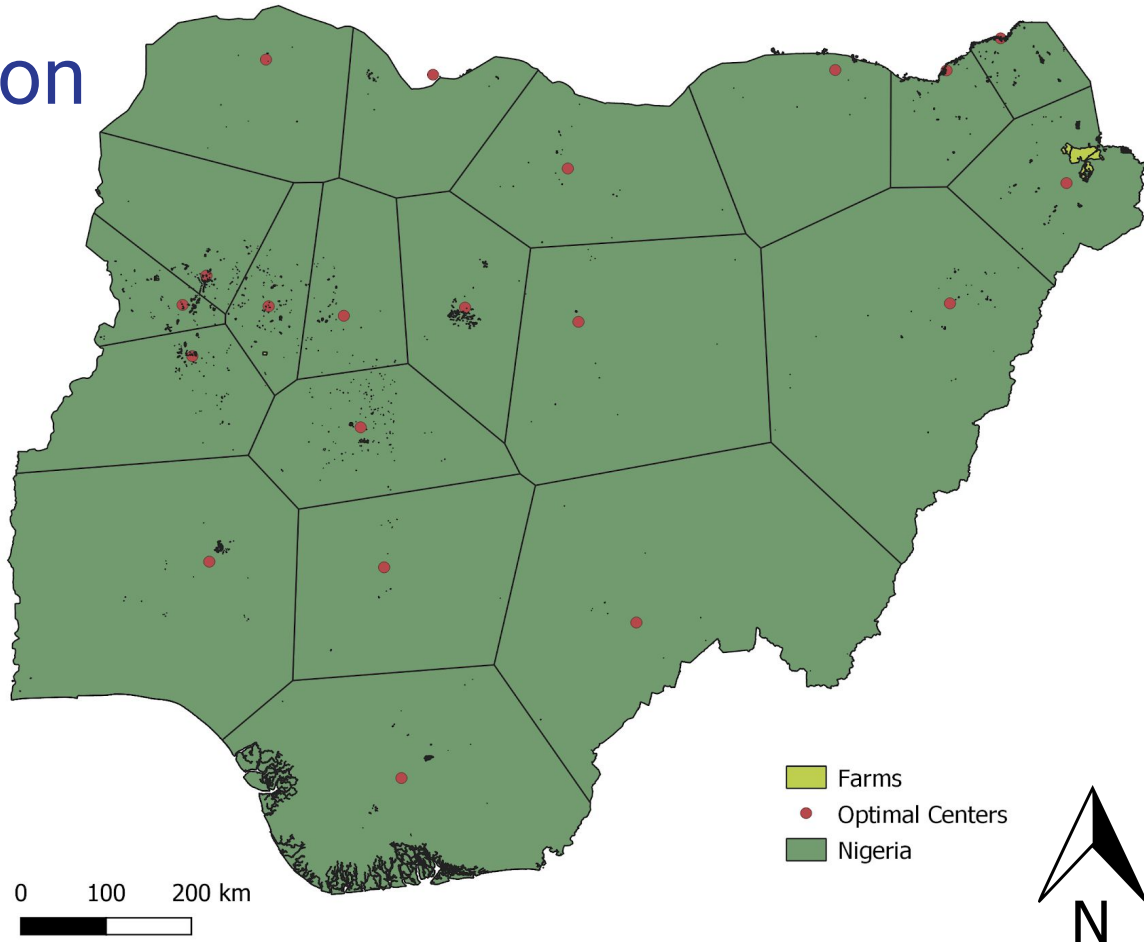
- Demand Points
- Candidate Points
- Cost/Distance Measure
- Demand*



Simple Initial Solution

1. Grab the center of nigerian farms.
2. Cluster the centroids of farms into 20 groups.
3. Choose the center of each group as optimal location.

