Global Ecological

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How can countries reduce their ecological footprint?

Linear regression model analysis


Global Warming

Definitions

- The Global Hectare (gha) is a unit of land normalized by biological productivity across land type, country and year.
- The Ecological Footprint is the area required to provide the ecological services (resource regeneration and waste assimilation) consumed by humanity.
- Biocapacity is how much biologically productive area exists to provide these ecological services each year.

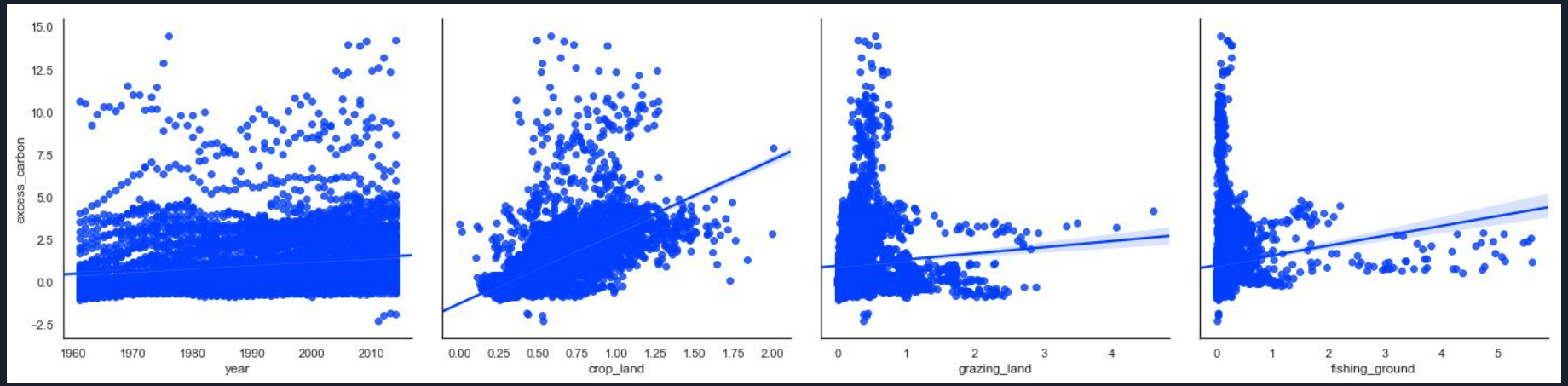
Exploratory Questions

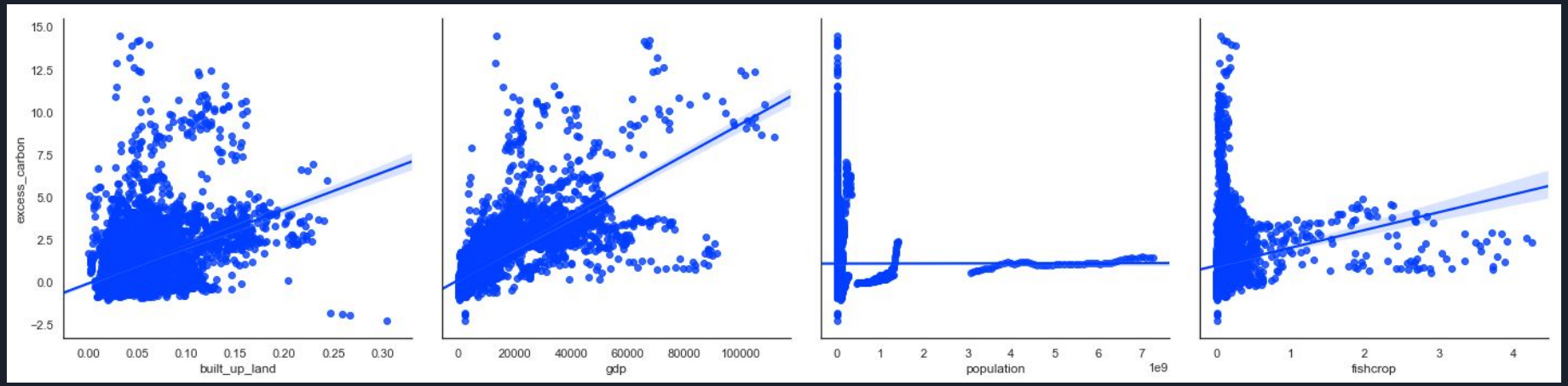
01 What variables are most important when attempting to reduce excess carbon?

