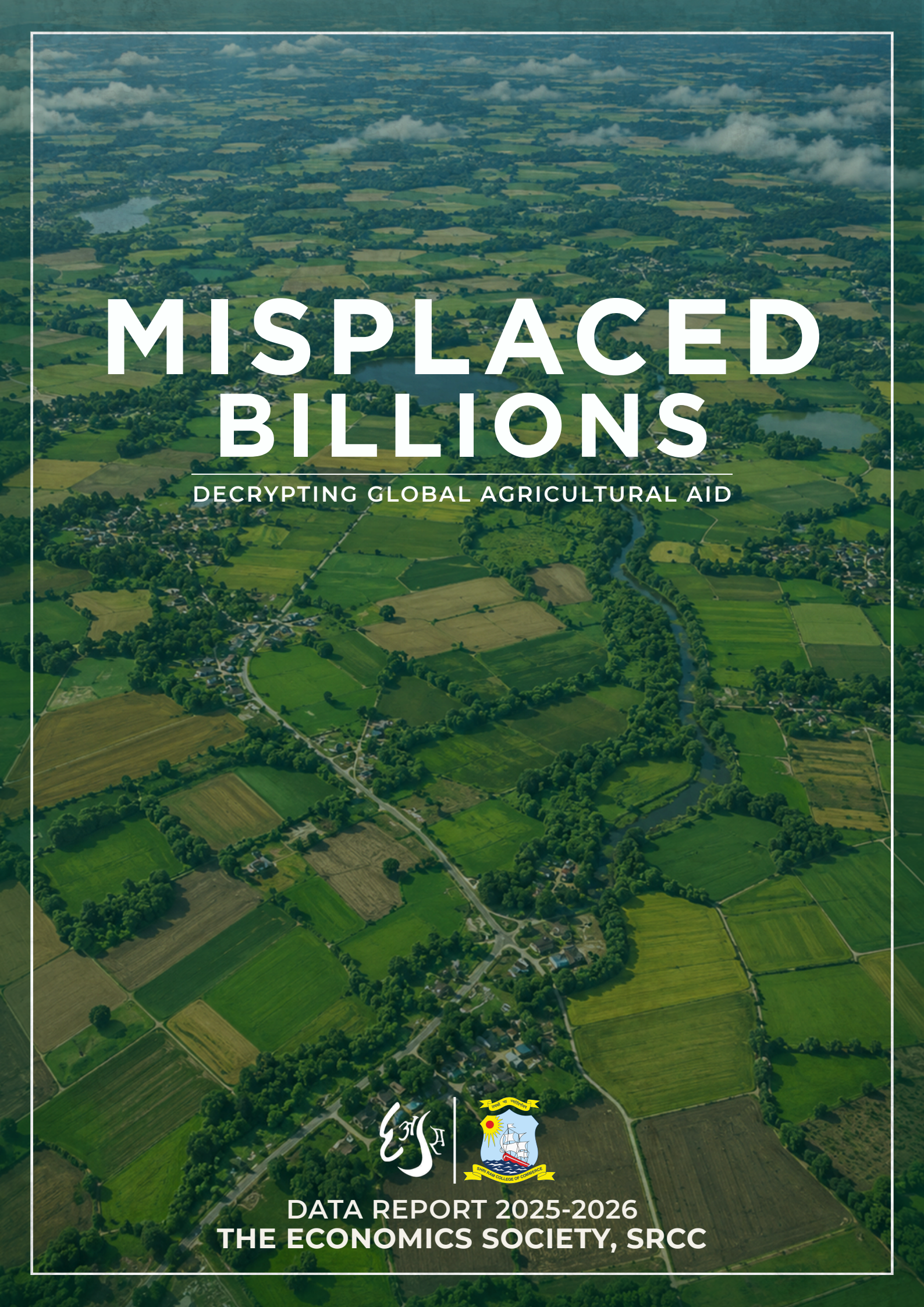


MISPLACED BILLIONS

DECRYPTING GLOBAL AGRICULTURAL AID

DATA REPORT 2025-2026

THE ECONOMICS SOCIETY, SRCC

TABLE OF CONTENTS

ABBREVIATIONS

S. No.	Abbreviation	Expanded Form
1	BC92	Battese and Coelli (1992) model specification
2	CEEW	Council on Energy, Environment and Water
3	DEA	Data Envelopment Analysis
4	EU	European Union
5	FAO	Food and Agriculture Organization
6	FE	Fixed Effects
7	GDP	Gross Domestic Product
8	GVA	Gross Value Added
9	ME	Metabolisable Energy
10	OECD	Organisation for Economic Co-operation and Development
11	OLS	Ordinary Least Squares
12	SFA	Stochastic Frontier Analysis
13	TE	Technical Efficiency
14	USD	United States Dollar

INTRODUCTION

The word 'agriculture' derives its meaning from the Latin words *ager* and *cultiva*, implying the cultivation of land; while 'subsidy' draws its roots from *subsidium,* meaning aid or reinforcement; comprehensively underlining what the report seeks to decipher and conclude: 'do agricultural subsidies translate into enhanced efficiency and productivity levels, or are they mere welfare transfers by the state?'.

The cornerstone of human civilisation, an industry that has deep, embedded roots in the very nature of our sustenance, driving employment, ensuring food security, spurring economic activity, and, at large, underpinning macroeconomic stability, is undoubtedly the agricultural sector. This significance is recognised *en masse* by governments and people in power across the globe, with ambitious targets set out for state-funded support, subsidies, and deployment of effective agricultural aid, all with the aim of enhancing overall returns and reaching welfare goals.

In an uncomplicated, isolated, and ideal premise, one might assume a direct relation, i.e., increased transfers in aid must routinely translate into greater productivity per capita, stabilisation of incomes, growth of the investment climate, and an overall conducive environment.

However, just as not all plants require the same amount of precipitation, the analysis of how effective these subsidies are underscores various other concerns and valid deliberations. While subsidies play a critical role in supporting vulnerable populations, their effectiveness in driving long-term productive gains remains ambiguous. The scale and intent of the state-backed funding exist, but market distortions and production constraints, which differ from country to country, impose significant fiscal burdens on the countries.

The OECD has reiterated such productivity debates repeatedly, condemning how large shares of agricultural support worldwide are not favourable to the economy and rather pose a threat to already unsustainable production ecosystems, often at the expense of long-term technological progress.

The driving question for our report is fundamental and intrinsically driven by a rather primitive premise, seeking to analyse if higher levels of government support are associated with more efficient agricultural production across 25 distinct countries, for an 11-year period.

By combining frontier-based efficiency estimation with panel econometric analysis, it seeks to contribute towards more meaningful and informed policy thesis and design, where subsidies are not only seen as instruments of support, but also as drivers of efficient and sustainable agricultural growth.

LITERATURE REVIEW

The report is an attempt to analyse the impact of state-backed subsidies on the productivity of the agricultural sector; it seeks to answer whether increasing subsidies or state funding towards different elements in the primary sector translates into increased efficiency, and if there exists a relation between the same. While no report structurally dissects the question in the same manner as we propose to, there are several variants of working papers and reports that break down the efficiency of agricultural subsidies at a macroeconomic level, which were referred to while we reviewed literature.

The *OECD's* **Agricultural Policy Monitoring and Evaluation Report 2025** covers 54 countries and 75% of global agricultural value to present a comprehensive view of the current subsidy context in relation to agricultural efficiency. Despite the substantial outlay of investment in agriculture globally, the report presents the misalignment in efficiency goals, which further leads to distortions. The report goes further to link different forms of subsidies as drivers of inefficiency, wherein almost two-thirds of the Producer Support Estimate is causing unsustainable investment practices and undermining the requisite investment in innovation. The recommendations are adept at differentiating between productivity-enhancing expenditure and market-distorting transfers, mentioning the need for better targeted support. It suggests that a mere focus on volume of subsidies is blinding to the idea that the type and targeting of support are equally relevant and can create a compounding effect on the overall enhancements.

Another localised but analytically congruent report titled **An analysis of the effect of agriculture subsidies on technical efficiency: Evidence from rapeseed production in China (Liu et al., 2024)** attempts to provide a critical assessment of agricultural subsidies and their contribution to the technical efficiency in the context of rapeseed production in China. This study establishes that in the case of a developing country, the subsidies provided to the agriculture sector are indeed significant contributors to productivity enhancement and provide the transformative leap to

reach a higher level of economic development. Using data analysis techniques like SFA (which is later discussed in the methodology section), the report endeavours to present a robust correlation between subsidy provision and the resultant technical efficiency. The distinctive finding of the report is that the subsidy provided has heterogeneous impacts across the different factors of production. There is also a mention of the threshold influence, i.e., a certain level until which the scale of farming is being improved, and there are marginal improvements attributed to an increase in subsidies. However, on larger holdings, the impact of subsidies is insignificant since the farmers are predisposed to financial advantages.

Another working paper by *OECD*, which had a conceptually similar approach to our analysis, titled **Measuring Industrial Subsidies: Some Conceptual Issues**, aided us in defining the scope of 'subsidies' for our report. It argued that subsidies must not be narrowly restricted to direct conspicuous transfers, but must also account for endogenous and hidden support provided by governments. It also reiterated a constant challenge we faced while estimating the subsidy support by highlighting that implicit subsidies are the most difficult to measure accurately, especially given that embedded credit aid forms a major proportion of agricultural subsidies. It also argued for the evaluation of subsidies to be done in a manner that separates the efficiency from desirability. Market failure rationale should not be used to justify the desirability of why a subsidy was given, and it should be ultimately measured against its welfare offsets as a whole.

Shifting the narrative to an Indian context in particular, we also reviewed the following literature to understand the subsidy landscape in India.

Agriculture is the backbone of the Indian economy, with over 60% of the population depending on agriculture for their livelihood, and about 58% of the total workforce being employed in agriculture. The sector provides essential food security to 1.4 billion people in the country, but it faces a decline as the nation shifts towards industrial advancement. To help revitalise the growth of the sector, the government has been aggressively providing financial support through a complex system of input subsidies provided primarily for fertilisers, power, irrigation, etc. While these subsidies successfully boosted production, they face criticism as they lead to overuse of resources and thus harm the environment. Moreover, as per the current situation, roughly 89% of the total subsidies are captured by medium

and large farmers, leaving only 11% for the small-scale farmers, a distribution pattern that exacerbates regional and social inequality.

A report, **"Overview of Agricultural Subsidies in India and Its Impact on Environment,"** which is included in the *Journal of the Current World Environment*, examines the allocation of funds under various subsidy schemes using secondary data from multiple Government sources. It highlights a major transition in the Indian agricultural context, a shift from low-input farming to intensive inorganic practices, and its severe impact on the environment. The report emphasises the fact that while subsidies facilitate technology adoption and food security, they also cause various negative environmental impacts such as water depletion, soil degradation due to overuse of subsidies, and biodiversity loss.

Additionally, the *Council on Energy, Environment and Water* (CEEW) report titled **Sustainable Agriculture in India 2021** identifies a significant imbalance in India's agricultural support. The government spends billions every year on fertiliser subsidies, yet merely 0.8 per cent on the National Mission for Sustainable Agriculture, therefore, showing a lack of focus on sustainable practices. This accentuates that the system is heavily focused towards an input-intensive farming, which penalises the farmers who wish to adopt sustainable techniques by reducing their access to these subsidies.

Gaps in the aforementioned report:

1. **Lack of specific technical efficiency modelling:** While the report provides a detailed descriptive analysis of government spending and input utilisation, it does not utilise any specific model to calculate the efficiency scores for the same.

2. **Limited Analysis:** The study outlines where and how the subsidies are utilised. However, it does not perform any regression analysis to show how exactly the change in subsidies affects the change in output.

METHODOLOGY

This research utilises panel data to evaluate the effectiveness of agricultural subsidies provided by the government across 25 selected countries over a span of 11 years. The analysis has been conducted using the software Stata as it is particularly suited for handling panel datasets and implementing regression and frontier-based models as opposed to software such as Microsoft Excel and at the same time it is user-friendly. The methodology proceeds in two stages.

First, country-wise agricultural production efficiency scores have been estimated by modelling the relationship between various production inputs and agricultural output using a Stochastic Frontier Analysis (SFA) model. The input variables were chosen to cover the key dimensions of labour, land use, capital, intermediate inputs, resource utilisation and external dependence (listed under parameter analysis). Agricultural production has been chosen as the output variable. This analysis provides us with time-varying technical efficiency scores for each country, which reflect the extent to which the country's output deviates from the estimated production frontier. By implementing this model on Stata, we obtained one efficiency estimate per country per year.

Second, the effectiveness of agricultural subsidies has been examined by analysing the relationship between the estimated production efficiency scores and government subsidy levels. The subsidy levels have been represented as a percentage of the agricultural production level of the country. A regression framework has been employed in which the production efficiency scores obtained from the SFA model are specified as the dependent variable and subsidies as the key explanatory variable. The estimated coefficient is interpreted as the marginal impact of subsidies on agricultural efficiency, thereby serving as a proxy for subsidy effectiveness. To capture both country-specific and overall effects, two model specifications are used. First, a country-wise regression is estimated using interaction terms to obtain individual subsidy efficiency coefficients for each country. The first model includes the lagged subsidy levels as well in order to account for the delayed nature of

subsidy impact. Second, a panel fixed-effects model (xtreg) is implemented to derive an overall measure of subsidy effectiveness while controlling for unobserved country-specific heterogeneity.

Data Description

A panel dataset of the required inputs and outputs of the 25 countries over the span of 11 years were collated from secondary sources. 10 input variables and a single output variable was collected in order to capture the production process of the agricultural sector. The output variable is defined as the total agricultural production (USD) and the selected input variables representing the key dimensions of agricultural production are:

- **Labour input:** Employment in agriculture (% of total employment)
- **Land-related inputs:** Agricultural land (% of land area), permanent cropland (% of land area), and area equipped for irrigation (thousand hectares)
- **Capital input:** Value of agricultural capital stock (USD millions)
- **Intermediate inputs:** Fertiliser consumption (kg per hectare), pesticide usage (g per unit of output)
- **Resource utilisation:** Annual freshwater withdrawals for agriculture (% of total freshwater withdrawal)
- **External dependence and support inputs:** Agricultural raw material imports (% of merchandise imports) and feed input measured through metabolisable energy (ME)

In cases where one or two data points were unavailable for a specified parameter, the method of linear interpolation was employed for data filling to obtain a balanced dataset. This method assumes a constant rate of change between adjacent observed data points

No scaling, standardisation, or normalisation of the variables has been carried out prior to the SFA estimation. This is in line with standard practice in Stochastic Frontier Analysis (SFA), where the functional form of the production function, typically specified in logarithmic terms, accounts for differences in magnitude across variables. In this model, since coefficients are interpreted as elasticity, the application of transformations on the variables can distort the underlying economic function. Retaining the original scale of the data ensures that the model's decomposition into random noise and inefficiency components reflects actual economic variation and not the adjustments made during scaling, standardisation, or normalisation.

Thus, the original dataset has been used after applying only a logarithmic transformation using estimation in order to linearise multiplicative relationships.

Prior to running the linear regression, subsidy levels were divided by the country's agricultural production level of the corresponding year. Thereby, the regression coefficient acts as a proxy for subsidy effectiveness becomes comparable across countries with agricultural sectors of different sizes. The subsidy levels were transformed as follows:

```
gen subsidies_billions = subsidies /
1000000000
```

Estimation of Agricultural Efficiency: Stochastic Frontier Analysis (SFA)

Stochastic Frontier Analysis (SFA) is an econometric approach used to estimate the technical efficiency of production units, in this study individual countries, by comparing observed output to a theoretically optimal production frontier. In this analysis, the production process was defined in terms of the selected agricultural inputs being converted into agricultural production. The framework was applied to estimate the efficiency of agricultural production across countries.

The SFA model explicitly separates the deviations from the frontier into the components of random noise and inefficiency.

$$\ln Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k \ln X_{kit} + v_{it} - u_{it}$$

- $\mathbf{Y_{it}}$: The logarithm of agricultural output for country *i* at time *t*
- $\mathbf{X_{kit}}$: The logarithm of the k^{th} agricultural input
- $\boldsymbol{\beta_k}$: The output elasticities of the respective inputs
- $\mathbf{V_{it}} \sim N(0, \sigma_v^2)$: random shocks affecting agricultural production
- $\mathbf{U_{it}} \sim N(0, \sigma_u^2)$: technical inefficiency in agricultural production

Data Preparation and Model Estimation

In order to process panel data using Stata, the dataset must first be declared as panel data. This specifies to Stata that the panel unit is a country with time being the variable, thus enabling further analysis. The dataset was declared as a panel using the command:

```
xtset country_id Year
```

All input and output variables were transformed into their natural logarithmic forms using the commands:

```
gen lnO1 = ln(O1)
gen lnI1 = ln(I1)
gen lnI2 = ln(I2)
...
gen lnI10 = ln(I10)
```

Here, O1 represents the output

variables while I1, I2, … I10 represent the input variables. A logarithmic transformation allows us to interpret the output as the elasticity of agricultural output with respect to the inputs. As previously mentioned, it also linearises the multiplicative production relationship.

The Battese and Coelli (1992) specification (model(bc92)) was chosen for this study as it is designed for panel data settings and allows inefficiency to vary over time, as is the case in the context of agricultural production. The following command was used to estimate the stochastic frontier model:

```
sfpanel lnO1 lnI1 lnI2 ... lnI10, model(bc92)
```

Estimation of Inefficiency and Efficiency Scores

Following estimation of the stochastic frontier, the inefficiency component $u_{it} \sim N(0, \sigma_u^2)$ was predicted using the command:

```
predict u_bc92, u
```

This provided estimates of the degree of inefficiency in agricultural production for each country-year observation. By construction, u_{it} is greater than or equal to 0.

From an interpretation standpoint, higher values of u_{it} indicate that a country operates further below the modelled agricultural production frontier, and hence is more inefficient in utilising its inputs.

Mathematically the relationship between technical efficiency and the degree of inefficiency have the following relationship and is bounded as:

$$\mathbf{TE}_{it} = \exp(-u_{it})$$

$$0 < \mathbf{TE}_{it} \leq 1$$

From an interpretation standpoint:

- $\mathbf{TE_{it}} = 1$ means the country operates on the agricultural production frontier (fully efficient)
- $\mathbf{TE_{it}} < 1$ means the country exhibits inefficiency in converting inputs into agricultural output

Thereby, the following command was used to obtain the technical efficiency scores:

```
gen te_bc92 = exp(-u_bc92)
```

Finally, the estimated efficiency scores were extracted using the command:

```
list country te_bc92
```

Hence, one agricultural efficiency score per country per year was obtained. The output captures the time-varying efficiency of agricultural production. These scores were subsequently used to estimate the degree of the relationship between subsidies and the efficiency of agricultural production across countries.

Note on Alternative Method: Data Envelopment Analysis

In addition to the SFA approach, a Data Envelopment Analysis (DEA) framework was also explored to estimate agricultural efficiency, but was not adopted as it lacked sufficient discriminatory power. Contrasting to the SFA model, DEA is a non-parametric method that constructs a piecewise linear production frontier using linear programming techniques and measures efficiency relative to this empirical frontier. Unlike SFA, DEA does not impose a functional form on the production process. Unlike the SFA model that classifies deviations into two components - inefficiency and statistical noise, DEA attributes all deviations from the estimated frontier to inefficiency and does not account for statistical noise.

The DEA-based estimates were not adopted in the final analysis due to issues of overfitting. In the output, a large proportion of efficiency scores for countries equaled one (i.e., classified as fully efficient). This is a well-known limitation of DEA, particularly in contexts with high dimensionality (many inputs) relative to the number of observations, as the method tends to place a significant number of units on the frontier. In such cases, even moderately performing units may appear efficient because the model lacks sufficient discriminatory power. Thereby, DEA was deemed less suitable for the study, and SFA was preferred as it provides a statistically grounded framework that separates inefficiency from random variation and yields more reliable efficiency estimates.

Regression: Econometric Estimation of Subsidy Efficiency

Following the estimation of agricultural efficiency scores using SFA, a regression-based approach was adopted to evaluate the effectiveness of subsidies. Regression is a statistical method used to estimate the relationship between a dependent variable and one or more explanatory variables. In this study, the efficiency scores obtained from the SFA model were regressed on subsidy percentage levels to quantify and estimate the effect of an increase in subsidy share equal to 1 percentage point on agricultural production efficiency.
The baseline model was defined as:

$$Efficiency_{it} = \alpha + \sum_{j=1}^{N-1} \delta_j D_{ij} + \beta_1 S_{it} + \sum_{j=1}^{N-1} \gamma_j \left(D_{ij} S_{it}\right) + \beta_2 L\left(S_{it}\right) + \sum_{j=1}^{N-1} \theta_j \left(D_{ij} L\left(S_{it}\right)\right) + \varepsilon_{it}$$

- α: The intercept for the reference country, i.e., Argentina, when current and lagged subsidy percentages are zero
- **D_i**: Country dummy variables (with one omitted reference country)
- δ_i: The difference in intercepts relative to the reference country
- **S_{it}**: Current subsidy as a percentage of agricultural GDP
- β_1: the current subsidy coefficient for the reference country
- γ_i**:** The difference in current subsidy effects for country i relative to the reference country
- **$L(S_{it})$**: Lagged subsidy as a percentage of agricultural GDP
- β_2: Lagged subsidy effect for the reference country
- θ_j: Additional lagged effect for country *j*
- **i_t**: Error term

Thus, the current country-specific subsidy coefficient is given by:

$$\beta_i = \begin{cases} \beta & \text{for the reference country} \\ \beta + \gamma_i & \text{for other countries} \end{cases}$$

The regression output produces different $\beta+\gamma_i$ coefficients for each country, each representing the effect of current subsidy share on agricultural production efficiency within that country. The coefficient is used as a proxy for subsidy efficiency as it measures the extent to which changes in subsidy as a percentage of agricultural GDP can be associated with changes in agricultural production efficiency. The desired model was thereby constructed by allowing this coefficient to vary across countries as it provides country-specific estimates of subsidy effectiveness, enabling a comparative analysis across the 25 countries.

Hence, the regression output also produces different $\beta_2 + \theta_j$ coefficients for each country, each representing the effect of the previous year's subsidy share on current agricultural production efficiency within that country. This lagged coefficient is used as a proxy for the delayed impact of subsidy policy, as it measures the extent to which changes in subsidy as a percentage of agricultural GDP in the preceding year are associated with changes in current agricultural production efficiency. By allowing this coefficient to vary across countries, the model captures differences in how long subsidy effects take to materialise across agricultural systems.

The regression analysis was done on Stata using the command:

```
regress Efficiency
i.country_id##c.subsidy_pct
i.country_id##c.L_subsidy_pct,
robust
```

This function included country-specific intercepts via `i.country_id` country-specific current subsidy coefficients via the interaction terms

`i.country_id#c.subsidy_pct`, and country-specific lagged subsidy coefficients via the interaction terms `i.country_id#c.L_subsidy_pct`

This specification allowed both the immediate and delayed effects of subsidy share on agricultural efficiency to vary across countries.

Panel Estimation of average cross-country subsidy effect (Fixed Effects Model)

To analyse the overall cross-country efficiency of agricultural subsidies, a Fixed Effects (FE) panel regression model was implemented using the xtreg command in Stata. This model is designed for panel data and allows for the control of unobserved, time-invariant heterogeneity across countries, such as geographical conditions, institutional structures, or long-term policy environments, which may influence agricultural production efficiency but are not directly observable.

The fixed effects model was defined as:

$$Efficiency_{it} = \alpha_i + \beta_1 SubsidyPct_{it} + \beta_2 SubsidyPct_{i,t-1} + \varepsilon_{it}$$

- **$Efficiency_{it}$**: Agricultural efficiency for country i at time t
- **$SubsidyPct_{it}$**: Current subsidy share (% of agricultural GDP)
- α_i: Country-specific fixed effects, i.e., all unobserved factors that are constant over time for each country
- β_1: Coefficient capturing the effect of the subsidy in the same time period.
- β_2: Coefficient capturing the delayed effect of the subsidy
- ϵ_{it}: The error term

Unlike the previous regression model, which allowed the subsidy coefficient to vary across countries, the fixed effects specification estimates a single common coefficient β_1 and β_2 that aims to quantify the average marginal impact and average delayed marginal impact of a change in subsidies (as a percentage of agricultural GDP) and on agricultural production efficiency across the entire sample of 25 countries.

The following code was run on Stata to generate the lagged efficiency scores:

```
gen L_subsidy_pct = L.subsidy_pct
```

The model was implemented in Stata using the command:

```
xtreg Efficiency subsidy_pct
L.subsidy_pct, fe vce(robust)
```

The inclusion of the lagged subsidy variable (L.subsidy_pct) allows the model to account for delayed or persistent effects of agricultural subsidies over time, recognising that current production efficiency may be influenced not only by current subsidy levels but also by subsidy support provided in the previous

period. The fe option specifies the fixed effects estimator, while vce(robust) ensures that the estimated standard errors are robust to heteroskedasticity and serial correlation.

By controlling for country-specific fixed effects, the model effectively isolates the within-country variation over time and thereby ensures that the estimated coefficients β_1 and β_2 reflected the impact of changes in subsidies (percentage) and lagged subsidy (percentage) on changes in agricultural performance, rather than differences across countries. This provides a global benchmark measure of subsidy efficiency, complementing the country-specific estimates obtained from the previous regression model.

Note on Alternative Model Specifications

In addition to the baseline regression models, several alternative specifications were explored to enhance the robustness of the analysis. In particular, regression models incorporating additional control variables besides subsidies such as the Producer Price Index (2014–2016 = 100), access to electricity in rural areas (% of rural population), and precipitation levels were estimated to account for macroeconomic conditions, infrastructure, and climatic factors that may influence agricultural production efficiency. However, the inclusion of these controls significantly increased the dimensionality of the model, leading to computational challenges in Stata. Specifically, the estimation procedure encountered convergence issues and excessive iterations. Consequently, these specifications were not retained.

Further, a rolling regression approach was also explored, wherein subsidy efficiency was estimated over moving time windows (i.e., three-year periods) for each country. While this approach was intended to capture short-term dynamics in subsidy effectiveness and compare these across time, it presented several limitations. The reduced sample size within each window led to overfitting, with coefficients becoming highly sensitive to small variations in the data. Given these constraints, the rolling regression approach was deemed unsuitable.

PARAMETER ANALYSIS

The dataset comprises one output variable and ten input variables, structured across six production dimension categories. Together, these parameters offer a comprehensive lens to assess the agricultural production landscape across 25 countries over an 11-year panel.

Output Variable

O_1 – Agricultural Production (1,000 USD)

The variable is defined as the monetary value of agricultural production in thousands of US dollars. This includes agricultural production such as crops and livestock. By using monetary values rather than physical quantities, this variable can aggregate various types of agricultural products. In addition, using monetary values can facilitate cross-country comparison. This is the dependent variable in the SFA model. It reflects the overall productive performance of agricultural production in a country based on how well the country can convert its inputs into outputs.

Labour Input

I_1 – Employment in Agriculture (% of Total Employment)

This represents the proportion of the total workforce employed in the sector of agriculture, forestry, and fishing. A higher agricultural workforce indicates a labour-intensive production structure, often associated with lower levels of mechanisation and traditional farming systems. By introducing this indicator, the analysis aims to identify the extent to which the country's agricultural sector is based on human capital as the principal production factor.

Land-Related Inputs

I_4 – Agricultural Land (% of Land Area)

This indicator reveals the share of a country's total land area that is used for agricultural purposes. Agricultural areas include arable lands, permanent crops, and permanent pastures. This shows that if a country has a larger agricultural resource base, this is because of its geographical location and its agricultural policies. This is important because it can help compare agricultural resources

between different-sized countries.

I_7 – Permanent Cropland (% of Land Area)

This figure reflects the proportion of permanent crops, those that do not require replanting after each harvesting period, such as fruit trees, vineyards, and coffee plantations. A high proportion of permanent crops is a good indicator of a structurally differentiated agricultural system. By including this variable, it is possible to account for land composition in the estimation of the production frontier, especially in those countries where tree crops are a significant part of agriculture.

I_{10} – Area Equipped for Irrigation (1,000 hectares)

This indicator refers to the total agricultural area equipped with irrigation infrastructure, without regard to actual water utilisation. An increase in the agricultural area equipped with irrigation infrastructure implies the state's ability to cultivate crops year-round or in multiple seasons, thereby reducing the state's dependence on rainfall variability. This parameter provides a supplement to the state's freshwater withdrawal by considering the infrastructure aspect of water-based agriculture, which illustrates the expansion of the state's agricultural land productivity due to investment in infrastructure.

Capital Input

I_9 – Value of Agricultural Capital Stock (USD millions)

This figure shows the total value of capital used in agriculture, including machinery, equipment, irrigation systems, and livestock. An increase in this value indicates that more mechanisation and modernisation of agriculture are taking place, and this usually implies higher productivity. This variable is used to assess how expansive a nation's agriculture investment strategy is, as well as a comparison of capital-intensive and labor-intensive production techniques.

Intermediate Inputs

I_2 – Fertiliser Consumption (kg per hectare of arable land)

This parameter looks at the degree of application of fertilisers per unit of arable land. This includes nitrogen, phosphate, and potassium. A higher application rate is usually associated with higher production. However, a very high ratio of application to production may suggest that there is inefficiency in the management of inputs. This parameter shows how far chemical inputs are being used to produce agricultural output. This model is able to identify which countries are using input intensity to produce agricultural output.

I_6 – Pesticide Usage (g per unit of agricultural production in Int$)

This indicator monitors the volume

of pesticides used, relative to the value of agricultural output. A high volume of pesticides per unit of output could be an indicator of poor financial management in controlling agrochemicals. It could also be an indicator of overreliance on chemical pesticides. The addition of this factor will allow us to pinpoint nations with similar output but lower pesticide use, thus being more efficient in agricultural production.

Resource Utilisation

I_5 – Annual Freshwater Withdrawals – Agriculture (% of Total Freshwater Withdrawal)

The above figure represents the percentage of a country's total water withdrawals that are assigned to agriculture. A high percentage may imply that a country is relying heavily on water-intensive agriculture, and a low percentage may imply that a country is using water efficiently or is relying on rain-fed agriculture. This parameter can be used to understand the stability and sustainability of agriculture by determining how much of a country's water is being used for Agriculture.

External Dependence and Support Inputs

I_3 – Agricultural Raw Materials Imports (% of Merchandise Imports)

This figure represents the extent to which a country relies on external sources for supply of agricultural raw materials like raw hides, wool, and cotton. A higher value of this share may reflect structural specialisation in processing rather than primary supply, or difficulties in supply that may arise in global commodity markets. This parameter puts cross-country differences in self-sufficiency and supply structure in agriculture in context in the frontier estimation.

I_8 – Feed Input – 1,000 Mcal of Metabolisable Energy (ME)

This indicator is a representation of total metabolisable energy derived from animal feeds consumed by livestock, measured in thousands of megacalories. Feed costs are the main cost drivers in animal production, and ME is a standardised unit of measuring animal production intensity. High ME values indicate a large animal production component in a given sector of agriculture. This parameter is of significant importance in countries such as the United States, Australia, and Argentina, where animal production is a large component of total output and must be well represented in the production frontier.

