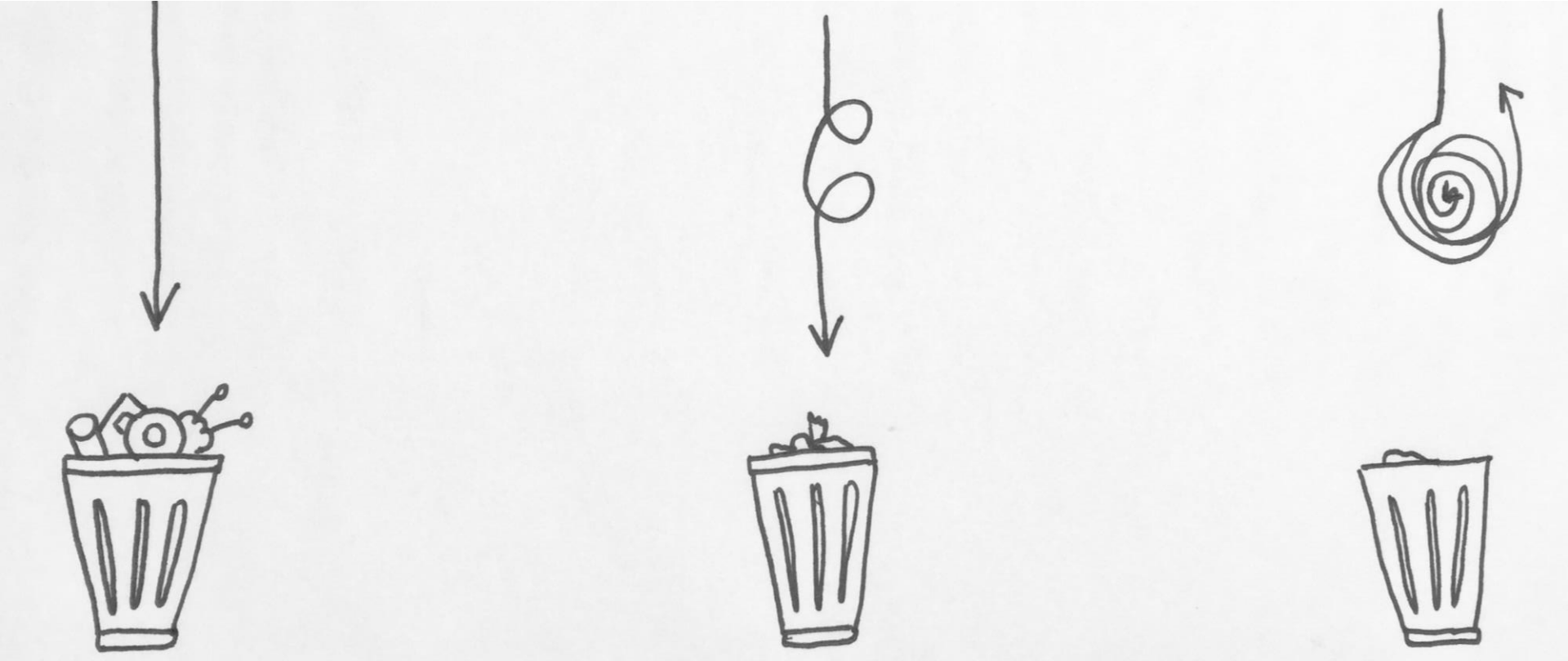

SUSFEED - Sustainable feed design applying circular economy principles: the case former food in pig nutrition

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Abstract

In developing countries, as a result of increasing per capita GDP (Tilman et al., 2011; FAOSTAT, 2017), we are observing shifts in diets towards increasing consumption of animal products (Pimentel et al., 2008). An example of shifting diet is represented by China, where during the last two decades' demand for and consumption of animal origin has grown rapidly. Public debates and scientific literature principally focused on how these habits affect the amount of required limited resources, addressing those changes as unsustainable, but which can be the effects of a shift in animal diets? SUS-Feed is a projects founded by Fondazione Cariplo aims at evaluating the effects of substituting conventional cereals with former food products in pig's diets, by addressing its impacts on growth performance, gut health, pig wellbeing, as well as its sustainability assessment and its implications in natural resources saving. In fact, among others, pigs represent an interesting case study, providing 36% of total meat production (113Mtons worldwide) and 51% of energy from animal products (124kcal/cap/day – global average) (FAOSTAT, 2017).

