## Contents

APPE	NDIX	. 1
A.	SPARQL Queries	. 1
В.	Ontology Rules in Description Logic	. 9

## **APPENDIX**

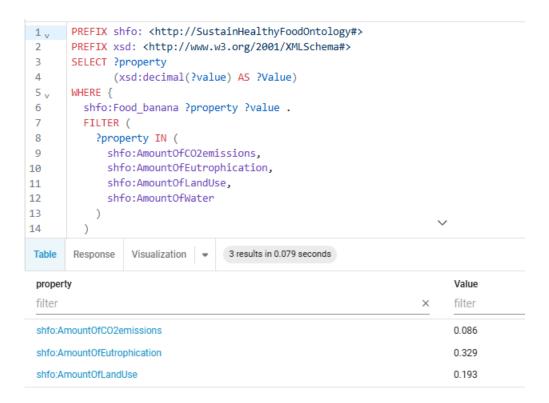
## A. SPARQL Queries

SPARQL Query for **CQ1: Which aspects of sustainability are related to food consumption?** 



**CQ2: What is the environmental (eco) score of a specific food?** (includes also and CQ3)

Specific food: food\_banana



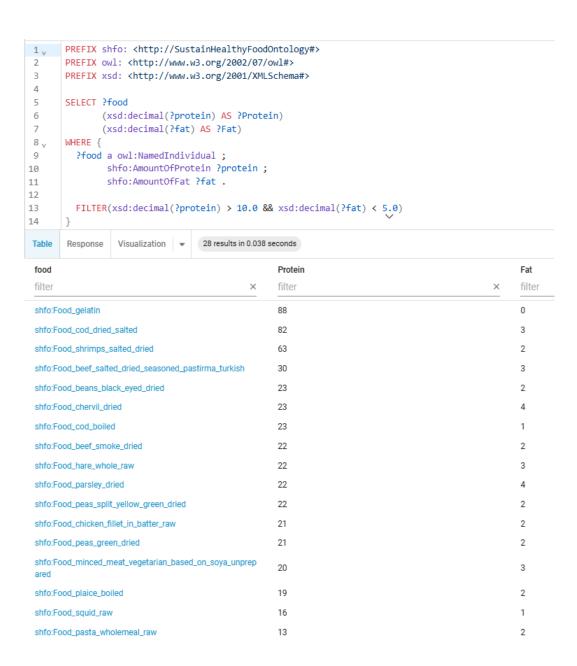
### CQ4: Lowest Eutrophication Footprint

```
PREFIX shfo: <http://SustainHealthyFoodOntology#>
         PREFIX owl: <a href="http://www.w3.org/2002/07/owl#">PREFIX owl: <a href="http://www.w3.org/2002/07/owl#">http://www.w3.org/2002/07/owl#</a>
3
         PREFIX xsd: <a href="http://www.w3.org/2001/XMLSchema#">http://www.w3.org/2001/XMLSchema#</a>>
4
         SELECT ?food
5
                   (xsd:decimal(?eutrophication) AS ?Eutrophication)
6 <sub>v</sub>
         WHERE {
7
           ?food a owl:NamedIndividual ;
8
                    \verb|shfo|: AmountOfEutrophication|| ? \underline{eutrophication}||.
Q
10
           FILTER(xsd:decimal(?eutrophication) > 0.0)
11
         ORDER BY ASC(?Eutrophication)
12
13
         LIMIT 20
14
         Response Visualization 🕶
                                            10 results in 0.071 seconds
 food
                                                                                                 Eutrophication
 filter
                                                                                                 filter
 shfo:Food smoothie fruit
                                                                                                 0.243
 shfo:Food_banana
                                                                                                 0.329
 shfo:Food_potatoes_raw
                                                                                                 0.348
 shfo:Food_oatmeal
                                                                                                 1.123
 shfo:Food_cane_sugar
                                                                                                 1.692
 shfo:Food_cheese_10_
                                                                                                 9.837
 shfo:Food_cheese_20_
                                                                                                 9.837
 shfo:Food_cheese_35_
                                                                                                 9.837
 shfo:Food_cheese_45_
                                                                                                 9.837
 shfo:Food_cheese_50_
                                                                                                 9.837
```

CQ6: What is the health (nutrient) score of a specific food? & CQ7: What is the micronutrient profile (key micronutrients) of the (consumed) food? & CQ8: What is the macronutrient profile (key macronutrients) of the (consumed) food?