Source: Openstreetmap Farm Polygons



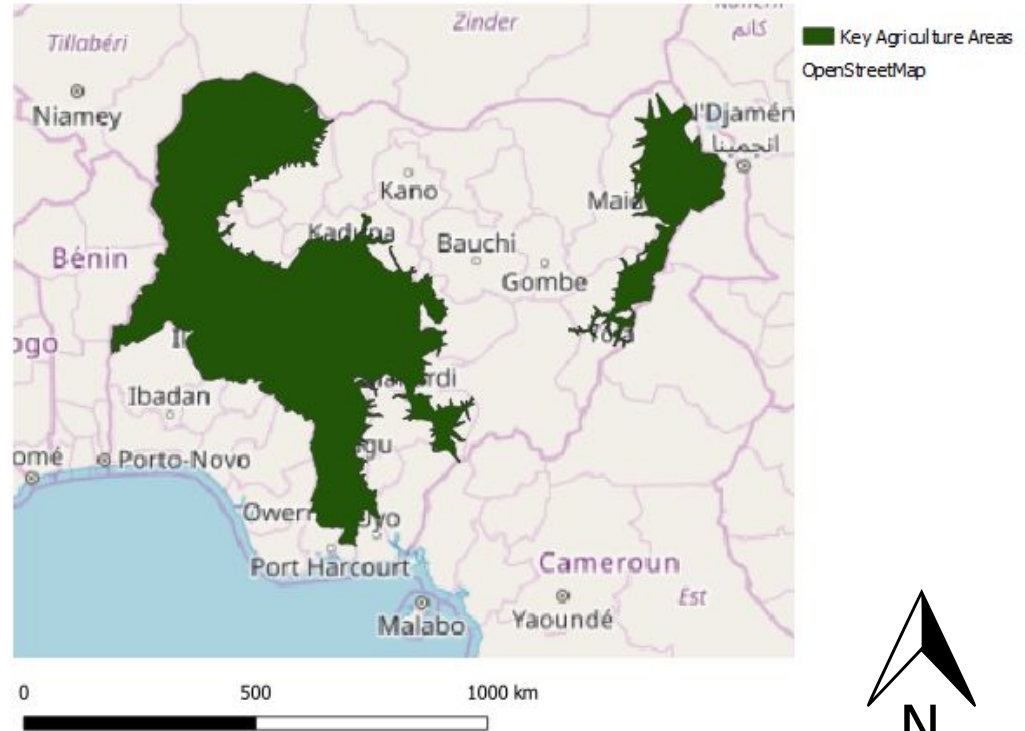
Key Agriculture Market

- Poverty percentage less than 70%.(median value)
- Regions with fertilizer percentage use 30% or more.
- Regions qualified as agriculture by USGS.
- Aridity as validation.

Sources:

