# Identifying links between hydroclimatic variability and economical components using stochastic methods

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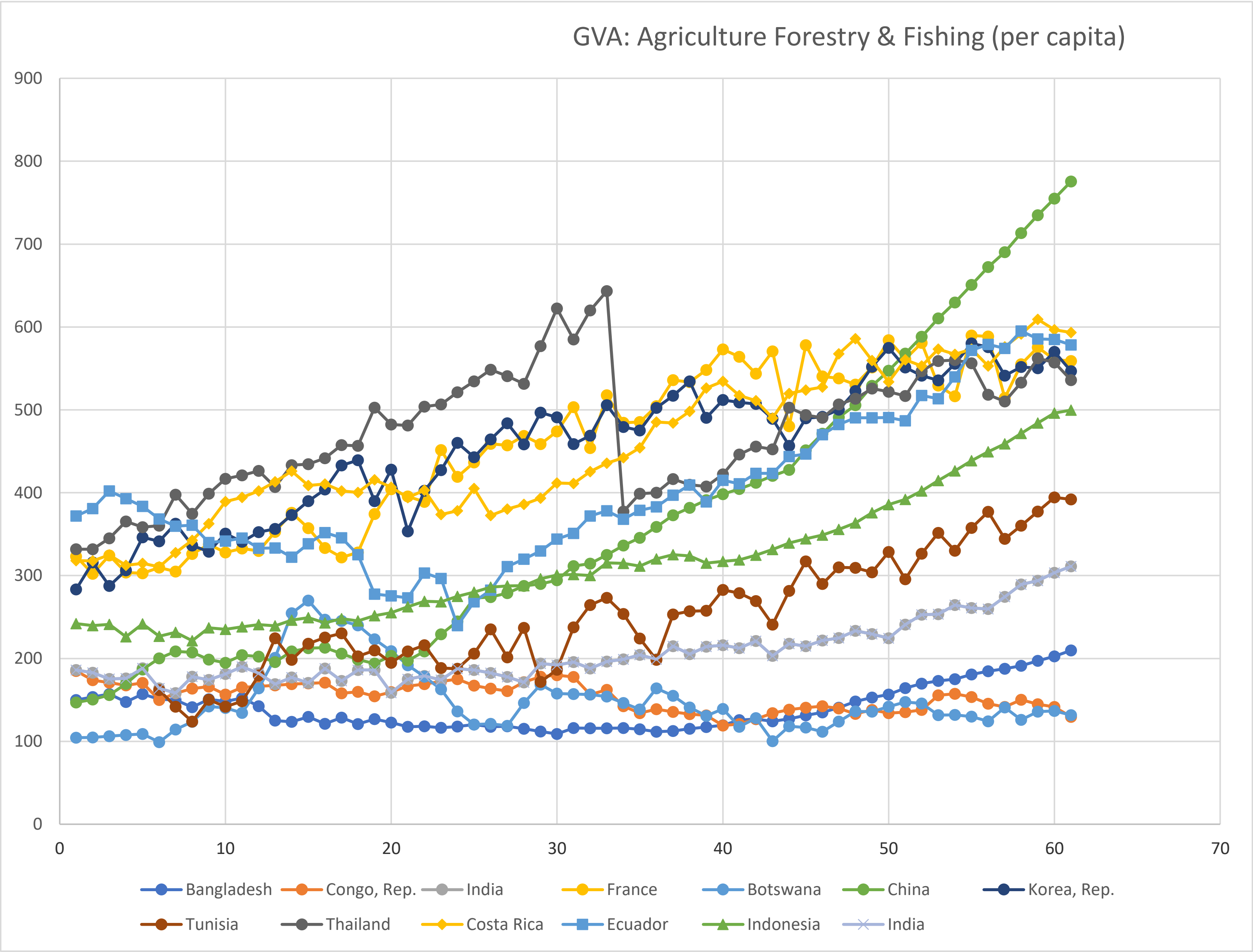
# Introduction

- Historically water has been a driving force for economic growth
- Breaking down the relationship between GDP and water resources availability
- We attempt to perform analysis in both temporal and spatial scale
- How sensitive are modern economies to hydroclimatic variability?
- Development of water infrastructure: Leads to desensitization?
- Occurrence of hydroclimatic extremes: Is GDP regressing? Do they limit growth?
- Spatial analysis by using the Köppen climate index
- Decoupling the water-food relationship as part of the perplexed WEF nexus.

# Gross Value Added: Agriculture Forestry & Fishing

- 1960-2020 yearly time series
- Gross value added (GVA) is an economic productivity metric that measures the contribution of a corporate subsidiary, company, or municipality to an economy, producer, sector, or region
- In the agriculture sector it shows the added value minus the intermediate internal consumption plus the subsidies given.