COUNTRY PROFILES

Decoding agricultural efficiency across 25 economies

ARGENTINA

GDP: $646.08B | AGRICULTURAL SUBSIDIES: $-9.01B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0255

REGRESSION

OLS | Scaled up by 1000 | No Lag

0.0090

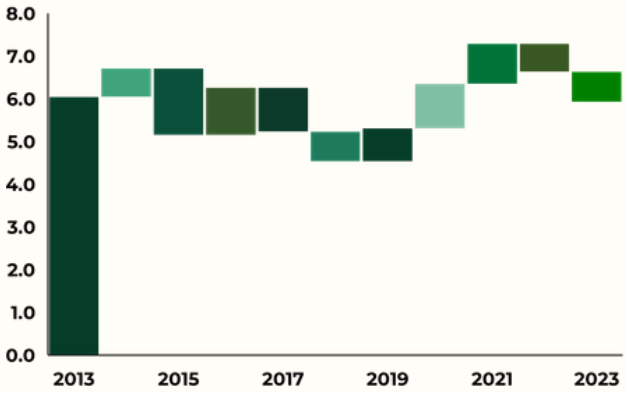
LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

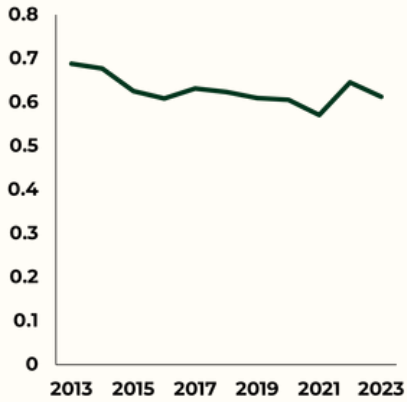
-0.0037

BROAD OVERVIEW

AGRI IMPORTS & EXPORTS
(% of Merchandise)

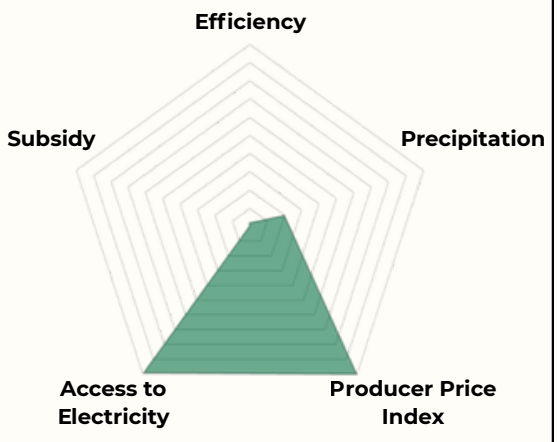


VALUE ADDED BY AGRICULTURE
(% of GDP)

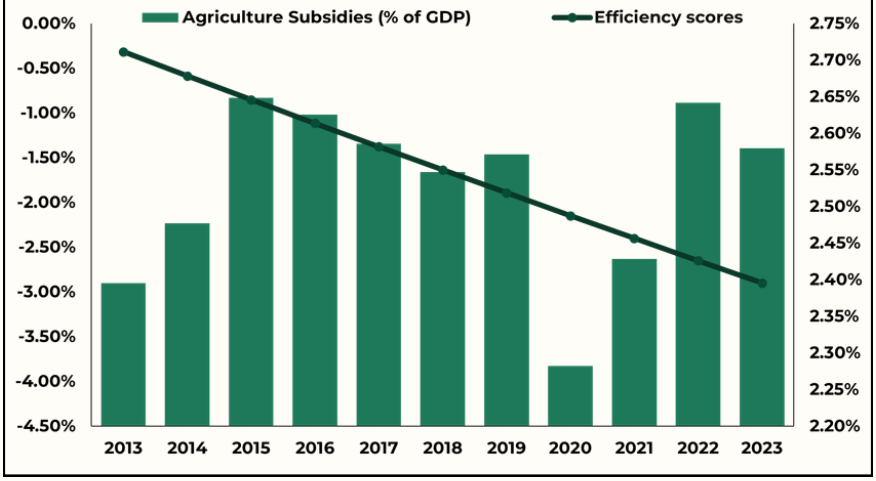


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Negative Subsidies:** Argentina's agricultural subsidies are consistently negative, reflecting a structural policy of extracting revenue from the sector rather than supporting it.
2. **Lagged Reversal:** The current regression coefficient is positive, but the lagged coefficient turns negative, suggesting that any positive effects of subsidies may be short-lived and do not persist.
3. **Resilient But Constrained:** The declining efficiency trend alongside persistent net taxation suggests long-run productive capacity is being gradually eroded.

AUSTRALIA

GDP: $1728.06B | AGRICULTURAL SUBSIDIES: $2.63B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0782

REGRESSION

OLS | Scaled up by 1000 | No Lag

0.0105

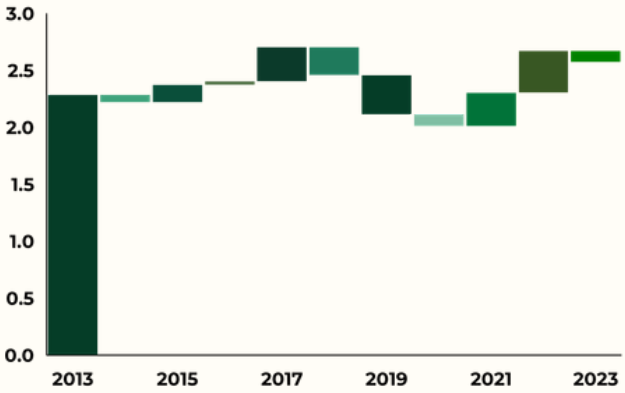
LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

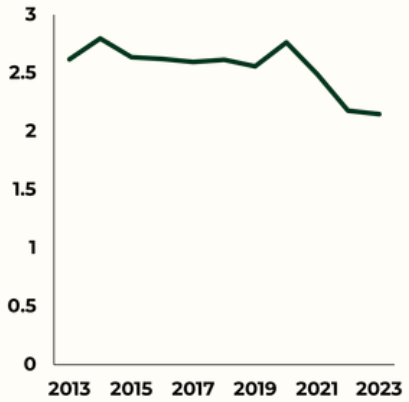
-0.4601

BROAD OVERVIEW

AGRI IMPORTS & EXPORTS
(% of Merchandise)

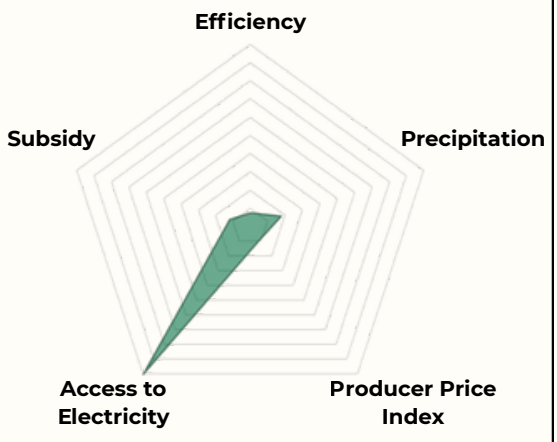


VALUE ADDED BY AGRICULTURE
(% of GDP)

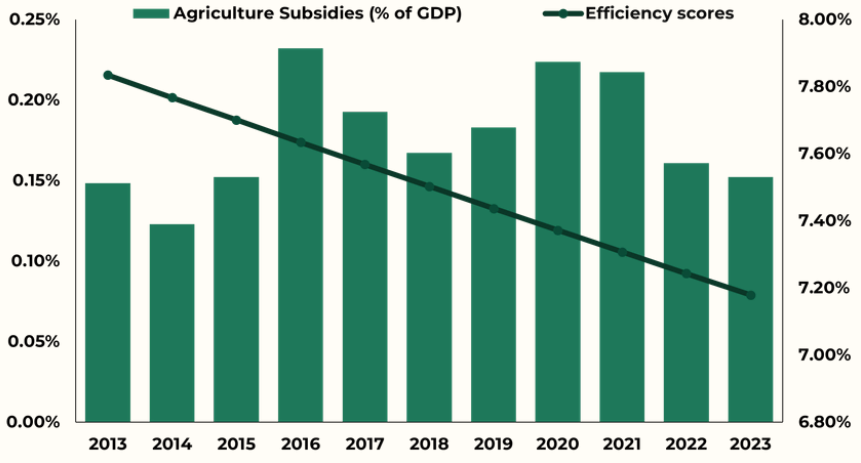


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Inverse Spending Trend:** Subsidies remained elevated after 2018 while efficiency scores declined steadily, indicating an inverse relationship between expenditure and productive output.
2. **Insignificant Transmission:** Current subsidy effect is insignificant (p = 0.996); the lagged coefficient is negative (−0.00046), referring to better welfare-transfer dominance.
3. **Sectoral Overview:** A structurally strong agri sector with high baseline efficiency does not mean subsidies result in efficiency gains, pointing to misallocation and diminishing productive returns.

AUSTRIA

GDP: $511.69B | AGRICULTURAL SUBSIDIES: $1.39B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0153

REGRESSION

OLS | Scaled up by 1000 | No Lag

0.0614

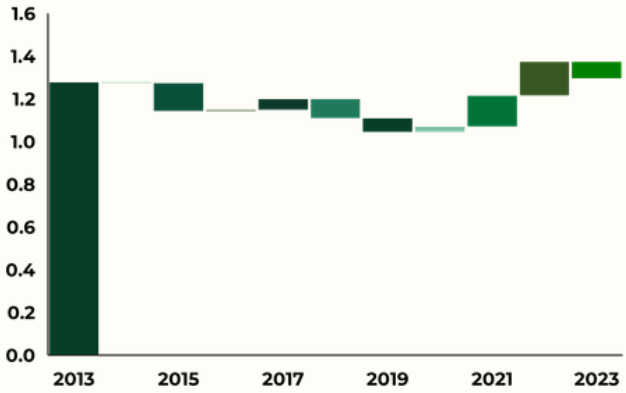
LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

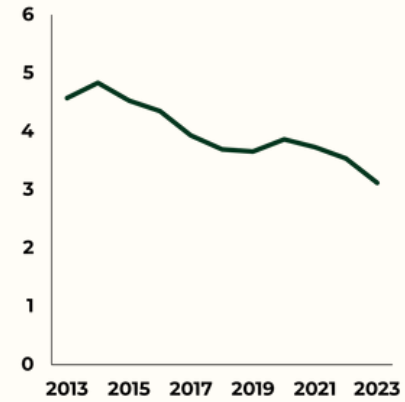
0.1034

BROAD OVERVIEW

AGRI IMPORTS & EXPORTS
(% of Merchandise)

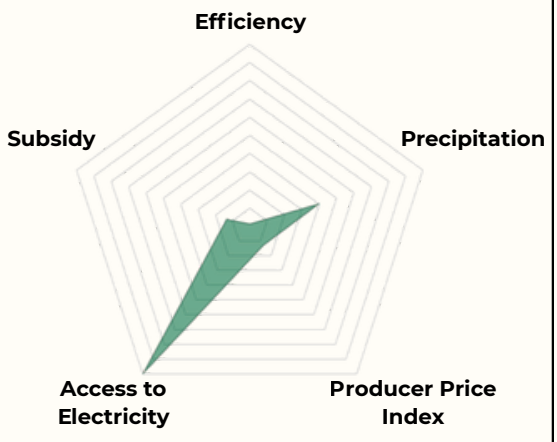


VALUE ADDED BY AGRICULTURE
(% of GDP)

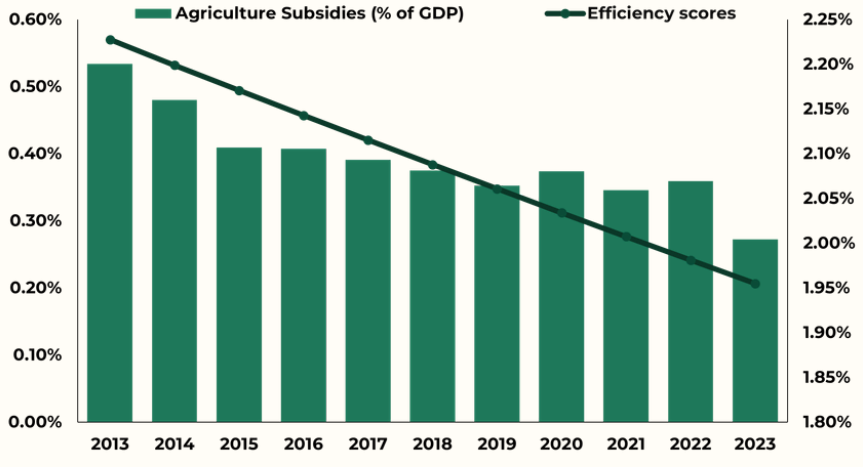


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Contracting Sector:** Employment in the agricultural sector and value-added have declined over the years, suggesting structural discrepancies rather than subsidy-driven growth.
2. **Regression Outlook:** Both subsidy coefficients are insignificant (inferred from negligible p-values), confirming subsidies have no measurable effect on efficiency.
3. **Productivity Impact:** Sluggish efficiency scores and statistically insignificant results suggest subsidies are functioning purely as income support with negligible productivity impact.

BELGIUM

GDP: $644.66B | AGRICULTURAL SUBSIDIES: $0.63B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0269

REGRESSION

OLS | Scaled up by 1000 | No Lag

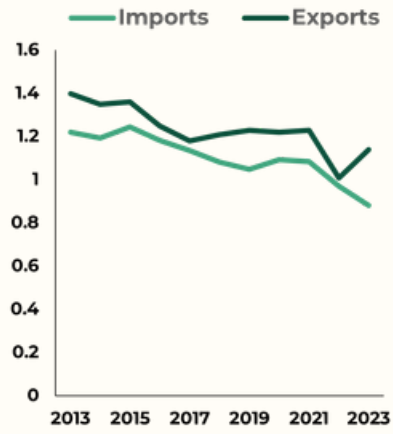
0.1009

LAGGED REGRESSION

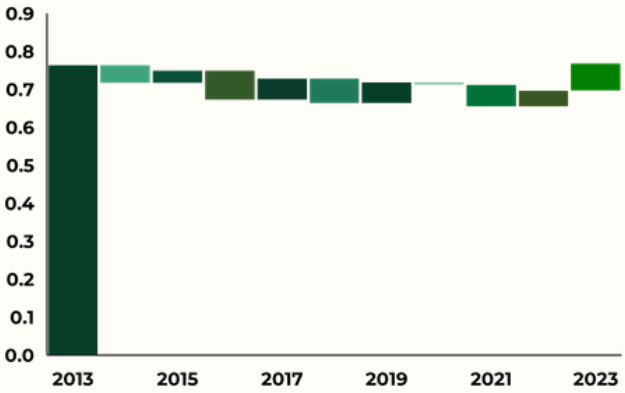
OLS | Scaled up by 1000 | 1-Year Lag

0.1138

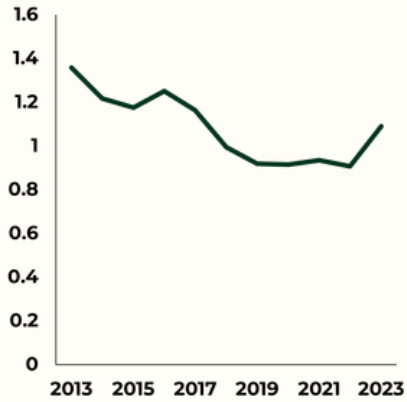
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

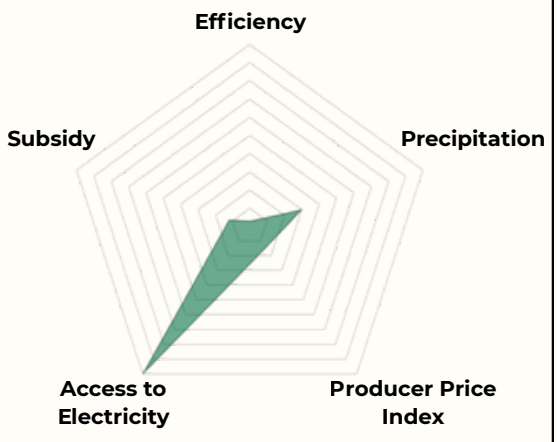


VALUE ADDED BY AGRICULTURE
(% of GDP)

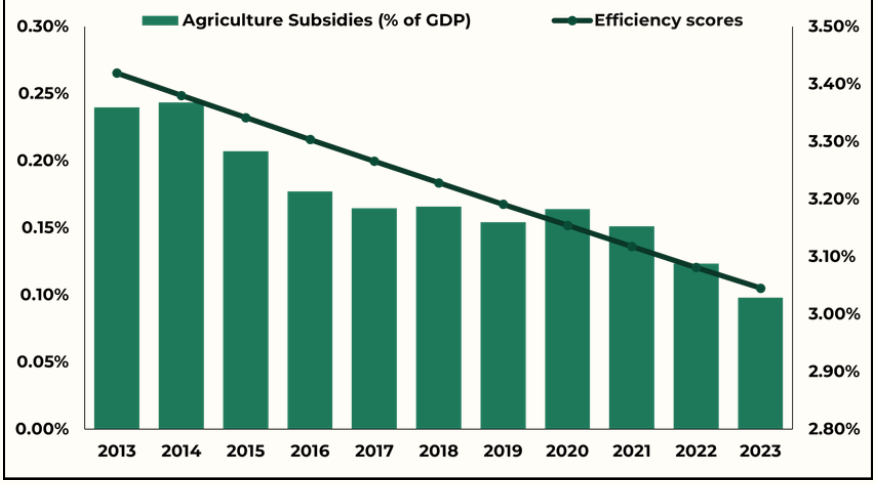


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Correlated Decline:** Subsidies declined consistently to ~0.15% of GDP, and efficiency scores followed a broadly downward path.
2. **Bilateral Significance:** Belgium is among the few countries with significant positive coefficients at both the current (p = 0.020) and lagged (p = 0.011), confirming a sustained subsidy efficiency relation.
3. **Policy Design Edge:** The persistence of positive effects suggests that inputs translate into measurable output gains across growing seasons.

CANADA

GDP: $2173.34B | AGRICULTURAL SUBSIDIES: $8.39B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.1447

REGRESSION

OLS | Scaled up by 1000 | No Lag

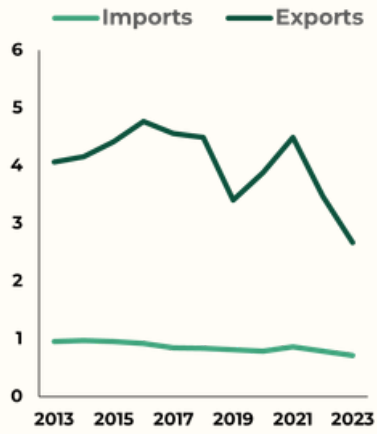
-0.201

LAGGED REGRESSION

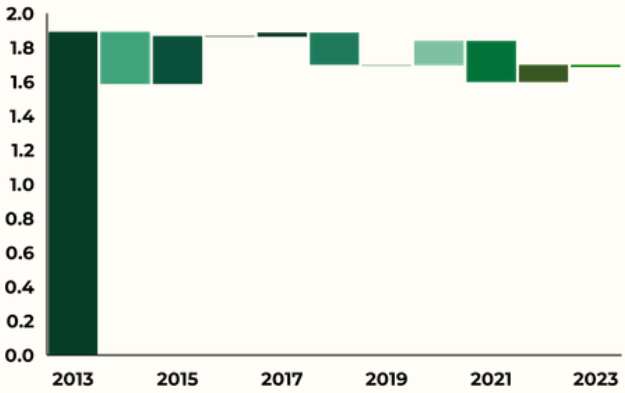
OLS | Scaled up by 1000 | 1-Year Lag

-0.2934

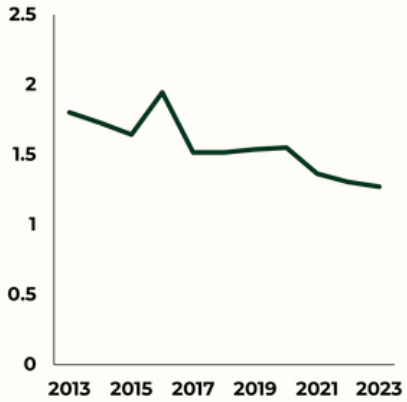
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

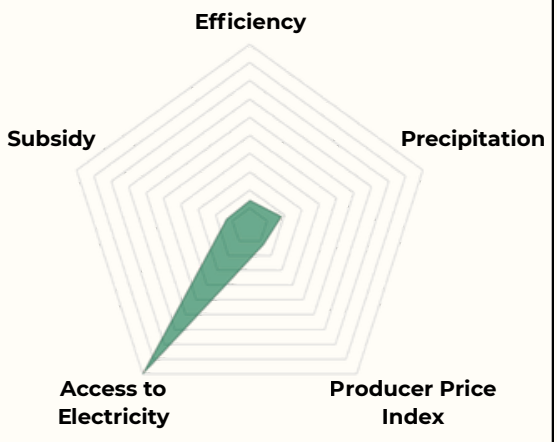


VALUE ADDED BY AGRICULTURE
(% of GDP)

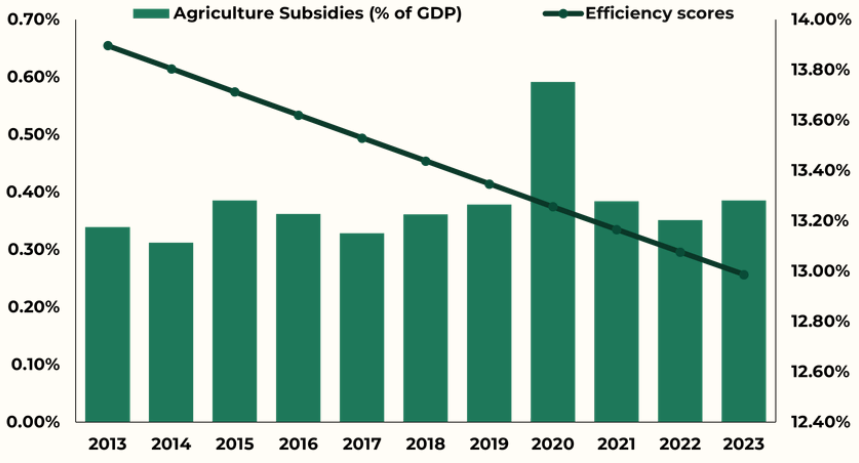


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Capital Intensification:** It was observed that employment in agriculture fell sharply during the years, while other parameters remain broadly stable, indicating capital intensification.
2. **Analytical Results:** Both current and lagged subsidy coefficients are negative and almost insignificant, suggesting subsidies may mildly restrict efficiency in Canada.
3. **Structural Implications:** High baseline efficiency (0.145) coexists with negative subsidy slopes, indicating Canada's agricultural strength is structurally driven, with subsidies offering limited impact.

CHINA

GDP: $18270.40B | AGRICULTURAL SUBSIDIES: $298.28B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.8927

REGRESSION

OLS | Scaled up by 1000 | No Lag

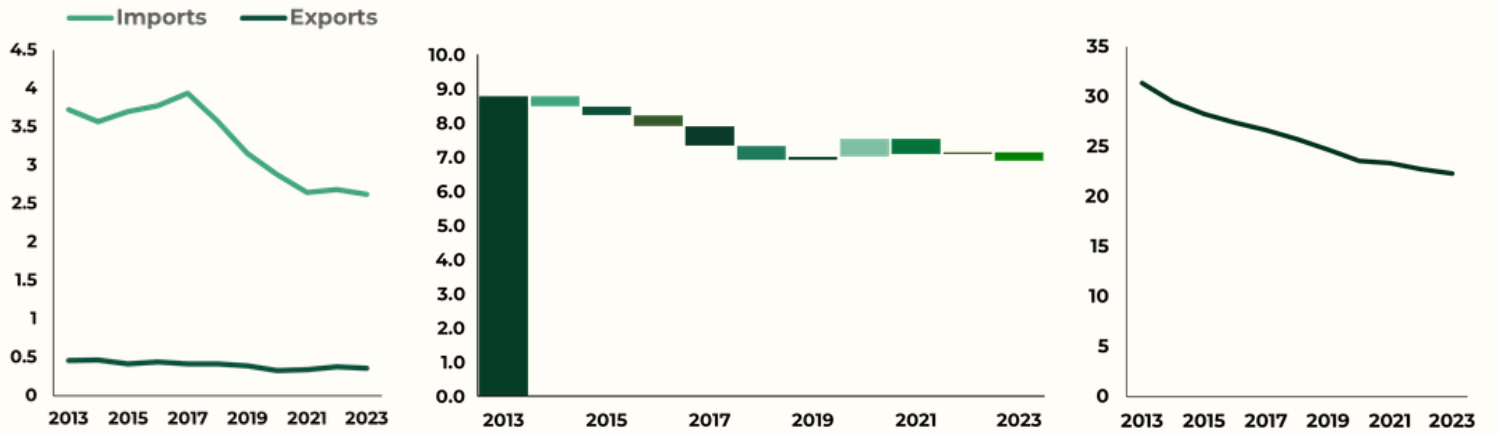
0.1383

LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

0.1536

BROAD OVERVIEW

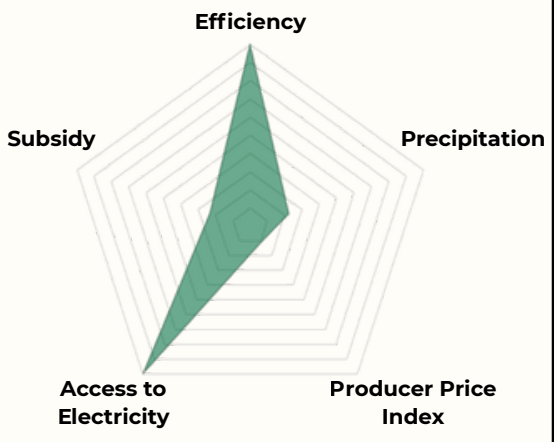


AGRI IMPORTS & EXPORTS
(% of Merchandise)

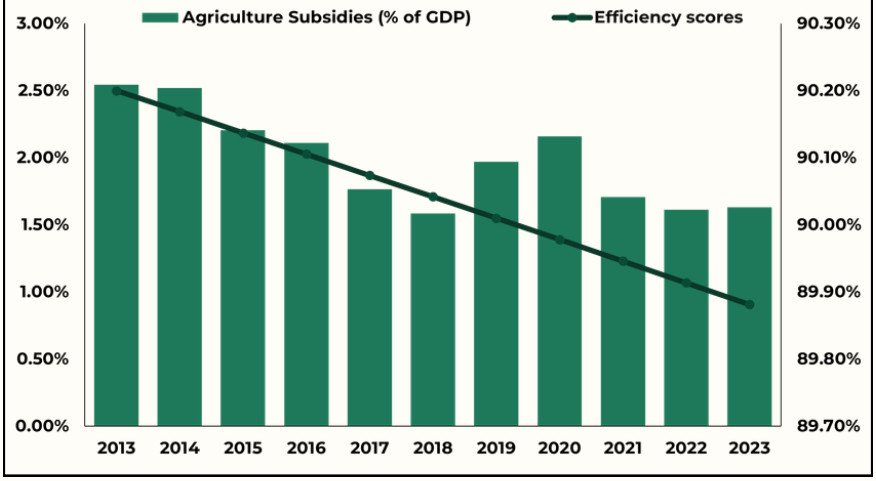
VALUE ADDED BY AGRICULTURE
(% of GDP)

EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY

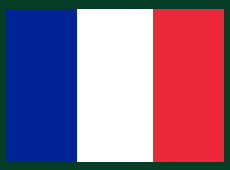


INFERENCES

1. **Employment Decline:** Employment in agriculture declined swiftly to 22%, while the GVA remained stable and robust. This shows a transition towards a capital-intensive, productive style of farming.
2. **Insignificant Results:** Subsidy coefficients are positive but insignificant due to low p-values, suggesting the scale of output gains is driven by structural transformation, not subsidies.
3. **Inherent Contributors:** China's sustained baseline efficiency dominance indicates high agricultural productivity, and while subsidies reinforce this, the structural development remains a key contributor.

FRANCE

GDP: $3051.83B | AGRICULTURAL SUBSIDIES: $9.05B



ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0378

REGRESSION

OLS | Scaled up by 1000 | No Lag

0.1461

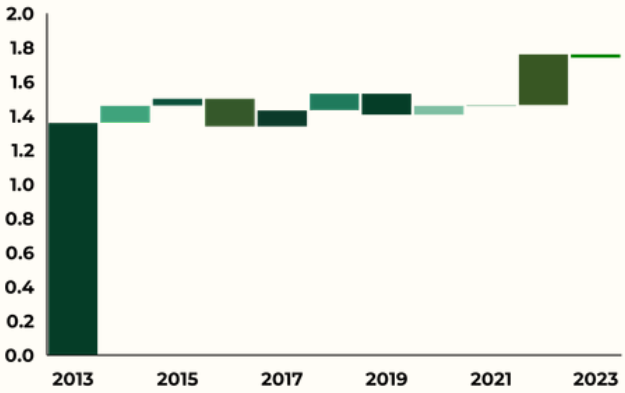
LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

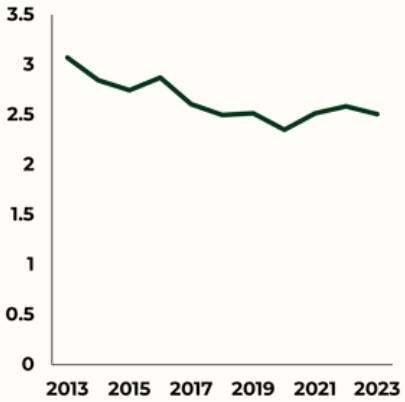
0.2066

BROAD OVERVIEW

AGRI IMPORTS & EXPORTS
(% of Merchandise)

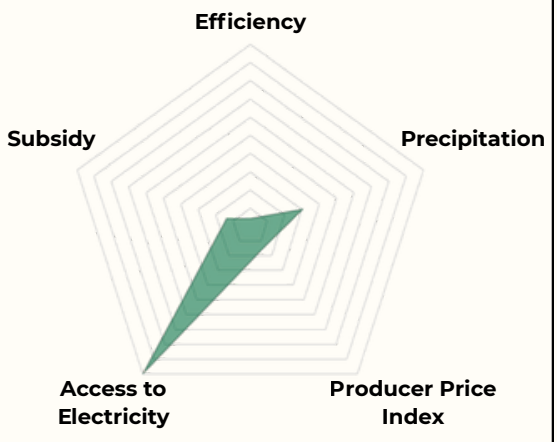


VALUE ADDED BY AGRICULTURE
(% of GDP)

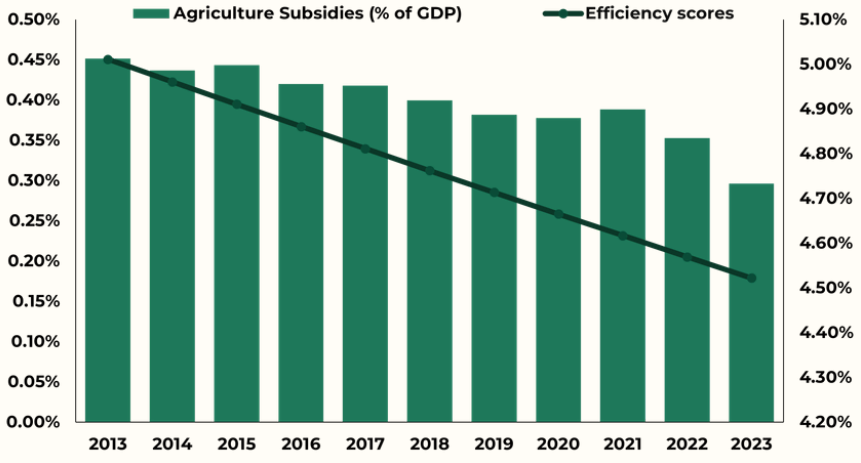


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Declining GVA:** As can be seen, GVA declined to 1% of GDP, and efficiency scores displayed downward trends despite a high absolute amount of subsidies provided.
2. **Delayed Impact:** Current subsidy effect is insignificant (p = 0.085), suggesting a delayed but weak positive response that fails to arrest efficiency decline.
3. **High spend, low returns:** France's declining efficiency despite high subsidies reflects a fundamental concern about large transfers that fail to bring institutional ramifications.