Nigeria - Agriculture Household 2015-2016

U.S.G.S. Land Use Survey 2013

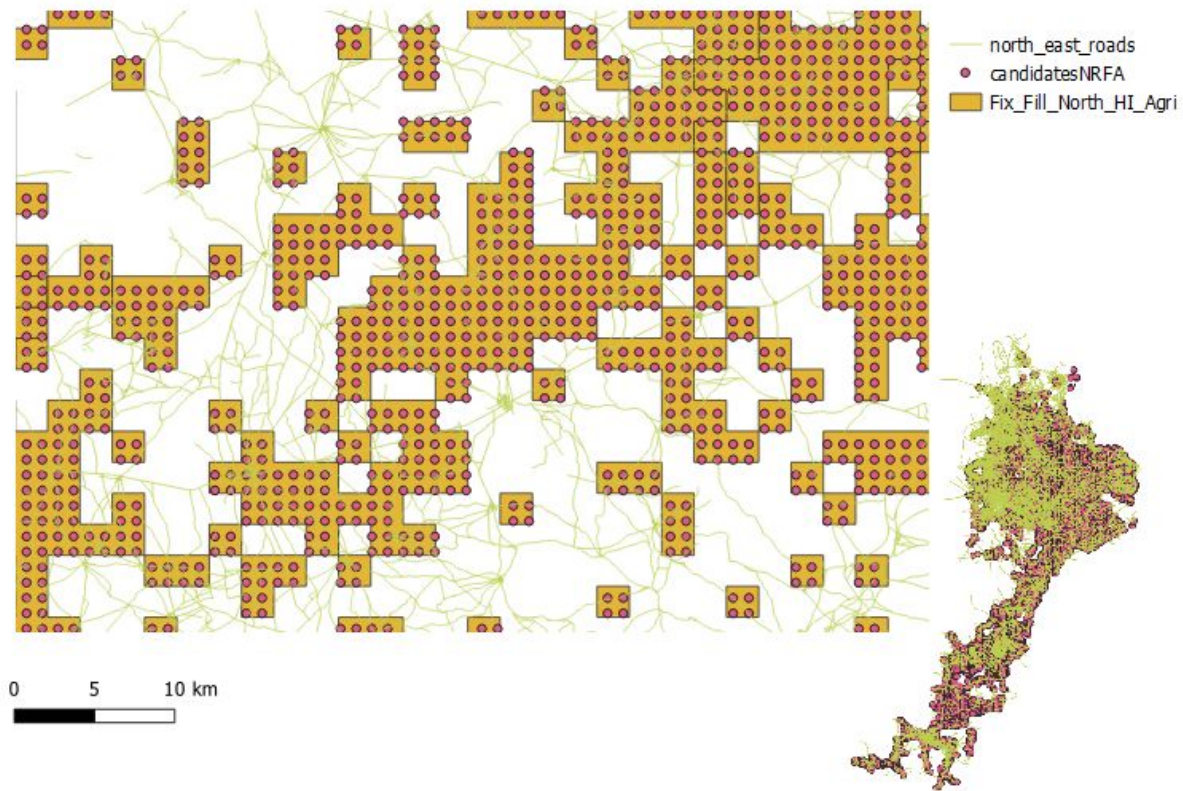


Methodology

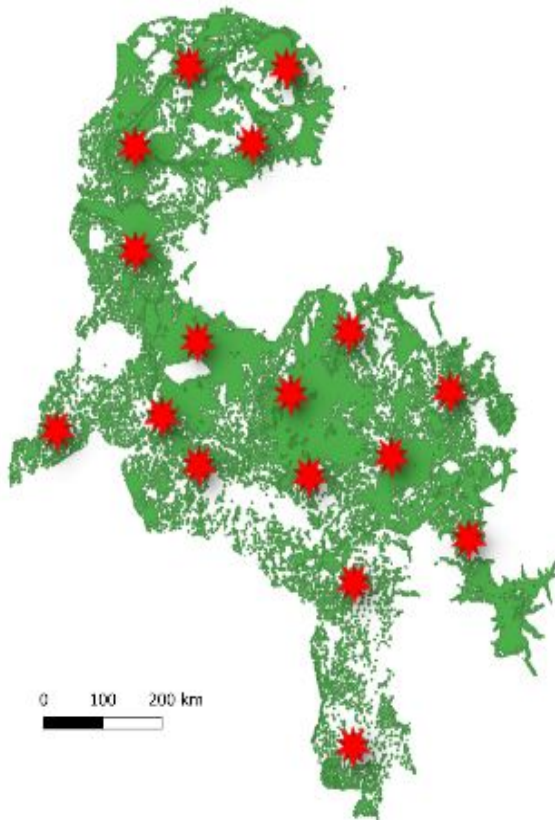
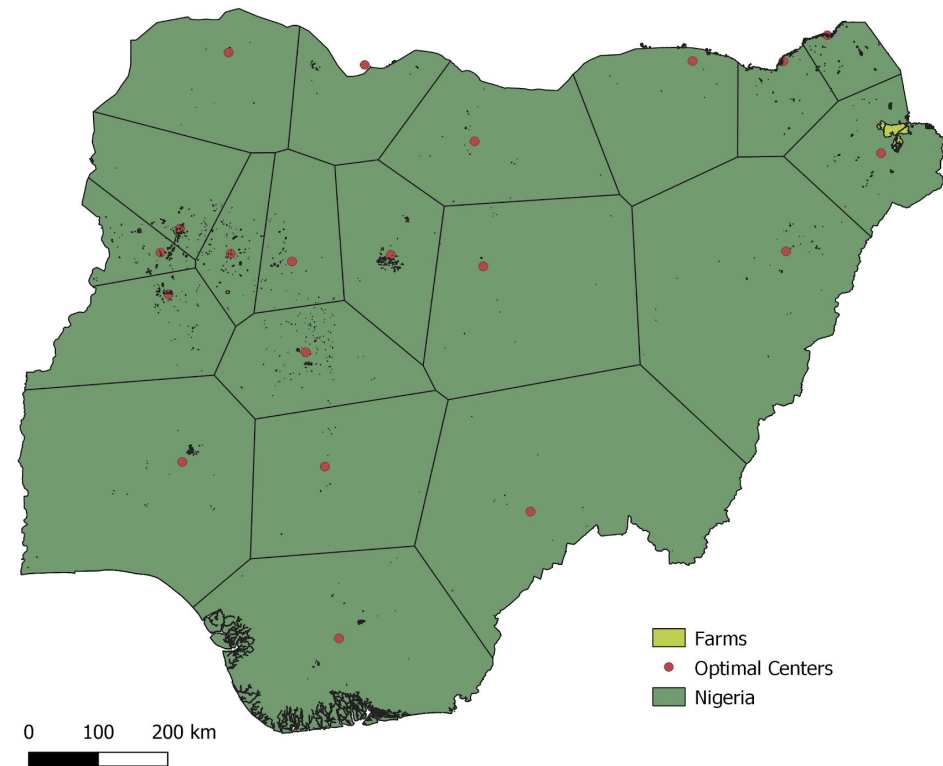
- Given the previous target polygons, create a 1 km grid of points. The polygons are filtered by demand determinants.
- Take points along the road network as candidate facilities.
- Calculate euclidean distance from customers to facilities
- Distance matrix and points where used as input to the “Tbart” R package



Methodology



Final Solution



Future Work

- Use government agents and banks as a customer filter
- Calculate network distances instead of euclidean
- Explore pgrouting software
- Use spatial features to estimate spatial demand
- Use demand on TBart Algorithm