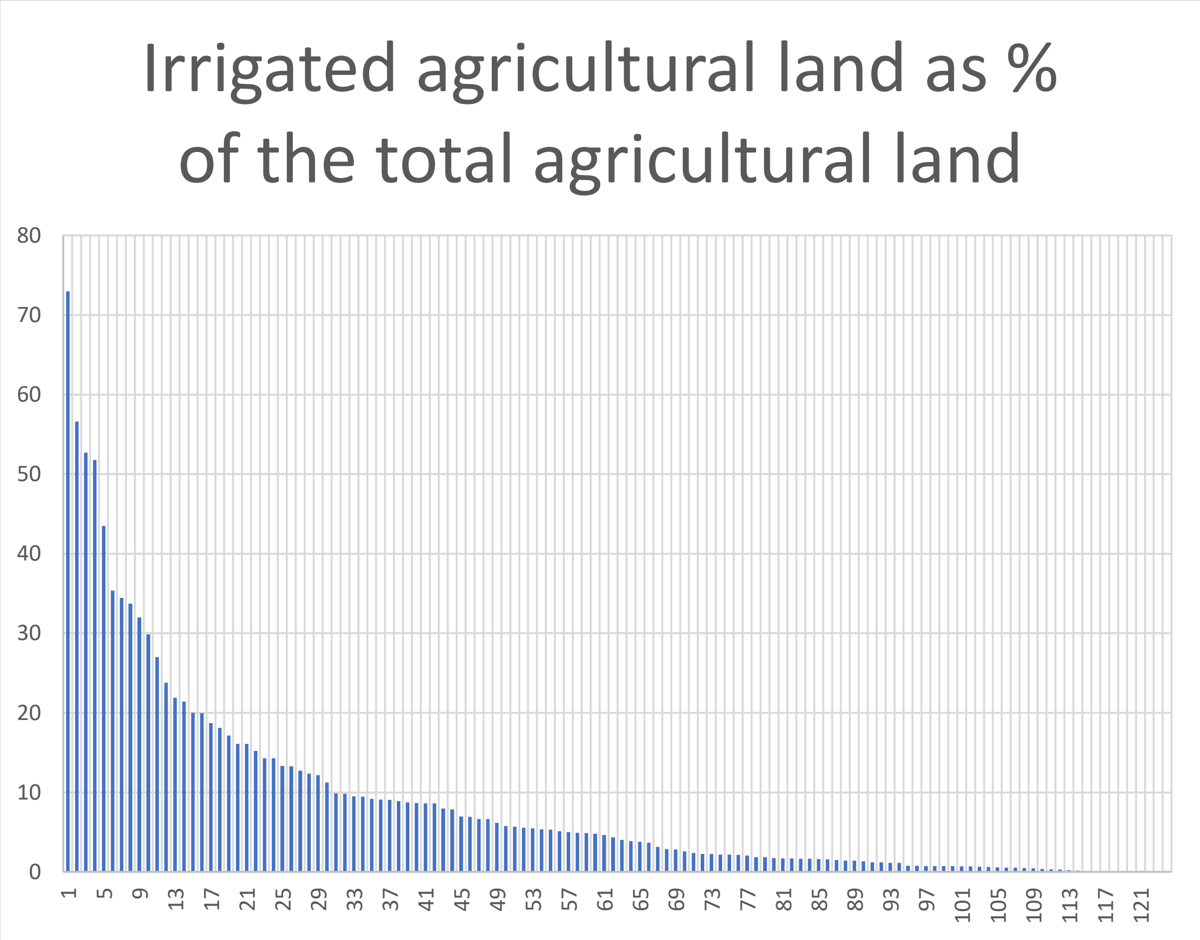


GVA: Agriculture Forestry & Fishing (per capita)
900
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
Bangladesh
Congo, Rep.
India
France
Botswana
China
Korea, Rep.
Tunisia
Thailand
Costa Rica
Ecuador
Indonesia
India