GERMANY

GDP: $4525.70B | AGRICULTURAL SUBSIDIES: $6.28B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0890

REGRESSION

OLS | Scaled up by 1000 | No Lag

0.3231

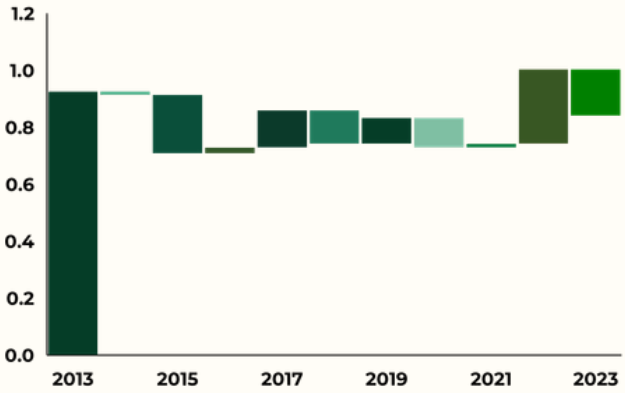
LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

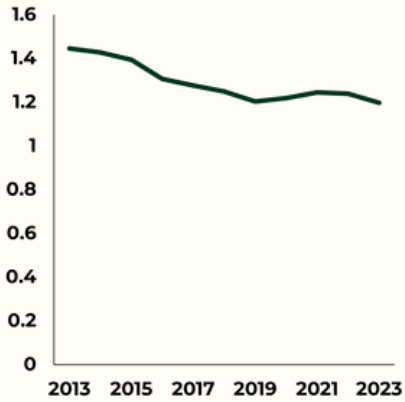
0.181

BROAD OVERVIEW

AGRI IMPORTS & EXPORTS
(% of Merchandise)

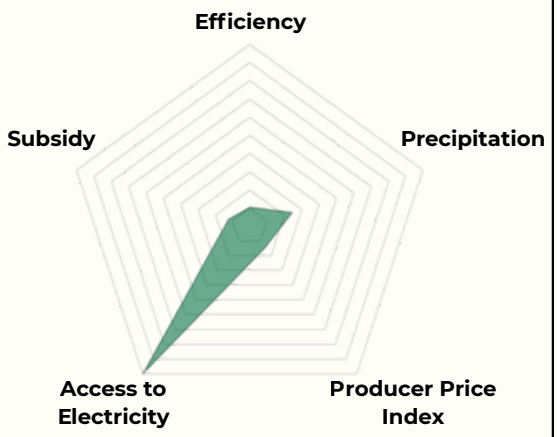


VALUE ADDED BY AGRICULTURE
(% of GDP)

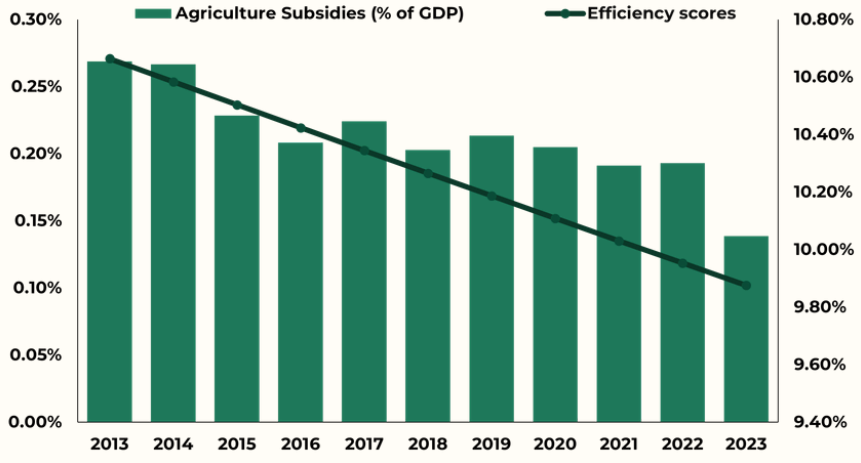


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Signs of Progress:** The GVA and employment rates followed a similar downward path, yet Germany continued to maintain stable efficiency scores, implying consolidation of productive units.
2. **Positive Effect:** Standing out, the current subsidy scores are statistically significant (p = 0.010, coeff. = 0.000314), proving Germany as a country with a meaningful contemporary effect.
3. **Productive Deployment:** Germany's significant positive subsidy coefficient alongside declining employment suggests subsidies are supporting capital-intensive efficiency gains.

INDIA

GDP: $3638.49B | AGRICULTURAL SUBSIDIES: $-27.77B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.1443

REGRESSION

OLS | Scaled up by 1000 | No Lag

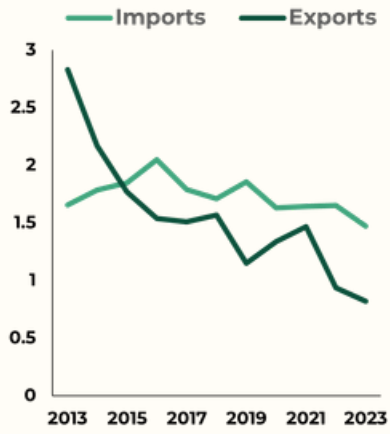
0.288

LAGGED REGRESSION

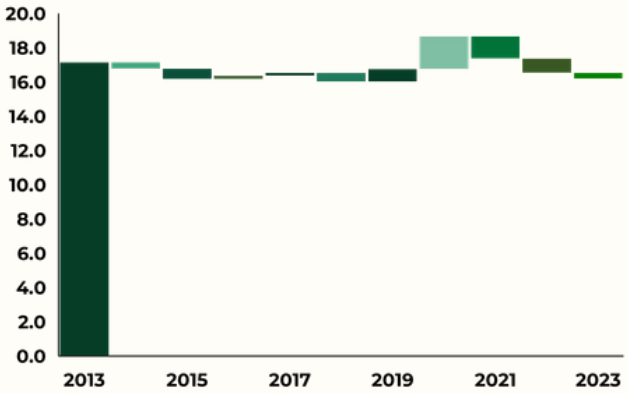
OLS | Scaled up by 1000 | 1-Year Lag

0.1218

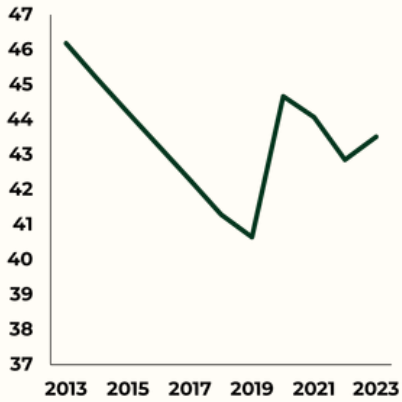
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

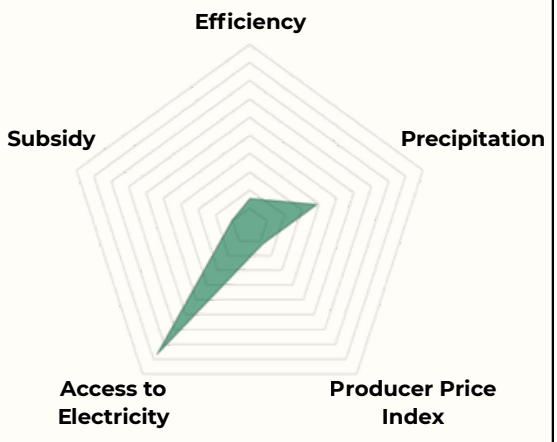


VALUE ADDED BY AGRICULTURE
(% of GDP)

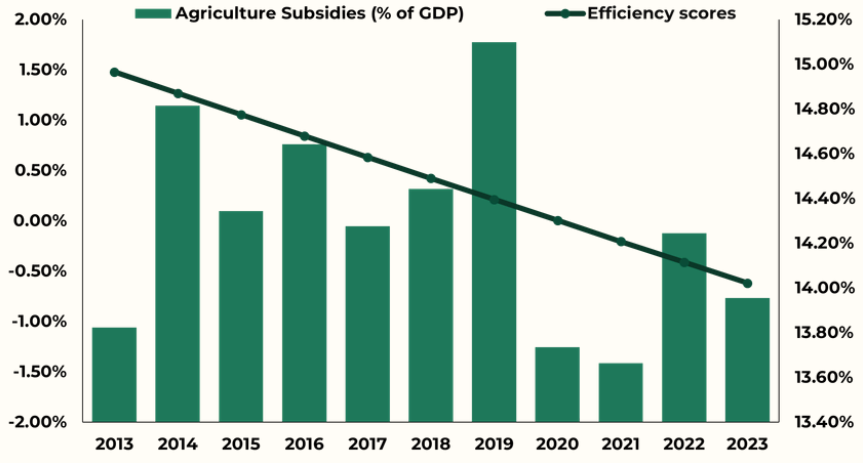


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Employment Overhang:** Employment in agriculture remains high, with volatile subsidy trends and efficiency scores showing a decline despite large subsidy outlay.
2. **Statistically Inert:** Both current (p = 0.110) and lagged (p = 0.306) subsidy effects are insignificant, suggesting limited returns on government aid.
3. **Distribution Failure:** India's high employment dependence and vast subsidy expenditure generate limited efficiency gains, outlining inequitable subsidy distribution and input misallocation.

INDONESIA

GDP: $1371.17B | AGRICULTURAL SUBSIDIES: $15.25B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0624

REGRESSION

OLS | Scaled up by 1000 | No Lag

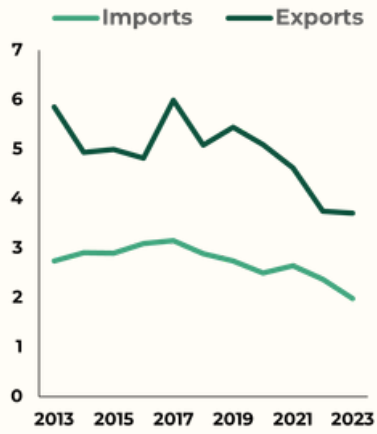
0.0952

LAGGED REGRESSION

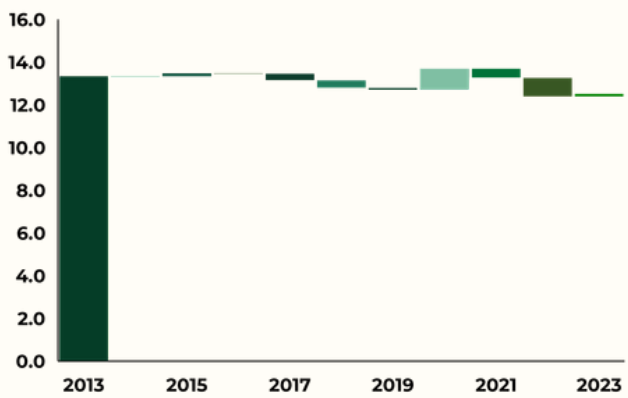
OLS | Scaled up by 1000 | 1-Year Lag

0.0872

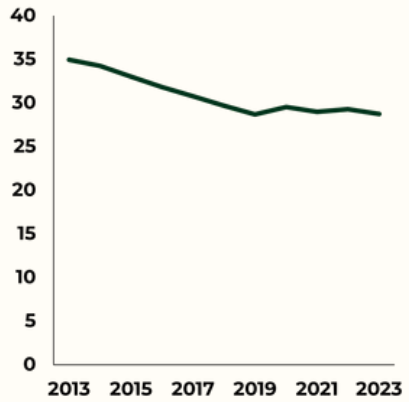
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

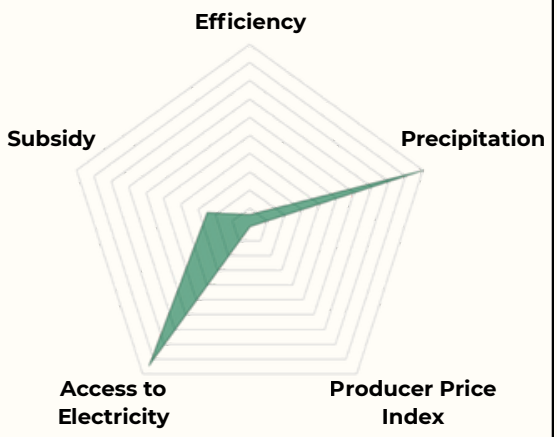


VALUE ADDED BY AGRICULTURE
(% of GDP)

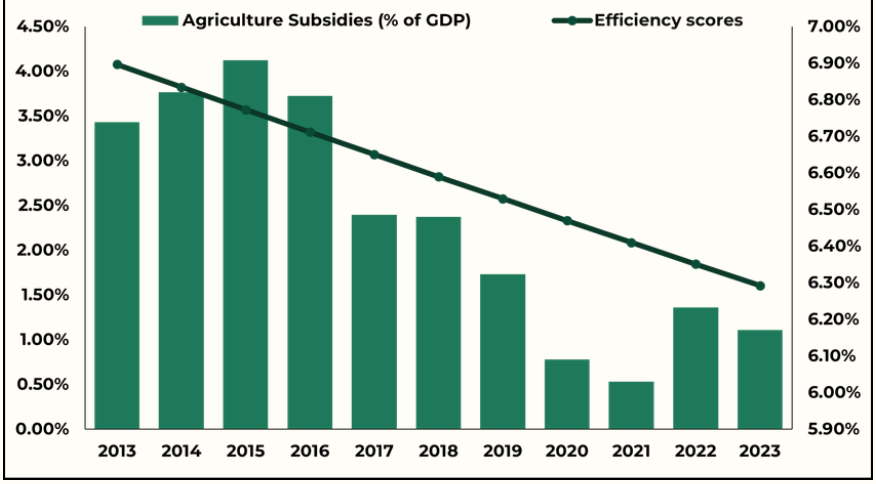


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Sharp Reduction:** Subsidies declined sharply to under 1% of GDP, and efficiency scores followed a similar downward trend, suggesting some dependency on subsidy support for productivity.
2. **Lagged Results:** The lagged coefficient is significant (p = 0.025, coeff. = 0.000091), while the current effect is borderline (p = 0.054), indicating a delayed positive transmission.
3. **Sustained Support:** The lagged significance suggests subsidies take time to materialise into productivity, warranting sustained policy continuity.

ISRAEL

GDP: $512.19B | AGRICULTURAL SUBSIDIES: $1.70B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0079

REGRESSION

OLS | Scaled up by 1000 | No Lag

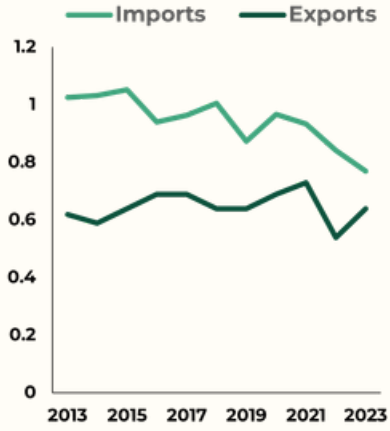
0.0139

LAGGED REGRESSION

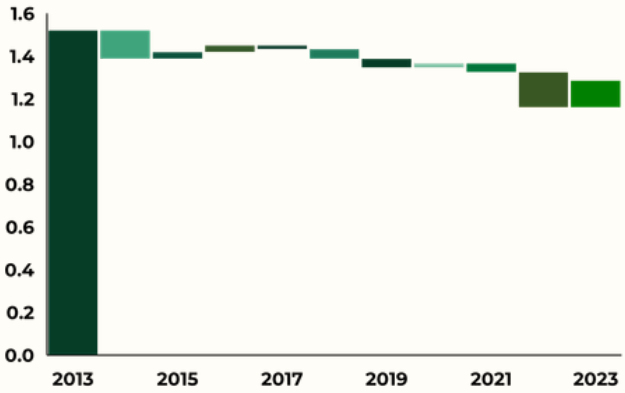
OLS | Scaled up by 1000 | 1-Year Lag

-0.0043

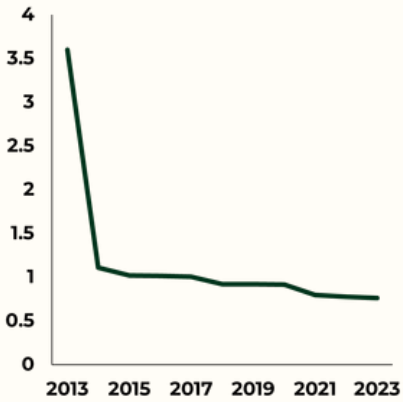
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

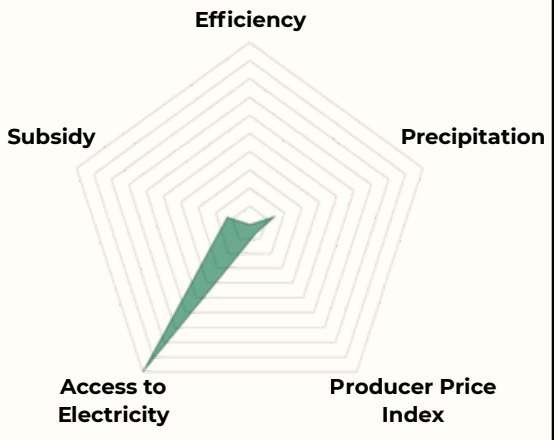


VALUE ADDED BY AGRICULTURE
(% of GDP)

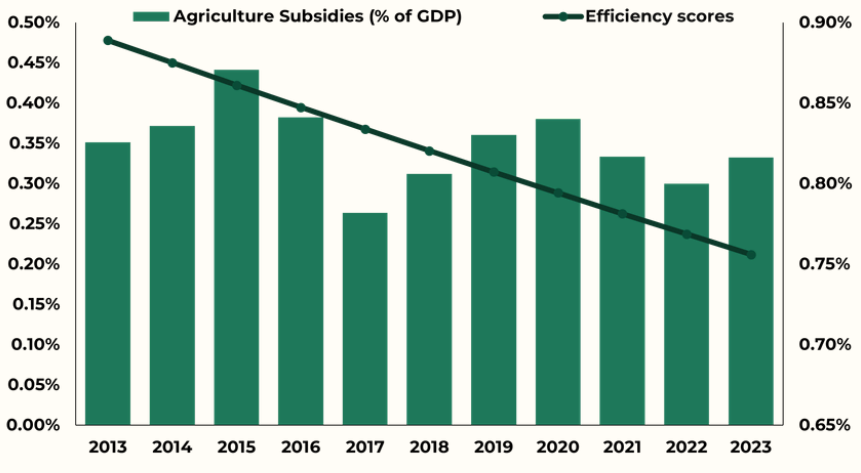


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Macroeconomic Outlook:** Employment in agriculture declined sharply to near-zero, while value-added held steady, with minimal labour.
2. **Irrelevant Coefficients:** Both current and lagged subsidy coefficients are insignificant ($p > 0.90$), confirming subsidies play a minimal role in driving efficiency.
3. **Productivity Enhancements:** Israel's efficiency is structurally driven by technology and innovation rather than subsidy policy. Subsidies are largely redundant, functioning solely as welfare support.

ITALY

GDP: $2304.61B | AGRICULTURAL SUBSIDIES: $7.40B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0345

REGRESSION

OLS | Scaled up by 1000 | No Lag

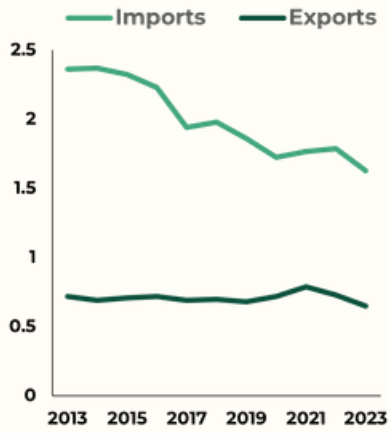
0.0297

LAGGED REGRESSION

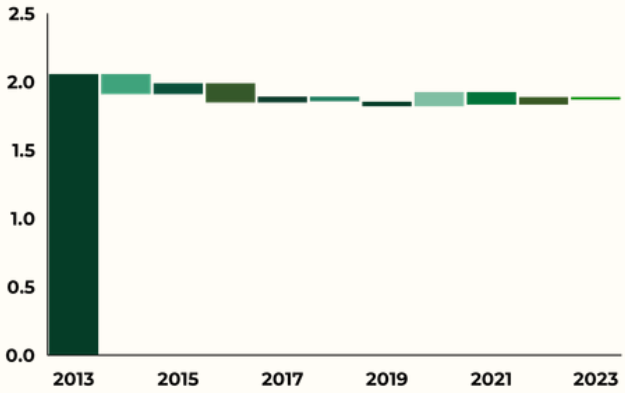
OLS | Scaled up by 1000 | 1-Year Lag

-0.053

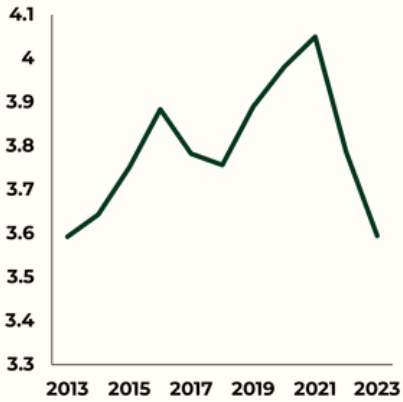
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

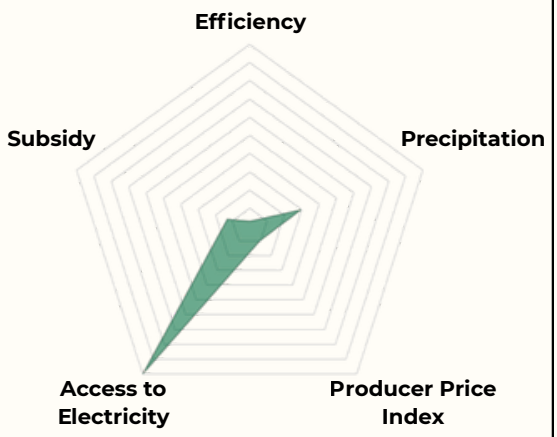


VALUE ADDED BY AGRICULTURE
(% of GDP)

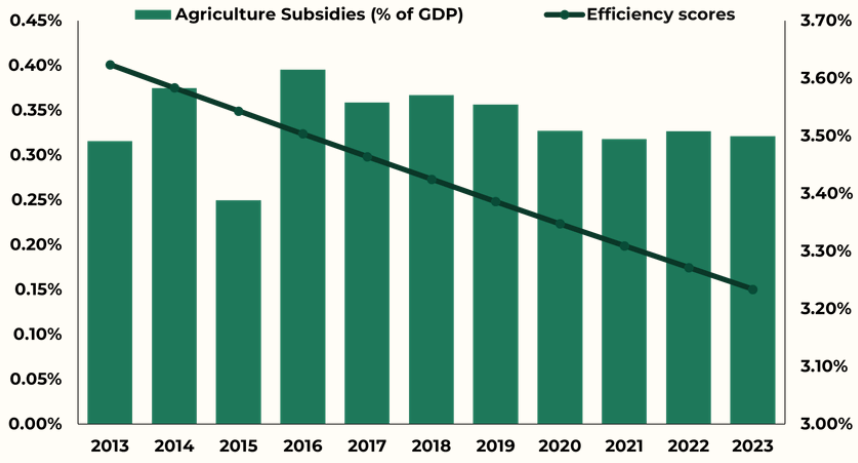


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY

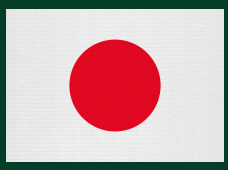


INFERENCES

1. **Basic Overview:** Agricultural employment increased slightly in recent years, while value-added remained flat, suggesting labour absorption without proportionate productivity gains.
2. **No Major Impact:** Both current (p = 0.930) and lagged (p = 0.719) subsidy effects are highly insignificant, indicating subsidies have no measurable influence on Italy's agricultural efficiency.
3. **Low Returns:** Italy's flat efficiency scores and insignificant subsidy coefficients, rising employment without GVA gains, indicate subsidies are absorbed as welfare transfers with no productive return.

JAPAN

GDP: $4213.17B | AGRICULTURAL SUBSIDIES: $30.82B



ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.1515

REGRESSION

OLS | Scaled up by 1000 | No Lag

0.1042

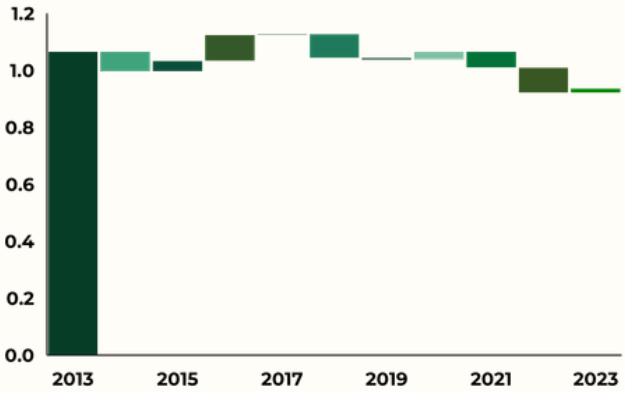
LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

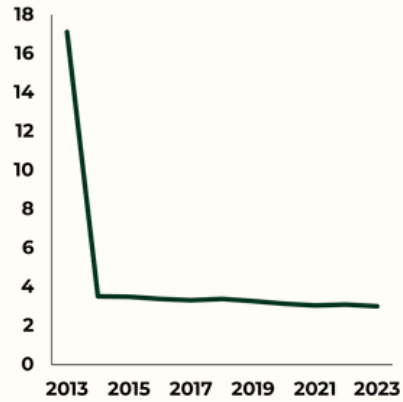
0.0548

BROAD OVERVIEW

AGRI IMPORTS & EXPORTS
(% of Merchandise)

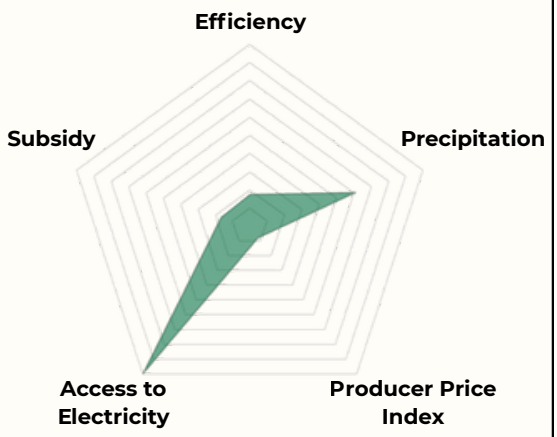


VALUE ADDED BY AGRICULTURE
(% of GDP)

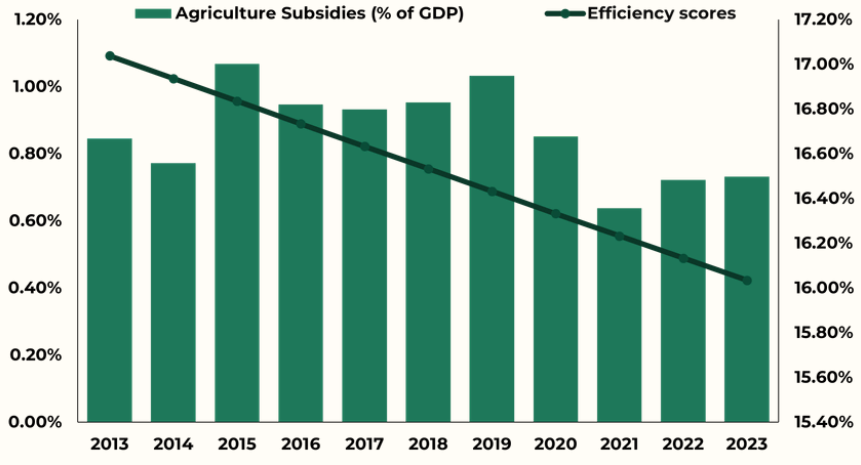


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Downward trends:** Agricultural employment declined sharply from 15% to under 4%, while value-added remained relatively stable.
2. **Inefficient transfers:** Subsidy effects are insignificant at both current (p = 0.158) and lagged (p = 0.404) methods, suggesting efficiency gains stem from structural reform, not subsidy allocation.
3. **Subsidies as welfare tools:** Japan's efficiency is sustained through technology. Subsidies serve a welfare and food-security role but do not contribute to measurable productivity improvements.

