

# Changes in global food production

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## Abstract

This report describes the findings after exploring four datasets from the Food and Agricultural Organization of the United Nations.

## 1 Introduction

In recent years, meat consumption has received a lot of attention as a result of global warming. Meat production is said to be one of the largest contributors to global warming and especially red meat has received a reputation for being a large contributor to climate change. This project will study data on production of crops and livestock along with data on population and agriculture emissions to see if this claim can be supported. It is suspected that the meat industry has affected the production of crops and it is assumed that crops production has lower greenhouse emissions compared to meat. The data that will be used comes from the Food and Agricultural Organization of the United Nations (FAO), and the data dates back to 1961.

### 1.1 Research questions

The four following research questions will be answered in this project:

1. How has the crops and meat production developed since 1960?
2. Is there a connection between the development of meat production and crop production?
3. How are the differences in production quantities between the different continents?
4. How has the development in agriculture affected emission of greenhouse gasses?

## 2 Data collection

There are four datasets from FAO that are used in this project. One dataset contains data on

crops production, one is regarding livestock production, another contains data on population, and finally there is one with carbon dioxide (CO<sub>2</sub>) emissions from agriculture production. The datasets can easily be downloaded from the website <http://www.fao.org/faostat/en/#data>. Their respective names are Crops, Livestock Primary, Annual population and Emissions intensities.

## 3 Data description

The data that is used in the project is described in this section, as well as what the original data included. The years that are studied are 1961 to 2007 as these are the years that all datasets have data on.

### 3.1 Crops production

The crops dataset that is used covers production of all primary crops, for all countries and regions in the world, and the production is only for human consumption. Household production, i.e. crops planted for personal consumption, is not included in the data. All production is recorded using the unit tonnes. The following categories are recorded: cereals, coarse grain, fruit excluding melons, oil crops & oil cakes, roots & tubers, vegetables & melons, others (pulses, jute & jute like fibers and fiber crops).

In the original crops dataset, production is recorded for 172 products apart from the categories mentioned above. Since this project aims at analyzing the general production of crops, it is more interesting to look at the total production of the different categories instead of looking at every type of item. Thus, only the category totals are kept, followed by modification into fewer categories for analysis.

### 3.2 Livestock production

The livestock dataset that is used covers production of all types of meat, for all countries and re-

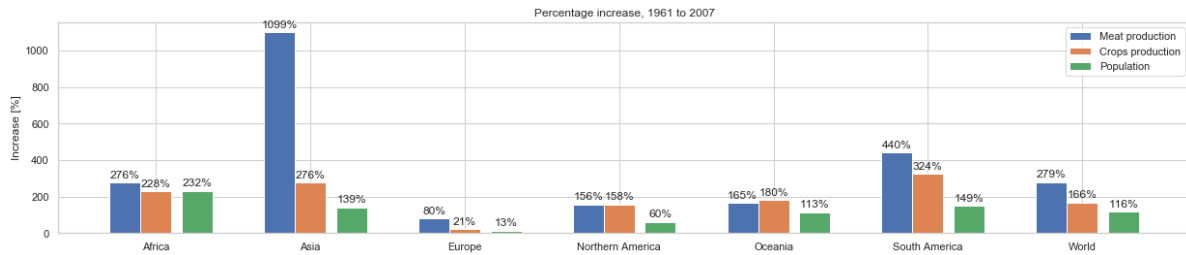


Figure 1: Increase in food production and population, 1961 to 2007, for each continent and for the world

gions in the world, and the production is from both industrial production and farm production. All of the production is recorded using the unit tonnes. The following categories are recorded: cattle, pig, chicken, equidae & camelidae (mammals from the horse and camelids families), bovidae (cloven-hoofed mammals), bird excluding chicken and others (rodents, game and other animals).

In the original livestock dataset, production is recorded for all types of livestock products. Since only meat production is of interest in this project, other livestock products are removed from the original dataset for analysis. The original meat categories are also modified into fewer product categories in order to make analysis easier.

### 3.3 Population

The population dataset that is used covers population numbers for all countries and regions in the world. All of the population is recorded using the unit 1000 persons. This unit means that the recorded population values should be multiplied by 1000 in order to get the correct number of people in the specified country or region.

### 3.4 Agriculture emissions

The agriculture emissions dataset that is used covers CO<sub>2</sub> emissions for different categories of crops and meat, for all continents in the world. All of the CO<sub>2</sub> emissions are recorded using the unit gigagrams. The following production categories are recorded: rice and paddy, cereals excluding rice, meat from cattle, meat from goat, meat from buffalo, meat from sheep, meat from pig and meat from chicken.

The original dataset includes other livestock products such as milk and eggs but there are not any other meat or crops categories than the ones mentioned above. This means that there is a lot of missing data in this dataset. For example, it is not possible to investigate the emissions from fruit or

turkey production. This has to be kept in mind in the analysis.