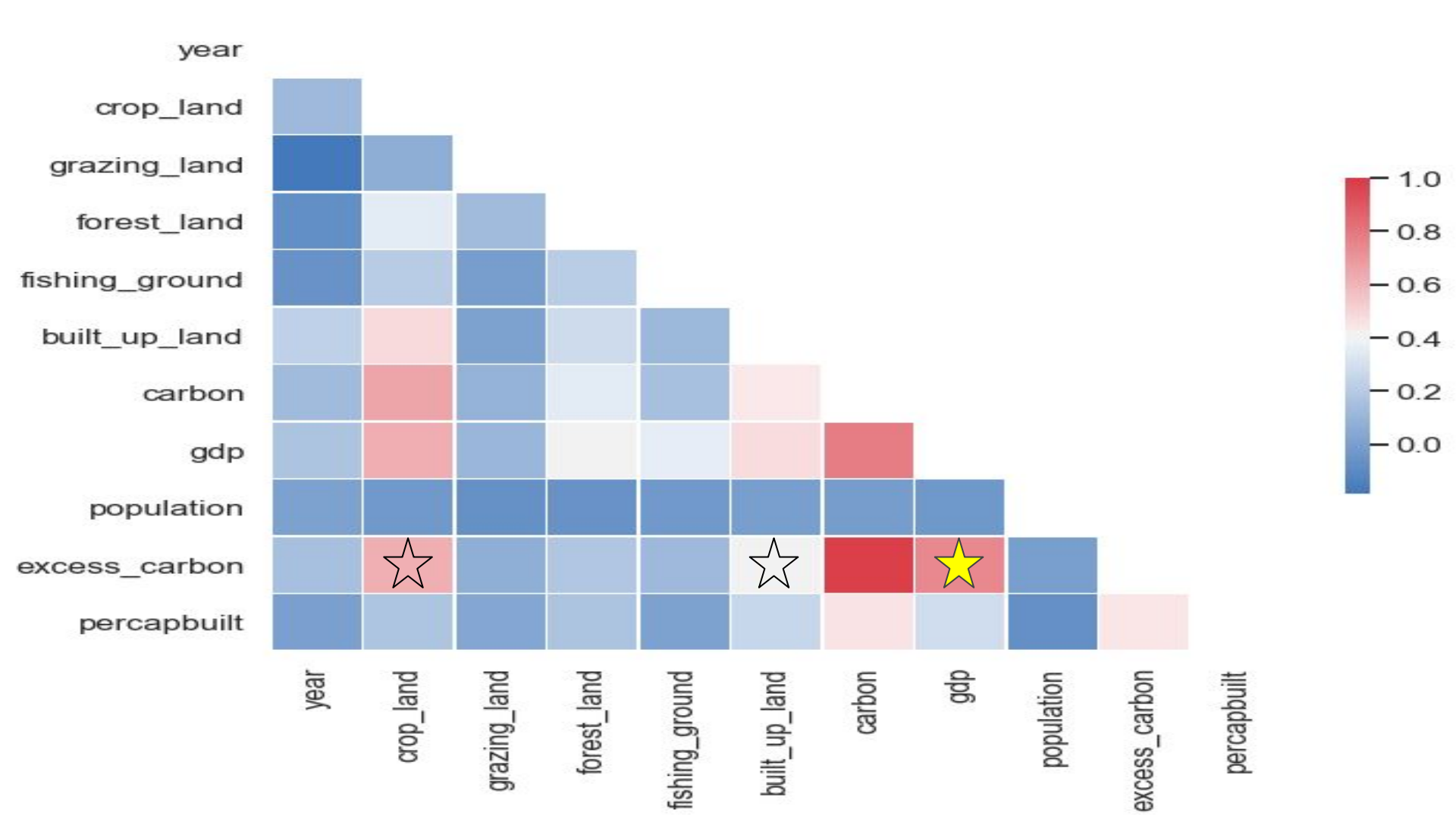
02 Has excess carbon been increasing over the years?