MEXICO

GDP: $1793.80B | AGRICULTURAL SUBSIDIES: $16.72B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0223

REGRESSION

OLS | Scaled up by 1000 | No Lag

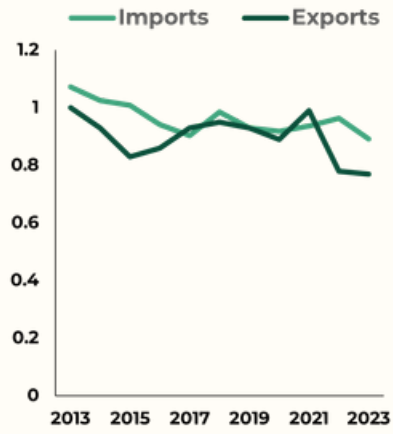
-0.0881

LAGGED REGRESSION

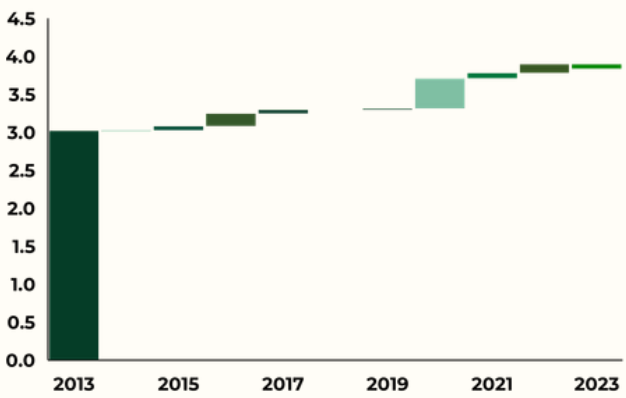
OLS | Scaled up by 1000 | 1-Year Lag

0.055

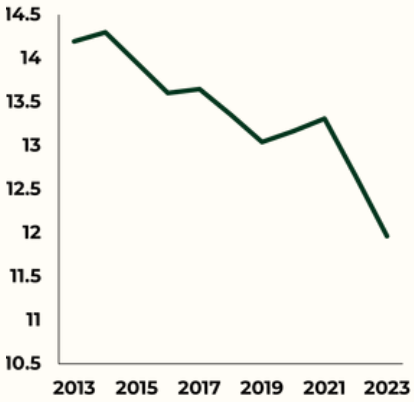
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

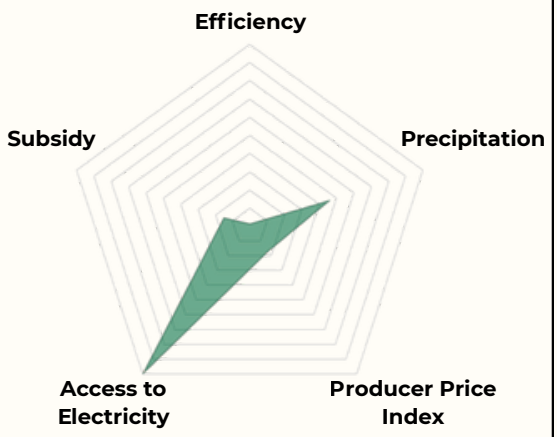


VALUE ADDED BY AGRICULTURE
(% of GDP)

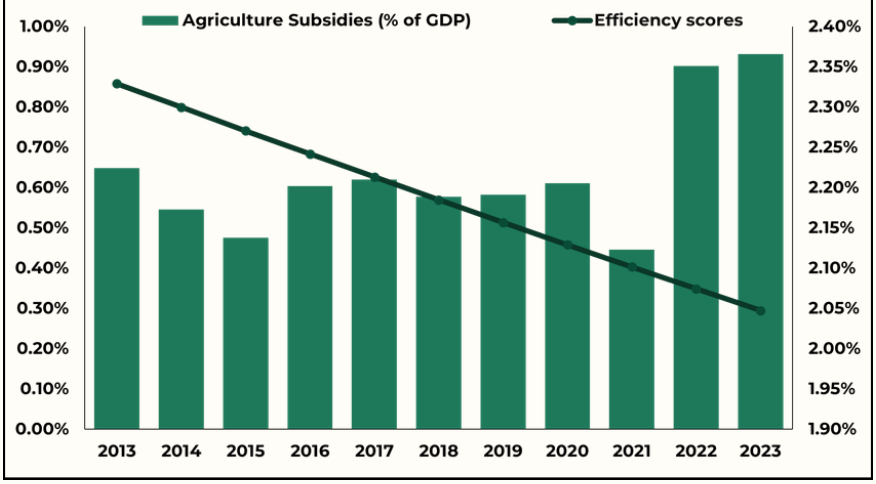


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Persistent Low Returns:** Subsidies declined sharply over the period, while efficiency scores remained low and broadly flat.
2. **Regression Coefficients:** Current subsidy coefficient is negative and insignificant (p = 0.346); the lagged effect turns mildly positive but remains insignificant (p = 0.544).
3. **Capacity Bottleneck:** Mexico's low baseline efficiency and negligible subsidy responsiveness indicate deep structural constraints in agricultural productivity.

NETHERLANDS

GDP: $1154.36B | AGRICULTURAL SUBSIDIES: $1.01B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0177

REGRESSION

OLS | Scaled up by 1000 | No Lag

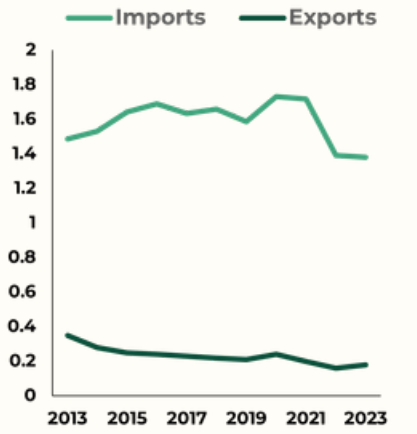
0.0747

LAGGED REGRESSION

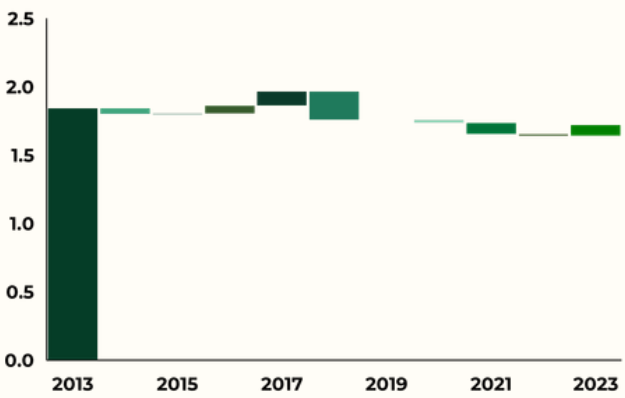
OLS | Scaled up by 1000 | 1-Year Lag

0.0502

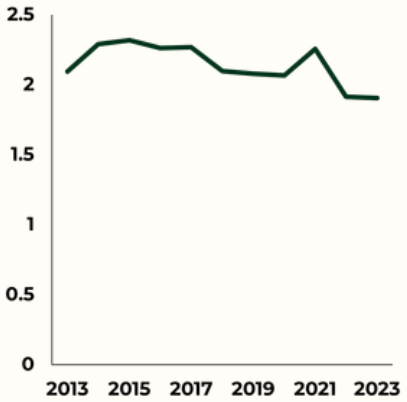
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

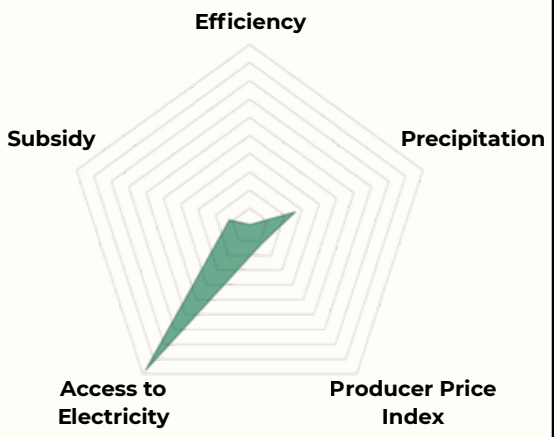


VALUE ADDED BY AGRICULTURE
(% of GDP)

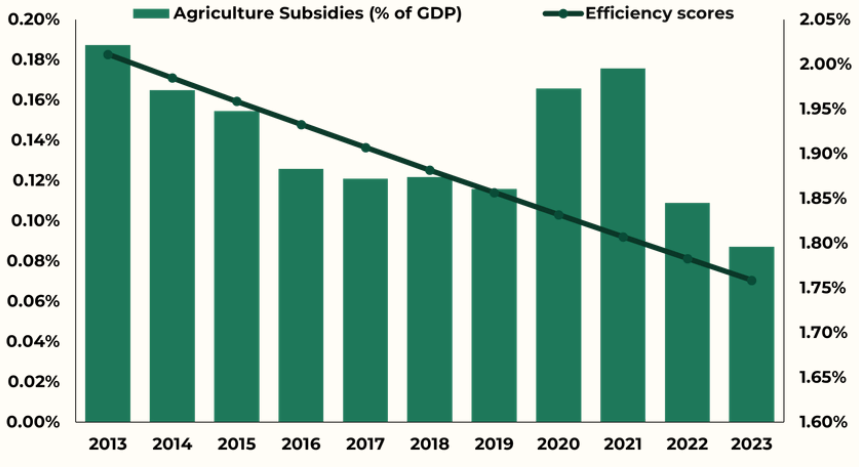


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Export Strength:** Despite being a high-export agricultural economy, efficiency scores declined, even as subsidy levels stabilised, highlighting that trade strength does not guarantee frontier efficiency.
2. **Statistically Neutral:** Both current ($p = 0.733$) and lagged ($p = 0.778$) subsidy coefficients are insignificant, confirming subsidies add no measurable efficiency value.
3. **Institutional Problems:** The Netherlands' world-class agricultural exports are driven by institutional excellence, not subsidy-driven efficiency. Subsidies are effectively inert as productivity instruments.

NORWAY

GDP: $482.95B | AGRICULTURAL SUBSIDIES: $3.21B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0389

REGRESSION

OLS | Scaled up by 1000 | No Lag

0.0805

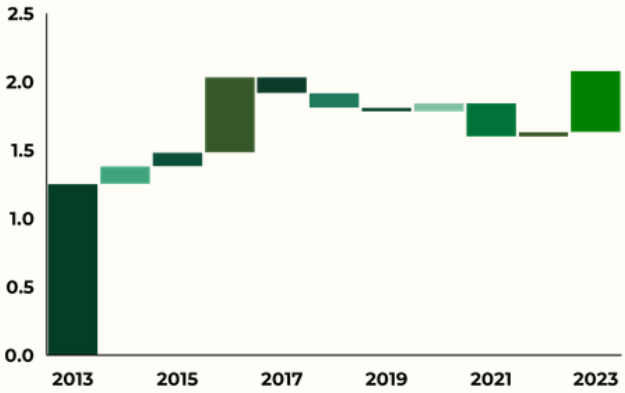
LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

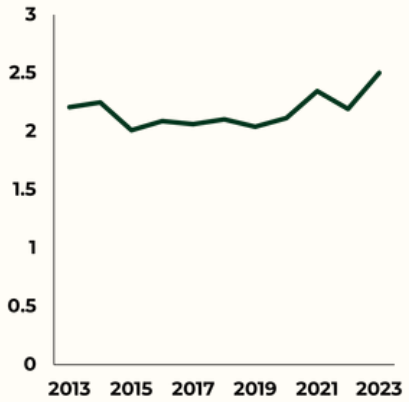
0.0766

BROAD OVERVIEW

AGRI IMPORTS & EXPORTS
(% of Merchandise)

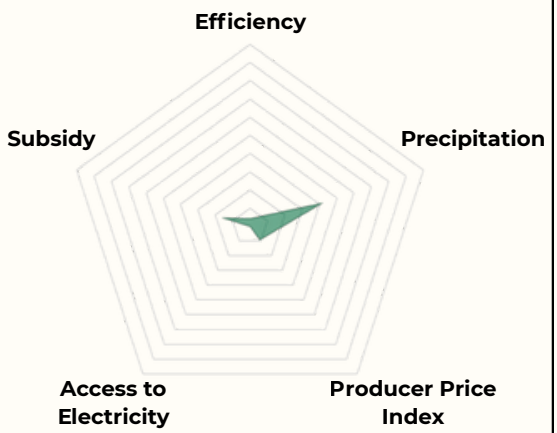


VALUE ADDED BY AGRICULTURE
(% of GDP)

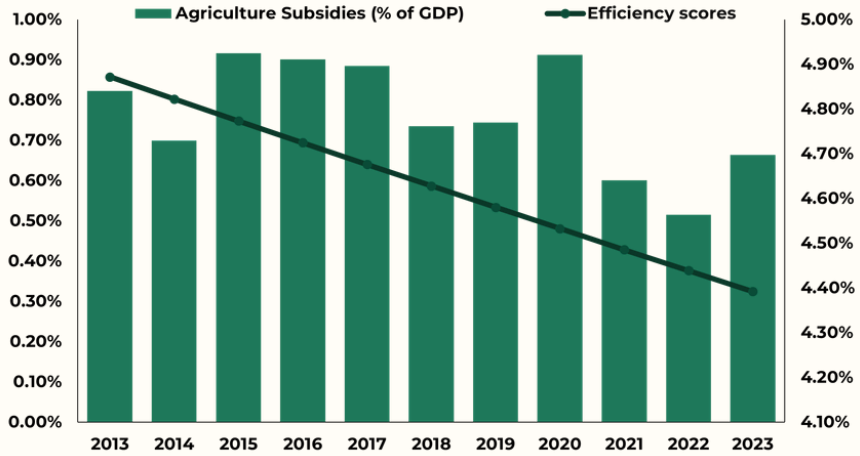


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Rising Employment:** Employment in agriculture increased slightly over the period, and value-added picked up, but agricultural employment yielded modest output gains.
2. **Dual Significance:** Both current (p = 0.015) and lagged (p = 0.012) coefficients are statistically significant and positive.
3. **Policy Benchmark:** Norway's significant coefficients suggest a well-structured subsidy policy successfully converts support into efficiency. Rising employment and GVA reinforce this consistency.

POLAND

GDP: $812.45B | AGRICULTURAL SUBSIDIES: $4.49B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0378

REGRESSION

OLS | Scaled up by 1000 | No Lag

0.094

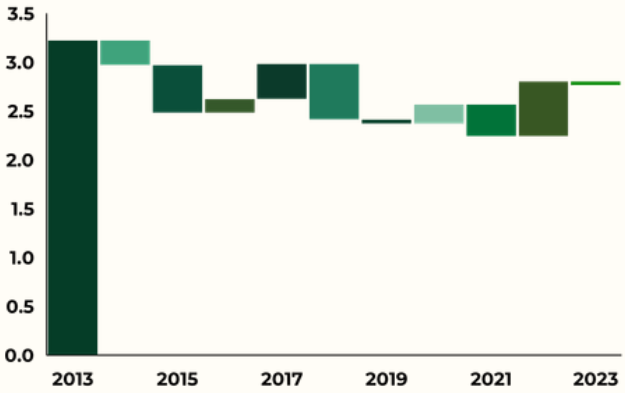
LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

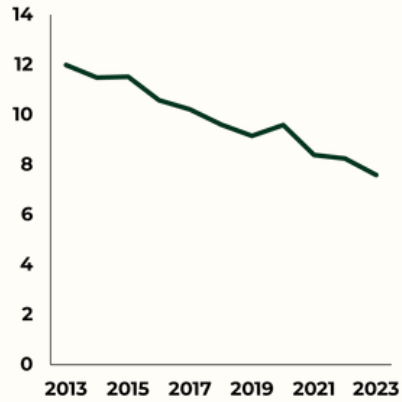
0.0598

BROAD OVERVIEW

AGRI IMPORTS & EXPORTS
(% of Merchandise)

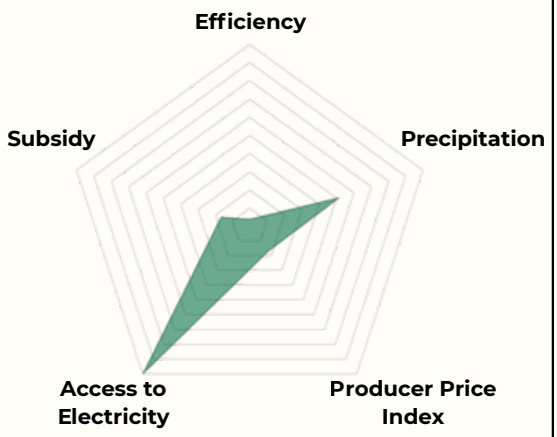


VALUE ADDED BY AGRICULTURE
(% of GDP)

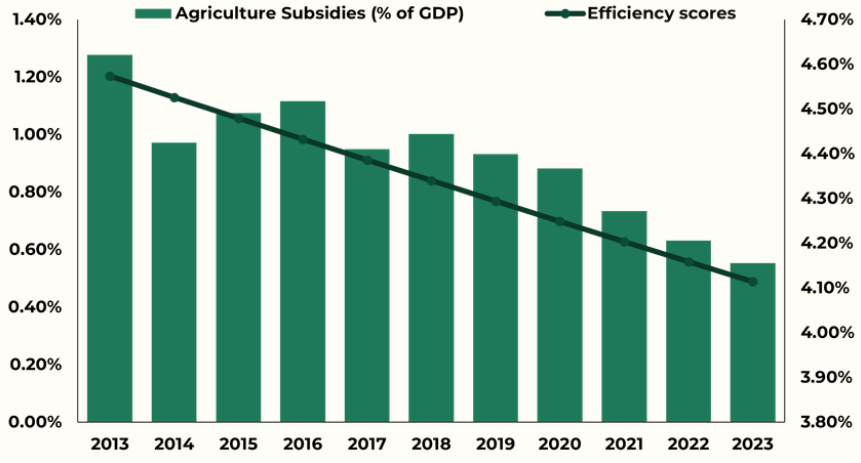


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Contraction Effect:** Subsidies declined steeply, and efficiency scores followed a downward trend, consistent with subsidy reductions weakening the productive base.
2. **Withdrawal Risk:** The current subsidy effect is borderline significant (p = 0.054), with a positive coefficient (0.000085); the lagged effect is positive but weaker (p = 0.290).
3. **Mere Support:** Poland's downward efficiency trend alongside falling subsidies and a near-significant current coefficient suggests subsidies were playing a supportive role.

RUSSIA

GDP: $2071.51B | AGRICULTURAL SUBSIDIES: $6.80B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0900

REGRESSION

OLS | Scaled up by 1000 | No Lag

0.1947

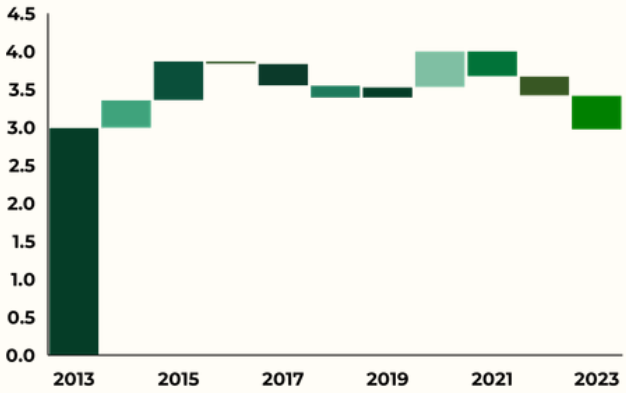
LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

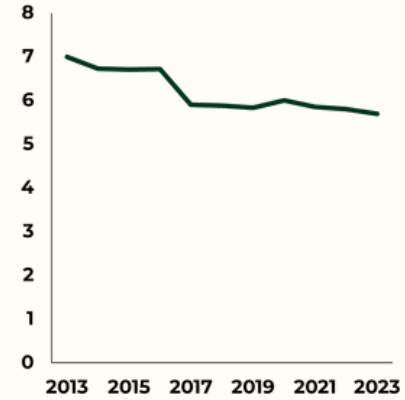
0.193

BROAD OVERVIEW

AGRI IMPORTS & EXPORTS
(% of Merchandise)

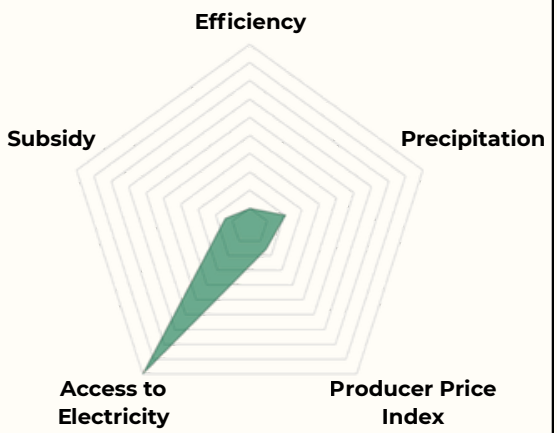


VALUE ADDED BY AGRICULTURE
(% of GDP)

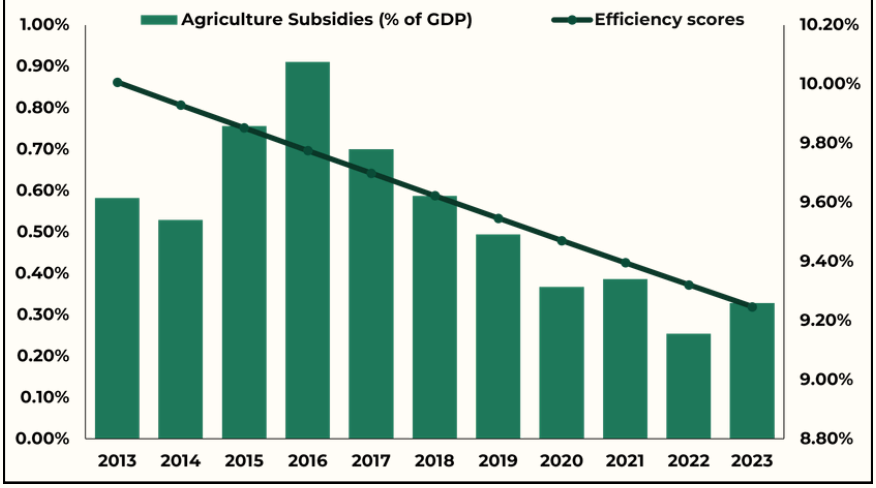


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **High Volatility:** Efficiency scores are highly volatile, peaking dramatically before collapsing, likely reflecting geopolitical disruptions.
2. **Insignificant Results:** Both current (p = 0.133) and lagged (p = 0.198) subsidy effects are insignificant, indicating that subsidy levels are not primary drivers.
3. **External Factors:** Russia's efficiency is overwhelmingly shaped by external macro shocks rather than subsidy policy.

SOUTH KOREA

GDP: $1712.79B | AGRICULTURAL SUBSIDIES: $23.61B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0485

REGRESSION

OLS | Scaled up by 1000 | No Lag

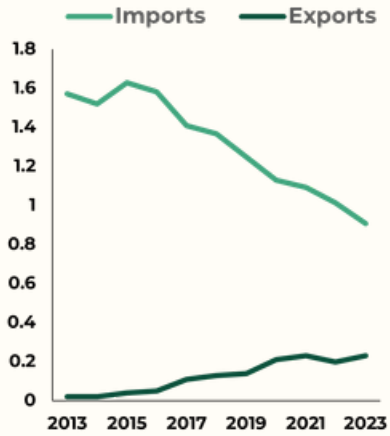
-0.0271

LAGGED REGRESSION

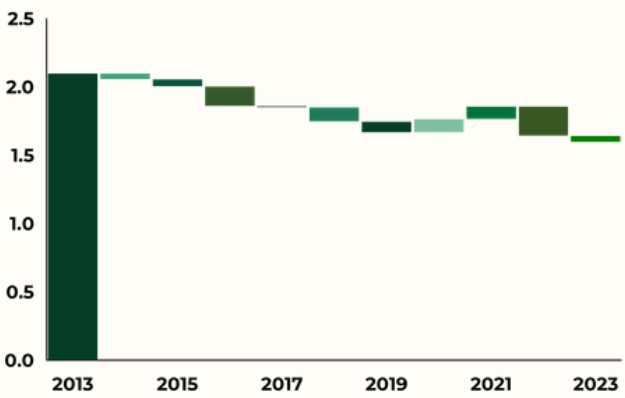
OLS | Scaled up by 1000 | 1-Year Lag

-0.0276

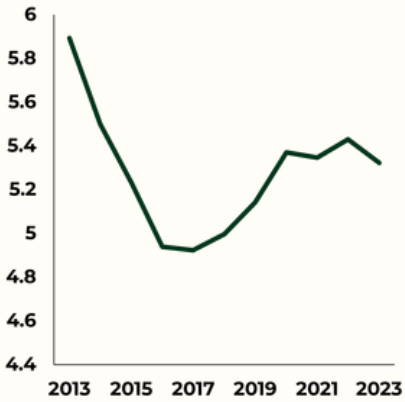
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

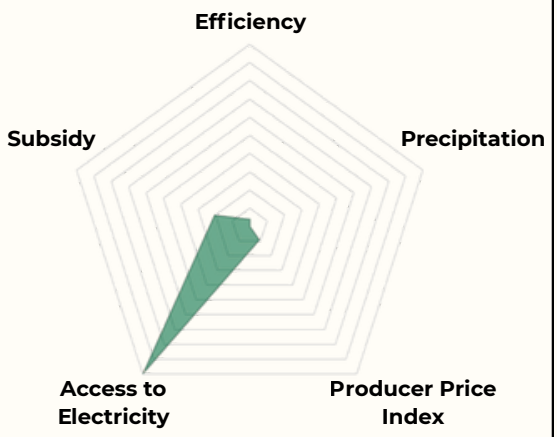


VALUE ADDED BY AGRICULTURE
(% of GDP)

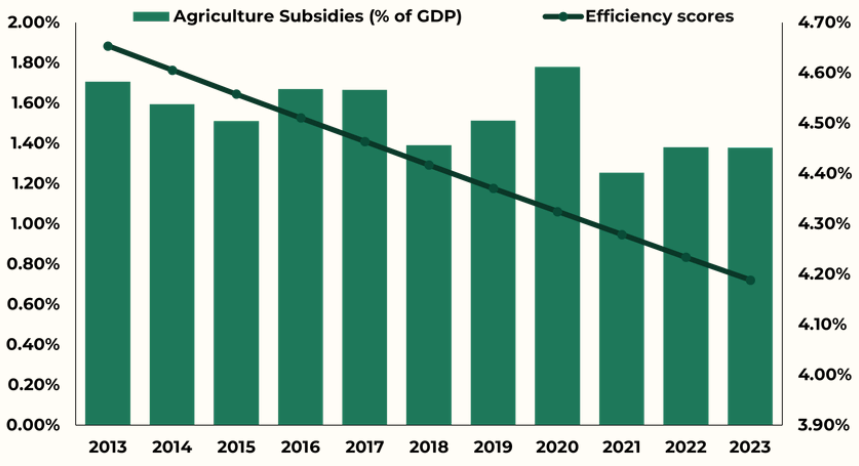


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Limited Returns:** Despite high subsidy levels (~1.5–2% of GDP), efficiency scores declined consistently over the period, indicating limited productive returns on a significant policy investment.
2. **Regression Coefficients:** Both current (p = 0.422) and lagged (p = 0.722) coefficients are negative and insignificant.
3. **Prevalent Bottlenecks:** South Korea's persistent efficiency decline despite sustained high subsidies reflects a pattern of welfare-prioritised agricultural support, with structural bottlenecks.

SPAIN

GDP: $1620.09B | AGRICULTURAL SUBSIDIES: $6.84B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0146

REGRESSION

OLS | Scaled up by 1000 | No Lag

0.1488

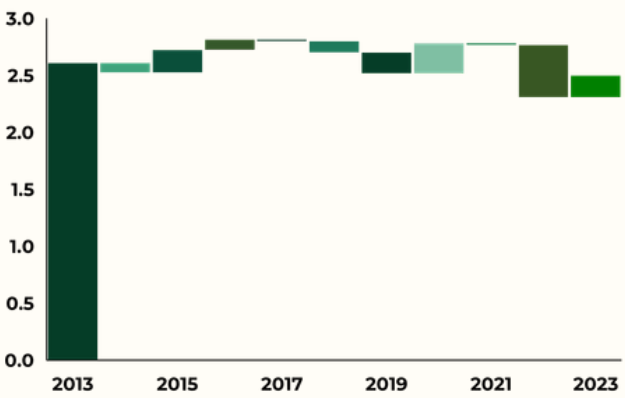
LAGGED REGRESSION

OLS | Scaled up by 1000 | 1-Year Lag

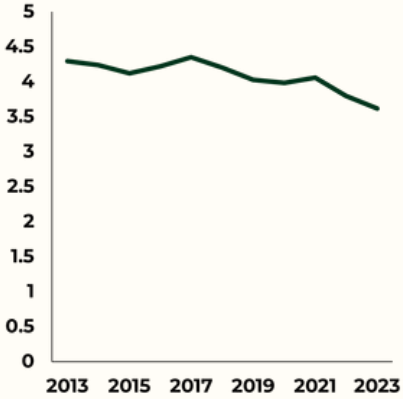
0.1434

BROAD OVERVIEW

AGRI IMPORTS & EXPORTS
(% of Merchandise)

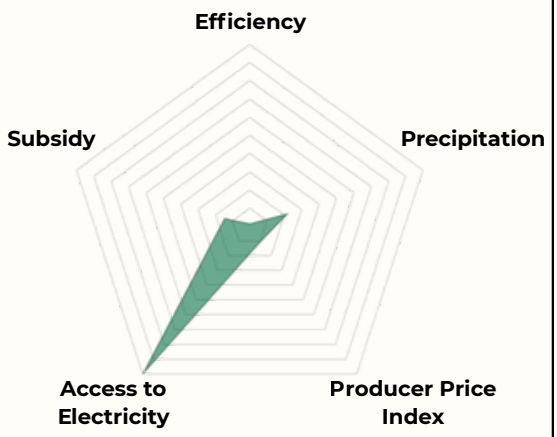


VALUE ADDED BY AGRICULTURE
(% of GDP)

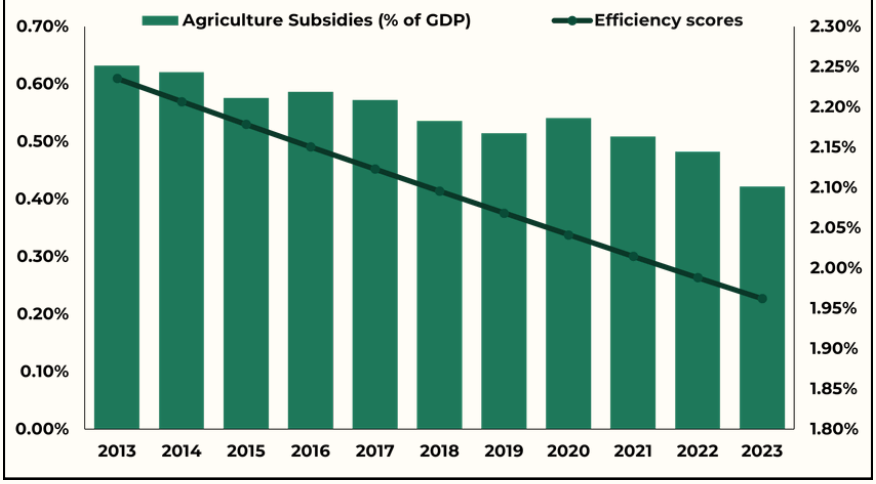


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Constant Decline:** Subsidies declined from ~0.6% to ~0.5% of GDP, and efficiency scores declined correspondingly.
2. **Statistically Relevant:** Both current (p = 0.039) and lagged (p = 0.036) coefficients are statistically significant and positive.
3. **Yield Returns:** Spain's significant bilateral subsidy effects, despite a declining trend, indicate that even reduced subsidies continue to yield efficiency returns.