Pig diet is mainly composed by soybeans and maize, whose harvested area worldwide are rapidly exploding, accounting for 187Mha and 111Mha for maize and soybean in 2013 respectively, creating environmental problems such as water scarcity, deforestation, pollution, fires. In order to assess the potential positive feedbacks of such conversion on natural resources, focus of our presentation, a spatial distributed physically based model is applied in order to quantify water and land saving by introducing former food products and the consequent positive feedback on water scarcity, water pollution and deforestation.

SusFEED Project
The framework

The 2018 CARIPLO call for «Circular Economy for a sustainable future» makes **susFEED project** happen.

The aim of the project is to evaluate the effects of **substituting conventional cereals with former food products** (FFPs) in pig's diet by addressing its **impact on growth performance**, **gut health**, **pig wellbeing**, as well as its **sustainability** assessment and its implications in natural **resources saving**.

For this purpose thirty-six weaned female pigs, after an adaptation period of 7 days, were fed or with the **control diet** or with this new **FFPs diet** which is based on the substitution of 30% conventional cereals for 30% FFPs. The trial had last 42 days.

SusFEED Project
Environmental impacts

Here we propose the enviromental impacts of such conversion in pig diets in terms of:

Fertile Agricultural Land needed to produce the main ingrediets in the animal diet considering:

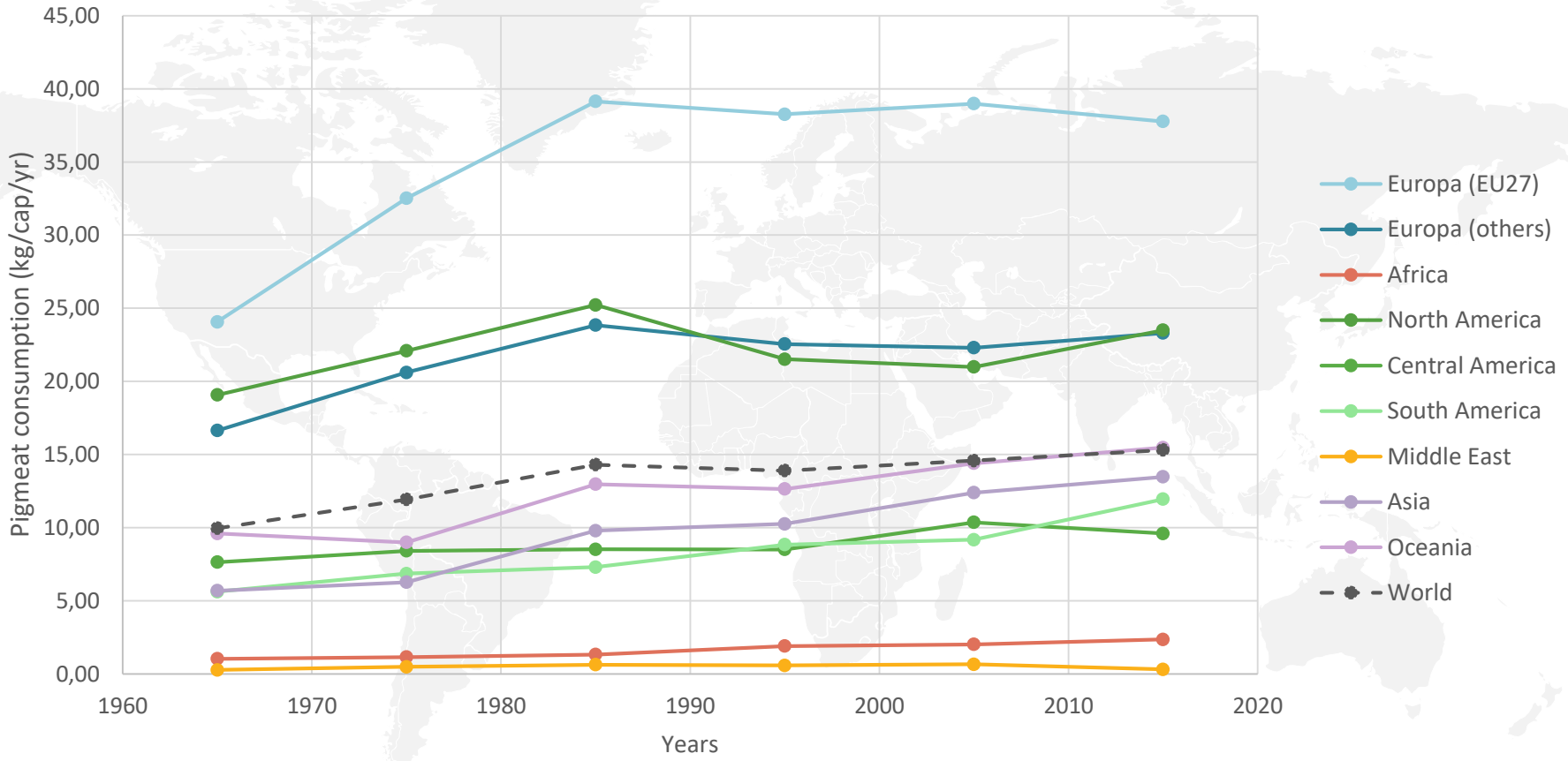
- Current balance diet
- New diet including former food stuff