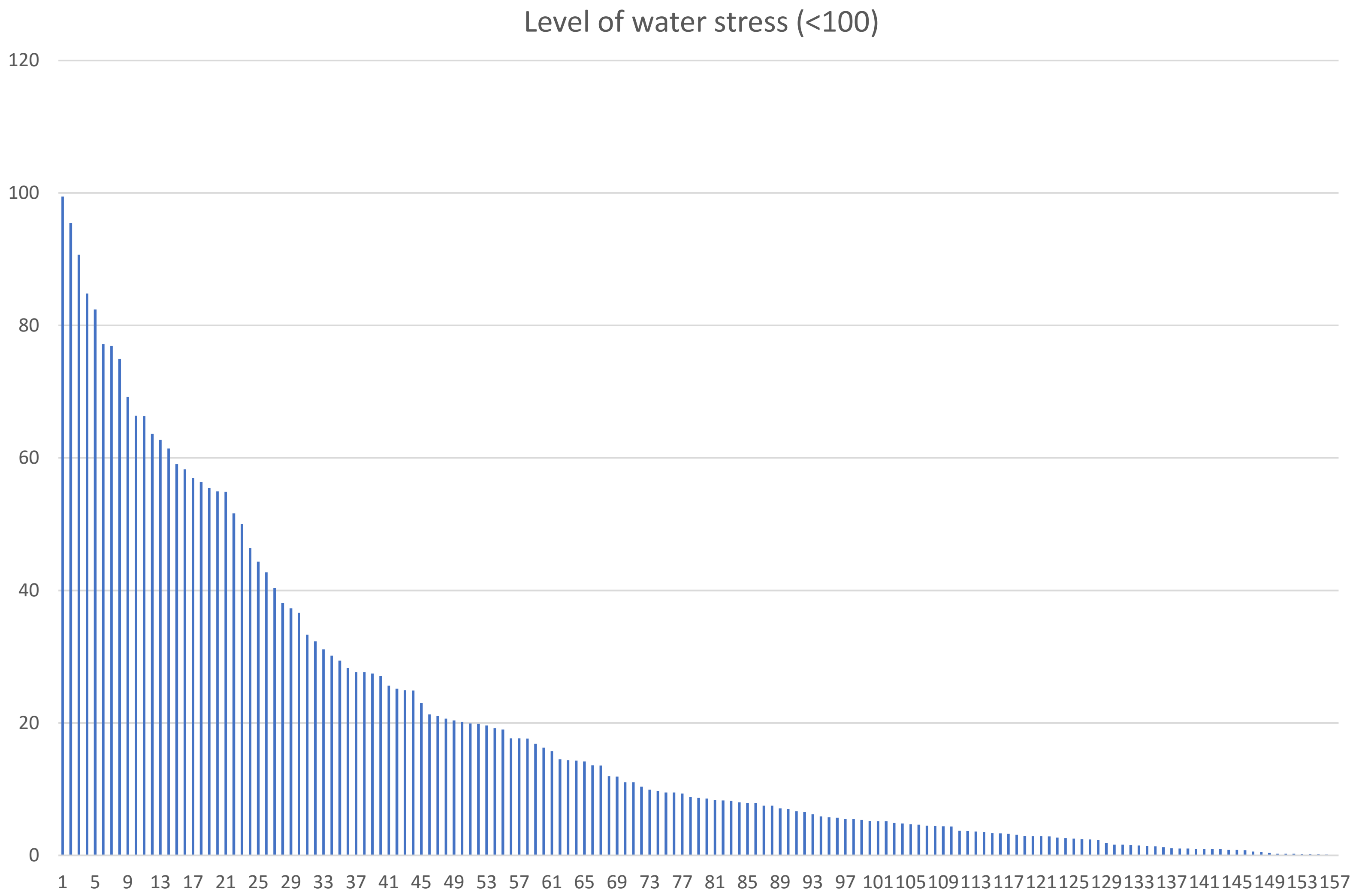

- Per capita

# Irrigated agriculture

- Only 9 countries exceed the 32% benchmark in irrigated agricultural land (as a % of total agricultural land)
- Nearly half of the countries lie down the 4.6% level
- Globally, approximately 70% of freshwater withdrawals are irrigating agriculture areas and ~20% are used for industrial purposes



# The role of water infrastructure




- Level of water stress: Freshwater withdrawal as % of available freshwater resources
- Half of the world's countries use lower than 10% of their water resources
- Some countries exceed the 100 threshold by water imports or desalination