SWEDEN

GDP: $585.49B | AGRICULTURAL SUBSIDIES: $1.15B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0701

REGRESSION

OLS | Scaled up by 1000 | No Lag

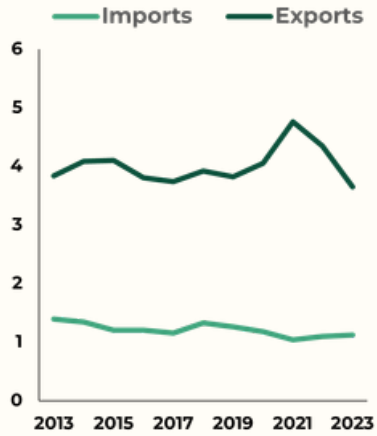
-0.5349

LAGGED REGRESSION

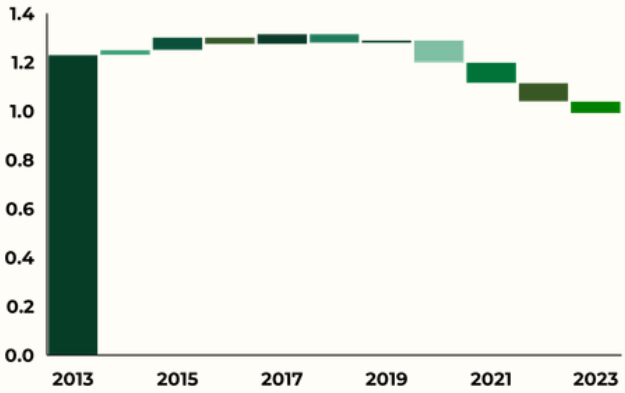
OLS | Scaled up by 1000 | 1-Year Lag

-0.3250

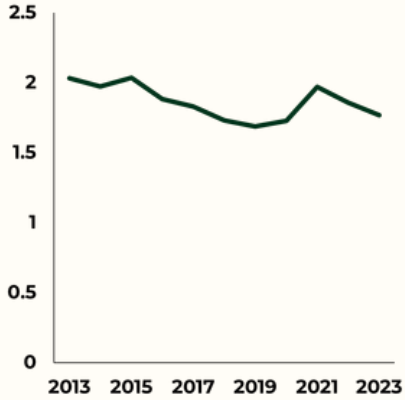
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

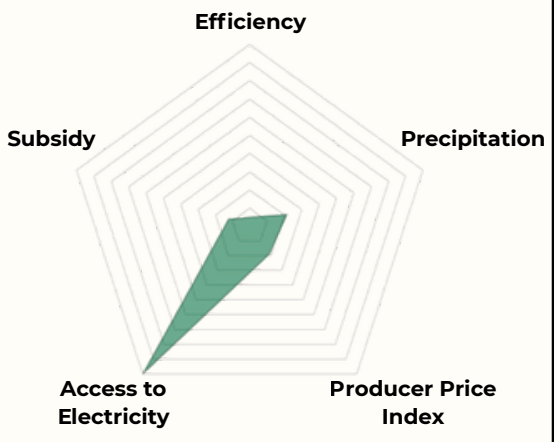


VALUE ADDED BY AGRICULTURE
(% of GDP)

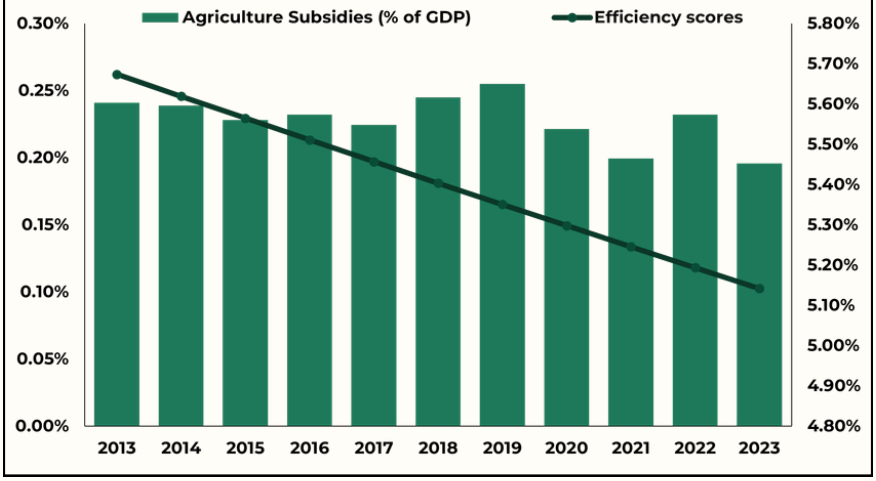


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Gradual Decline:** Subsidy levels declined gradually while efficiency scores also trended downward, with the sector showing high import dependence.
2. **Suppressed Efficiency:** Current subsidy coefficient is significantly negative (p = 0.004), and the lagged effect is also negative (p = 0.141), indicating subsidies actively suppress efficiency in Sweden.
3. **Outlier Patterns:** Sweden is an outlier; subsidies significantly reduce efficiency, likely due to misalignment between transfer mechanisms and productivity incentives.

SWITZERLAND

GDP: $894.43B | AGRICULTURAL SUBSIDIES: $8.52B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0061

REGRESSION

OLS | Scaled up by 1000 | No Lag

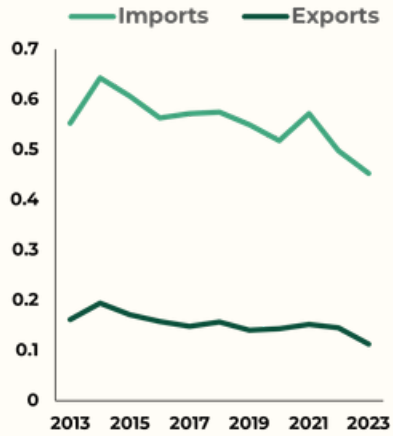
0.0251

LAGGED REGRESSION

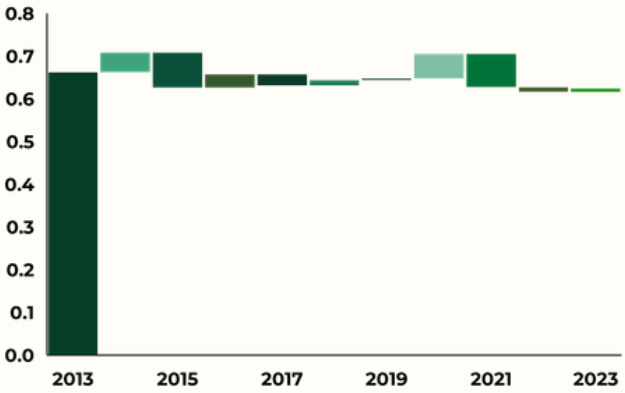
OLS | Scaled up by 1000 | 1-Year Lag

0.0291

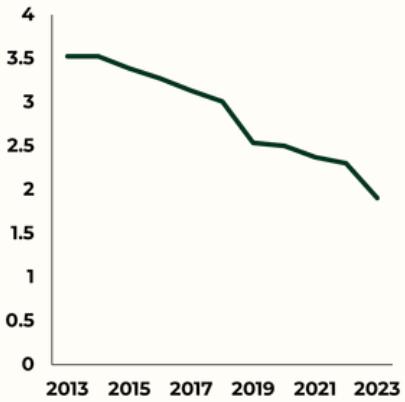
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

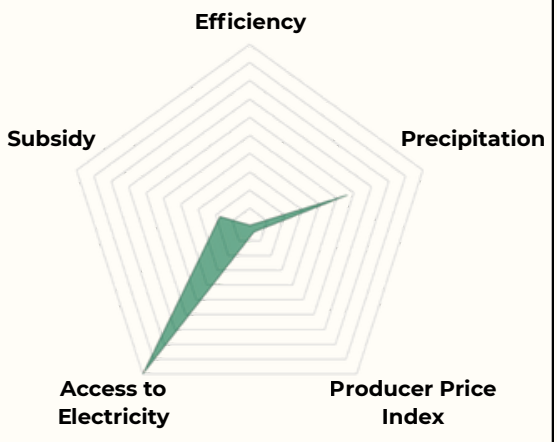


VALUE ADDED BY AGRICULTURE
(% of GDP)

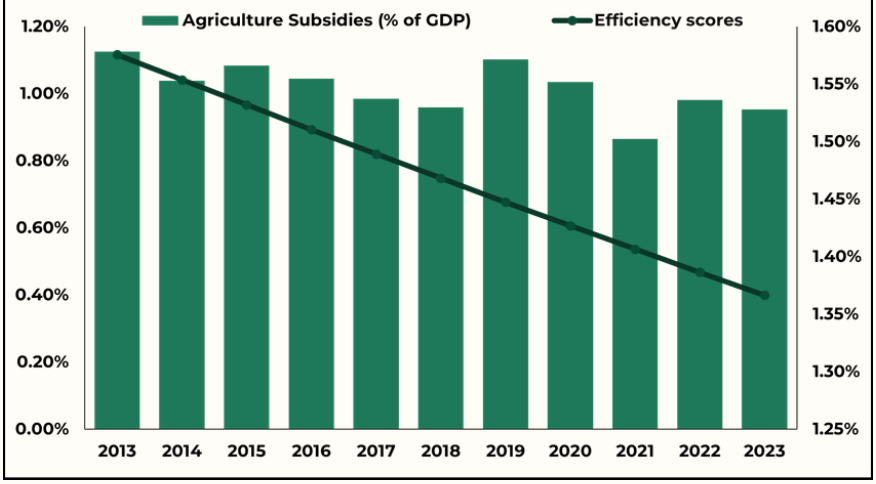


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Steep Decline:** Subsidies declined steeply from ~1.1% to ~0.4% of GDP, and efficiency scores followed a steady downward trajectory.
2. **Unconfirmed Relationship:** Both current (p = 0.496) and lagged (p = 0.263) coefficients are positive but insignificant, suggesting a directionally positive but unconfirmed subsidy-efficiency relationship.
3. **Insignificant Dependencies:** Switzerland's declining efficiency amid falling subsidies hints at dependency, yet regression insignificance prevents strong causal conclusions.

TÜRKIYE

GDP: $1118.25B | AGRICULTURAL SUBSIDIES: $14.01B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0254

REGRESSION

OLS | Scaled up by 1000 | No Lag

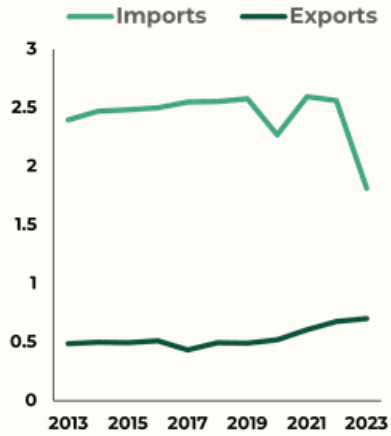
0.1184

LAGGED REGRESSION

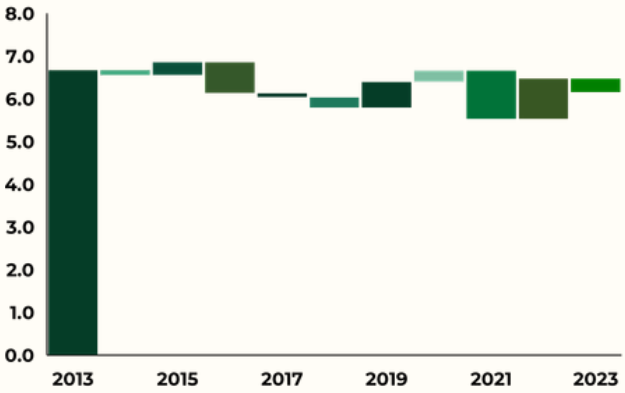
OLS | Scaled up by 1000 | 1-Year Lag

0.0302

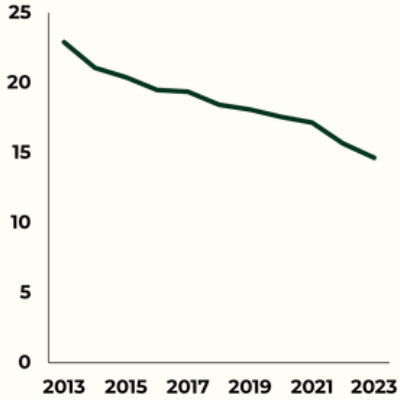
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

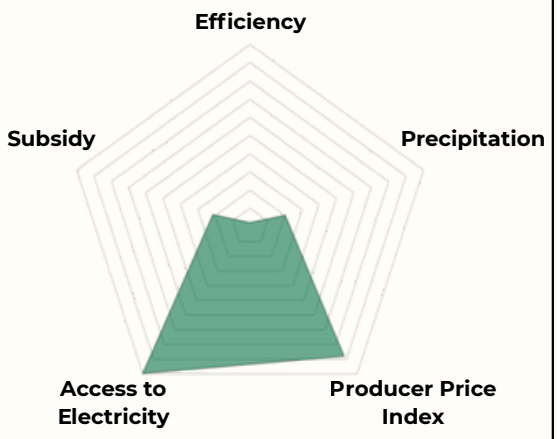


VALUE ADDED BY AGRICULTURE
(% of GDP)

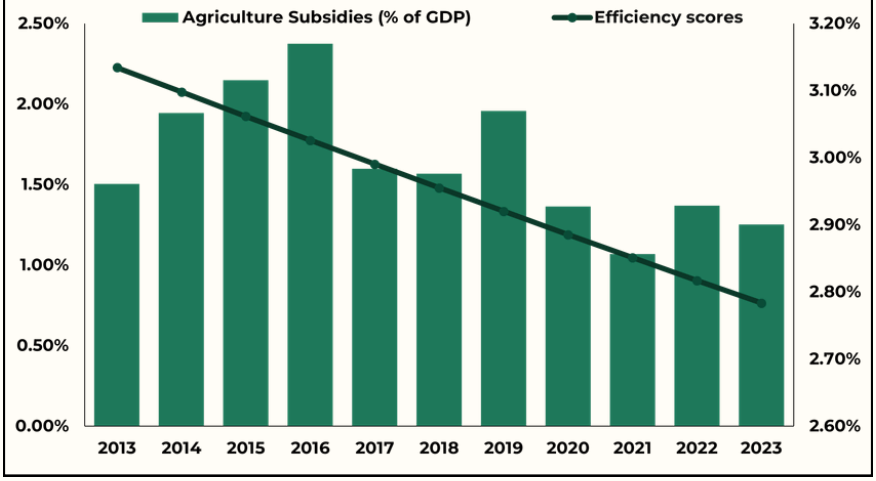


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Consistent Decline:** Subsidies declined sharply from ~2% to ~1% of GDP while efficiency scores also declined consistently.
2. **Regression Outlook:** The current coefficient is significant; the lagged effect is positive but insignificant, indicating an immediate but non-persistent subsidy effect.
3. **Responsiveness to Aid:** There is a significant contemporaneous subsidy-efficiency link, suggesting short-run productive responsiveness.

UNITED KINGDOM

GDP: $3369.86B | AGRICULTURAL SUBSIDIES: $7.82B

ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.0952

REGRESSION

OLS | Scaled up by 1000 | No Lag

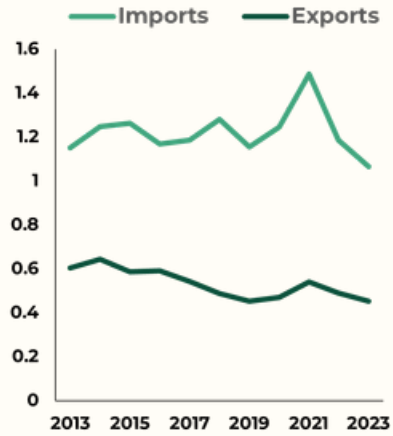
0.0598

LAGGED REGRESSION

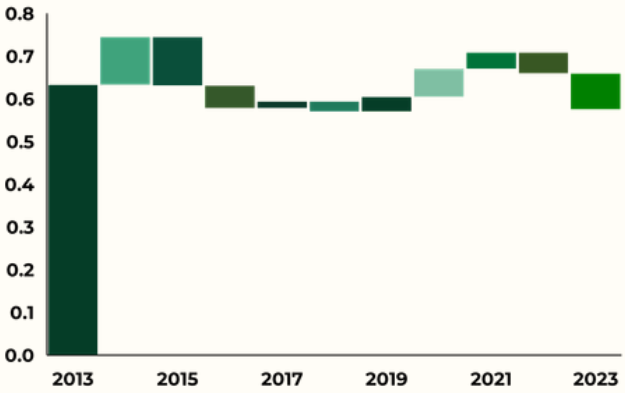
OLS | Scaled up by 1000 | 1-Year Lag

0.0466

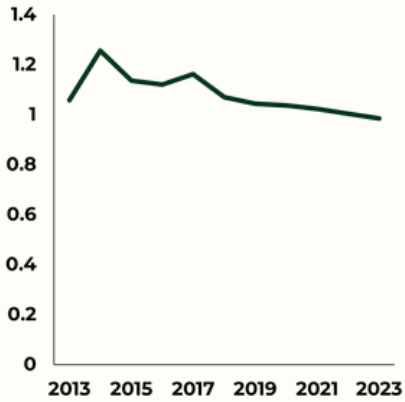
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

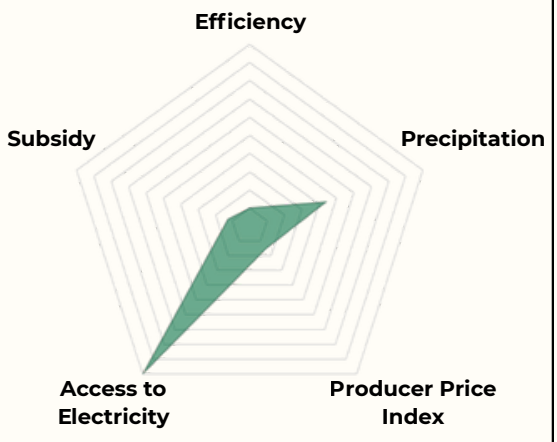


VALUE ADDED BY AGRICULTURE
(% of GDP)

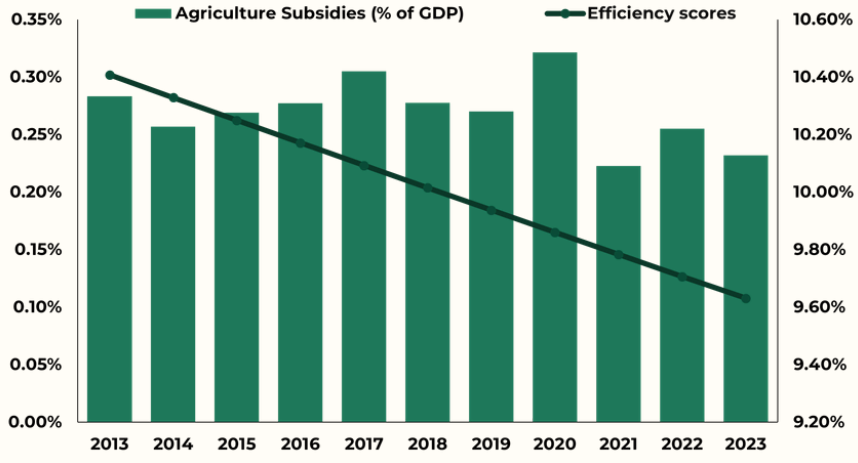


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY

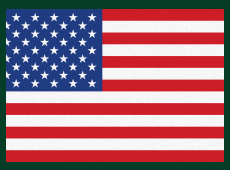


INFERENCES

1. **Employment Collapse:** Efficiency scores declined consistently despite broadly stable subsidy levels, while employment dropped, suggesting consolidation without commensurate productivity retention.
2. **Fully Decoupled:** Both current (p = 0.716) and lagged (p = 0.721) coefficients are highly insignificant, confirming subsidies play no measurable role in UK agricultural efficiency.
3. **Economic Growth:** The UK's structural agricultural decline, falling employment, and inefficiency are unrelated to subsidy design. Subsidies function as decoupled income support.

UNITED STATES

GDP: $27720.70B | AGRICULTURAL SUBSIDIES: $120.59B



ANALYTICS

STRUCTURAL EFFICIENCY

Fixed Eff. | Absolute Coeff. | No Lag

0.2174

REGRESSION

OLS | Scaled up by 1000 | No Lag

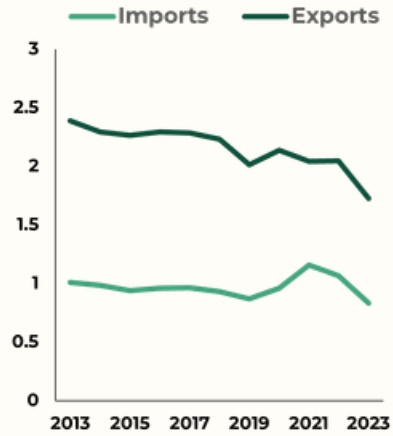
0.0353

LAGGED REGRESSION

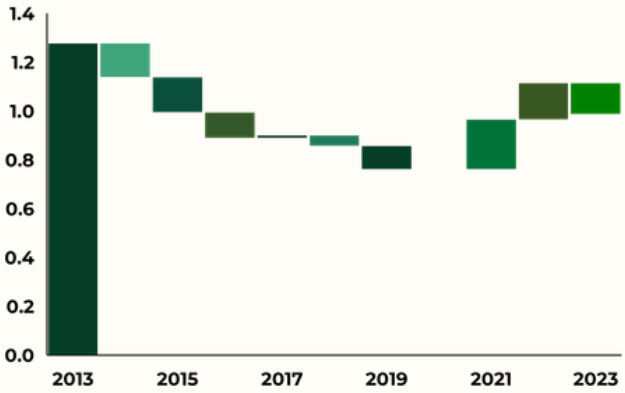
OLS | Scaled up by 1000 | 1-Year Lag

-0.1472

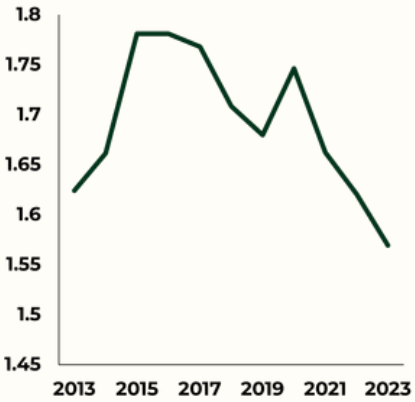
BROAD OVERVIEW



AGRI IMPORTS & EXPORTS
(% of Merchandise)

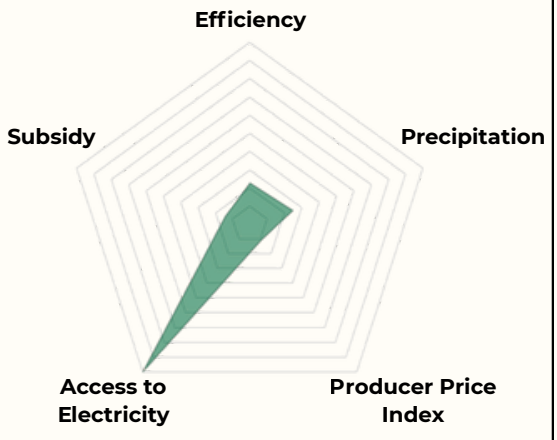


VALUE ADDED BY AGRICULTURE
(% of GDP)

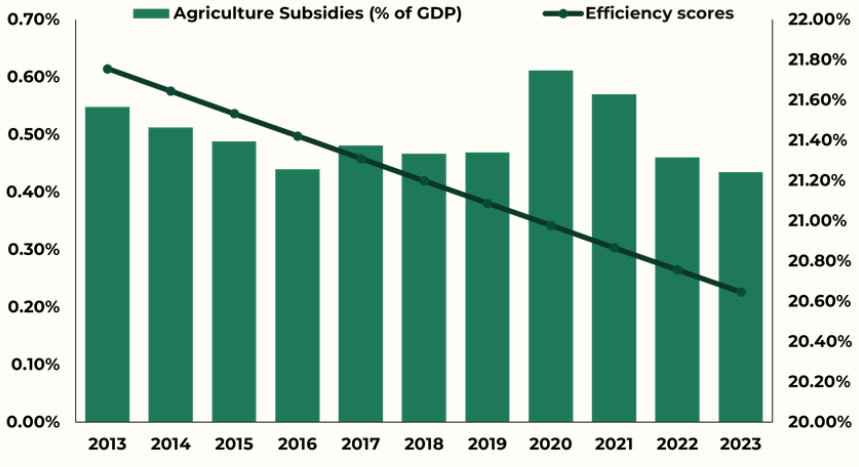


EMPLOYMENT IN AGRI
(% of Total Employment)

RELATIVE PROFILING



SUBSIDY AND EFFICIENCY



INFERENCES

1. **Efficiency Scores:** The efficiency scores declined over the period, even as value-added remained relatively stable.
2. **Regression Results:** Both current (p = 0.749) and lagged (p = 0.133) coefficients are insignificant; the lagged effect is notably negative (−0.000144), suggesting prior subsidies may suppress efficiency.
3. **Hidden Contributors:** The US agricultural sector operates at the frontier through scale, technology, and institutional strength, and not subsidy design.

STRATEGIC INSIGHTS

After employing the two-stage analytical framework, the Stochastic Frontier Analysis (SFA) to estimate the agricultural efficiency scores for each country, followed by regression and fixed effects modelling to link those scores to the agricultural subsidy levels across 25 countries over a period of 11 years, we were able to derive the following insights from both the panel results and the country-specific results:

Subsidies predominantly act as welfare transfer schemes rather than a way of increasing agricultural productivity

The most consistent finding from the analysis is that agricultural subsidies, with their current structure, function primarily as an income support or welfare scheme rather than a productivity-enhancing investment. The results confirm that there is no statistically significant relationship between subsidy levels and agricultural efficiency in most of the countries (high p-value). Only a small cluster of countries, including Belgium, Norway, Germany, Spain, Indonesia, Sweden, and Türkiye, shows a meaningful relationship between subsidy and agricultural efficiency.

Even the few countries that have a statistically significant relationship, i.e., a low p-value, have negligible subsidy coefficients, indicating an insignificant increase in agricultural efficiency with an increase in subsidies. This is consistent with the issues raised with the structure of subsidy in the OECD's Agricultural Policy Monitoring and Evaluation Report 2025, cited in the Literature Review, which found that nearly two-thirds of Producer Support Estimate were linked to unsustainable practices and did not increase productivity. Therefore, even if subsidies might not be failing at their welfare goals, it is definitely inefficient in the productivity rationale.

Difference in structural efficiency across different countries

The baseline agricultural efficiency derived from the SFA model highlights a major difference in the efficiency across different countries. China dominates over other countries with an efficiency score of 89.3%, which is more than 4 times that of the next best country, reflecting the scale and intensity of China's agricultural system followed

by the US, India, Japan, and Canada, forming the second tier, while some European countries, including Israel, Switzerland, Spain, and Austria, have extremely low efficiency scores even before accounting for subsidy effects. This highlights that subsidy-induced efficiency is much different from baseline efficiency; a country can have high structural efficiency while simultaneously showing negative or insignificant subsidy coefficients. Similarly, a country with low baseline efficiency might show high subsidy coefficients, indicating that subsidies are actually helping in increasing production levels.

Delay in Policy Transmission

In the analysis, a pattern was observed in many countries showing a positive subsidy-efficiency relationship, where the effect is stronger in the lagged specification, i.e., successive years rather than in the current period. This points out the logical and agronomic reality that effects of subsidies improving soil health, agricultural infrastructure, crop management, etc., are actually visible across growing seasons. Measuring the same in the current period might understate the true effect of subsidies, misleading the government in assessing its programmes.

Scale does not predict efficiency

Across the sample, there is no meaningful relation between the size of the subsidy programme and its corresponding subsidy-efficiency coefficient. Some of the highest spenders, like China, Japan, and the United States, show the most insignificant or negative relationship, while some of the modest spenders, like Belgium and Norway, show the most consistent and statistically robust positive efficiency effects. This pattern was also highlighted in OECD's Measuring Industrial Subsidies working paper, which warned against evaluating subsidies solely by volume. The evidence from our analysis adds quantitative weight to that argument.

POLICY RECOMMENDATIONS

The following **policy recommendations** are derived from the study's empirical findings and are designed to be actionable at both the national and multilateral levels. The unifying principle across all five recommendations is the same: subsidy effectiveness depends on structure and design rather than the volume of subsidies.

Shift focus from output to efficiency

Most governments assess agricultural subsidy programmes on output growth, tonnes produced, farm income levels, or hectares covered. These are appropriate welfare metrics, but they do not capture whether inputs are being used productively at their best potential. The recommendation is to supplement existing output-based evaluation with efficiency assessments, periodically re-estimating the production frontier and measuring the programme's contribution to improving efficiency rather than merely expanding agricultural output.

Adopt lag awareness evaluation cycles

The benefits of agricultural subsidies are often visible only after a year or more in terms of productivity outcomes; therefore, evaluating programmes based only on a single year can give a misleading picture of their effectiveness. This may lead to the early discontinuation or scaling down of actually impactful schemes. To avoid this, governments should assess agricultural support programmes over at least a two-year rolling period, using delayed or lagged efficiency gains as an important measure of performance alongside short-term results.

Differentiate between welfare subsidies and productivity support

There is often a significant difference in the outcomes from agricultural subsidies in different economies, not because of the scale of the subsidies but because they vary in the allocation of the funds. This makes it necessary for the government to review the subsidy programmes at the instrument level, distinguishing

between schemes that distort markets and schemes that genuinely enhance productivity.

Tailor subsidy design to economic conditions

Agricultural support policies should vary for different economies based on their structural conditions rather than following a uniform policy for all of them. In structurally efficient economies, subsidies usually show limited impact in improving productivity; therefore, the government should shift its spending to innovation, agricultural research, and development. In developing economies, where the long-term impact is visible, the focus should be on expanding the subsidy scheme while simultaneously trying to improve it as well. In highly efficient economies, subsidies usually do not show a significant impact; the priority here should be to redesign the schemes from input price distortions to direct farm-level support linked to practices that directly improve agricultural efficiency.

Integrate efficiency outcomes into subsidy monitoring frameworks

Currently, the monitoring frameworks, including the OECD's Producer Support Estimate, are mainly focused on tracking the volume of the agricultural support rather than its actual impact on improving agricultural efficiency.

Since agricultural subsidies affect both the environment and fiscal policy, simply measuring how much the government spends is no longer sufficient. The frameworks should shift their focus to evaluating how the spending actually improves the productivity of agricultural production. Policy makers and research institutions should incorporate efficiency-focused evaluation criteria, allowing for a more complete assessment.

CONCLUSION

Agricultural subsidies hold a distinct identity in public policy. They can be seen as both defended and scrutinised categories of government spending, helping farmers and rural communities. The study set out to evaluate whether agricultural subsidies improve productivity or not, and whether the claim that it makes agriculture efficient holds up when you actually look at the numbers. The short answer is that it usually does not.

The data does not show a generally significant relationship between subsidy levels and agricultural efficiency. Countries spending more on agricultural subsidies do not necessarily get more efficient agriculture in return. And while the country-level analysis does show some significant relationships between subsidies and efficiency in some countries, even those relationships are small enough in magnitude, indicating an almost negligible effect. It seems that currently, subsidies are achieving something, but that is keeping farmers afloat financially, rather than pushing agricultural systems closer to their potential. This is not a criticism, as there is nothing inherently wrong with subsidies that mainly act as a welfare support. Ensuring food security is an important policy objective, and so is ensuring stable income in the rural communities. The real issue here is that agricultural subsidy programmes are often validated as a tool for improving productivity, even though they fail in doing the same.

This misalignment matters because it shapes how programmes are designed, evaluated, and whether they are ever seriously reformed. A subsidy justified on productivity grounds but delivering welfare outcomes will rarely be scrutinised the way it should be.

What the study can say with confidence is that the countries with the most effective subsidy are not writing the biggest cheques but being more deliberate about what they fund and why. The goal should not be to sustain the structure as it exists today, but to make it more productive. The closing gap is less about how much the governments are willing to spend and more a question of whether they are realising and being honest about what their spending is achieving.