Credits: Pisatoday


Credits: Deyan Georgiev - Fotolia

Furtherly, we estimate **the Fresh Water** needed to irrigated those crops in both scenarios.

Pig meat consumption: an overview at the global scale



Source: FAOSTAT

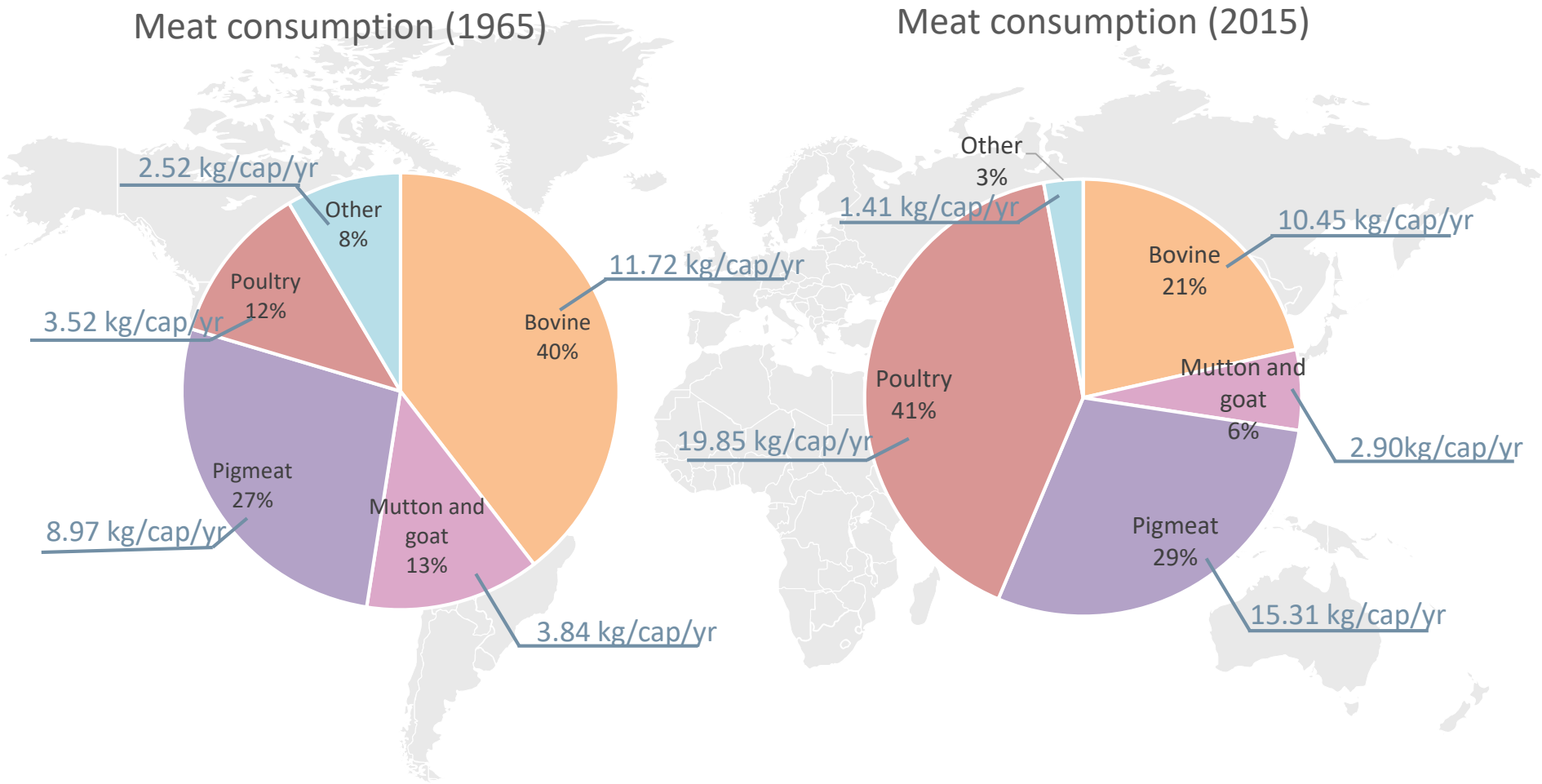
The world economic scenario in 2013

Pigmeat production has been attested to 109.5 million tons (+2.5%) with respect to the 106.8 million tons of 2012.