# Köppen-Geiger climate classification

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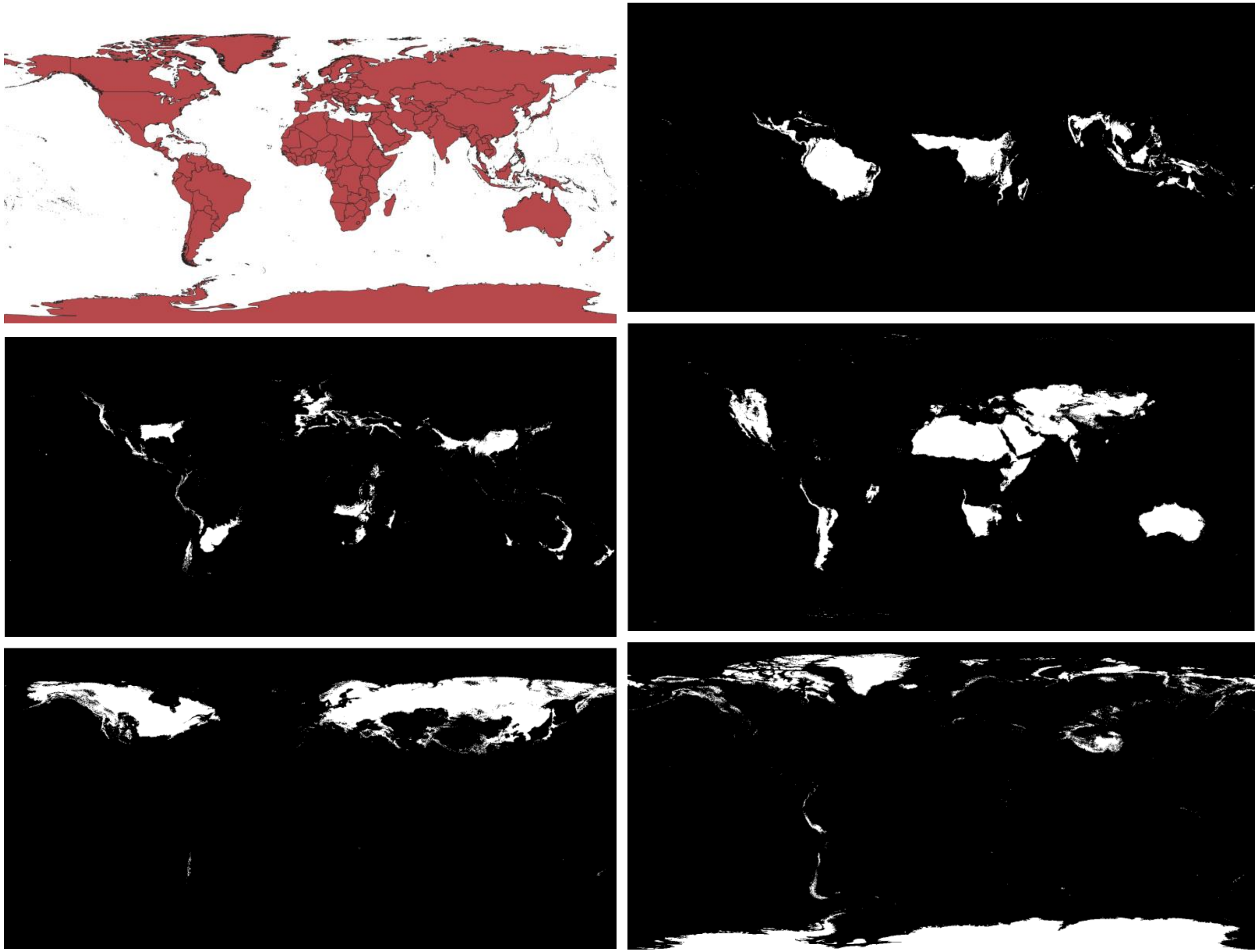