Sources

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Tappan, G. G., Cushing, W.M., Cotillon, S.E., Mathis, M.L., Hutchinson, J.A., and Dalsted, K.J., 2016, West Africa Land Use Land Cover Time Series: U.S. Geological Survey data release, <http://dx.doi.org/10.5066/F73N21JF>

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Appendix

Fertility use in the northern states is typically higher than in the southern states (map 12.1). This is partly attributed to lower soil fertility, larger area cultivated, and the growth of high-value crops, such as vegetables and particular cereals, in the region. Northern states have also traditionally provided greater fertilizer subsidies since the colonial era

		CEREALS				OILSEEDS				FRUITS/VEG						
		Wheat	Rice	Maize	Oth Ce	Soy	Palm	Oth OS	Fibre	Sugar	R&T	Fruits	Veg	Grass	Residual	
		% of World	Qty (kt)	Qty (kt)	Qty (kt)	Qty (kt)	Qty (kt)	Qty (kt)	Qty (kt)	Qty (kt)	Qty (kt)	Qty (kt)	Qty (kt)	Qty (kt)	Qty (kt)	
South Africa	N	0.4%	21	0	268	8	5	0	12	1	32	13	27	19	24	9
	P2O5	0.4%	9	0	94	4	8	0	13	0	18	9	9	10	13	6
	K2O	0.4%	2	0	19	1	5	0	4	0	47	8	23	12	5	4
	N+P+K	0.4%	31	0	381	12	18	0	28	1	96	29	59	41	42	19

Caveats

3 areas that didn't pass the "demand filters"

- South Plantation
- South Cropland and fallow with oil plants
- North Agriculture in Shallows and North farms in OSM



Key Messages:

- Each farming household holds an average of 2.6 plots approximately, 0.5 a hectare each in size and approximately 1.7 percent of these plots are irrigated.
- On average, 7 percent of male and 2.2 percent of female plot managers own land from outright purchases.
- Family inheritance happens to be the main means of farm land acquisition, with 71 and 66 percent of males and females headed households acquiring farm lands through this means.
- Fertilizer is applied on about 47 percent of plots. Purchased seeds, animal traction, herbicides and pesticides are also used. Male-headed households utilize considerably more farm inputs than female-headed households, except purchased seed.
- Goats (67.3%) and chickens (64.8%) are the most commonly owned animals.
- Livestock is commonly slaughtered (29%) or sold (28.5%).
- Only 13.7 percent of households participate in extension services.

Region	% Used Fertilizer
North Central	28.0
North East	50.7
North West	92.8
South East	46.8
South South	8.0
South West	9.3
Urban	41.3
Rural	48.1
NGA	47.3

Crop Type	% Fertilizer
Grain Crops	
Maize	64.9
Rice	57.1
Sorghum	71.5
Millet	88.7
Root Crops	
Yam	29.8
Cassava	23.8
Oil Crop	
Sesame/beeni-seeds	47.3
Legumes	
Cowpeas	48.4
Groundnut	41.0

Nigeria National Bureau of Statistics. General Household Survey, Panel (GHS-Panel) 2015-2016 . Ref. NGA_2015_GHSP-W3_v01_M. Dataset downloaded from www.microdata.worldbank.org

Region	Agriculture	
	Male	Female
Post-planting (August–October)		
North Central	48.2	36.0
North East	64.4	34.9
North West	52.8	9.6
South East	26.8	36.4
South South	18.2	20.1
South West	12.3	8.9
Urban	10.3	6.4
Rural	54.2	30.8
NGA	38.5	21.8
Post-harvest (February–April)		
North Central	30.0	20.7
North East	24.0	11.7
North West	34.7	5.6
South East	22.1	33.6
South South	15.3	19.0
South West	11.5	6.6
Urban	7.4	4.5
Rural	33.7	20.1
NGA	24.1	14.3

TABLE 7

Fertilizer use by crop in SSA

Crop	Fertilizer use (1 000 tonnes N + P ₂ O ₅ + K ₂ O)	Percent
Cereals		
Barley	24.7	4.0
Maize	160.5	26.0
Rice	49.7	8.0
Sorghum & millet	107.8	17.4
Wheat	42.4	6.9
Roots & tubers		
Cassava, taro, yam	32.3	5.3
Potato	18.9	3.1
Pulses	25.5	4.1
Oil crops		
Groundnut	11	1.8
Oil-palm	2.8	0.5
Soybean	2.5	0.4
Fruit crops	17.1	2.8
Beverages and sugar		
Sugar cane	7	1.1
Coffee	17.8	2.9
Tea	9	1.5
Fibres: cotton	35.1	5.7
Vegetables	26.4	4.3
Tobacco	19.8	3.2
Others	7.6	1.2
Total	617.9	100.0

Source: FAO, 2002.