In 2016 in EU, the production of amounted to 23.4 million tonnes. This translated to 45.9 kg per each EU inhabitant and was one and a half kilogramme per person more than in 2006.

The Italian pig sector is mainly focused on the production of heavy pigs used for the traditional drycured hams. According to ERSAF (2014), 13million pigs were slaughtered in Italy in 2013.

Pig meat consumption in the world

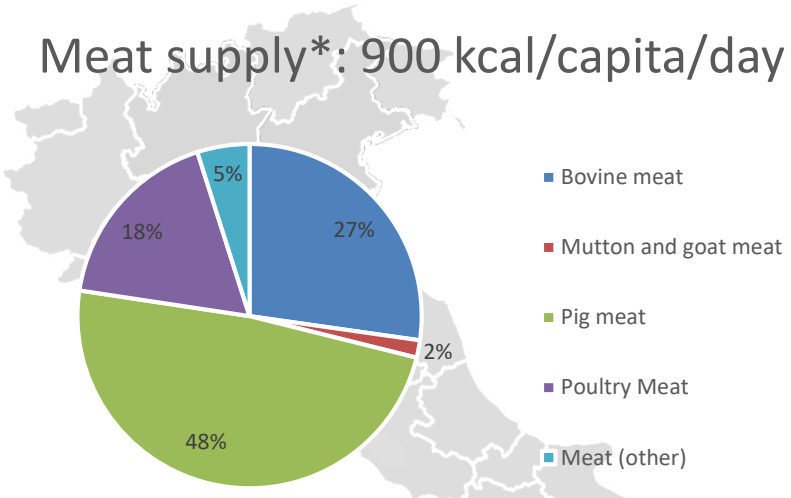


Source: FAOSTAT

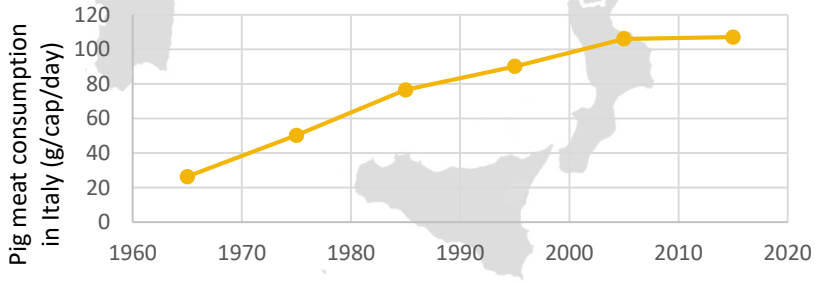
The case study: heavy pigs in Lombardy region