APPENDIX

LEGEND

Countries

ARG	Argentina	IDN	Indonesia	RUS	Russia
AUS	Australia	ISR	Israel	KOR	South Korea
AUT	Austria	ITA	Italy	ESP	Spain
BEL	Belgium	JPN	Japan	SWE	Sweden
CAN	Canada	MEX	Mexico	CHE	Switzerland
CHN	China	NLD	Netherlands	TUR	Türkiye
FRA	France	NOR	Norway	UK	United Kingdom
GER	Germany	POL	Poland	US	United States
IND	India				

Input Parameters

I1 Employment in Agriculture (% of total employment)

I2 Fertiliser Consumption (Kilograms per hectare of arable land)

I3 Agricultural raw materials imports (% of merchandise imports)

I4 Agricultural land (% of land area)

I5 Annual freshwater withdrawals agriculture (% of total freshwater withdrawal)

I6 Pesticide usage (per value of agricultural production g/Int$)

I7 Permanent cropland (% of land area)

I8 1000 Mcal of Metabolisable Energy (ME) - Parameter for Feed

I9 Value of Agricultural Capital Stock ($millions)

I10 Area equipped for irrigation (1000 hectares)

Panel Regression Results

	Country Fixed Effects		Current Regression		Lagged Regression	
Country	Coefficient	P Value	Coefficient	P Value	Coefficient	P Value
ARG	0.0255	0	0.000009	0.635	-0.0000037	0.889
AUS	0.0782	0	0.0000105	0.996	-0.0004601	0.16
AUT	0.0153	0	0.0000614	0.429	0.0001034	0.134
BEL	0.0269	0.25	0.0001009	0.02	0.0001138	0.011
CAN	0.1447	0	-0.000201	0.08	-0.0002934	0.062
CHN	0.8927	0	0.0001383	0.25	0.0001536	0.104
FRA	0.0378	0	0.0001461	0.085	0.0002066	0.055
GER	0.089	0	0.0003231	0.01	0.000181	0.278
IND	0.1443	0	0.000288	0.11	0.0001218	0.306
IDN	0.0624	0	0.0000952	0.054	0.0000872	0.025
ISR	0.0079	0	0.0000139	0.913	-0.0000043	0.989
ITA	0.0345	0.133	0.0000297	0.93	-0.000053	0.719
JPN	0.1515	0	0.0001042	0.158	0.0000548	0.404
MEX	0.0223	0.317	-0.0000881	0.346	0.000055	0.544
NLD	0.0177	0	0.0000747	0.733	0.0000502	0.778
NOR	0.0389	0	0.0000805	0.015	0.0000766	0.012
POL	0.0378	0	0.000094	0.054	0.0000598	0.29
RUS	0.09	0	0.0001947	0.133	0.000193	0.198
KOR	0.0485	0.002	-0.0000271	0.422	-0.0000276	0.722
ESP	0.0146	0	0.0001488	0.039	0.0001434	0.036
SWE	0.0701	0	-0.0005349	0.004	-0.000325	0.141
CHE	0.0061	0	0.0000251	0.496	0.0000291	0.263
TUR	0.0254	0.97	0.0001184	0.028	0.0000302	0.46
UK	0.0952	0	0.0000598	0.716	0.0000466	0.721
US	0.2174	0	0.0000353	0.749	-0.0001472	0.133

SFA Efficiency Scores

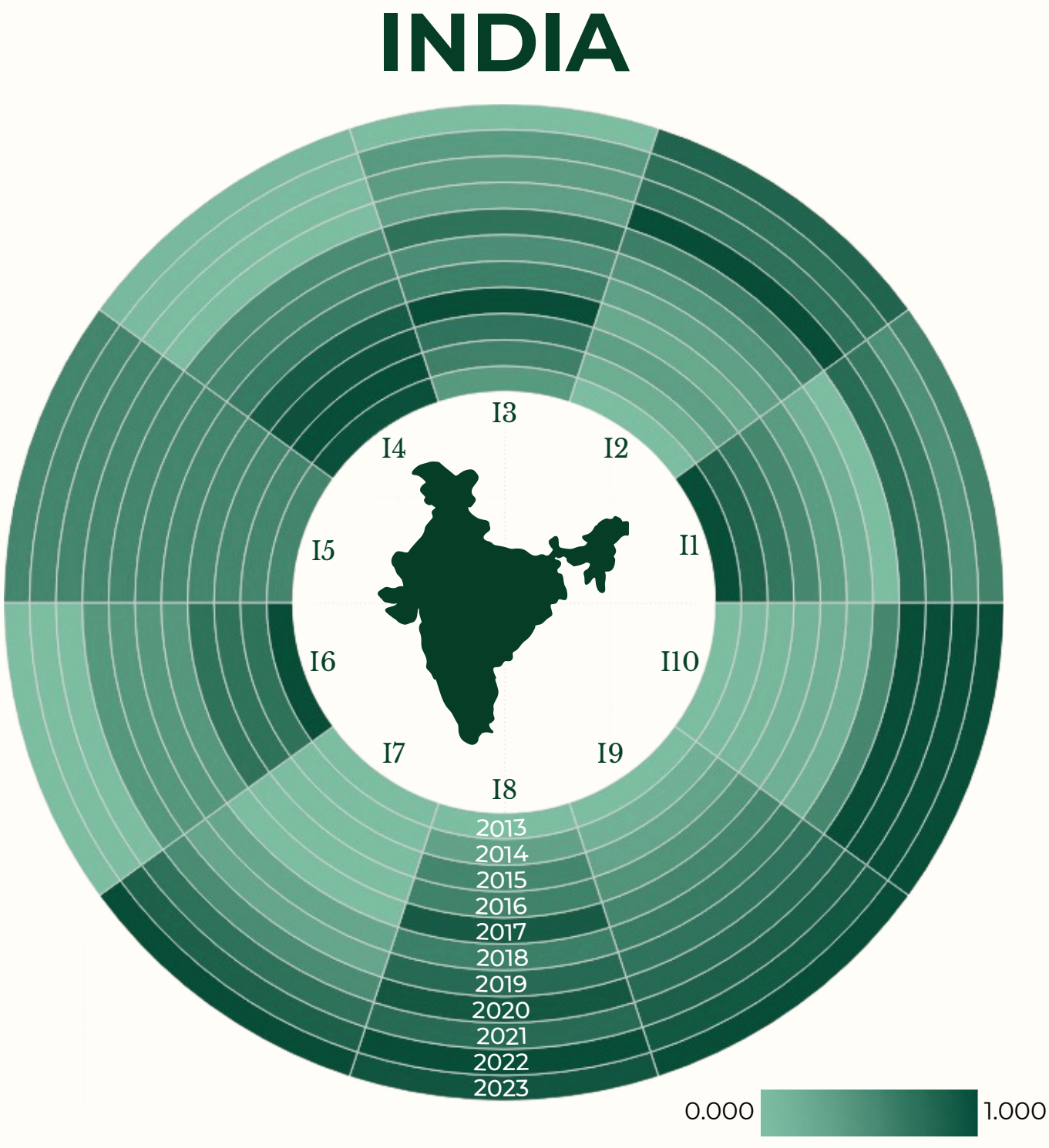
Country	2013	2014	2015	2016	2017
ARG	0.027116	0.026787	0.026461	0.026139	0.025819
AUS	0.07835	0.077679	0.077011	0.076347	0.075686
AUT	0.022277	0.021992	0.02171	0.021431	0.021155
BEL	0.034195	0.033807	0.033422	0.03304	0.032662
CAN	0.138972	0.138049	0.137128	0.136211	0.135296
CHN	0.902002	0.901688	0.901372	0.901056	0.900739
FRA	0.050116	0.049611	0.04911	0.048613	0.048119
GER	0.106644	0.105841	0.105041	0.104244	0.103451
IND	0.149663	0.148706	0.147751	0.1468	0.145851
IDN	0.068969	0.068349	0.067732	0.067119	0.066509
ISR	0.008891	0.008751	0.008612	0.008474	0.008339
ITA	0.036241	0.035837	0.035436	0.035038	0.034644
JPN	0.170386	0.16937	0.168357	0.167347	0.166339
MEX	0.023292	0.022998	0.022707	0.022419	0.022133
NLD	0.020112	0.019848	0.019587	0.019328	0.019072
NOR	0.048723	0.048228	0.047737	0.047249	0.046764
POL	0.045739	0.045265	0.044794	0.044326	0.043862
RUS	0.100067	0.099292	0.09852	0.097752	0.096987
KOR	0.046538	0.046059	0.045582	0.045109	0.044639
ESP	0.022357	0.022071	0.021789	0.021509	0.021232
SWE	0.056742	0.056195	0.055651	0.05511	0.054573
CHE	0.015757	0.015538	0.015321	0.015106	0.014893
TUR	0.031347	0.030982	0.03062	0.030262	0.029906
UK	0.104084	0.103291	0.102502	0.101716	0.100933
US	0.217569	0.216451	0.215334	0.21422	0.213108

SFA Efficiency Scores

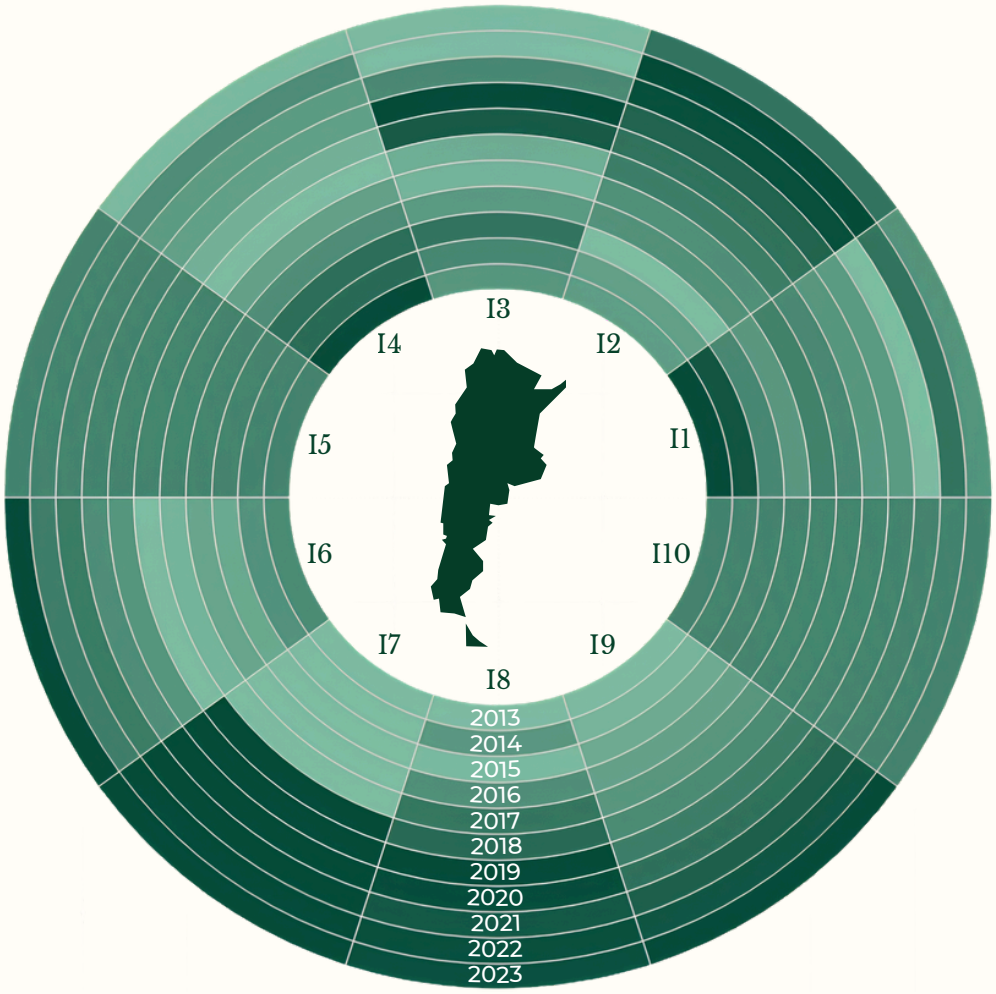
2018	2019	2020	2021	2022	2023
0.025502	0.025188	0.024876	0.024568	0.024262	0.023959
0.075029	0.074375	0.073725	0.073078	0.072435	0.071796
0.020881	0.02061	0.020341	0.020075	0.019812	0.019551
0.032287	0.031914	0.031545	0.031179	0.030815	0.030455
0.134385	0.133477	0.132572	0.13167	0.130771	0.129875
0.900421	0.900102	0.899782	0.899461	0.899139	0.898816
0.047628	0.047141	0.046656	0.046176	0.045698	0.045225
0.102661	0.101874	0.101091	0.100311	0.099535	0.098762
0.144906	0.143963	0.143023	0.142086	0.141153	0.140222
0.065902	0.0653	0.0647	0.064105	0.063512	0.062924
0.008205	0.008073	0.007943	0.007814	0.007687	0.007561
0.034252	0.033864	0.033479	0.033097	0.032718	0.032342
0.165334	0.164332	0.163332	0.162335	0.161341	0.16035
0.02185	0.021569	0.021291	0.021016	0.020744	0.020474
0.018819	0.018568	0.01832	0.018074	0.01783	0.017589
0.046283	0.045805	0.04533	0.044858	0.04439	0.043926
0.043401	0.042944	0.042489	0.042038	0.04159	0.041146
0.096225	0.095467	0.094712	0.093961	0.093213	0.092469
0.044173	0.043709	0.04325	0.042793	0.04234	0.04189
0.020957	0.020685	0.020416	0.020149	0.019885	0.019624
0.05404	0.053509	0.052983	0.052459	0.051939	0.051423
0.014683	0.014475	0.01427	0.014066	0.013865	0.013666
0.029554	0.029204	0.028858	0.028514	0.028173	0.027836
0.100154	0.099379	0.098606	0.097838	0.097072	0.09631
0.211998	0.210889	0.209783	0.208679	0.207577	0.206478

Agricultural Inputs Scaled Heatmap

The agricultural inputs heatmap provides a visualisation of the comparative input level of each input across the span of 11 years. The inputs have been each scaled across the 11 data points using min-max. Thereby the darkest shade represents the year with the highest level of input whereas the lightest shade represents the lowest level of input during the time period. Thereby, the heatmap allows the reader to understand the fluctuations in various input levels across the years at a single glance.



ARGENTINA



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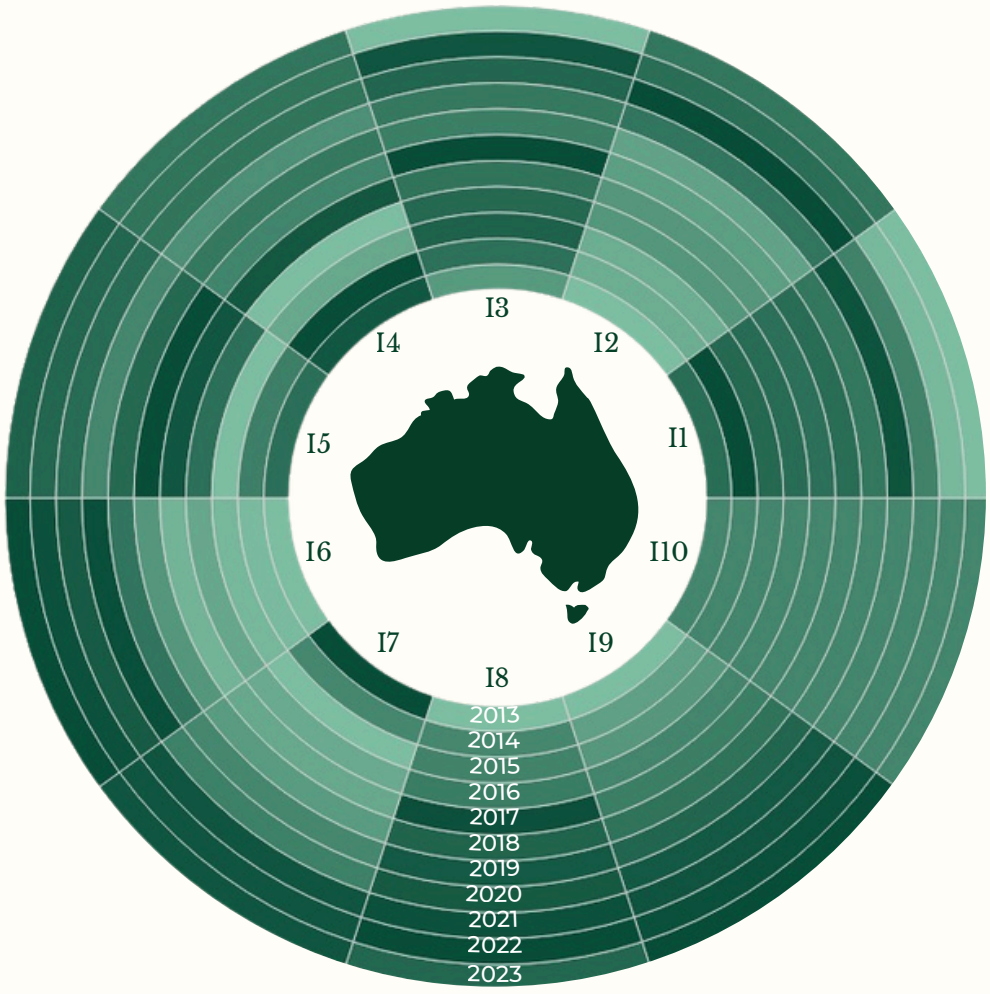

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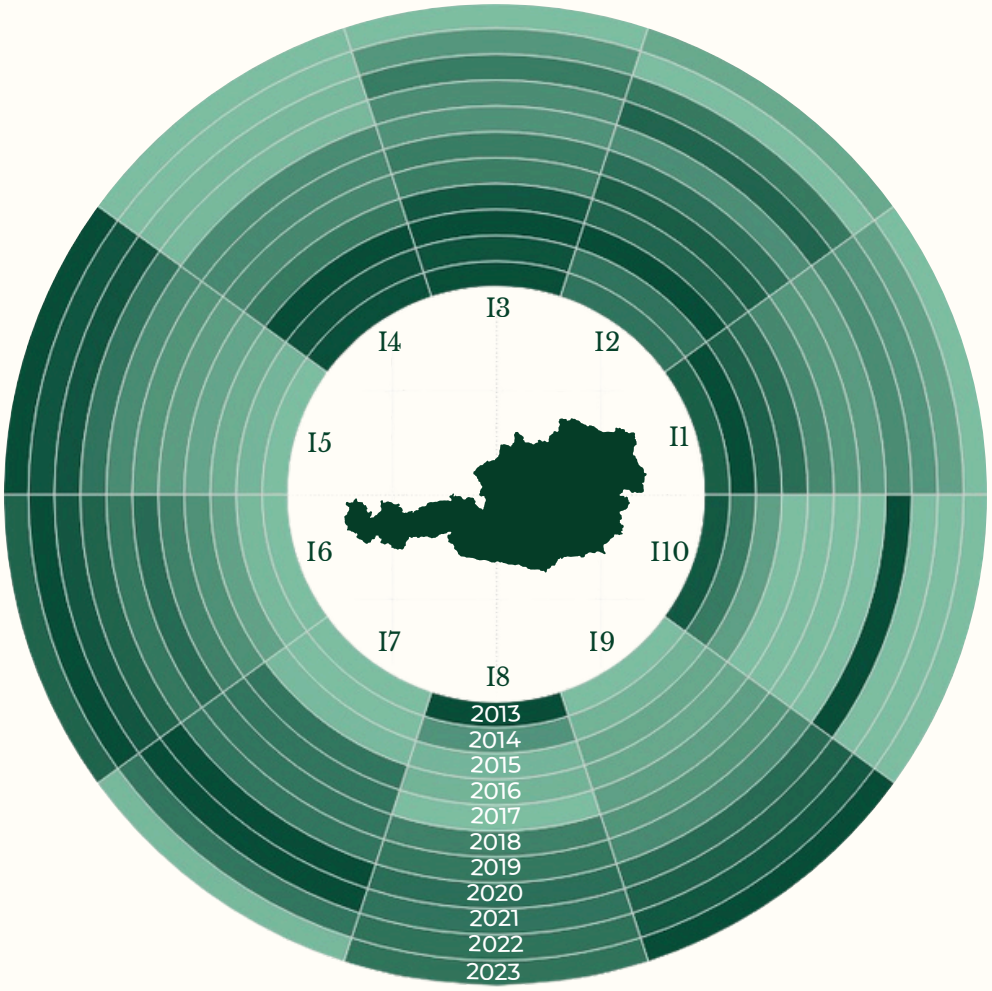

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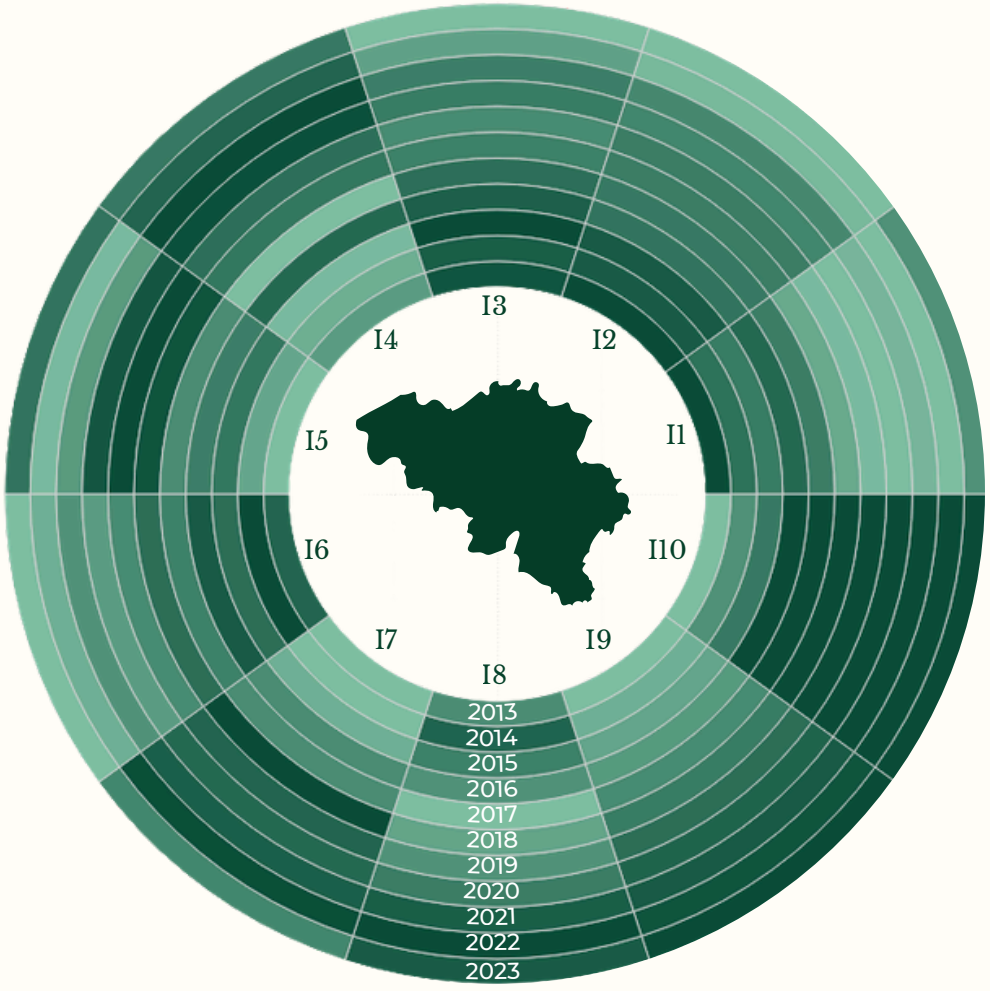

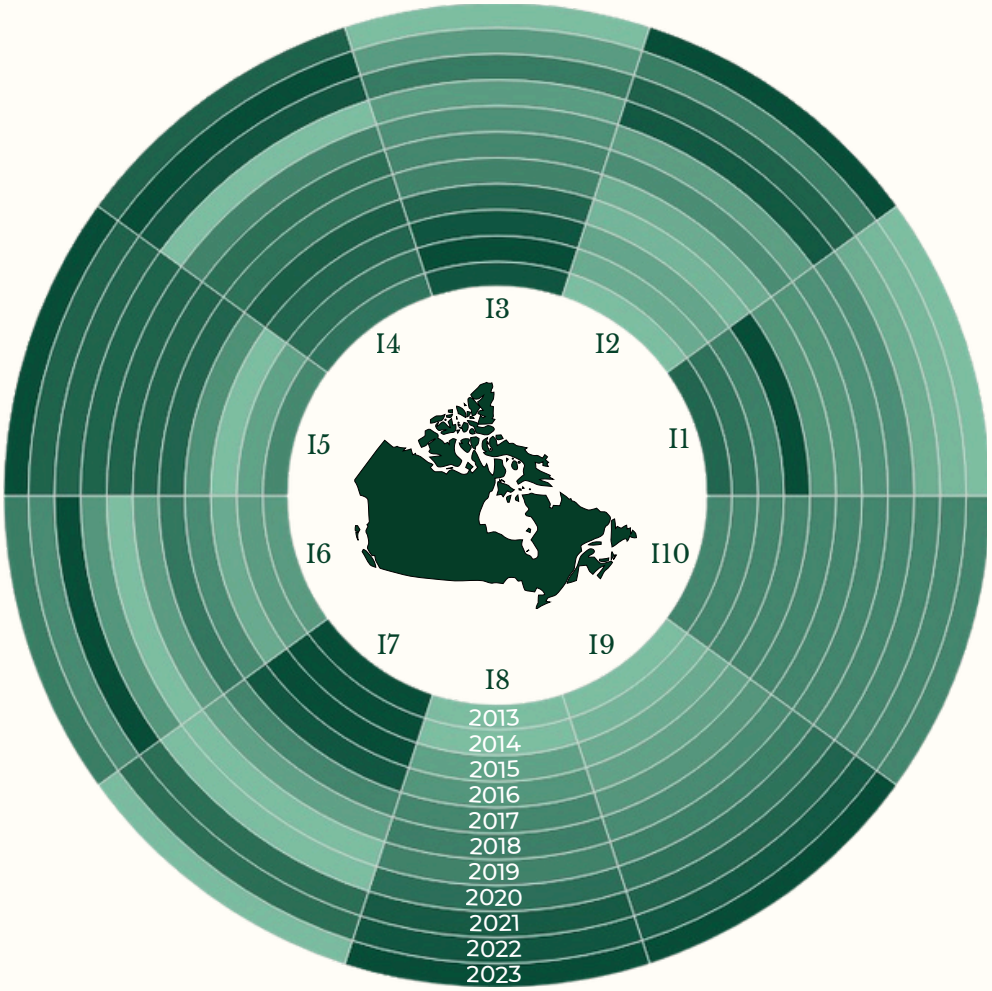

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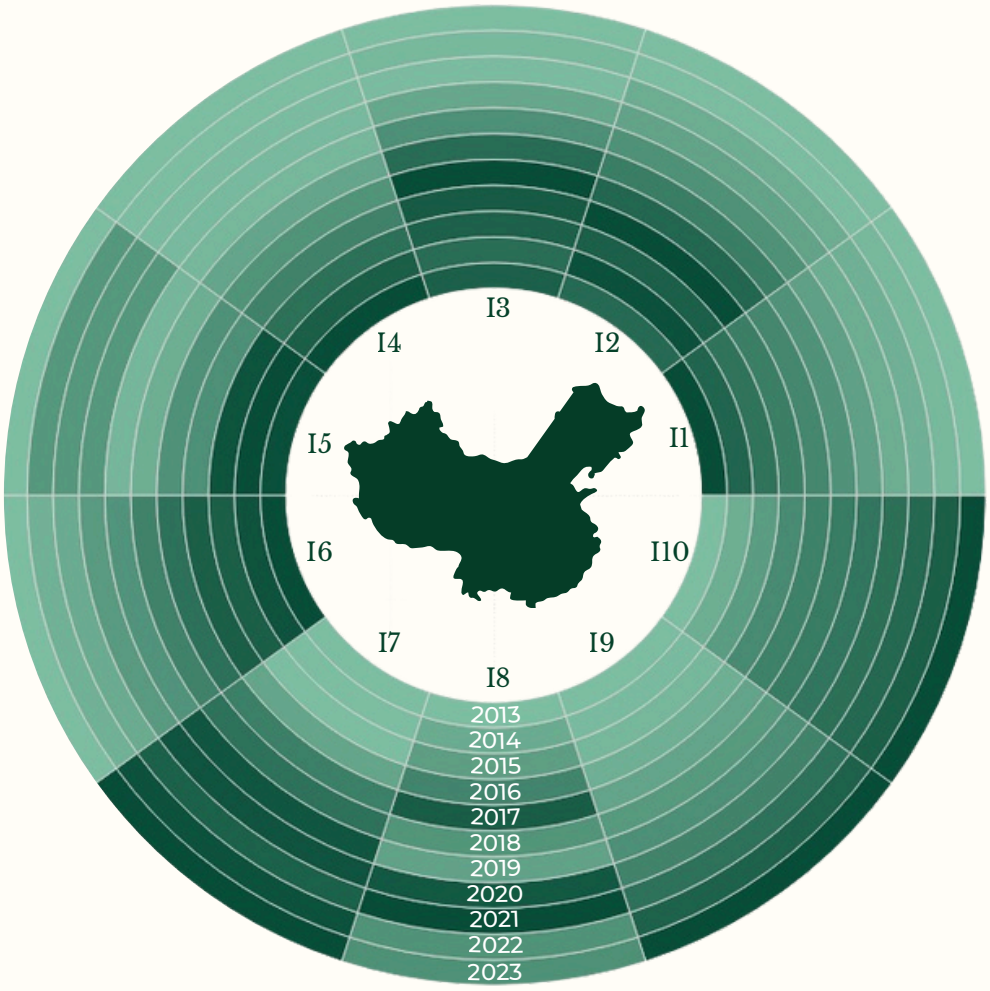
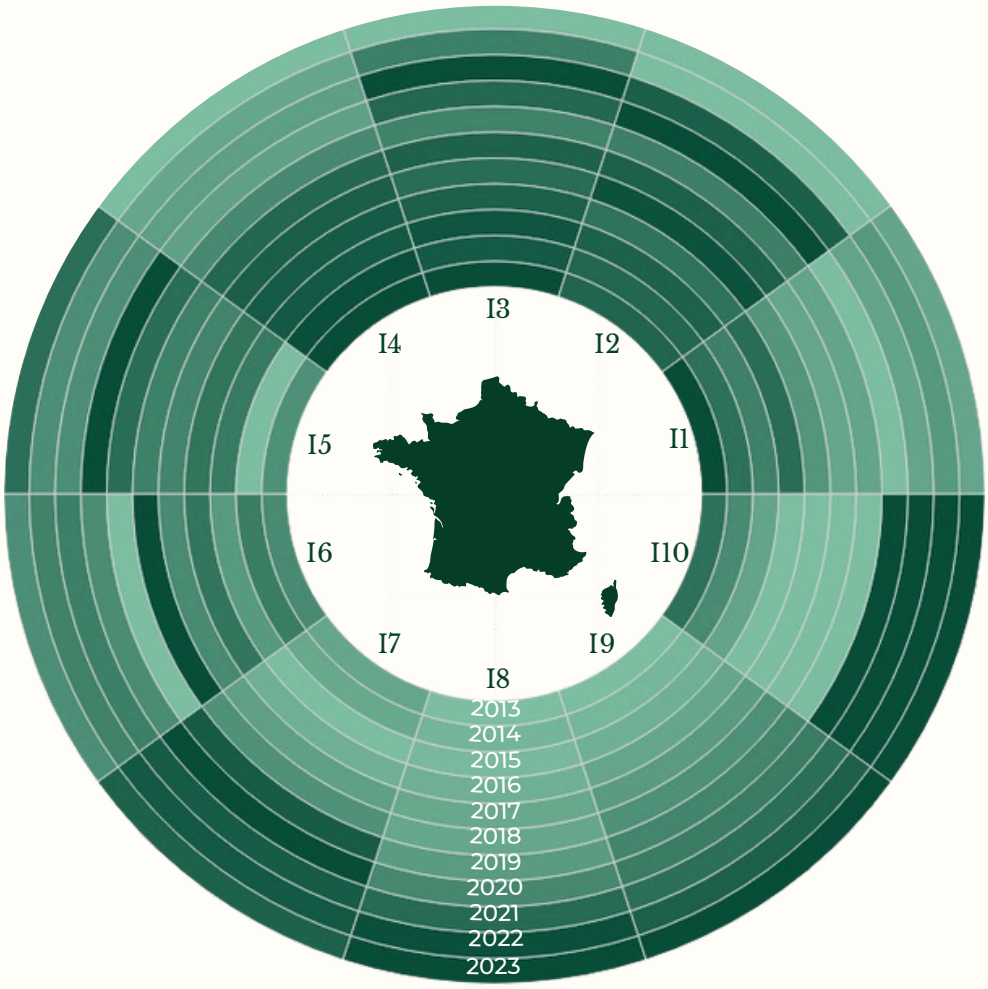
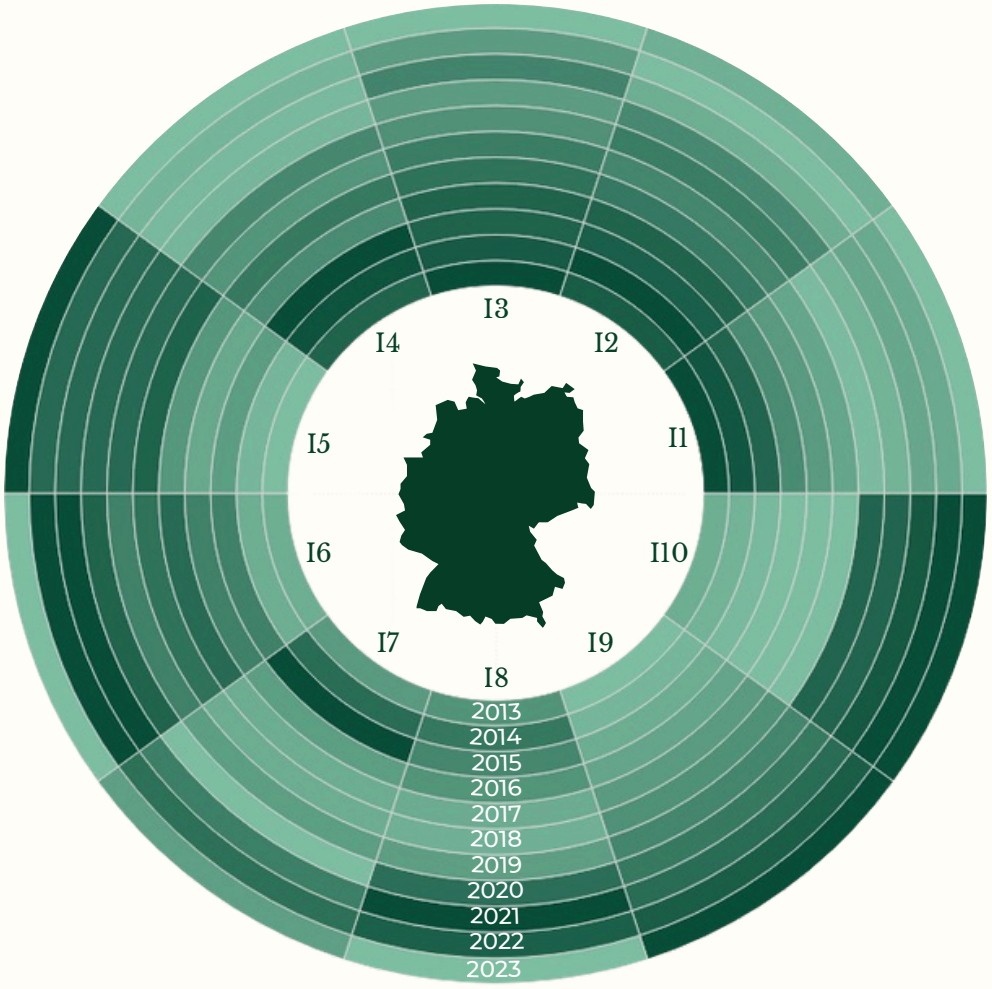


