

# An insight into Food self-sufficiency of Switzerland

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## Abstract

As part of the CS-401 Applied Data Analysis course at EPFL, this project aimed to analyze the status of Switzerland in terms of food supply self-sufficiency and the relevance of possessing a strong food sovereignty. In order to provide further depth to the study, Helvetian statistics were compared to its neighboring countries. Data retrieved from the Food and Agriculture Organization allowed to observe that Switzerland is behind its surrounding countries as far as food self-sufficiency is concerned. Therefore, ways that may improve this situation were discussed.

## 1 Introduction

In the wake of the years 2000s, food self-sufficiency policies have gained increasing attention in a number of countries. Since then, diverse countries have expressed interest in improving their levels of food self-sufficiency.

In September 2018 in Switzerland, the debate was materialized into a popular referendum asking whether a food self-sufficiency politic should be adopted or not. Such a politic could have tremendous consequences considering a country like Switzerland with a restrained area.

Self-sufficiency is a vague concept that possesses various definitions [1] [2]. The more extreme one claims that a self-sufficient country produces everything it consumes. A more economical characterization states that food importations should match the exportations [3], to ensure the country's food security. The latter definition is the one chosen here, as it allows to include global food market to the analysis, a key component of Switzerland food supply. Hence, this report aims to provide an insight of the

self-sufficiency status of Switzerland compared to the neighboring countries, discuss its relevance and explore the possibilities to increase it.

## 2 Data collection and cleaning

The Food and Agriculture Organization of the United Nation Statistics (FAOSTAT) database provides access to food and agriculture data from over 245 countries and territories from 1961 to the most recent years. In particular, it contains reliable and clean data on crops production for human consumption, foodstuff trades, land-use, population and fertilizer use, among other categories. Additionally to loading those data categories for Switzerland, statistics for its neighbouring countries (France, Germany, Italy, Austria) were also included, as previously stated. Indeed, these countries are assumed to be well-suited for comparison thanks to their similarities in terms of politics, economics, culture and climate. Note that data concerning Liechtenstein was not included in this study, as it is missing from a lot of datasets considered here.

To limit the bias and variability that exists between the studied countries and increase their comparability, the study was focused on 7 raw products: wheat, maize, potatoes, sugar beet, apples, barley and grapes. Those correspond to the shared 10 most produced foodstuffs between the selected countries and are thus assumed to be the most representative ones.

Moreover, the influence of temperature over the Swiss production was also investigated. This data was retrieved from the Swiss Federal Office of Meteorology and Climatology (MeteoSwiss).

Finally, because of limited availability of data for years before 1986, the study will be narrowed on a period ranging from 1986 to 2017.

### 3 Definition and evolution of the self-sufficiency ratio

The self-sufficiency definition introduced earlier is mathematically represented by the self-sufficiency ratio (SSR) and is expressed as follows [3]:

$$SSR = \frac{Production * 100}{(Production + Imports - Exports)}$$

As displayed on Figure 1, Switzerland has one of the smallest SSR ratio for the 7 products considered. It oscillates between 70 and 90 % over the years and its trend has been decreasing during the past decade. This indicates that Switzerland has never been food self-sufficient since 1986. It is interesting to note that Germany, France and sometimes Austria have SSR superior than 100 %. Mathematically, this means that those countries export more than they import, resulting in an economically favorable situation. It is essential to note these numbers are boosted. Indeed, they represent the SSR for the 7 selected products, which can all be produced in these countries. In reality, the SSR is most certainly lower as lots of imported exotic foodstuffs would be included. This is confirmed by Jennifer Clapp [3] which calculated a SSR of less than 60%. Nevertheless, these results are still highly informative when compared between countries.