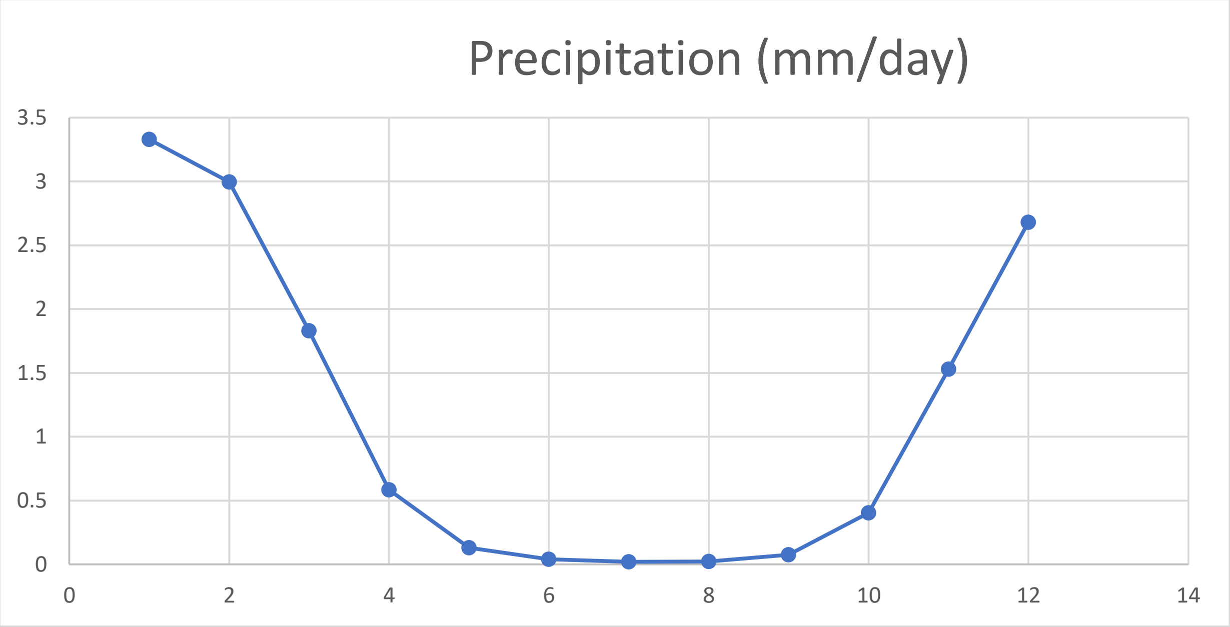
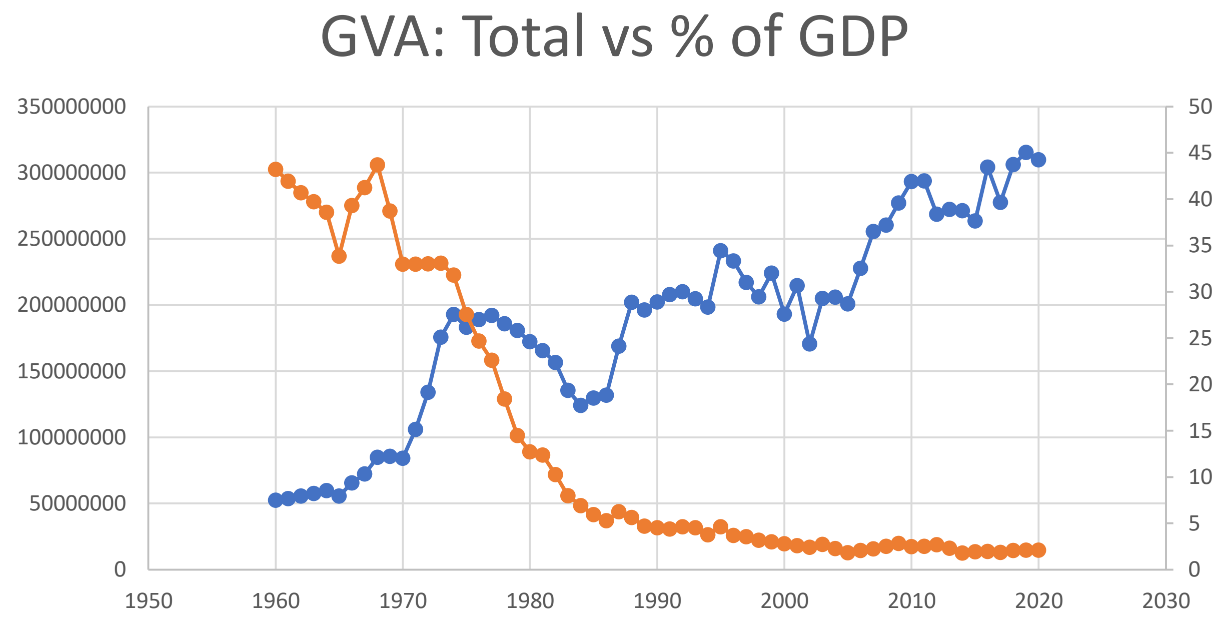
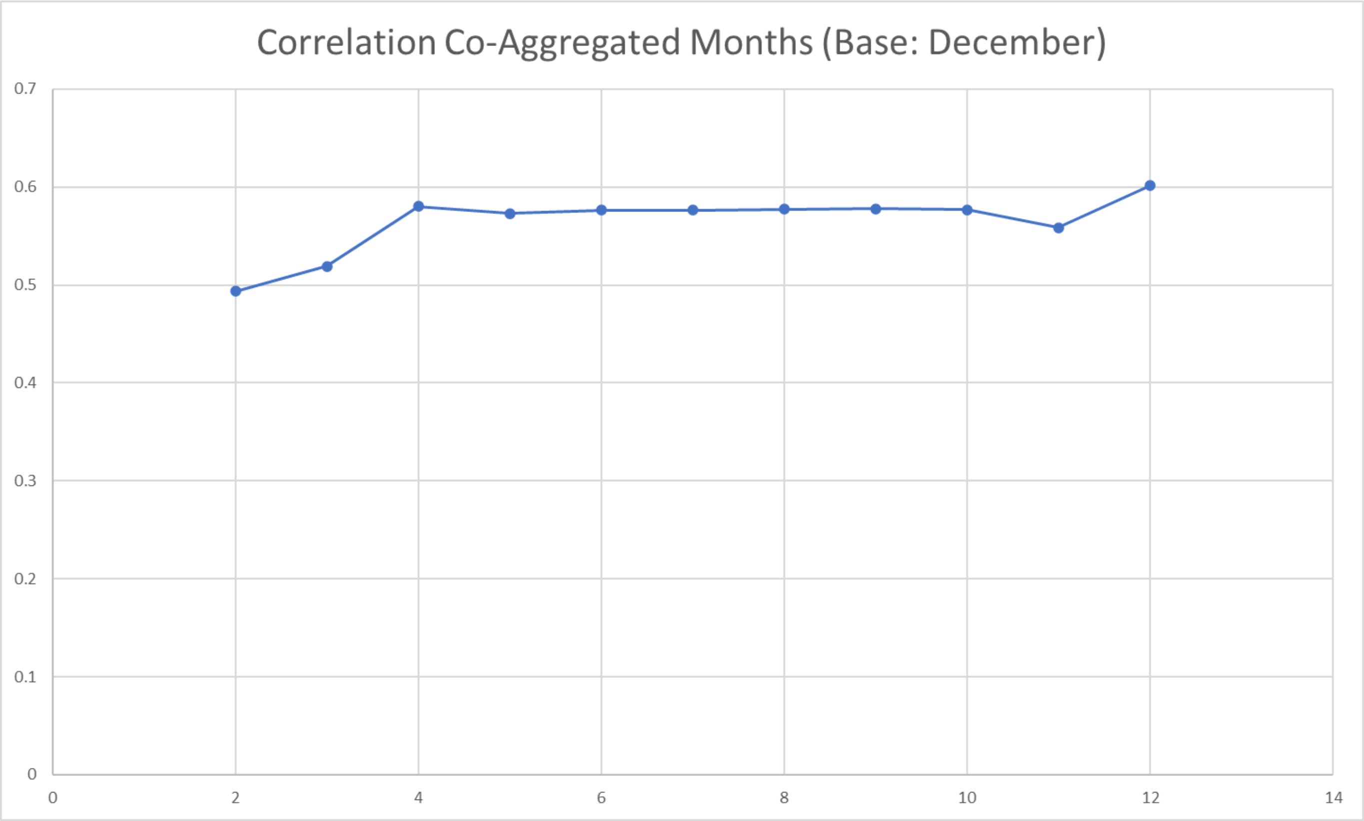