CHINA

FRANCE



GERMANY



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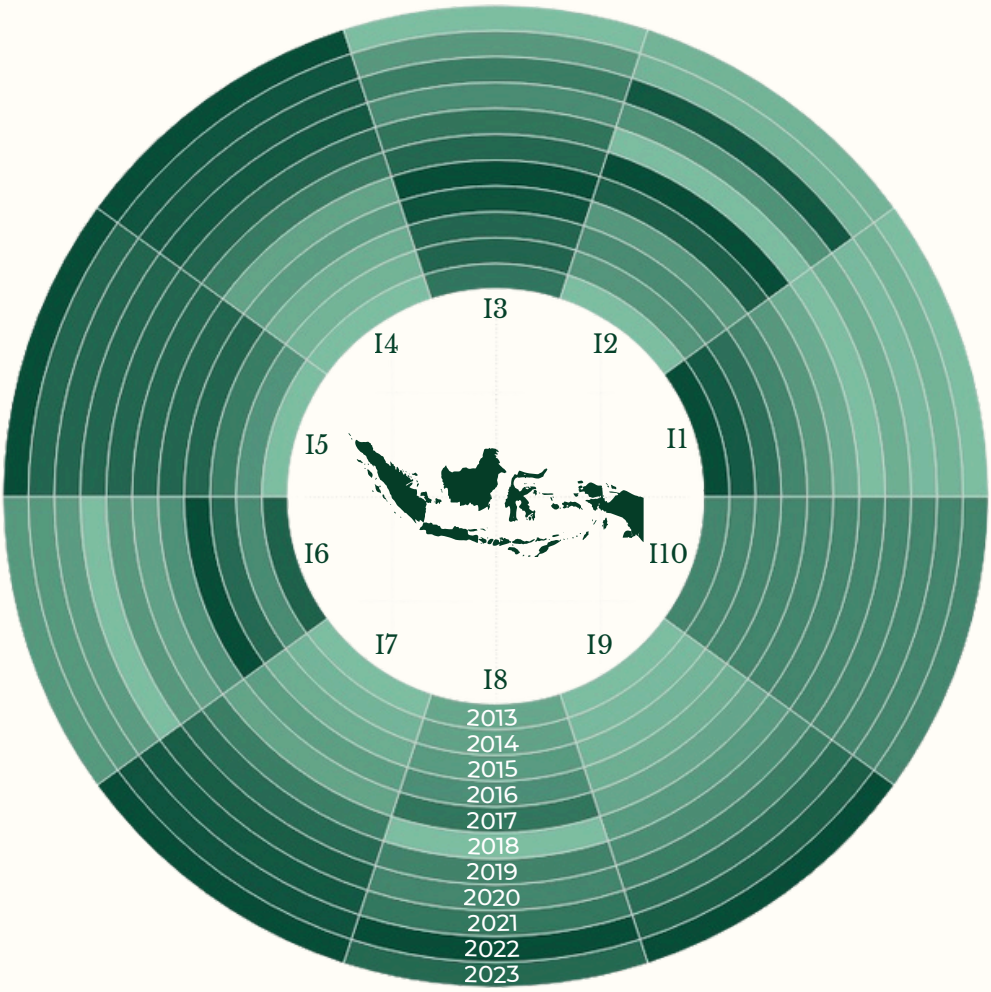

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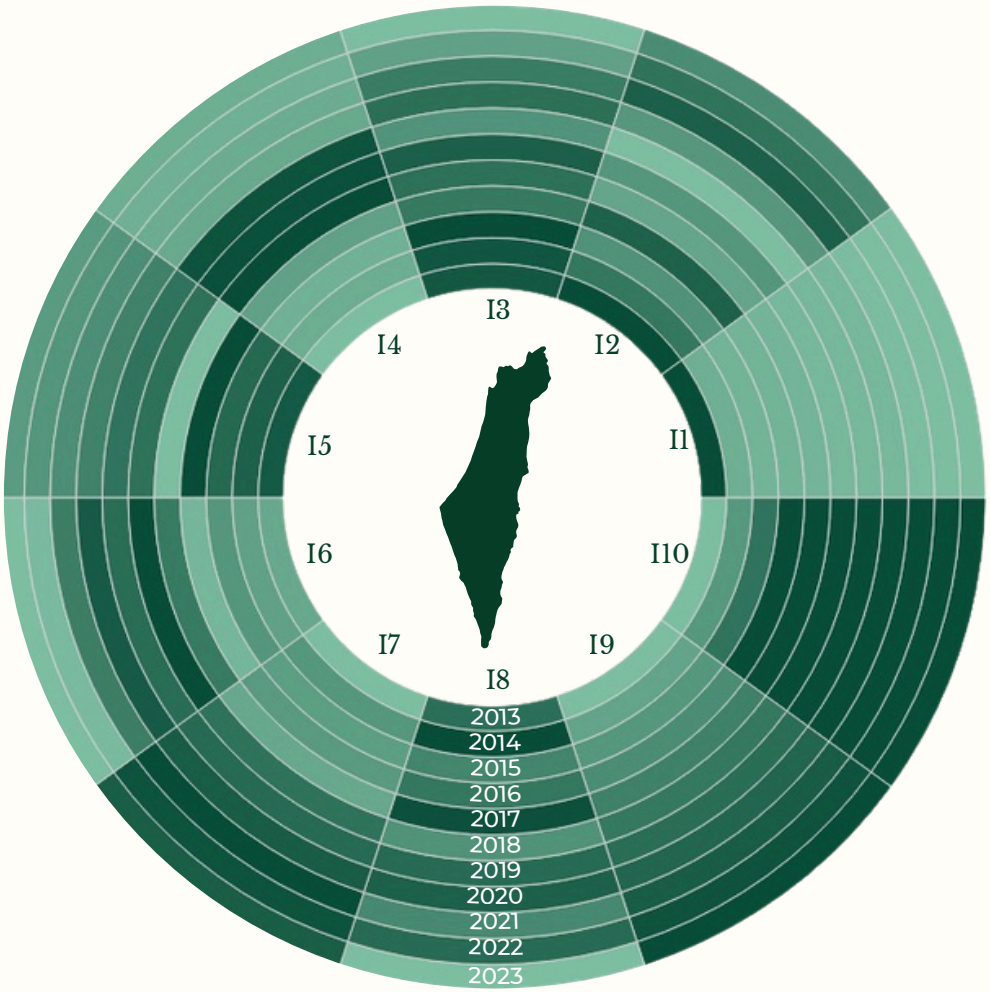

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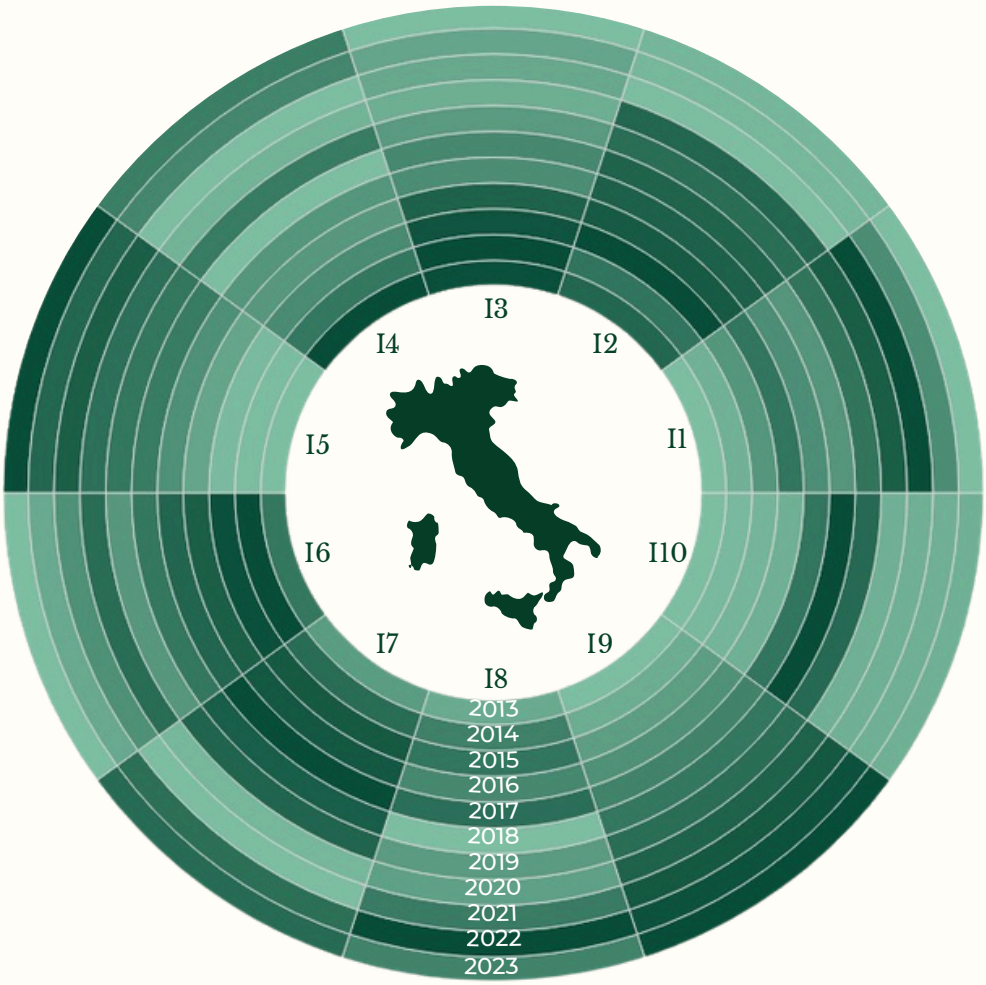
I3
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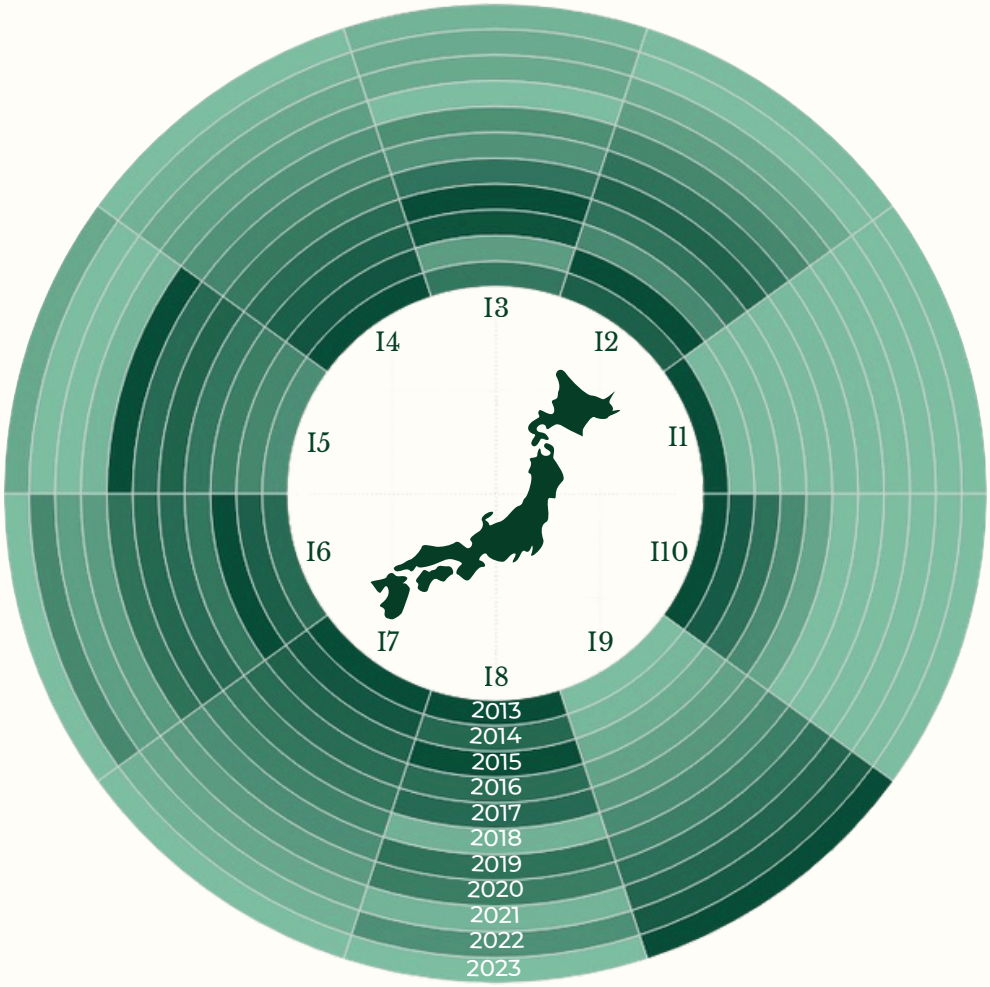
2023

JAPAN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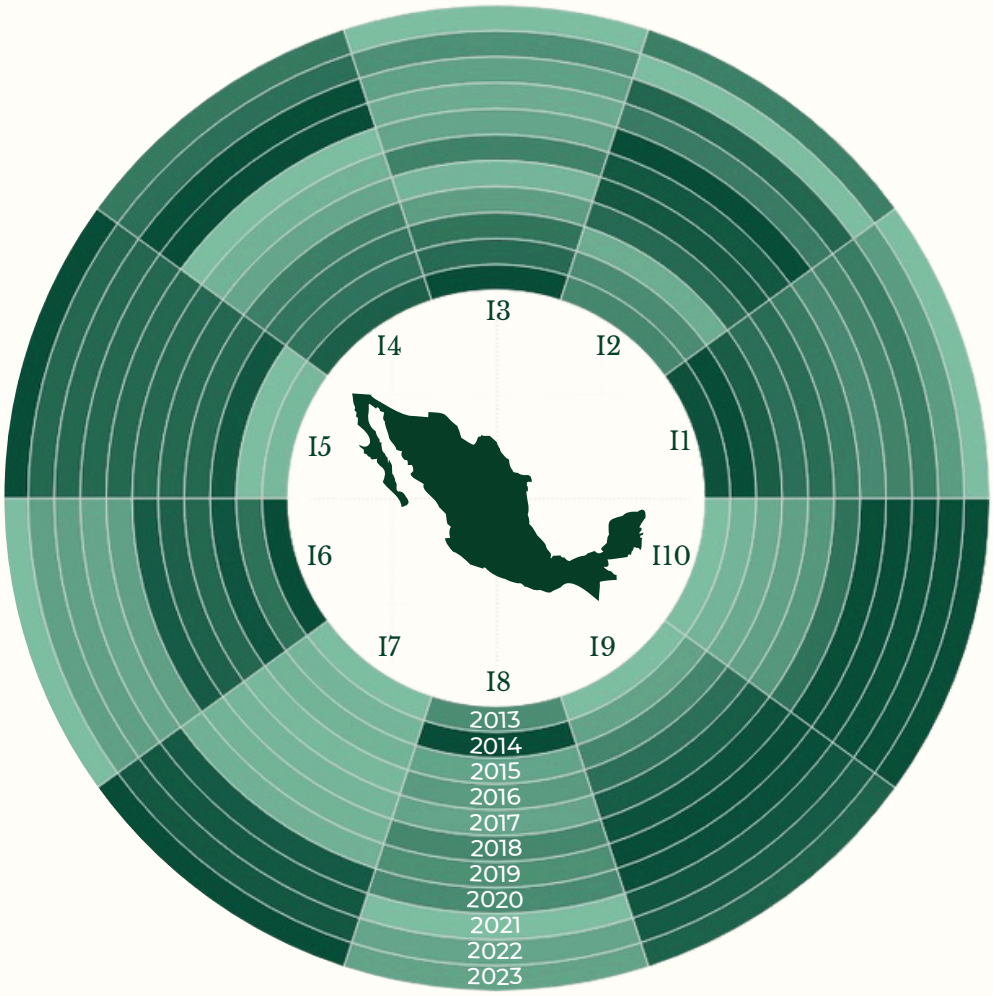
MEXICO



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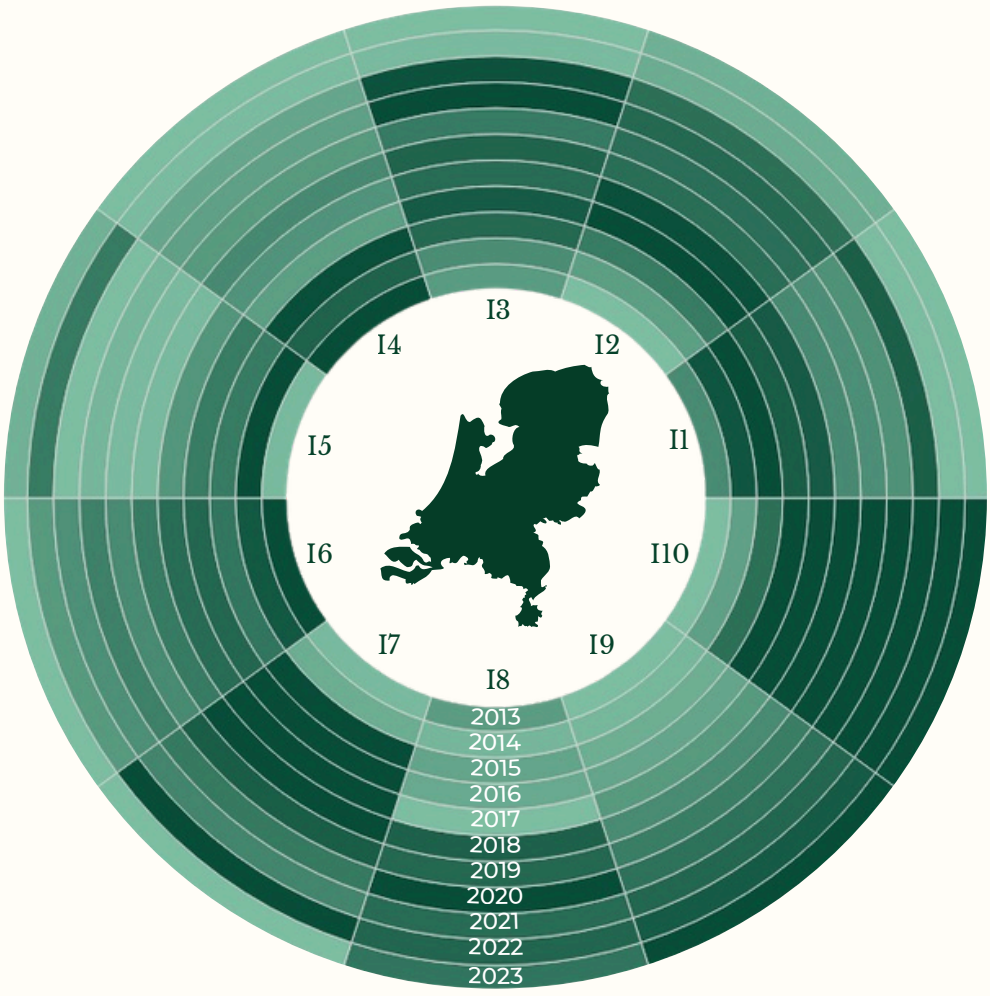
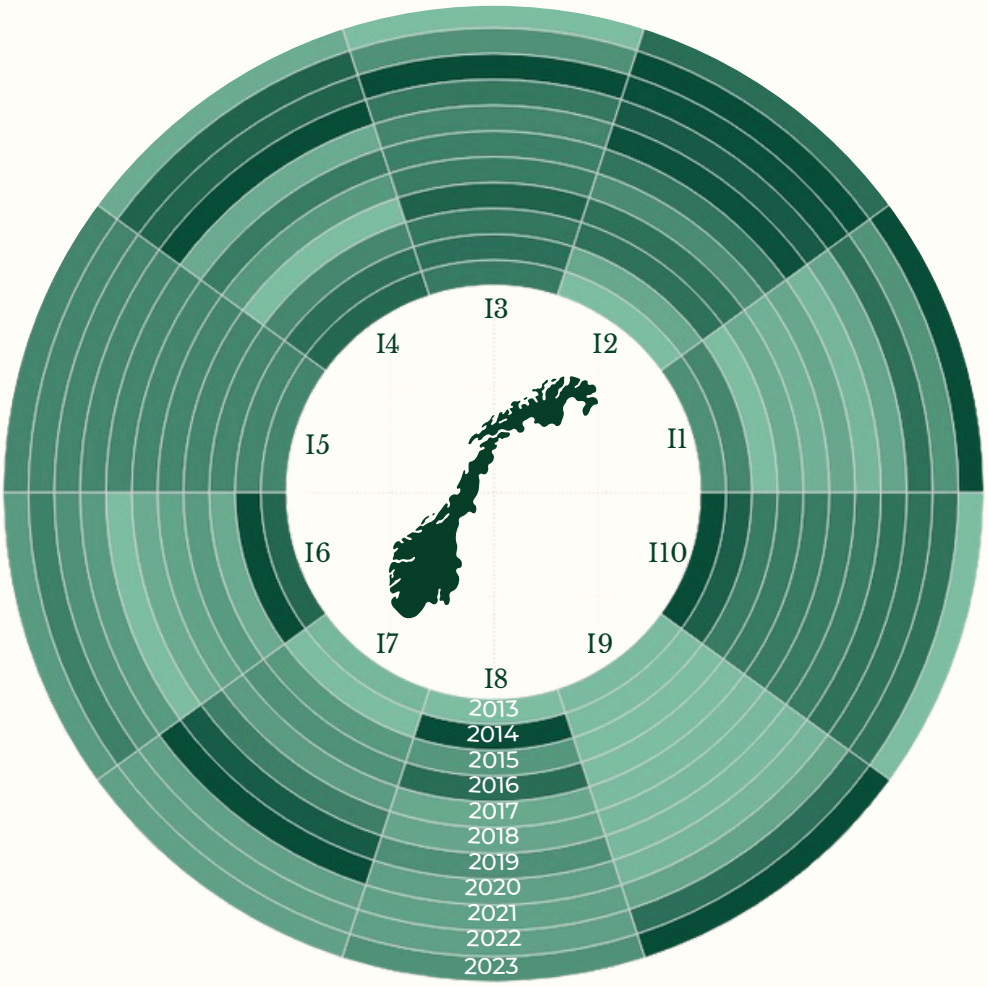


NORWAY



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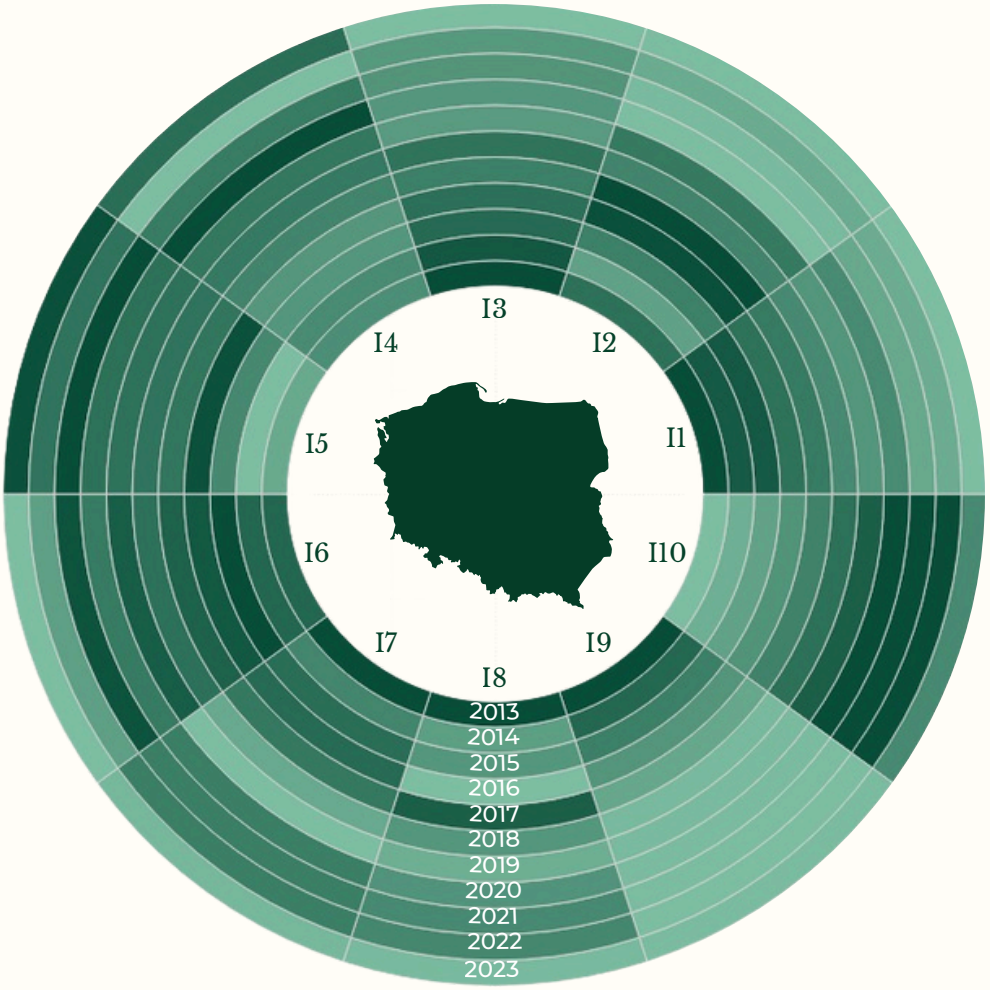

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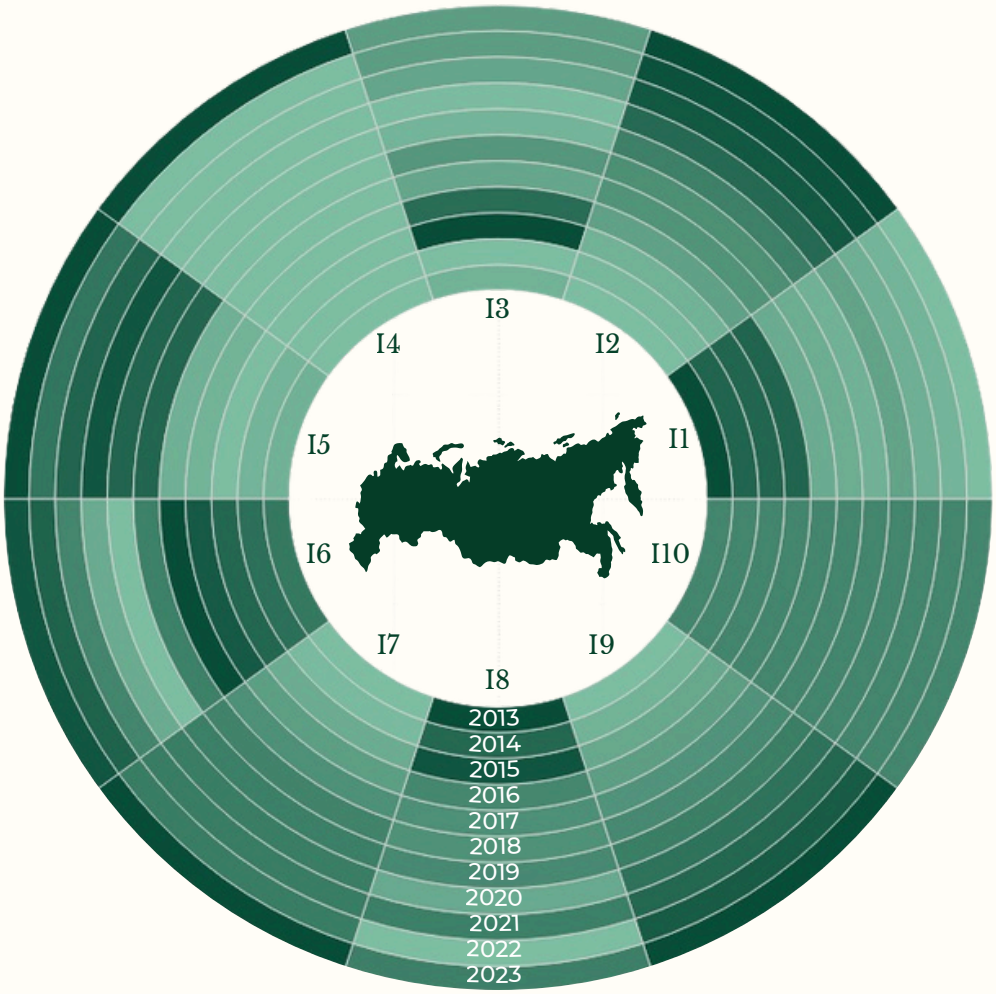