CQ9: Which foods are rich in protein but low in fat?



# CQ10: What is a better (healthier) alternative for a specific food based on a health state?

Specific food: Food\_cheese\_gouda\_48\_av

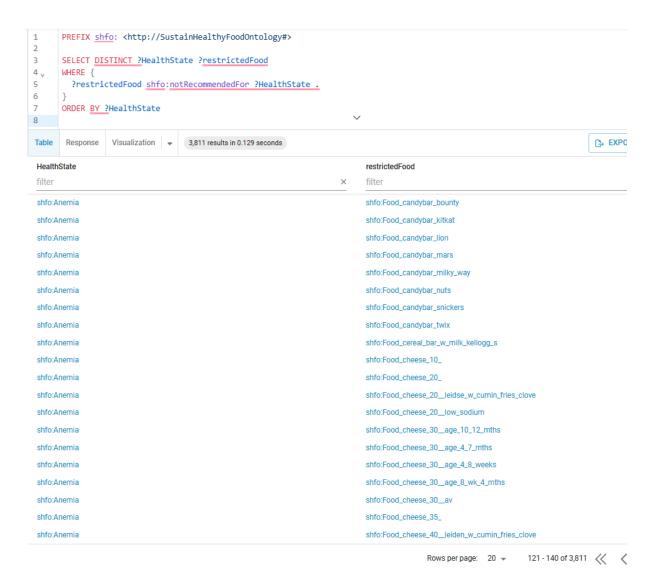
```
PREFIX shfo: <http://SustainHealthyFoodOntology#>
 1 <sub>v</sub>
 2
        PREFIX xsd: <a href="http://www.w3.org/2001/XMLSchema">http://www.w3.org/2001/XMLSchema</a>
 3
        PREFIX owl: <a href="http://www.w3.org/2002/07/owl">http://www.w3.org/2002/07/owl">
 4
 5
        SELECT ?food
                 (REPLACE(STR(xsd:decimal(?score)), "^(\\d+)$", "$1.0") AS ?formattedScore)
 6
 7 <sub>v</sub>
        WHERE {
 8
         # Get the reference score for feta
 9
          shfo:Food cheese gouda 48 av shfo:hasNutrientScore ?fetaScore .
10
          # Get other food and their scores
11
          ?food a owl:NamedIndividual;
12
                  shfo:hasNutrientScore ?score .
13
14
          # Only return foods with a higher score than feta
15
16
          FILTER(xsd:decimal(?score) > xsd:decimal(?fetaScore))
17
18
        ORDER BY ASC(xsd:decimal(?score))
19
                                        406 results in 0.282 seconds
                     Visualization -
 Table
         Response
 food
                                                                                      formattedScore
                                                                               ×
                                                                                      filter
                                                                                      0.5
 shfo:Food_cashew_nuts_unsalted
 shfo:Food_hazeInuts_unsalted
                                                                                      0.5
 shfo:Food_flour_spelt_wholemeal
                                                                                      0.5
 shfo:Food_flour_wheat_wholemeal
                                                                                      0.5
                                                                                      0.5
 shfo:Food_pasta_wholemeal_raw
 shfo:Food_custard_soft__airy
                                                                                      0.51
                                                                                      0.51
 shfo:Food_oatmeal
                                                                                      0.51
 shfo:Food_pear_dried_soaked_in_water
 shfo:Food_tomatoes_tinned
                                                                                      0.51
                                                                                      0.52
 shfo:Food_cheese_spread_kids_eru
 shfo:Food_cheese_w_cumin_48__average
                                                                                      0.52
                                                                                      0.52
 shfo:Food_tomatoes_stewed_w_vegetable_oil
 shfo:Food_bulgur_wheat_cooked
                                                                                      0.53
 shfo:Food_custard_half_fat_all_flavours
                                                                                      0.53
 shfo:Food_infant_food_fruit_12_months
                                                                                      0.53
 shfo:Food_milk_based_drink_yakult_original
                                                                                      0.53
```

CQ11: What are the recommended daily intake levels for specific nutrients based on age, sex, and activity level?