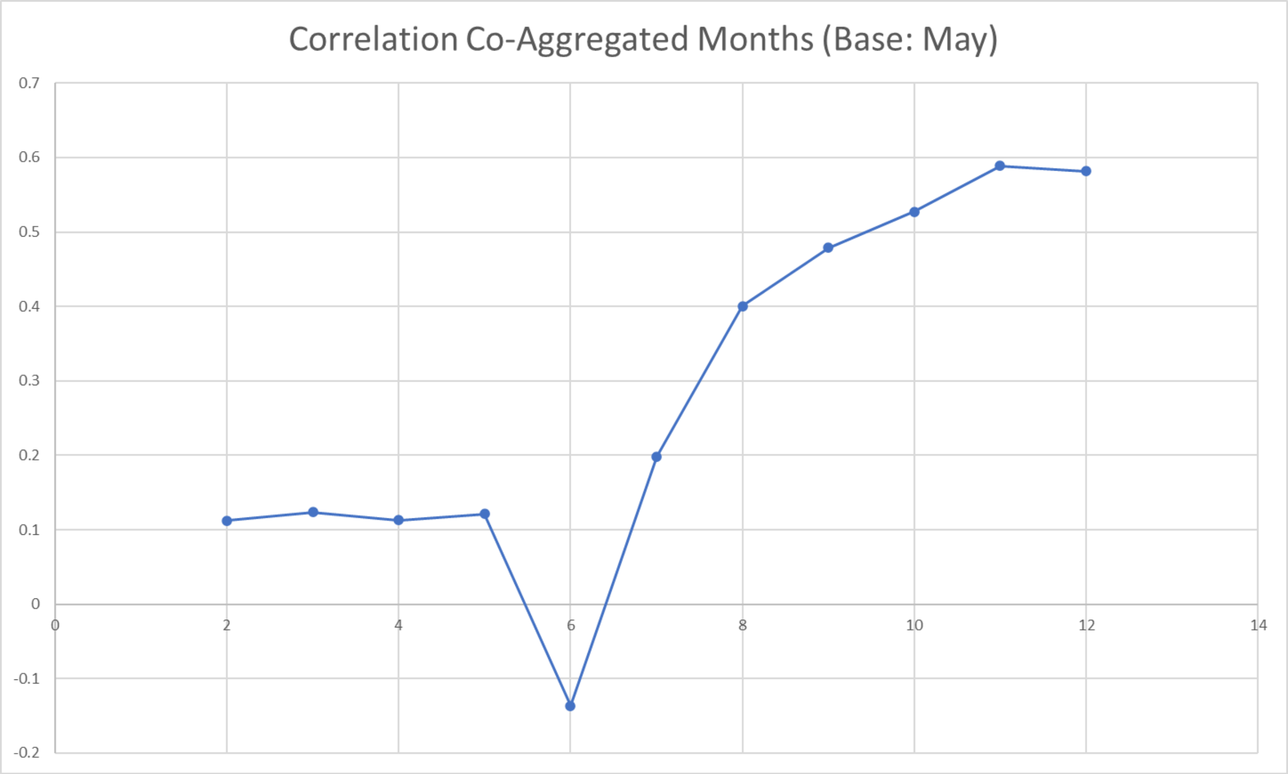
# The case of Botswana

Irrigated land: 0.0035%
Level of water stress: 1.6
Köppen index: 100% B (dry)