Average diet*: >3580 kcal/capita/day

Meat supply*: 900 kcal/capita/day

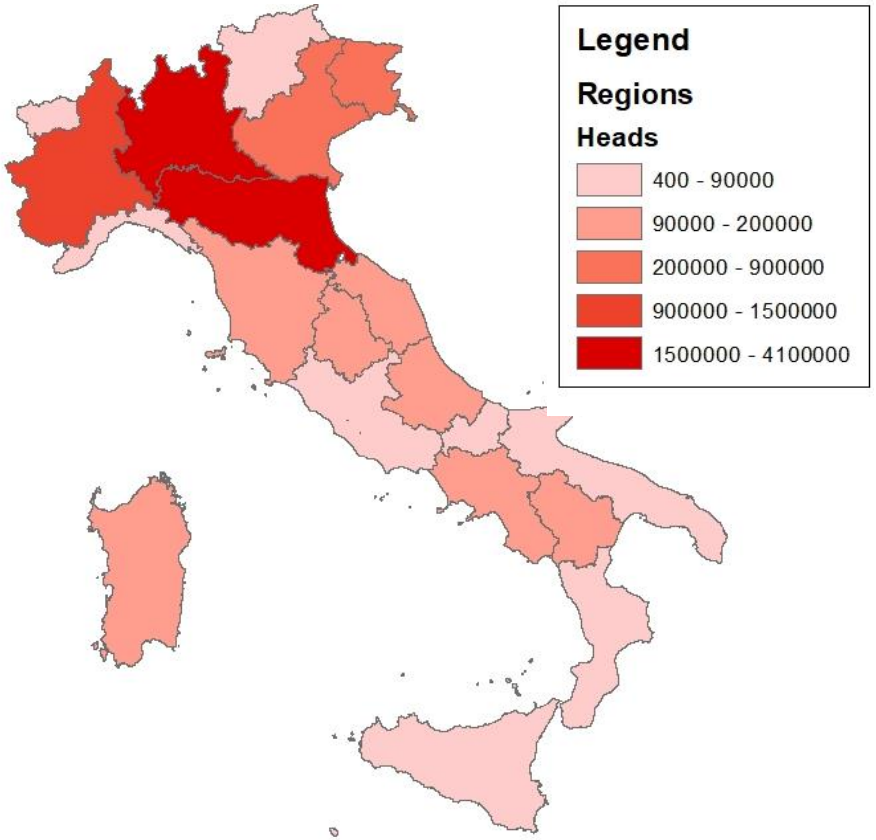


Pig meat supply*: 180 kcal/capita/day



*Year 2013, FAOSTAT

Pig stocks



Source: ISTAT

Method

Diet components

Control diet (CTR)

Former food product diet (FFPs)

Dry matter coefficients

Conversion coefficients

kg dry matter/cap/day

kg processed matter/cap/day

kg raw material/cap/day

Limiting factor: diet component that, when transformed in raw material, directly satisfy the request of the other component

The diet

Post weaning

Cycle duration [day]	42
Mean assumption [gr/die]	700
Live weight [kg]	7kg-25kg
FCE	1.3-1.4

CTR		FFPs	
Ingredients	g raw material/cap/die	Ingredients	g raw material/cap/die
Former food	-	Sugarcane	11.19
Barley	334.62	Barley	324.35
Flakes of hulled barley	127.27	Flakes of hulled barley	-
Maize	57.90	Maize	35.63
Maize flakes	134.65	Maize flakes	20.71
Vegetable fibre	41.87	Vegetable fibre	41.87
Wheat	99.84	Wheat	103.02 (21.04)
Wheat flakes	51.32	Wheat flakes	8.55
Wheat bran	125.60	Wheat bran	121.77 (17.94)
Vegetable oil	24.53	Vegetable oil	10.90 (2.72)
Soy oil	58.99	Soy oil	19.66
Soy meal (50%)	34.76	Soy meal (50%)	34.76

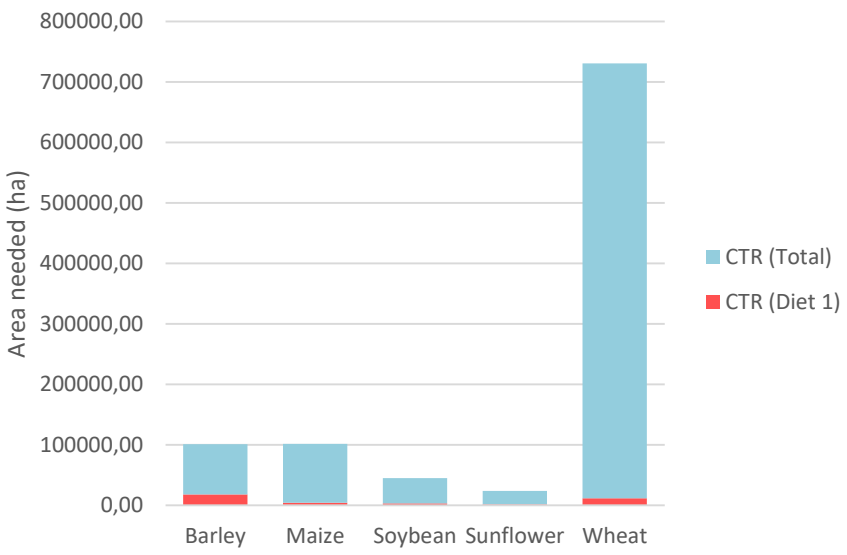
Early growth

Cycle duration [day]	30
Mean assumption [gr/die]	1600
Live weight [kg]	25kg-50kg
FCE	1.6-2.2