For person\_5446

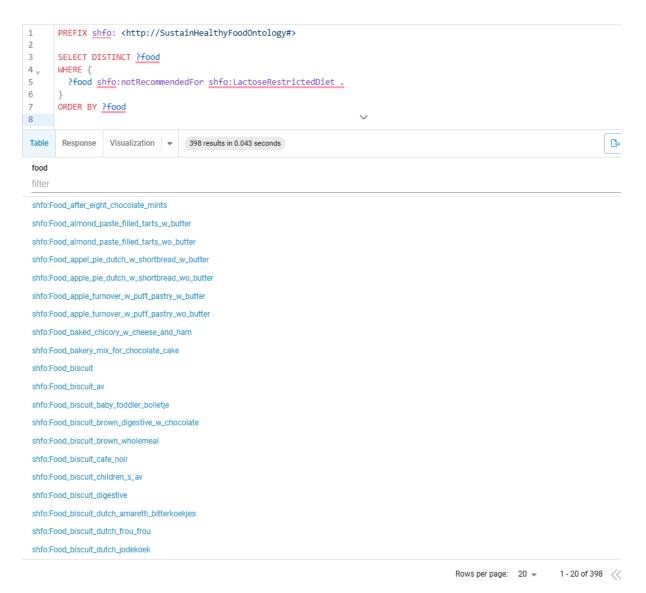
```
1_{v}
       PREFIX shfo: <http://SustainHealthyFoodOntology#>
 2
        PREFIX xsd: <a href="http://www.w3.org/2001/XMLSchema#">http://www.w3.org/2001/XMLSchema#</a>
 3
       SELECT ?property
 4
                (IF(isNumeric(?value), REPLACE(STR(xsd:decimal(?value)), "^(\\d+)$", "$1.0"),
 5
                  STR(?value)) AS ?formattedValue)
 6 <sub>v</sub>
       WHERE {
 7
         shfo:Person_5449 ?property ?value .
 8
         FILTER (
           ?property IN (
 9
              shfo:AmountOfCaloriesNeededPerDay,
10
              shfo:AmountOfProteinNeededPerDay,
11
             shfo:AmountOfFatNeededPerDay,
13
             shfo:AmountOfCarbsNeededPerDay,
14
              shfo:AmountOfFiberNeededPerDay,
15
              shfo:AmountOfVitaminENeededPerDay,
              shfo:AmountOfIronNeededPerDay,
16
17
              shfo:AmountOfSodiumNeededPerDay,
              shfo:AmountOfMagnesiumNeededPerDay,
18
19
              shfo:AmountOfCalciumNeededPerDay
 Table
                                     10 results in 0.124 seconds
        Response
                   Visualization ...
 property
                                                                                formattedValue
                                                                                filter
                                                                                1000.0
 shfo:AmountOfCalciumNeededPerDay
                                                                                2406.625
 shfo:AmountOfCaloriesNeededPerDay
 shfo:AmountOfCarbsNeededPerDay
                                                                                270.7-391.1 g
 shfo:AmountOfFatNeededPerDay
                                                                                53.5-93.6 g
 shfo:AmountOfFiberNeededPerDay
                                                                                25 g
 shfo:AmountOfIronNeededPerDay
                                                                                18.0
                                                                                310.0
 shfo:AmountOfMagnesiumNeededPerDay
 shfo:AmountOfProteinNeededPerDay
                                                                                60.2-210.6 g
 shfo:AmountOfSodiumNeededPerDay
                                                                                2000.0
 shfo:AmountOfVitaminENeededPerDay
                                                                                15.0
```

CQ12: Which health states lead to dietary restrictions?



CQ13: What food should be avoided if a person has specific dietary restrictions?

Diet: LactoseRestrictedDiet



CQ14: What food can be consumed in a certain amount if a person has specific dietary restrictions or a health state?

CQ15: Which food groups is not suitable for individuals with specific dietary restrictions (e.g., vegan, lactose-intolerant)?