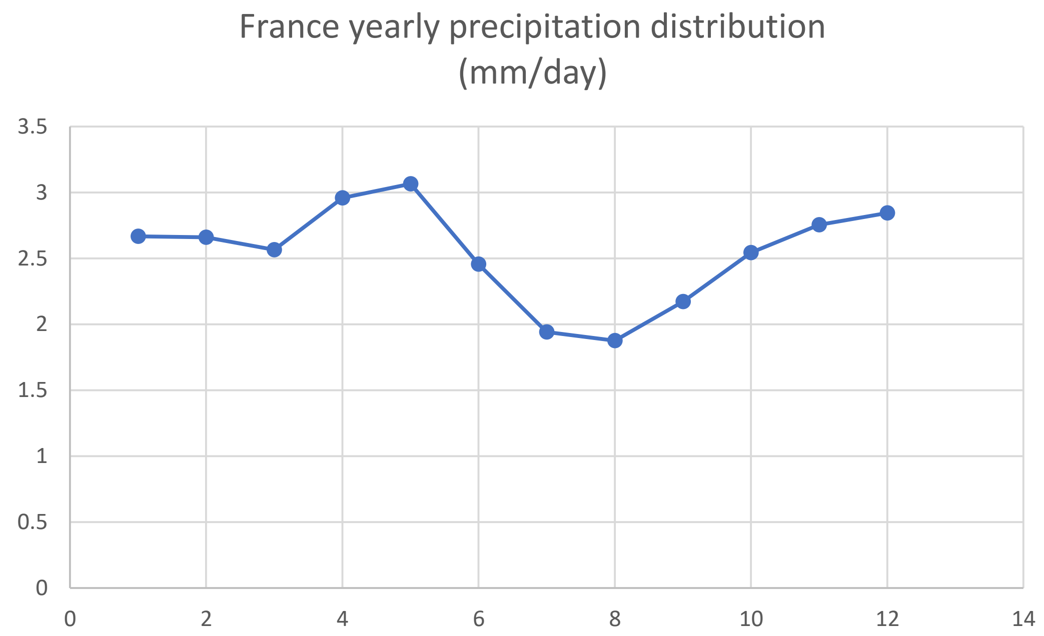



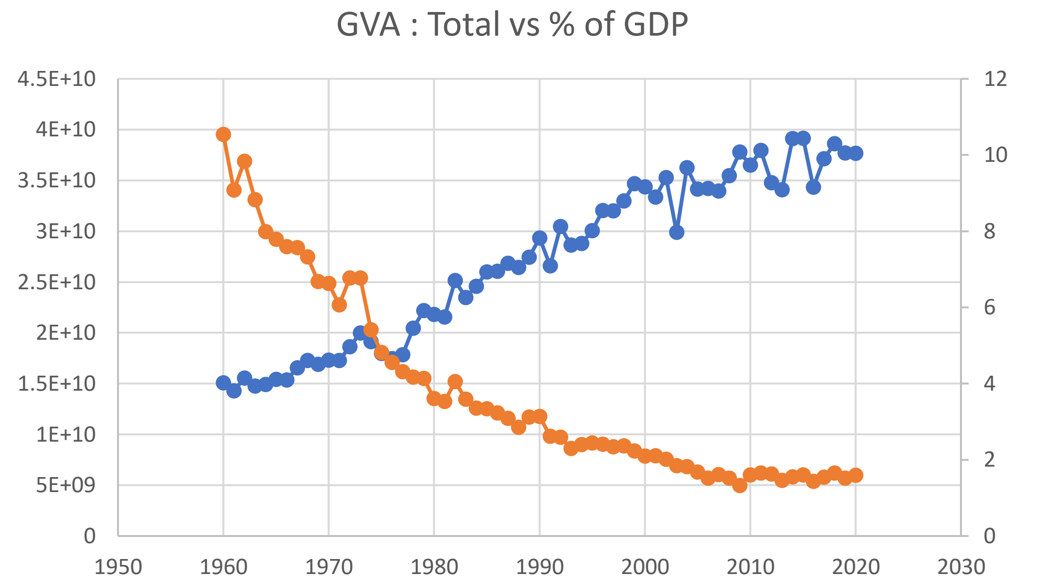

Correlation Co-Aggregated Months (Base: December)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
14

