I-KNOW-FOO: Interlinking and creating KNOWledge graphs for near-zero CO2 emission diets and climate-change robust FOOd production

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Introduction
The diet of the world’s population has a huge impact on climate change. However, it is not straightforward to see the impact of consumed products, both for end users and within the supply chain. For example, it may be unknown to consumers that the production of mineral water - due to the packaging materials used - can be more harmful to the climate than the production of rice as data and knowledge within the supply chain is often not easily reachable or linkable.

Objective
The aim of the project is to be able to unlock the available data and derived information via (automated) semantic web services. We would like to show the feasibility of connecting data from various sources to evaluate the impact of diets on climate change and how to suggest alternatives to the commonly consumed products to support climate adaptation.

Methodology
We will link different scattered data sources and suggest alternatives to the mostly consumed products. This process will be partly manual in the beginning and will be increasingly automated during the project.

For this purpose, first an inventory has been made of relevant databases, ontologies, and knowledge graphs in the areas of nutritional values, and sustainability and food. We will apply the steps to three top products in terms of import to the Netherlands, selected on the basis of FAOSTAT statistics from the past five years.

Results
- Soybean, potato and wheat crops were found to be the main imported and consumed crops using FAOSTAT database (Table 1). As a start, we use this information to find alternatives in diets for these food products in order to make diets more robust against climate change.
- At first, the nutritional values and environmental impacts of the selected crops were looked up using the PDA web services (Fig. 1). These services are linked to NEVO database from RIVM. The original goal was to find alternative crops/products with similar nutritional values using the Food Item Ontology (FIO). However, finding alternatives using FIO data will be computationally expensive. Alternatively, the ‘Alternatief’ application has been used to find alternatives (Fig. 2).
- In parallel, the FAO Land & Water Crop Information was also used in the semi-manual process of finding other alternative food item considering growth conditions. This process will be automated step by step, incorporating more and more aspects of climate change: first only temperature, later also drought, water needs, etc.

Conclusions and Future Work
Alternative food products are mapped out with software tools. Then, based on the climatic conditions for their possible growth in the Netherlands and other regions, the best alternative is determined. The final step is to evaluate the sustainability impact once the food item has been replaced in a diet in the Netherlands. For this, a linked data model approach will be developed which can then be used to automate generating alternatives for diets in a changing climate.

Acknowledgements
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Table 1. Most Imported Food Groups and Food Supply Data in Netherlands (FAOSTAT)

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Maize</td>
<td>Cocoa Beans</td>
<td>Milk - Excluding Butter</td>
<td>Milk - Excluding Butter</td>
</tr>
<tr>
<td>Soybeans*</td>
<td>Palm oil</td>
<td>Sugar beet</td>
<td>Potatoes and products*</td>
</tr>
<tr>
<td>Wheat*</td>
<td>Soybeans*</td>
<td>Wheat and products*</td>
<td>Wheat and products*</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>Wine</td>
<td>Maize and products</td>
<td>Vegetables, other</td>
</tr>
<tr>
<td>Barley</td>
<td>Chocolate products</td>
<td>Potatoes and products*</td>
<td>Beer</td>
</tr>
<tr>
<td>Potatoes*</td>
<td>Maize</td>
<td>Soybeans*</td>
<td>Sugar (Raw Equivalent)</td>
</tr>
<tr>
<td>Cheese</td>
<td>Barley and products</td>
<td>Apples and products</td>
<td></td>
</tr>
</tbody>
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DFSQ: Domestic Food Supply Quantity (1000 tonnes/yr)
FSQ: Food Supply Quantity (kg/capita/yr)
* Selected crops for being replaced by alternatives