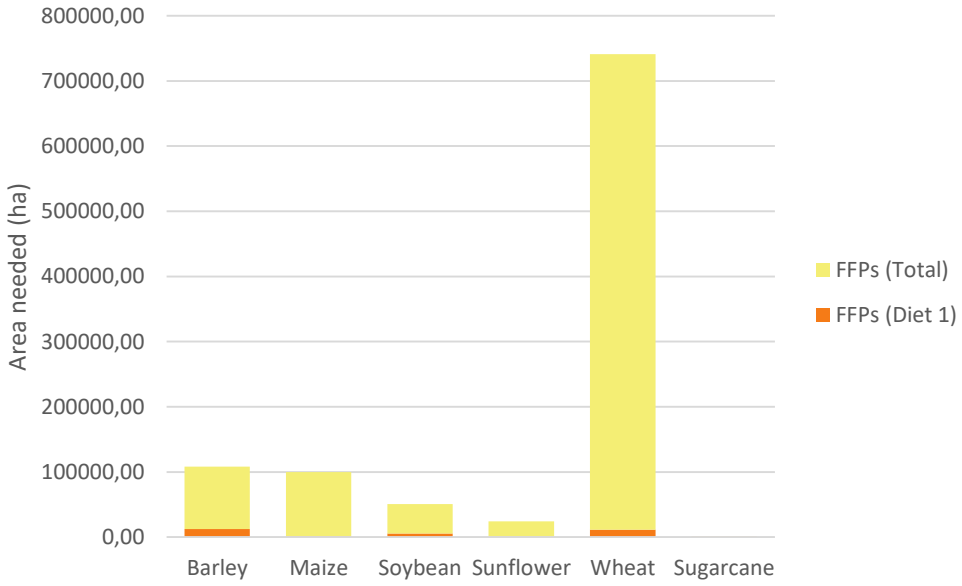
Ingredients	g raw material/cap/die
Maize meal	645.42
Wheat	877.74
Soy meal	295.79
Barley	402.55
Distillers	301.32
Farinetta di grano	74.21

The land demand

CTR diet (diet 1)



FFPs diet (diet 1)



The total needed area is **1001839 ha** of which **38655 ha** for diet 1 (CTR).

The total needed area is **992319 ha**, **30606 ha** for diet 1 (FFPs) of which 4.5 % are due to FFPs.

(*) Only the stock consistencies are here considered.
(**) Only the major importer country for sugarcane (Eswatini) is considered.

Water Footprint

CTR diet (diet 1)

Crop	Area needed (10^3 ha)	Volume of water (10^6 m^3)
Barley	101.13 (18.03)	263.16 (46.93)
Maize	101.41 (4.19)	401.74 (16.59)
Soybean	44.76 (3.08)	166.71 (11.48)
Sunflower	23.61 (1.60)	77.44 (5.26)
Wheat	730.92 (11.75)	4545.65 (73.06)

The total volume of water needed is **5454.71 10^6 m^3** of which **153.32 10^6 m^3** for diet 1 (CTR).

FFPs diet (diet 1)

Crop	Area needed (10^3 ha)	Volume of water (10^6 m^3)
Barley	95.76 (12.66)	249.19 (32.95)
Maize	98.63 (1.41)	390.73 (5.57)
Soybean	44.82 (5.78)	166.91 (21.53)
Sugarcane	0.02 (0.02)	0.24 (0.24)
Sunflower	23.61 (0.7)	77.45 (2.3)
Wheat	730.92 (11.48)	4545.65 (71.39)

The total volume of water needed is **5430.16 10^6 m^3** of which **133.98 10^6 m^3** for diet 1 (FFPs), of which 6.4 % due to FFPs.

Take home messages

- Improved knowledge about the effects of FFPs on growth performance, energy status, metabolimics and gut health:

  - Ex-food is a a value-added biomass that can be re-used in the feed production chain
  - Quality, functional properties and safety of ex-food as feed
  - Knowledge about pig energy status

- Environmental feasibility in a perspective of re-use of already consumed resources to avoid waste:

  - Contribution to the calculation of the environmental footprint of compound feed production
  - Role of ex-food in the circular economy
  - Saving resources *(on going)*

! To note that the land demand and the water consumption are related only to the **production of the raw materials**, the manufacturing processes are excluded.

Thank you

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