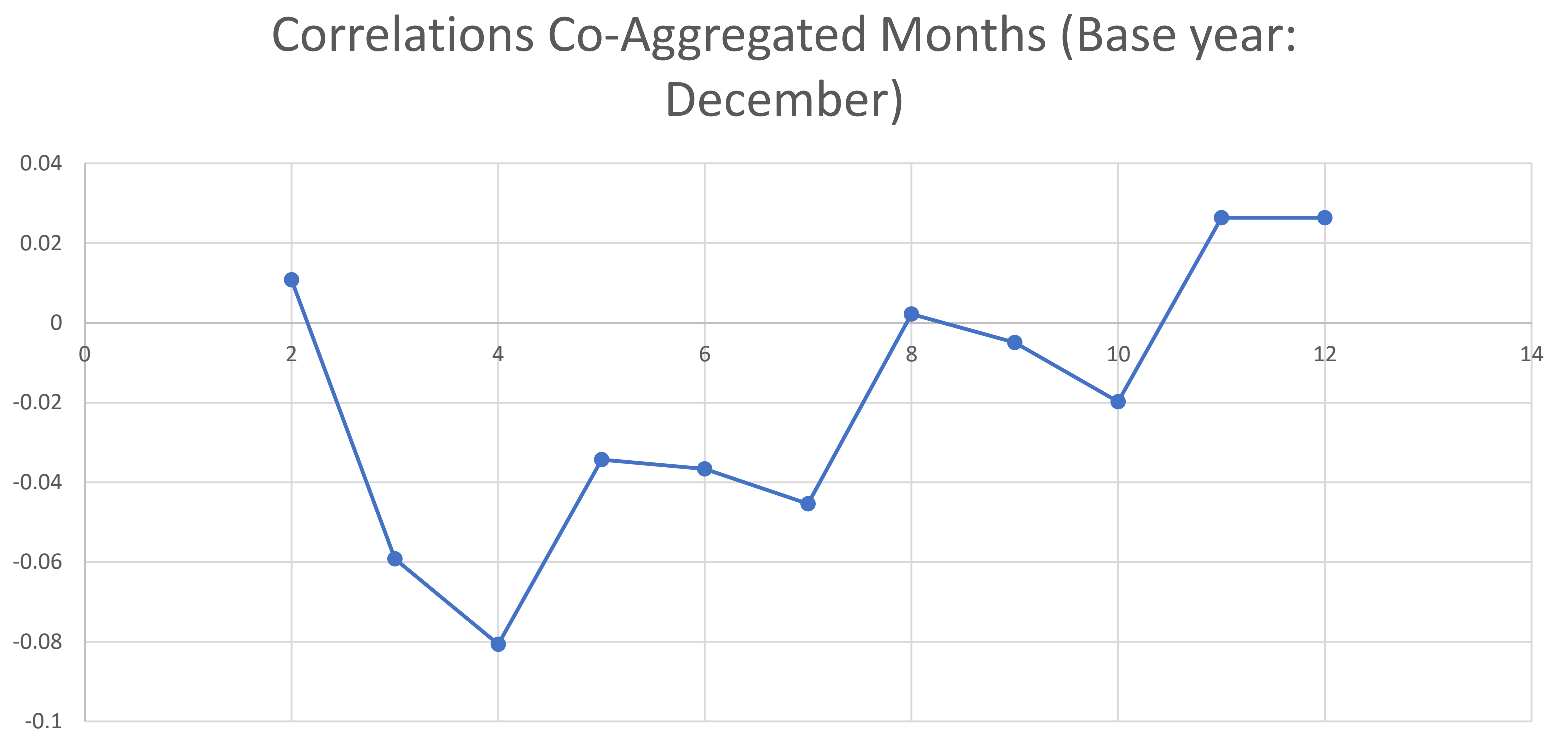

Correlation Co-Aggregated Months (Base: May)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
0
2
4
6
8
10
12
14

# The case of France

Irrigated Agri Land: 4.9%
Level of Water Stress: 29.39
Köppen index: 91% C (temperate)
7% D (continental)




Correlations Co-Aggregated Months (Base year: December)
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
0
2
4
6
8
10
12
14

# Conclusions

- GVA has an  increasing trend in absolute values for most countries, yet this trend is less pronounced when normalized with the population
- Developing countries with poor water infrastructure seem to be more sensitive to hydroclimatic variability
- The same countries for the same reasons keep small and incomplete data and the multi-scale (time)  analysis becomes difficult
- The crop-mix of each agricultural sector may be related taking into account smaller time frames
- Finding a holistic index for measuring the water infrastructure of each economy will provide a foundation for more rigorous analysis
- Type B (dry) Köppen index countries: present strong correlation during the wet periods
- Land use competition between water-energy-food sectors must be taken into account in the generic water resource-GDP relationship

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# Questions