The Nutritious Supply Chain:
Optimizing Humanitarian Food Aid

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Understanding Society

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My field of Data Science work for the big Corporates

Large amounts of data (big data)

Mathematical models (prescriptive)

Computer power

$$Max \quad z = \sum_{j=1}^{n} c_j x_j$$

$$Constraint \quad \sum_{j=1}^{n} a_{ij} x_j \leq b_i$$

$$x_j \geq 0$$

+

+

= Solutions

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The impact was sometimes quite big

Optimization solutions **+** Communities of Practice **+** GO Academy

Cumulative savings from 2008-2011:
€ 207 mln

Reducing CO_2 emissions by 283 million kg
(1,000 trucks 7 times around the earth)

THE FRANZ EDELMAN AWARD
Achievement in Operations Research

2012 FRANZ EDELMAN AWARD in LA
Most prestigious global award in applied optimization

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Some 10 years ago two things happened

I was wondering whether data science/business analytics could be used in humanitarian contexts?

Peter Bakker, at that time CEO of TNT, introduced me to the UN-Word Food Programme

Now:
President of the World Business Council on Sustainable Development

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The World Food Programme in Rome

→ We have a transportation issue (at this moment)

→ The United Nations – World Food Programme (biggest aid organisation in the world; headquarters in Rome) is playing a big role in **supporting 80-100 Million** of the 821 Million people that suffered from mal nutrition (FAO 2017)

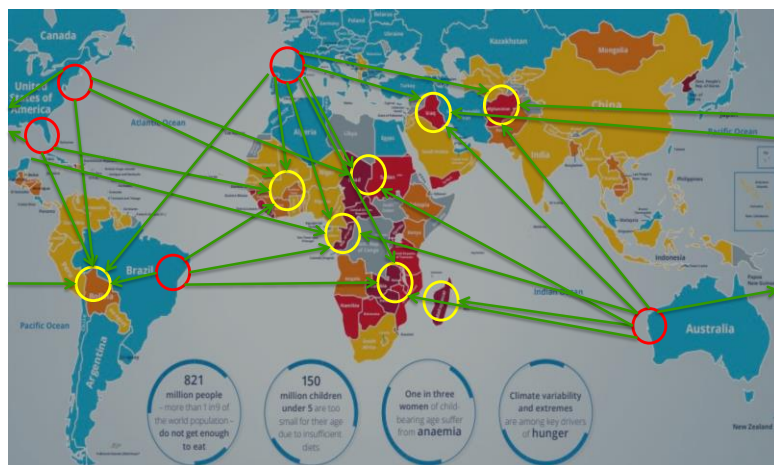**WFP**

→ They ship **4 million metric tons** each year…

→ From Tilburg University we are helping them with data analysis and modeling

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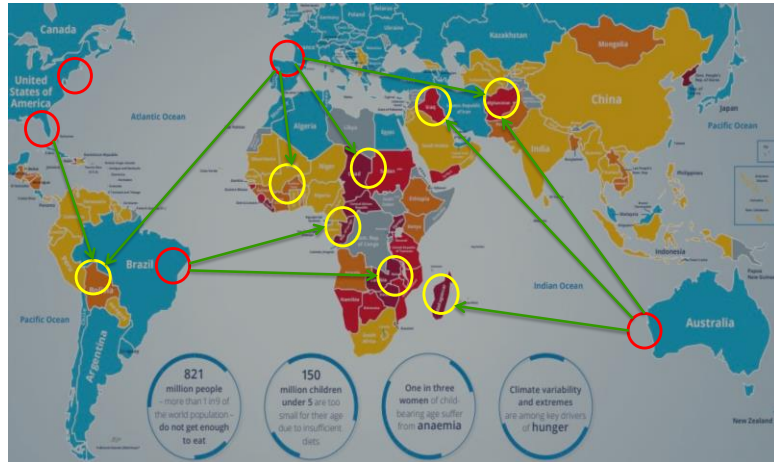# How is Tilburg University helping WFP?

• We develop mathematical models to optimize food flows across the world

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An example of a Food Supply Plan

End-to-end trade off of: procurement cost ←→ transportation cost ←→ handling cost

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But we*) found something more…

- Beneficiaries don't need specific types of food; they need **nutrients**

- We changed the traditional fixed commodity food basket of WFP to a nutrient based, flexible food basket

→ The result: **an optimal food basket** for one beneficiary taking into account that what can be bought or grown locally (cash & vouchers and local farming)

*) WFP, Tilburg University and Georgia Tech

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Software tool called Optimus