03 Are the countries that use a small amount of fishing ground countries that are not surrounded by water?

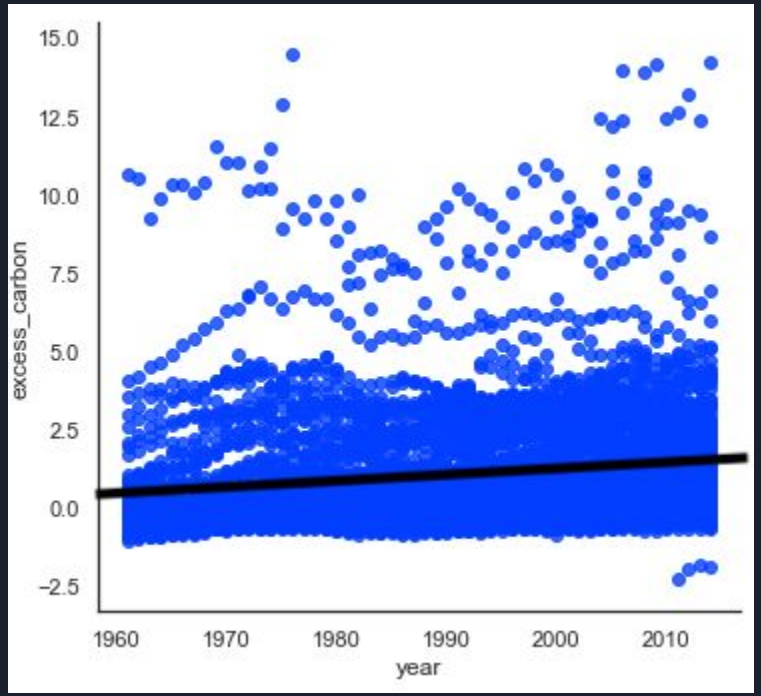
What variables are most important when attempting to reduce excess carbon global hectares?


excess_carbon
15.0
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
1960
1970
1980
1990
2000
2010
year
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
crop_land
0
1
2
3
4
grazing_land
0
1
2
3
4
5
fishing_ground


excess_carbon
15.0
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
0.00
0.05
0.10
0.15
0.20
0.25
0.30
built_up_land
0
20000
40000
60000
80000
100000
gdp
0
1
2
3
4
5
6
7
population
1e9
0
1
2
3
4
fishcrop


year
crop_land
grazing_land
forest_land
fishing_ground
built_up_land
carbon
gdp
population
excess_carbon
percapbuilt
1.0
0.8
0.6
0.4
0.2
0.0

Have excess carbon global hectares been increasing over the years?



Are the countries that use a small amount of fishing ground countries that are not surrounded by water?

Surprisingly enough, some of the countries that contain data points in which average fishing ground over all years is less than 0.01 contain large lakes (like Niger) or are surrounded by water (like Ethiopia).

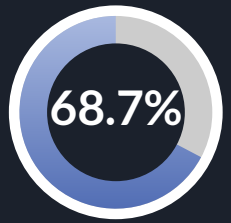
country	fishing_ground
Afghanistan	0.000176
Armenia	0.007928
Azerbaijan	0.006858
Bolivia	0.006256
Burkina Faso	0.007301
Ethiopia	0.000677
Guinea-Bissau	0.007009
Mauritania	0.008611
Mongolia	0.003873
Mozambique	0.009240
Nepal	0.001114
Niger	0.004734
Paraguay	0.005513
Rwanda	0.001959
South Sudan	0.005176
Sudan	0.001114
Tajikistan	0.002655
Turkmenistan	0.007457
Uzbekistan	0.001657
Zimbabwe	0.005104

The Predicting Model

$$\text{Excess Carbon} = 1.8631\,(\text{Crop Land}) + 7.21e^{-5}\,(\text{GDP}) - 0.2059\,(\text{Fishing Ground}) + 1.169e^{7}\,(\text{Per-capita Built-up Land}) - 30.5650\,(\text{All Land Types Interaction}) - 0.7891$$

Excess Carbon = Carbon - Forest Land

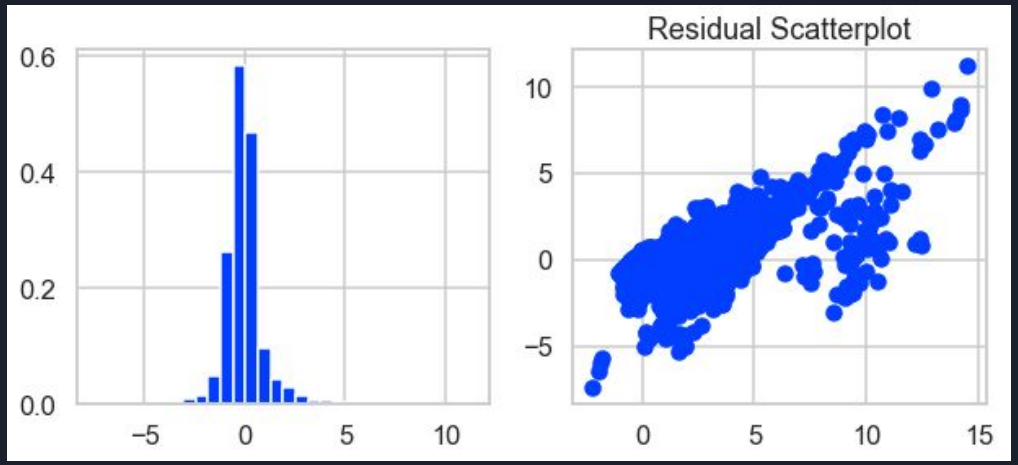
All Land Types Interaction = Crop Land x Fishing Ground x Built-up Land x Grazing Land



of the variation in Excess Carbon is explained by our model.