## 4 Findings

Through different plots and calculations, the findings in this section were obtained. Here, the different research questions are answered.

### 4.1 How has the crops and meat production developed since 1961?

Food production has increased in all continents from 1961 to 2007 following a general pattern, that is, the population growth. However, more food is produced per person in 2007 compared to 1961, as seen in Figure 1. All continents but North America and Oceania have had a larger increase in meat production than both crops production and population growth. Meat production in Asia has increased more than ten-fold, which is not surprising as the majority of Asians in 1961 were living in extreme poverty, whereas in 2007, the majority of Asians were living out of extreme poverty (Gapminder, 2019).

No food category has decreased in popularity since 1961 on a world level, this is of course different when studying the production on a continent level. All food categories have increased in production as seen in Figure 2, however the smallest crops and meat categories have held a quite consistent production quantity over the years.

The three most produced meat categories are pig, chicken and cattle with pig being the largest one. In fourth place, we have bovidae, since it is big in Oceania (sheep) and Africa (goat and buffalo). All continents but North America and Oceania have had a larger increase in meat production than both crops production and population growth since 1961. The biggest crops production category is cereals which is not surprising as this includes rice and wheat.

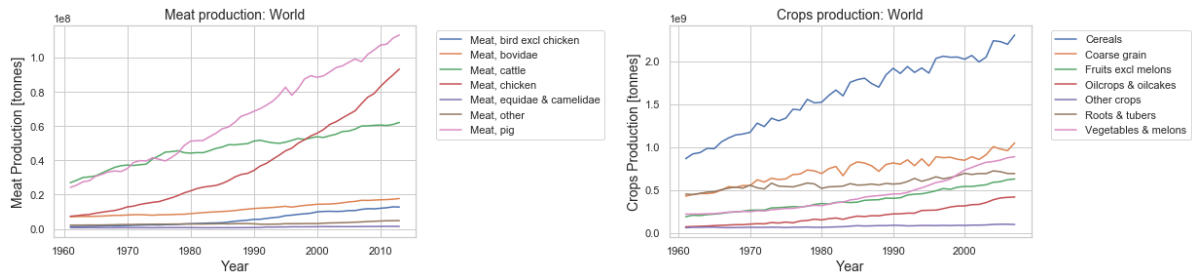


Figure 2: How the production of different food categories have developed from 1961 to 2007

#### 4.2 Is there a connection between the development of meat production and crop production?

Food production per person has increased globally by nearly 25% and meat production has increased more than crop production, as can be seen in Figure 3. It is not surprising that production numbers have grown since the world has become richer when measured in GDP per capita (The World Bank, 2019).

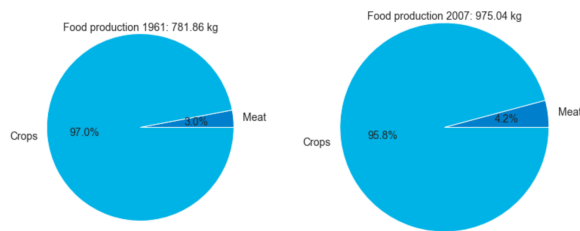


Figure 3: Composition of crops and meat production

Meat production per person has not just risen globally, it has also risen in all continents. Asia and South America have had the largest growth, which most likely has to do with an increased standard of living.

Interestingly, crop production per person has increased on all continents except Africa, where the population has grown faster than crop production, as can be seen in Figure 1. There are probably many reasons for this decrease, but one speculation is that while the population in Africa has increased, farmable area might have decreased due to global warming and expansion of deserts, such as Sahara (Cloudsley-Thompson, J, 1974). Another speculation is that the production of more livestock might have crowded out some of the crop production.

#### 4.3 How are the differences in production quantities between the different continents?

Figure 4 shows how food production is distributed between the different continents, normalized on population. From the plot it is possible to see the following:

- The less developed continents are producing less food per person.
- There are huge differences in food production. In 2007, North America is producing  $\frac{3.28}{0.64} \approx 5.1$  times as much food as Africa per person.

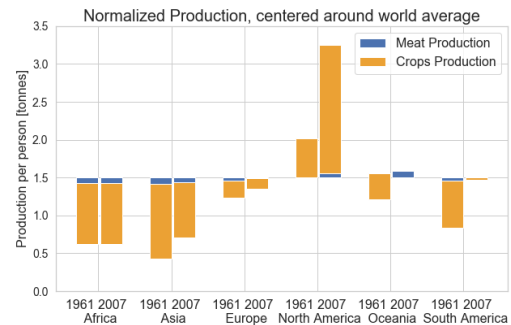


Figure 4: Normalized meat and crops production in 1961 and 2007. Centered around world the world average in 2007. 1961-values have been corrected for different means.