- Tilburg students/Ph.D have developed a software tool called OPTIMUS that carries out the supply chain & food basket optimization
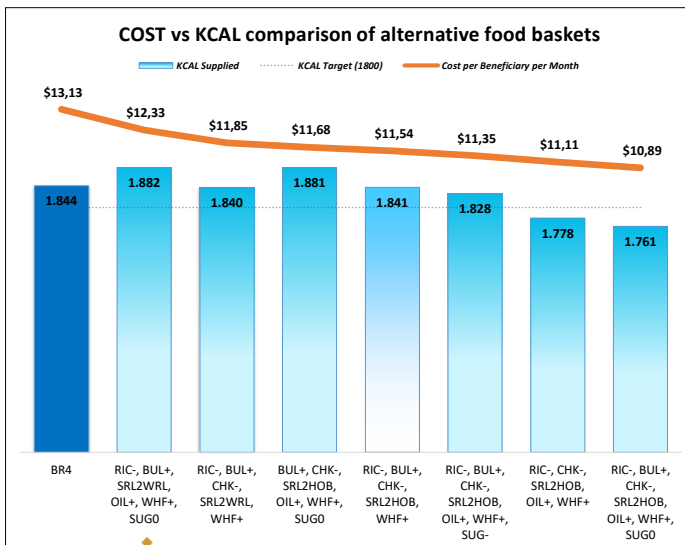
Major innovations are:
- ✓ End to end supply chain optimisation
- ✓ Food basket/beneficiary driven <> UN/Government driven
- ✓ Modalities for local food supply and cash are real alternatives

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Application example IRAQ

COST vs KCAL comparison of alternative food baskets

- KCAL Supplied
- KCAL Target (1800)
- Cost per Beneficiary per Month

BR4	RIC-, BUL+, SRL2WRL, OIL+, WHF+, SUG0	RIC-, BUL+, CHK-, SRL2WRL, WHF+	BUL+, CHK-, SRL2HOB, OIL+, WHF+, SUG0	RIC-, BUL+, CHK-, SRL2HOB, WHF+	RIC-, BUL+, CHK-, SRL2HOB, OIL+, WHF+, SUG-	RIC-, CHK-, SRL2HOB, OIL+, WHF+	RIC-, BUL+, CHK-, SRL2HOB, OIL+, WHF+, SUG0
1.844	1.882	1.840	1.881	1.841	1.828	1.778	1.761
$13,13	$12,33	$11,85	$11,68	$11,54	$11,35	$11,11	$10,89

- The **funding outlook was not sufficient** to continue the original food basket
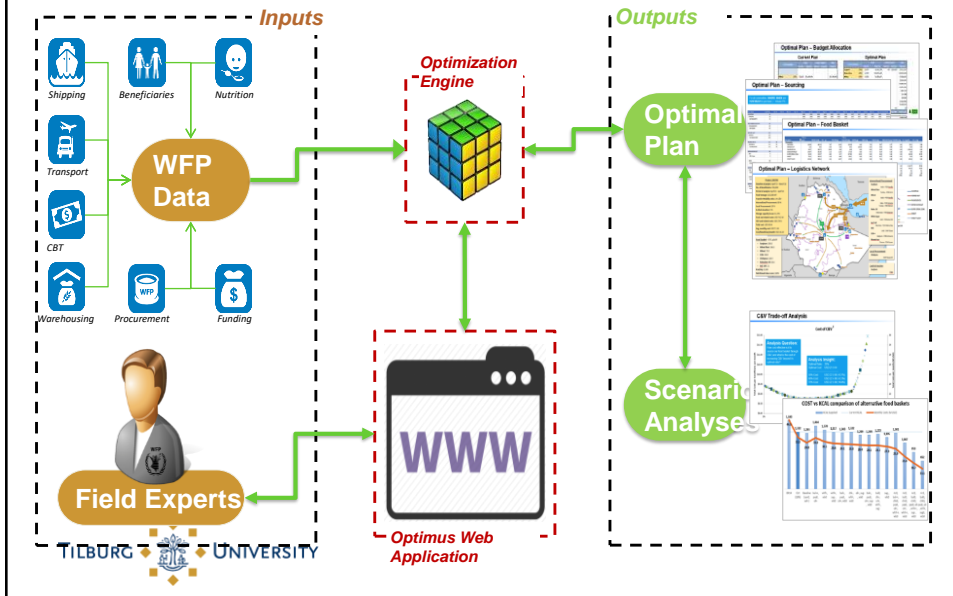
- Using Optimus we evaluated **hundreds of scenarios** (different food baskets, different sourcing strategies, etc.) **in collaboration with local experts** to find alternative options

- **The WFP planners took a scenario which was more than $1.60 (12%) cheaper per month**
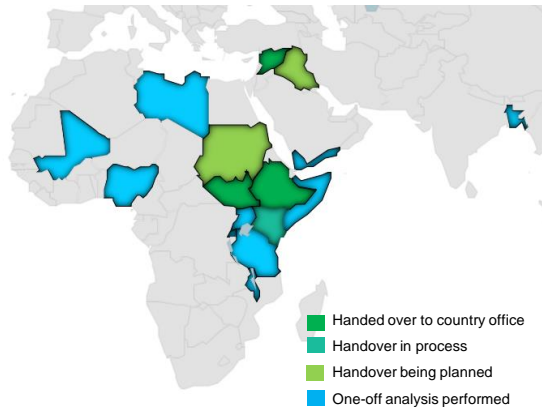
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Optimus can be accessed online, and allows users to interact with data from a wide range of sources in order to optimize their operation