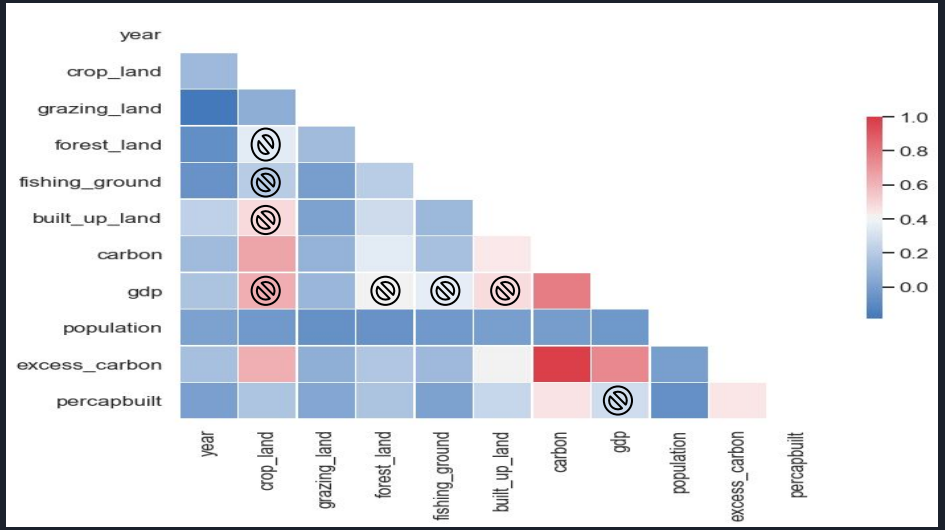
Error trends

Residuals seem to be positively correlated.



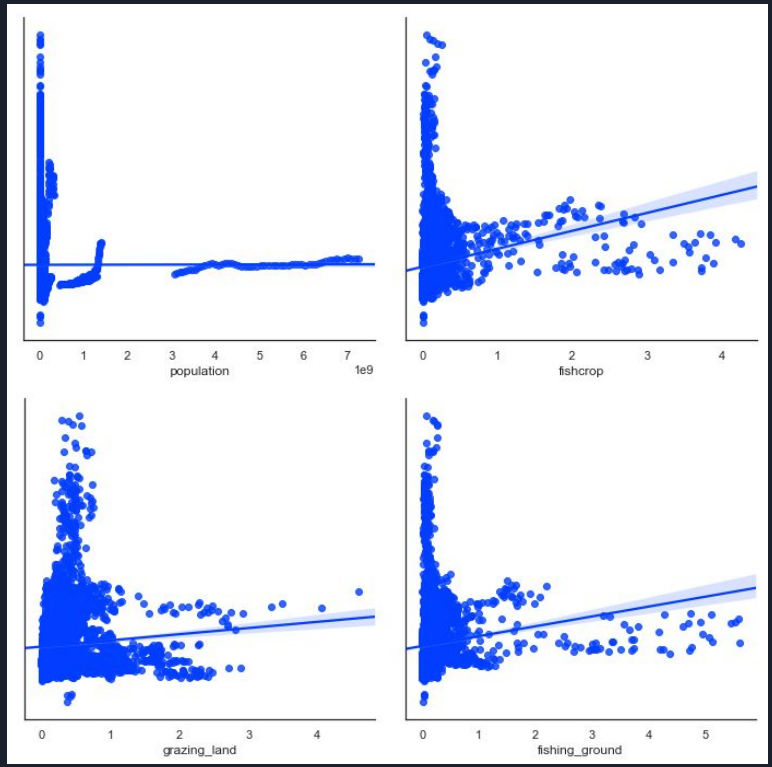
After many variations transformations and interaction terms were tested, we have concluded that this data is not best fit using linear regression.

Other Models



Ridge Regression

A multiple regression technique for analyzing data that experiences strong multicollinearity.



Time series

An *L-shaped* scatter plot represents sudden changes in the relationship between two time series.

Conclusion

Actual model:

Multiple linear regression model (predicts almost 70%)

Suggested model:

Time series or ridge regression

- Data heavily related to time
- Underlying multicollinearity in predictor variables