Although Figure 4 can indicate important patterns, it is difficult to conclude. We have no data on export-import of food, which may be a good reason for North America's extremely high food-production. In addition, this analysis is on a continent level, and there can be big differences in the countries within a continent.

#### 4.4 How has the development in agriculture affected emission of greenhouse gasses?

As the CO<sub>2</sub> emissions dataset only has emission data for a limited amount of items, a few of the items in the crop and meat datasets are not considered answering this question since it is desired to link production with its emissions. Having said this, the following meat and crop categories are studied; cereals, rice, buffalo, cattle, chicken, goat, pig and sheep.

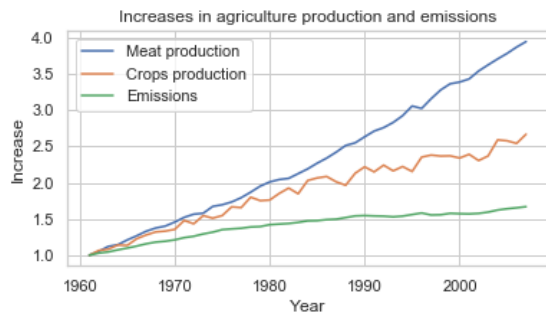


Figure 5: Increase in CO<sub>2</sub> emissions from agriculture and meat/crop production, 1961-2007.

As can be seen in Figure 5, meat and crop production have increased and as a result, emissions have increased as well. Regardless of what is being produced, CO<sub>2</sub> is emitted as well. Agriculture emissions have increased by 66% between 1961 and 2007. In Figure 5, it is also possible to see that increases in production of both crops (166%) and meat (277%) are larger than that of the emissions increase, which at first might seem strange. How come that emissions, resulting from agriculture production, have not increased as much as the production itself?

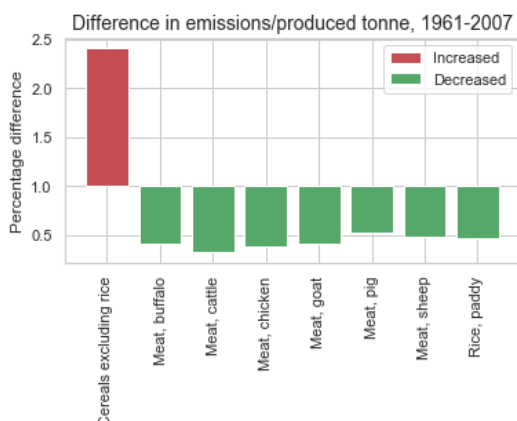


Figure 6: Difference in production emission efficiency, 1961-2007.

In Figure 6 it is possible to see that the production of 7 out of 8 agriculture items has become approximately twice as efficient. This means that producing one tonne of meat or cereals generally emits half of what it did in 1961. Furthermore, in Figure 2 it is shown that the production of pig and chicken has increased more than others. The animals for which production has increased the most are also the ones that emit less, as can be seen in Figure 7. Cattle and animals from the bovidae family are the largest contributors to CO<sub>2</sub> emissions, but these categories have not seen the same increase in production. Both the improvements in production efficiency and the fact that production of less polluting animals has increased more than the production of emission intensive animals, has resulted in a smaller increase in emissions compared to the increase in agriculture production.

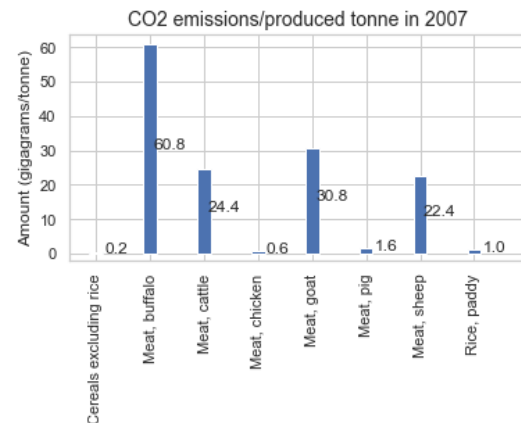


Figure 7: CO<sub>2</sub> emissions per produced tonne for different agriculture items.

## 5 Summary

To summarize, food production has increased a lot since 1961, mostly due to a growing global population, and particularly meat production has increased. More food is produced per person in 2007 compared to 1961 and the richer continents in the world are producing a lot more food per person than what the less developed continents are. People's diet in 2007 consists of more meat than what it did in 1961. It is better to avoid the meat categories cattle and bovidae animals as these categories emit a lot more CO<sub>2</sub> during production than for example pig and chicken do. In 2007, pig was the most produced meat category and cereals was the most produced crop category. The production of food is more efficient in 2007 and this leads

to lower CO<sub>2</sub> emissions resulting from agriculture production.

## References

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