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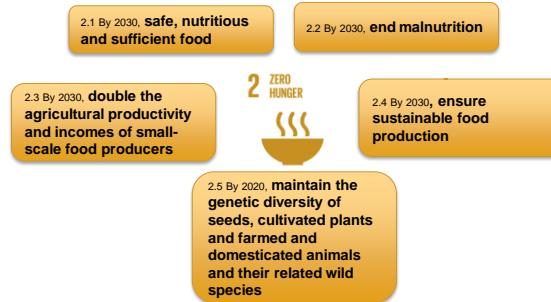# Impact of Optimus since end of 2015:

- Nearly every time we find improvements of 15-20% which means an enormous impact on the amount of beneficiaries that can be fed (many millions)

- All big operations are now planned with the tool

- Implementation in next two years to all 80 country offices of WFP

Handed over to country office
Handover in process
Handover being planned
One-off analysis performed

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In our research on SDG-2 we realized something more

- Despite the very good results for WFP **much much** more needs to be done to solve the zero-hunger problem

2.1 By 2030, **safe, nutritious and sufficient food**

2.2 By 2030, **end malnutrition**

2 ZERO HUNGER

2.3 By 2030, **double the agricultural productivity and incomes of small-scale food producers**

2.4 By 2030**, ensure sustainable food production**

2.5 By 2020, **maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species**

- We are currently starting up a **Zero Hunger Lab (ZHL)** at Tilburg University where we want to investigate new directions

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On the basis of Data Science and Co-creation with a number of good partners we want to explore these new directions

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Preliminary Research Agenda 2019-2021

ZHL model development and enhancement;

- convert WFP Optimus solution into generic ZHL solution(s) for multiple types of RRD projects
- enhance and improve nutrition measures and food baskets,
- include (carbon) footprint,
- **include multiplier effect of investing in local and regional agriculture and logistics**
- enable combination with non-food requirements

Model potential shifts in the Agriculture and Food System:

- Contract Farming
- Cold Chain Solutions
- Fortified Food Solutions
- Big data farming

Dealing with uncertainty in:

- Demand and Supply
- Access (infrastructure/safety & security)
- Prizes of commodities
- Funding and Finance

Data crunching:

- Analyzing large datasets (databases, satellite images) with machine learning techniques

Application of Optimus together with WFP:

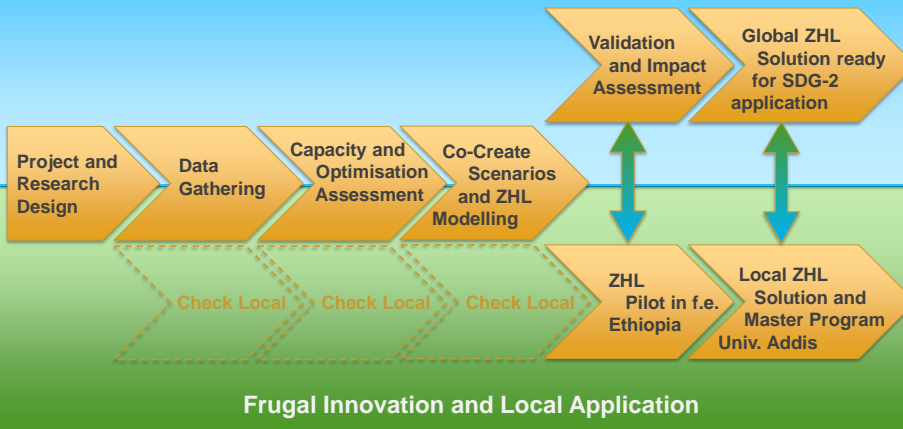- Implement and train 80 country/regional offices
- FCI project India

Relief — Rehabilitation — Development

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Zero Hunger Lab and Frugal Innovation

DURATION 20-28 months

Zero Hunger Lab Innovation and Global Application

- Project and Research Design
- Data Gathering
- Capacity and Optimisation Assessment
- Co-Create Scenarios and ZHL Modelling
- Validation and Impact Assessment
- Global ZHL Solution ready for SDG-2 application

- Check Local → Check Local → Check Local
- ZHL Pilot in f.e. Ethiopia
- Local ZHL Solution and Master Program Univ. Addis

Frugal Innovation and Local Application

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Relationship ZHL with the World bank?

FOOD SECURITY

The World Bank Group works with partners to improve food security and build food systems that can feed everyone, everywhere, every day.

We would like to become one of the partners and to work on:

1) Improving supply chains to reduce post-harvest food losses, …., and better link production and consumption centers

2) In Samoa …. The program has increased fruit and vegetable yields and strengthened the connections between local farmers to markets. The percentage of locally produced fruit and vegetables sold domestically increased ten-fold between 2012 and 2018.

3) In Rwanda, a program on land husbandry, water harvesting, and hillside irrigation aimed to better manage rainfall in watersheds to prevent hillside erosion. The program reached over 300,000 farmers through farmers' organizations, erosion control, productivity enhancement, and policies which increased farmers' access to finance.

And many others….

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Thank you for your attention!

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