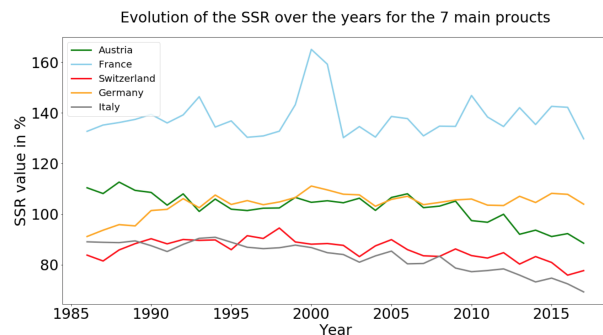


Figure 1: Evolution of the SSR of Switzerland and its neighbours for the considered period and the 7 selected products.

### 4 Relevance of having a high SSR

In accordance with the growing world demography, Swiss population has increased from 6.5 to 8.5 million people between 1986 and 2017. However, the country production of

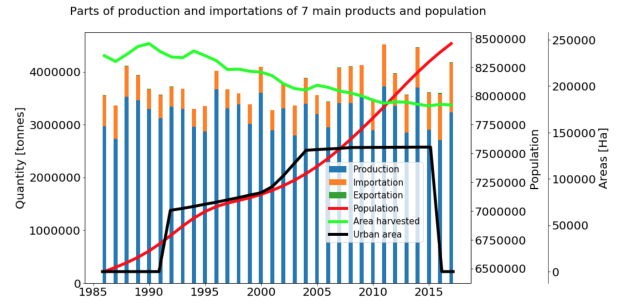


Figure 2: Evolution of Switzerland's population, areas, trades and production over the years. *Urban area data was restrained from 1991 to 2015, so the data was completed with zeros to fit the considered time window.*

the basic foodstuffs does not correlate to the demography trend, as shown on Figure 2. On the contrary, the production is stable and even seems to decrease a bit at the expense of importations. Note that Swiss exports for these products are negligible.

Furthermore, the area distributions confirm this lack of production to respond to the growing population. Indeed, area allocated to harvest these commodities is decreasing, while the urban area of the country is increasing rapidly.

#### 4.1 Comparison with France

As France possesses the highest SSR (see Section 3), it provides an interesting insight to compare its situation with Switzerland. On Figure

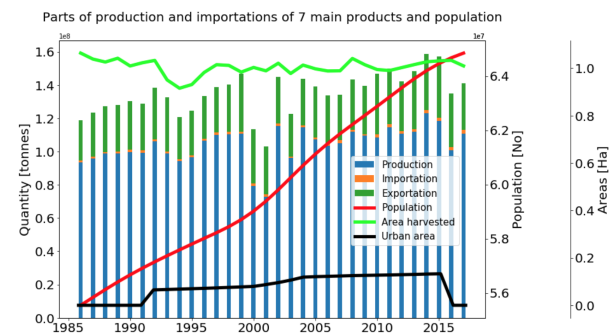


Figure 3: Evolution of France's population, areas, trades and production over the years. *Urban area data was restrained from 1991 to 2015, so the data was completed with zeros to fit the considered time window.*

3 is shown the latter. Impressively, the proportions of the exports and imports are reverted compared to Switzerland. Moreover, the production is also stable for France, with a slight tendency (although

maybe not significant) to increase. Finally, France seems to have protected its harvested areas for these products, and limited its urban expansion more than Switzerland. Overall, this provides a quite detailed decomposition of the SSR that partly explains the gap between Switzerland and France for this metric.