For vegans

```
1
        PREFIX shfo: <a href="http://SustainHealthyFoodOntology#">http://SustainHealthyFoodOntology#>
2
        SELECT DISTINCT ?food
3
4 <sub>v</sub>
        WHERE {
5
           ?food shfo:notRecommendedFor shfo:Vegan .
6
7
        ORDER BY ?food
8
                                               6 results in 0.033 seconds
Table
          Response
                       Visualization
 food
 filter
 shfo:Dairy
 shfo:Fish
 shfo:Meat
 shfo:MixedDishes
 shfo:Pastry_and_Biscuits
 shfo:SavouryDishes
```

# B. Ontology Rules in Description Logic

### **DL Notation**

```
∃ hasHealthState.Pregnancy ⊑ hasSex = "Female"
```

Dairy 

∀ notRecommendedFor.(LactoseIntolerant ⊔ LactoseRestrictedDiet)

Dairy  $\sqcup$  Meat  $\sqcup$  Fish  $\sqcup$  MixedDishes  $\sqcup$  Pastry\_and\_Biscuits  $\sqcup$  SavouryDishes  $\sqsubseteq$   $\forall$  notRecommendedFor.Vegan

Meat  $\sqcup$  Fish  $\sqsubseteq \forall$  notRecommendedFor.Vegetarian

Meat 

∀ notRecommendedFor.Pescatarian

PorkMeat 

∀ notRecommendedFor.HalalDiet

HighFiberFood 

∀ notRecommendedFor.DietaryFiberRestrictedDiet

 $HighFatFood \sqsubseteq \forall \ notRecommendedFor.FatRestrictedDiet$ 

#### **DL Notation**

HighSaltFood 

∀ notRecommendedFor.SaltRestrictedDiet

HighIronFood ⊑ ∀ recommendedFor.Anemia

HighSugarFood ⊔ HighCarbFood ⊑ ∀ notRecommendedFor.Diabetes

Person  $\sqcap$  (hasAge  $\geq 0 \sqcap$  hasAge  $\leq 12$ )  $\rightarrow$  Child

Person  $\sqcap$  (hasAge  $\geq 13 \sqcap$  hasAge  $\leq 17$ )  $\rightarrow$  Teenager

Person  $\sqcap$  (hasAge  $\geq 18 \sqcap$  hasAge  $\leq 64$ )  $\rightarrow$  Adult

Person  $\sqcap$  (hasAge  $\geq$  65)  $\rightarrow$  SeniorAdult

Person  $\sqcap$  (hasBMI < 18.5)  $\rightarrow$  Underweight

Person  $\sqcap$  (18.5  $\leq$  hasBMI  $\leq$  25)  $\rightarrow$  NormalWeight

Person  $\sqcap$  (25  $\leq$  hasBMI  $\leq$  30)  $\rightarrow$  Overweight

Person  $\sqcap$  (hasBMI  $\geq$  30)  $\rightarrow$  Obesity

Peanut 

∀ RestrictedFood.Peanut\_Allergy

Milk ⊑ ∀ RestrictedFood.Milk Allergy

Egg ⊑ ∀ RestrictedFood.Eggs\_Allergy

Almond ⊔ Cashew ⊔ Walnut ⊔ Hazelnut ⊔ Nuts ⊑ ∀ RestrictedFood.TreeNuts\_Allergy

 $Soy \sqsubseteq \forall RestrictedFood.Soy\_Allergy$ 

Wheat  $\sqcup$  Barley  $\sqcup$  Rye  $\sqsubseteq$   $\forall$  RestrictedFood.Wheat\_Allergy

Fish ⊔ Salmon ⊔ Tuna ⊔ Cod ⊑ ∀ RestrictedFood.Fish\_Allergy

Shrimp ⊔ Crab ⊔ Lobster ⊑ ∀ RestrictedFood.Shellfish\_Allergy

Hypertension ⊑ ∀ FoodInLimitedAmount.{Salt, ProcessedFood, CannedFood, SnackFood, FastFood, FriedFood, Butter, Margarine, Soda, Alcohol, Pickles}

Hypertension ⊑ ∀ FoodToBeConsumedInHighAmount.{LowSodiumFood, FreshFood, NoSaltFood, OliveOil, Avocado, Nuts, WholeFruit, DarkChocolate, Water, HerbalTea, LeafyGreens, Beets, BellPeppers}

Diabetes 

∀ FoodInLimitedAmount. {WhiteBread, WhiteRice, Pastries, SugaryCereal, Sugar, Sweet, Candy, Soda, Juice, Butter, Fried, FastFood, Chips, Cookies, Cake}

Diabetes 

∀ FoodToBeConsumedInHighAmount.{WholeGrains, BrownRice, Quinoa, Oats, Berries, Apple, Pear, Citrus, GreekYogurt, LowFatDairy, OliveOil, Avocado, Nuts, Hummus, Seeds, DarkChocolate}