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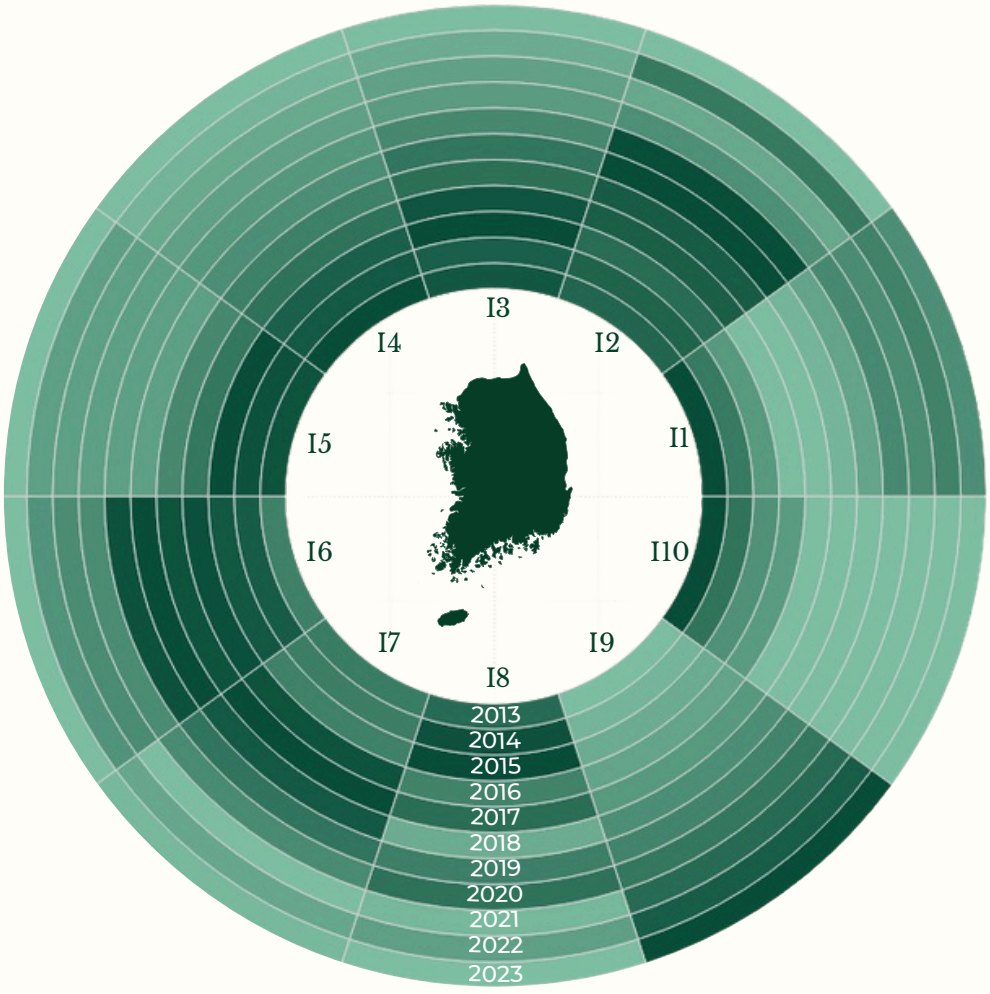

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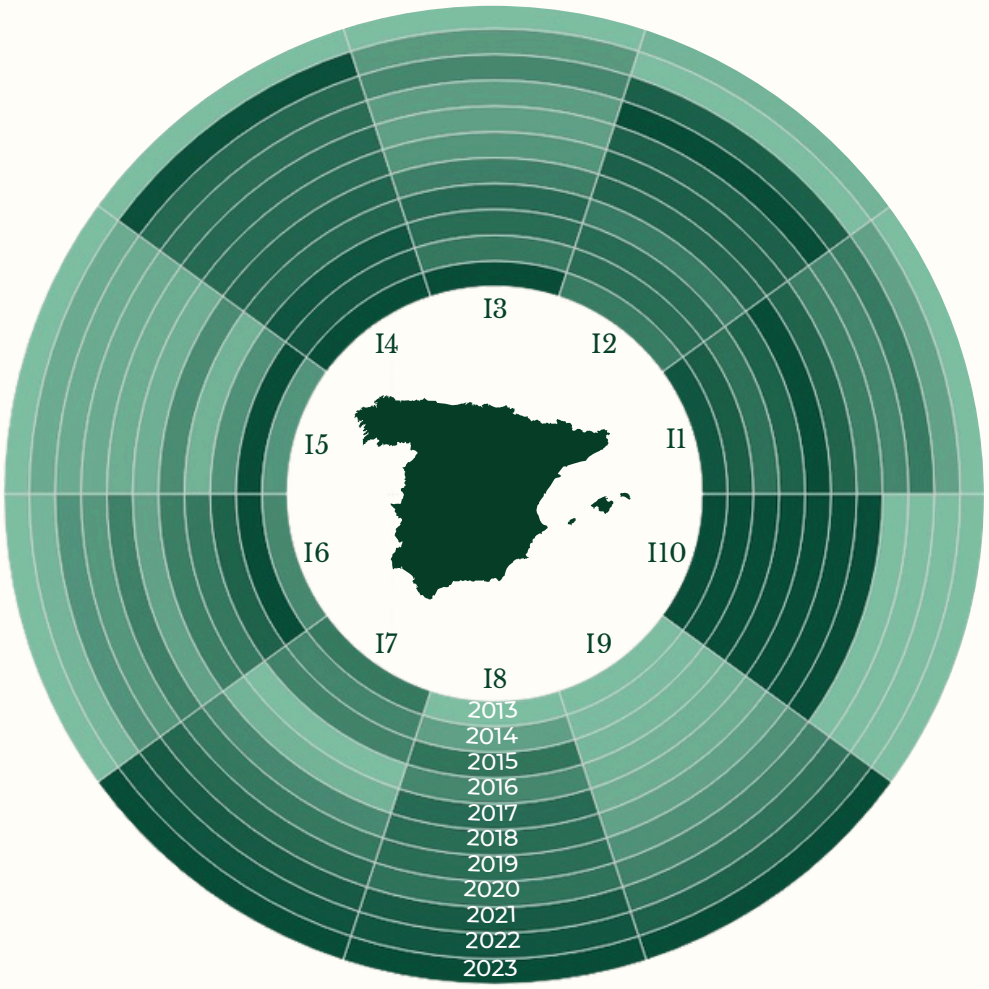

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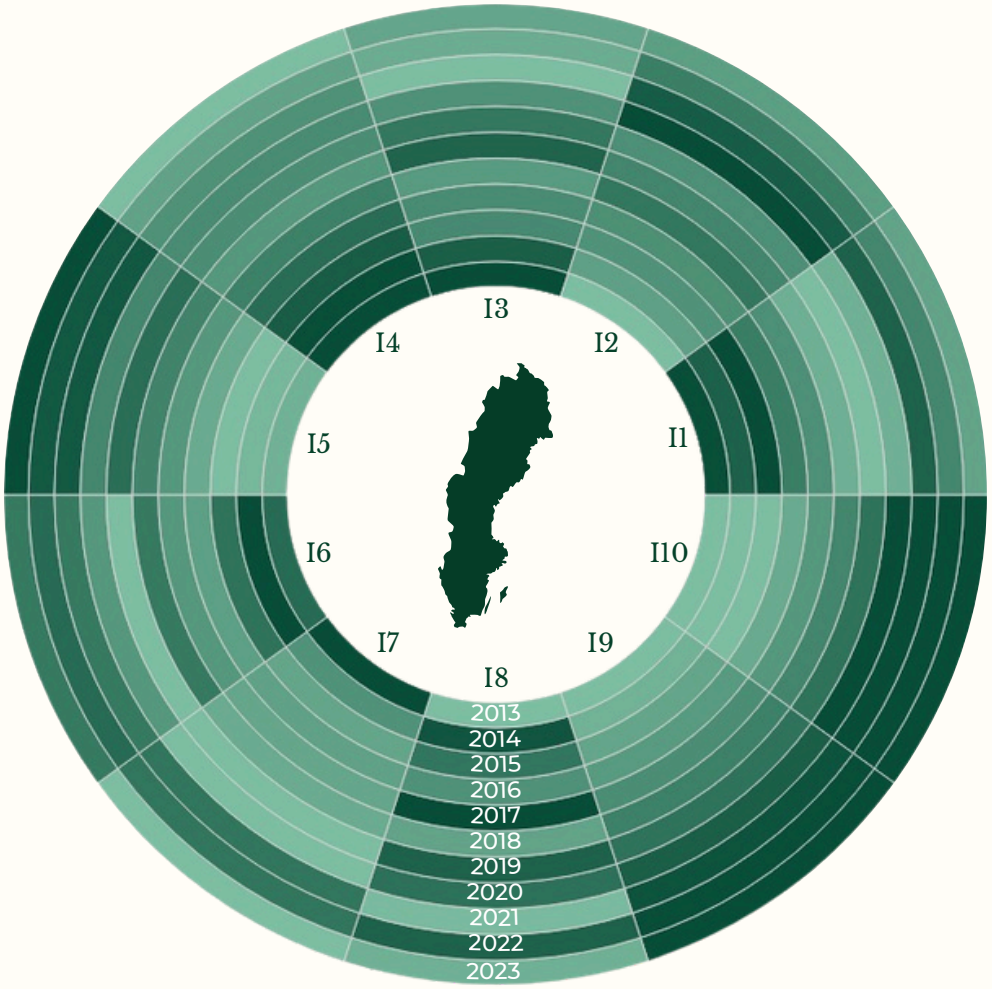

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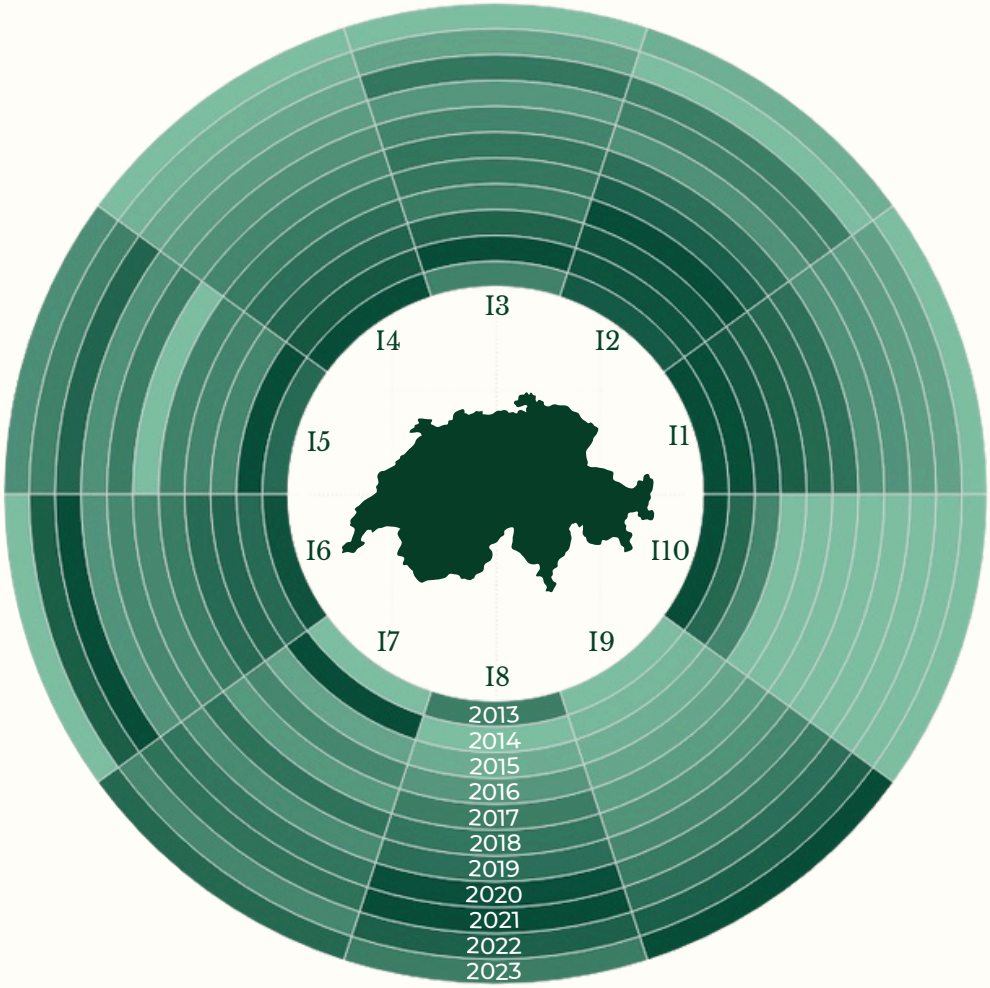

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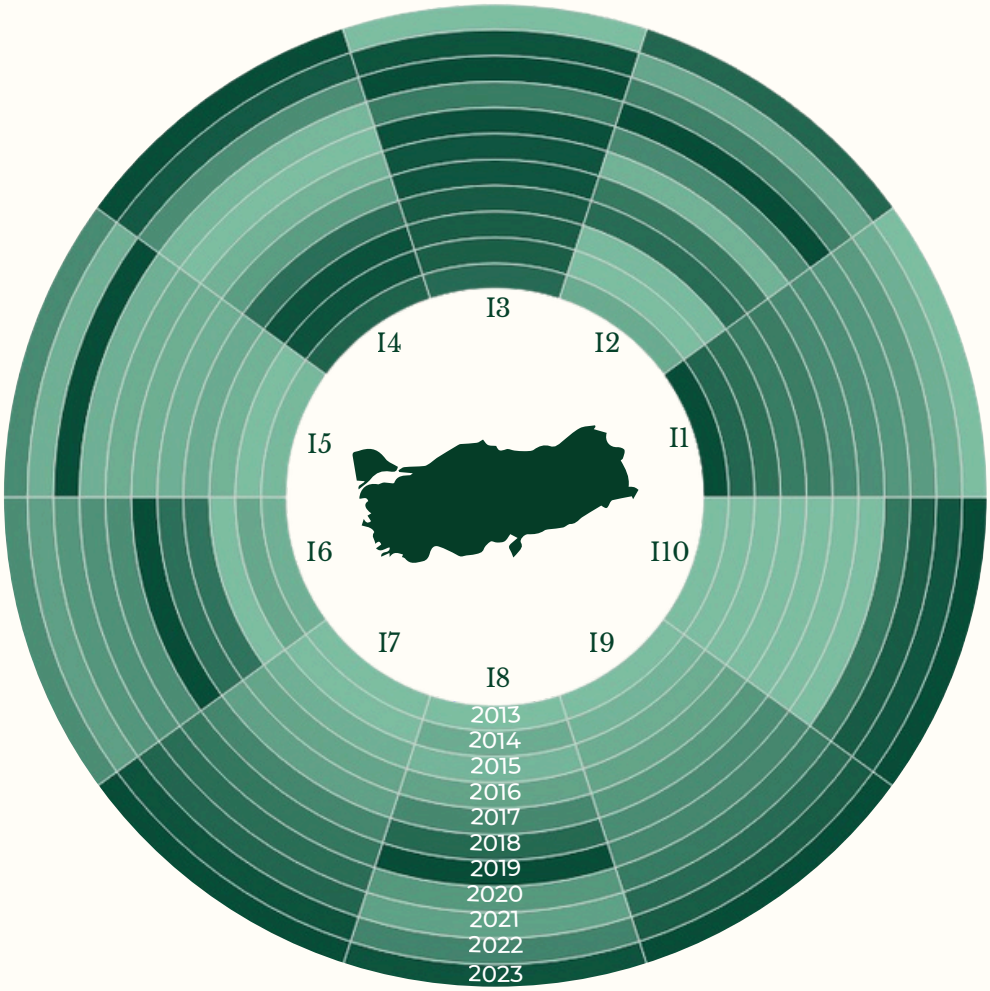

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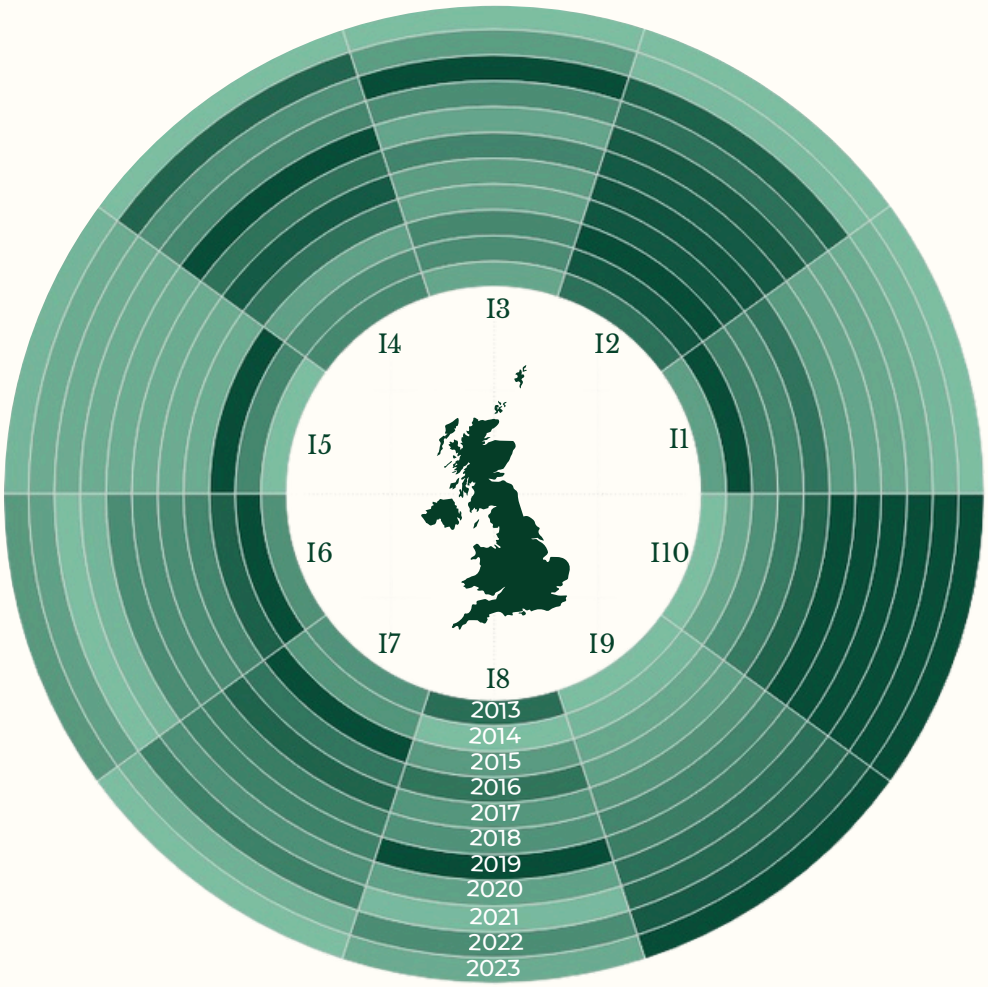

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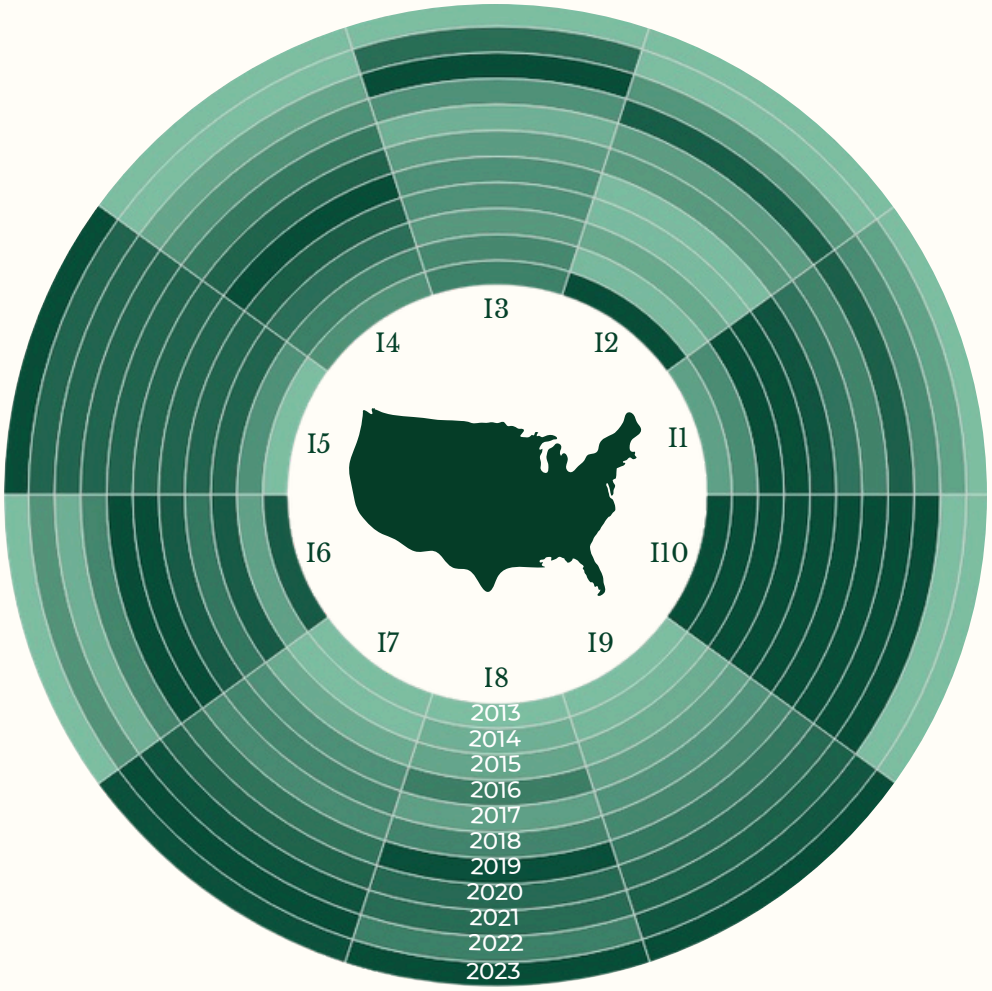

REFERENCES

- OECD. (2025). Agricultural policy monitoring and evaluation 2025. OECD Publishing. https://doi.org/10.1787/28a9c1ab-en

- Liu, Y., Chen, X., & Wang, J. (2024). An analysis of the effect of agriculture subsidies on technical efficiency: Evidence from rapeseed production in China. Agricultural Economics, 55(2), 213–228. https://doi.org/10.1111/agec.12821

- OECD. (1996). Measuring industrial subsidies: Some conceptual issues. OECD Economics Department Working Papers. OECD Publishing. https://doi.org/10.1787/eco_studies-v1995-art10-en

- Battese, G. E., & Coelli, T. J. (1992). Frontier production functions, technical efficiency and panel data: With application to paddy farmers in India. Journal of Productivity Analysis, 3(1–2), 153–169. https://doi.org/10.1007/BF00158774

- Srivastava, S. K., & Kumar, R. (2015). Overview of agricultural subsidies in India and its impact on environment. Current World Environment, 10(1), 19–28. https://doi.org/10.12944/CWE.10.1.03

- Council on Energy, Environment and Water. (2021). Sustainable agriculture in India 2021. CEEW. https://www.ceew.in/publications/sustainable-agriculture-india

- Food and Agriculture Organisation of the United Nations. (2023). *The state of food and agriculture 2023*. FAO. https://doi.org/10.4060/cc7724en

- World Bank. (2022). *World development indicators*. The World Bank Group. https://databank.worldbank.org/source/world-development-indicators

- Food and Agriculture Organisation of the United Nations. (2023). *FAOSTAT: Food and agriculture data*. FAO. https://www.fao.org/faostat

- Zhu, X., & Lansink, A. O. (2010). Impact of CAP subsidies on technical efficiency of crop farms in Germany, the Netherlands and Sweden. Journal of Agricultural Economics, 61(3), 545–564. https://doi.org/10.1111/j.1477-9552.2010.00257.x

- Rizov, M., Pokrivcak, J., & Ciaian, P. (2013). CAP subsidies and productivity of the EU farms. Journal of Agricultural Economics, 64(3), 537–557. https://doi.org/10.1111/1477-9552.12030

- Swinnen, J. F. M. (2010). The political economy of agricultural and food policies: Recent contributions and new frontiers. Applied Economic Perspectives and Policy, 32(1), 33–58. https://doi.org/10.1093/aepp/ppq002

- Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). An introduction to efficiency and productivity analysis (2nd ed.). Springer. https://doi.org/10.1007/b136381

- Kumbhakar, S. C., & Lovell, C. A. K. (2000). Stochastic frontier analysis. Cambridge University Press. https://doi.org/10.1017/CBO9781139174411

- OECD. (2023). Agricultural outlook 2023–2032. OECD Publishing. https://doi.org/10.1787/08801ab7-en

- Latruffe, L., Balcombe, K., Davidova, S., & Zawalinska, K. (2004). Determinants of technical efficiency of crop and livestock farms in Poland. Applied Economics, 36(12), 1255–1263. https://doi.org/10.1080/0003684042000176793

- Huang, J., & Rozelle, S. (1996). Technological change: Rediscovering the engine of productivity growth in China's rural economy. Journal of Development Economics, 49(2), 337–369. https://doi.org/10.1016/0304-3878(95)00061-5

- Gocht, A., Ciaian, P., & Salputra, G. (2017). EU-wide economic and environmental impacts of CAP greening. *Journal of Agricultural Economics*, *68*(3), 651–681. https://doi.org/10.1111/1477-9552.12207

- Ministry of Agriculture and Farmers Welfare, Government of India. (2022). *Annual report 2021–22*. Department of Agriculture and Farmers Welfare. https://agricoop.nic.in

- StataCorp. (2023). *Stata statistical software: Release 18*. StataCorp LLC.

- Roser, M., & Ritchie, H. (2023). Employment in agriculture. Our World in Data. https://ourworldindata.org/employment-in-agriculture

- OECD. (2023). Producer support estimates (PSE) database. OECD Agriculture Statistics. https://stats.oecd.org/Index.aspx?DataSetCode=MON2023

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Divleen Kaur

EXECUTIVE MEMBERS

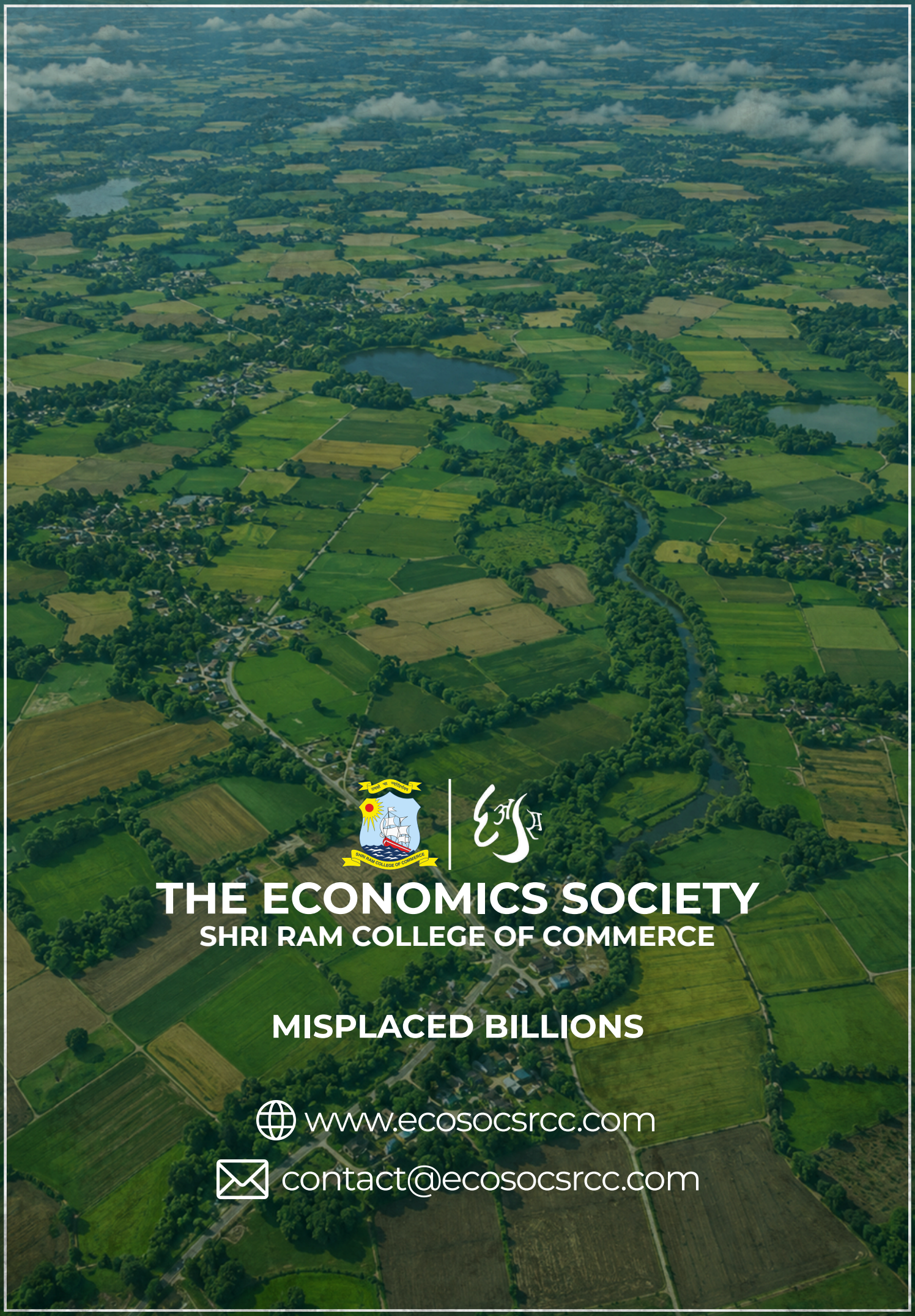
Aditya Rajoteaya

Anju Subramanian

Hitesh Bhalotia

Keshav Gupta

Shreeya Sawhney



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