## 4.2 Trade network

Since it was shown that the production is not responding to the growing population, one could question what category of products has increased in the past decades to fulfill the population needs. A selection of all the raw agricultural goods that are not produced in Switzerland is performed, the imports of these exotic products being displayed on Figure 4. Interestingly, there is a large

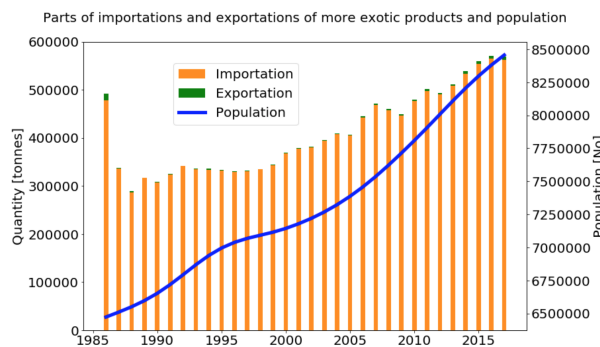


Figure 4: Importations of exotic products

increase of those imports, reflecting roughly the growing population. No certainties on the cause of these results can be drawn, nevertheless it could be hypothesized that they reflect a change in consumption habits.

Such a trend may potentially be hazardous for Switzerland in the mid-/long-term. Indeed, its main trade partners in 2017, shown on Figure 5, are Spain, Italy, Brazil and Colombia. These two South American countries are politically unstable and reflect well the fragility of such relations to ensure food supply. Besides, environmental impact importations is highly questionable in the current climate change context.

In brief, Switzerland has strong reasons to increase its SSR in the coming years to improve its food sovereignty and reduce its vulnerability to other countries crises, trade collapse and climate change.

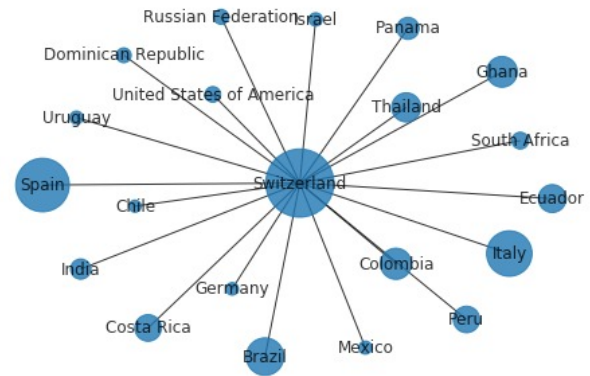


Figure 5: Importation partners of Switzerland for exotic products

## 5 Ways to increase SSR

### 5.1 Reorganize territory

The main aspect on which Switzerland could act to increase its SSR is to re-allocate surface to agriculture that was lost in the last decades. As described previously, urban area has tremendously expanded and this phenomenon could be reduced by sustainable land use planning. Besides, it is

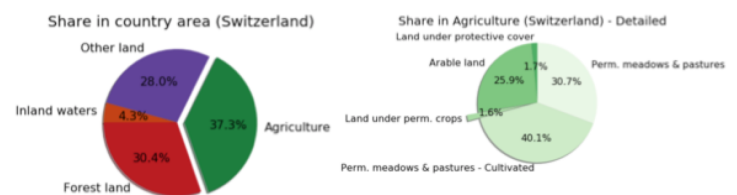


Figure 6: Land distribution, year 2017

highlighted on Figure 6 that the only valuable and feasible solution would be to reduce the land portion allocated to animal breeding and husbandry. This could heavily impact the Swiss nutrition, as it would orient the food diet towards more plant-based products.

### 5.2 Change products according to climate

Facing the on-going climate change would also be challenging for Switzerland. Under the assumption of normal distributions, the Pearson correlation coefficients displayed in Figure 7 provide estimation for the impacts of temperature on the main items production.

Summer temperatures seem to impact the most production, even though not every correlation coefficient is important. All products but sugar beet possess a negative Pearson coefficient with

|        | Sugar beet | Apples | Grapes | Wheat | Potatoes | Barley | Maize |
|--------|------------|--------|--------|-------|----------|--------|-------|
| summer | 0.56       | -0.19  | -0.57  | -0.41 | -0.59    | -0.51  | -0.57 |
| winter | 0.12       | -0.01  | -0.07  | 0.13  | -0.06    | 0.09   | 0.18  |

Figure 7: Temperatures and production correlations for the seven main items

summer temperatures. While it cannot be concluded that warmer summers are the cause of this production decrease (few other reasons for production decrease were stated earlier), these results point out the need for adaptation of the agriculture to climate change. Indeed, favoring products that resist better to rising temperatures would be judicious. In addition, diversity of foodstuffs produced in Switzerland is much lower than the one in France for instance, with 66 and 99 different products, respectively. Increasing this number could potentially make the agriculture more resilient to climate change and favor local food consumption.

