DYNAMICS OF GLOBAL AGRICULTURAL PRODUCTIVITY AND DEMOCRATIC GOVERNANCE STRUCTURE: IMPLICATIONS FOR SUSTAINABLE FOOD SUPPLY

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Introduction

- governments and governance around the world have invested in agricultural and food systems research and development to **boost productivity and food security**
- globalisation, green gas effects, failure of governance and policy systems, environmental management technologies continue to impair progress towards self-sufficiency at family, national and sub-national levels
- lack of coherent policies and effective governance structure through appropriate democratic institutions are likely the cause of slow progress towards food and income security
- **democracy and dictatorship** regime types have continued to dominate the world's micro, macro and socio-economic environment
- the regime types either accelerate or exacerbate **sustainable** food sopply and systems

Research questions

- What is the global trend of agriculture contribution to GDP since 1960?
- What are the various governance (democratic or regime type) systems and how they affect agriculture contribution to GDP?
- Which governance structure has optimum agriculture contribution to GDP and what are the factors promoting it?

Methods

- data on average index of democracy for 167 countries for the years 2006-2021 was collected from EIU (2022)
- average agricultural productivity (1961-2022) in the form of contribution of agriculture to total GDP of the 167 countries was obtained from FAOSTAT (2022)
- the index was used to classify regime types into *Authoritarian* (A), *Full Democracy* (FD), *Flawed Democracy* (FLD), *authoritarian-hybrid* (AH) and *hybrid democracy* (HD)
- the data was analysed by estimating various **multilevel models** rather than *multiple linear models* (Doulas et. al., 2015)
- models estmated **fixed effects** of continents and regime type; **random effects** (do *continents or regime types* with more of a *regime type or continent* have better agriculture contribution to GDP compared to those with less or more?)

The model estimated is specified as shown below.

$$Y_{ij} = X_{ij^t}\beta + U_{ij^t}\gamma_i + \epsilon_{ij}$$

Where Y_{ij} = response of j-th member of cluster i, i = 1, . . . , m, j = 1, . . . , n_i; m = number of clusters; n_i = size of cluster i; X_{ij} = covariate vector of j-th member of cluster i for fixed effects, $\in R^p$; β = fixed effects parameter, $\in R^p$; U_{ij} = covariate vector of j-th member of cluster i for random effects, $\in R^p$; γ_i = random effect parameter, $\in R^p$; $\gamma_i \sim N_q(0, D)$, $D \in R_{q\times q}$, Σ_i = covariance matrix of error vector ϵ_i in cluster i, $\epsilon_i := (\in_{i1}.\,\vdots\, \in_{n_i}) \sim N_{n_i}(0, \Sigma_i)$, $\Sigma_i \in R^{ni\times ni}$; $\gamma_1, \ldots, \gamma_m$, $\epsilon_1, \ldots, \epsilon_m$ independent; D = covariance matrix of random effects γ_i. The various scenarios are in Table 1.

Table 1: Models estimated, variables and scenarios

Model*	Model type	Fixed intercept	Fixed effects**	Random Intercept	Factor***	Variances***
0	Linear	FI	.	.	.	.
1	Linear	FI	FE	.	.	.
2	Multilevel	FI	.	RI	x7	x8
21	Multilevel	FI	.	.	x8	x7
3	Multilevel	FI	.	RI	x7	.
31	Multilevel	FI	.	RI	x8	.
4	Multilevel	FI	.	.	x7	x8
41	Multilevel	FI	.	.	x8	x7
5	Multilevel	FI	FE	RI	x7	x8
51	Multilevel	FI	FE	RI	x8	x7
6	Multilevel	FI	.	RI	x7	.
61	Multilevel	FI	.	RI	.	x8
7	Multilevel	FI	FE	.	x7	.
71	Multilevel	FI	FE	.	x8	.

*y= Agricultural productivity, **Overall democracy score = x1, Electoral process and pluralism = x2, Functioning of government= x3, Political participation = x4, Political culture = x5, Civil liberties = x6. ***x7 = Regime type, x8 = Continent

Results

- countries which practice FD have lower agriculture contribution to GDP except those in the Middle East (Fig. 1 & 2)
- countries with high (20% & above) agriculture contribution to GDP practice imperfect democracy and they are in Africa, Asia, CIS, Oceania and South America, the only exception again being the Middle East (Fig. 2)
- mixed effect variances are wider between continents than between regime types (Fig. 3)
- mixed effect factors estimate a cut in the agriculture contribution to GDP of all Regime types except FD and all continents except North America (Fig. 4 & 5)
- countries in Africa and those not practicing **FD** should work towards cutting agriculture contribution to **GDP** by at least 50% through investing in higher productivity technology thereby reducing land and labour-intensive resources for promoting green economy. The free resources can be utilised in other sectors; particularly, food processing and supply chains; for greater efficiency to achieve sustainable food systems and supply.

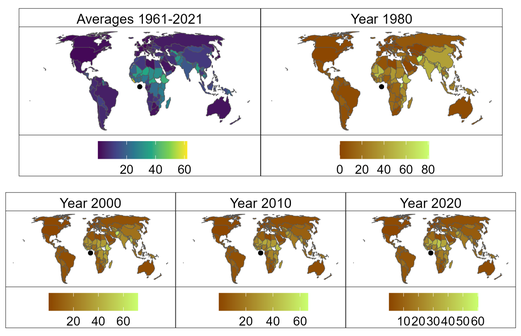

Figure 1: Global trend in agricultural contribution to GDP

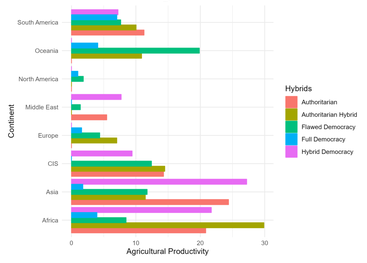

Figure 2: Continental mean of agriculture contribution to GDP of the various regime types

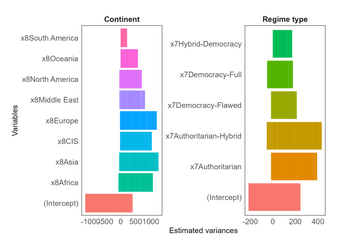

Figure 3: Estimated variances of agricultural productivity of various continents and regime types

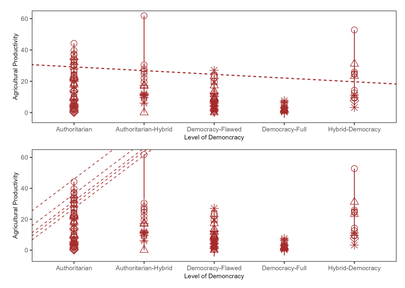

Figure 4: Estimates of fixed effects and random intercept/slope for regime types

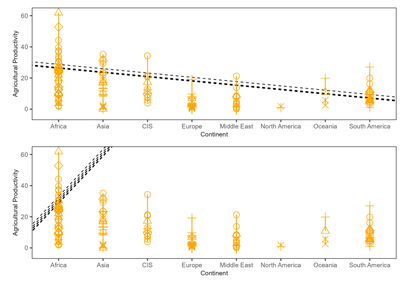

Figure 5: Estimates of fixed effects and random intercept/slope for continents

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Selected Poster prepared for presentation at the 2023 Agricultural & Applied Economics Association Annual Meeting, Washington DC: July 23- 25, 2023