### 5.3 Agriculture mechanization

It has been demonstrated before that Switzerland is behind its neighbors regarding self-sufficiency. However, its average yield is the highest, as shown in Figure 8. This could result

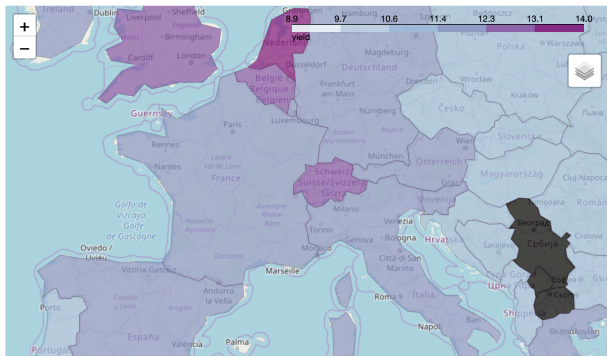


Figure 8: Zoom-in of world map showing the yield of each country on a logarithmic scale.

from a high floor quality, and/or an excessive spreading of pesticides and fertilizers over the harvested fields.

However, their use is constant over years (see Figure 9), since regulated by laws. This could therefore not explain the continuously increasing yield, unless their efficiency is improved by to chemical engineering. Moreover, the employment rate in agriculture was seen to decrease these past

years. Both these facts lead to the conclusion that a better mechanization and automation of agriculture could possibly be the explanation for the increasing yield of Switzerland.

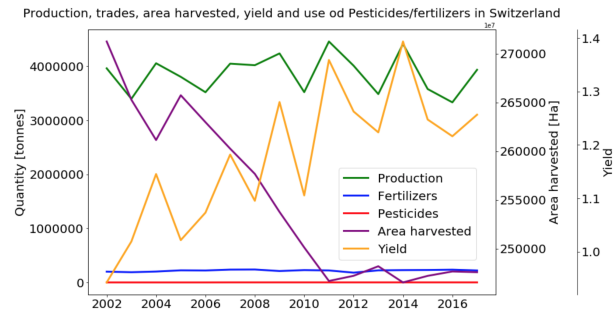


Figure 9: Global view on production, yield, area harvested and pesticides, fertilizers.

## 6 Conclusion

In short, despite the relatively high level of development of Switzerland, it is not the best country in terms of food self-sufficiency as represented by the SSR, especially compared to its neighbouring countries. Agricultural production of basic foodstuffs is not responding to the demographic pressure, while imports keep rising slightly for those products and considerably for more exotic goods. This makes Switzerland progressively more dependent on foreign countries for its own food supply and thus more prone to world instabilities. To counter this phenomenon, land use planning could be reconsidered, consumption habits reoriented, production diversity increased and resilient species to climate change favored. Finally, technological progress might offer further yield improvement in agriculture.

Nevertheless, the choice of including solely products that were produced, imported and exported at the same time in Switzerland reduced a lot the analysis spectrum and thus the results discussed in this project should be interpreted carefully, as it is not representative of the whole products present on the market. As such, a broader analysis could be performed in future work, where processed and animal products would be included. Finally, it would be interesting to inspect the effect of agricultural policies establishment on the country self-sufficiency in the past and predict the impact of forthcoming ones.

## References

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- [2] M. Porkka et al. "From Food Insufficiency towards Trade Dependency: A Historical Analysis of Global Food Availability". In: *PLOS ONE* 8.12 (2013), e82714.
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