

The Main phases of the Simulation:

Phase 1: basic simulation of food supply chain

- Complete simulation of the food supply chain, from seed growth to bread consumption, and all intermediate exchanges
- Basic CO₂, water and soil pollution

Phase 2: different types of agriculture

- Achieve the current situation in Switzerland in terms of productivity, and methods of farming
- Have an approximation of pollution emitted by food supply chain

Phase 3: impact of types of agriculture

- Farmers change the way they cultivate, and we compare the impact vs phase 2's results

Phase 1, basic simulation of food supply chain

- What do we simulate:
 - Agricultural sector
 - **grain farmer**
 - **cereal farmer**, only wheat
 - **cattle farmer**
 - ⇒ next:
 - * *pig farmer, poultry farmer*, based on most consumed type of animal in Switzerland
 - “Stats”
 - * more cereals (based on the most consumed ones)
 - Food industry
 - **wholesaler**
 - **packaging compagny**
 - Cereals: **agricultural cooperative, mills, bakery**
 - Beef Meat: **slaughtered house, butchery + ?** TODO
 - “Assumptions”
 - ⇒ next: TBD
 - **People**
 - Workers and consumers at the moment, constant and guaranteed salary
 - Only buy one type of food (bread, steak)
 - ⇒ next:
 - variable pay, based on current swiss situation if data available
 - add the origin of food (bio farm, permaculture, ...) to the product sold on market
 - if data concerning behavior of people regarding food consumption based on their salary + product's origin + meat consumption implement it
 - Lands TODO
 - **arable land**: only represent the surface, and crops type
 - **other lands**: ?
 - ⇒ next: add soil quality (parameters TBD...)
- Markets:
 - 2 types of market: **derivative, on spot**
 - * **derivative**: *right (options)/obligation (futures)*
 - Exchange-traded derivative contract
 - Over-the-counter
 - * **on spot**: exchange directly (physical)
- The food supply chain (bread wheat)
 1. Farmers buy *seeds* and *feedstuff* (only feed wheat + grass atm) to

wholesaler and/or agricultural cooperative

2. Cereals are sold to *cooperative* or *wholesaler*
 3. Cows are sent to *slaughtered houses*
 4. Cereals are *stored, transformed into flour* on the spot or inside *mills*
 5. Meat is sent to *butchery*
 6. Flour is sent to *bakery* to be transformed into *bread*
 7. Meat and bread are sold to *packaging company*
 8. They are ready to be distributed on the market.
- What are the sources ?
 - Find the start point where basic supplies are just “generated”:
 - * ex: vaccin are made by pharmaceutical laboratory, but this one does not need to import nitrate, alcohol, etc., it just creates vaccin
 - Can be seen as factory that does not have any requirements
 - • seeds farmers
 - • pesticides, fertilizer, vaccines + ?
 - • agricultural equipment (tractor, cereal bins,...)
 - Add a basic (simple) production of CO₂, water & soil pollution, for the food supply chain
 - \Rightarrow *Next*: Extends to more fields (more gas, social impact, biodiversity, climate, energy and resources use, nutrients management, plant and crop health, animal husbandry, production)
 - Data structure of lands: TODO
 - Connecting different lands (i.e. the network of roads):
 - We want given a location, to know the nearest (in time travelling) buyer/seller. Not as a crow flies (think about going from Lausanne to Thonon, near for bird, high for cars)
 - Phase 1: Store shortest path to go from your city to every city in your district, from your district to every other district of your canton, from your canton to every other canton.
 - \Rightarrow *Next* (Ideal version): you got the shortest path from every starting point to every other point $\rightarrow O(\# \text{address} * (\# \text{address} + \# \text{roads}))$
Big
 - The relationship network, represented as a graph
 - Goal: Create relation between agents, in order to make usual buyer/seller, that can have some advantages when making deals, prefers to trade with each other than with others on the market etc.
 - Each agent is represented as a node
 - Relation between agents are represented by edge

- Edges are created by making exchange between the 2 nodes
- \Rightarrow next: edge have different level == importance of relationship
 - * level1 = basic level, both nodes can directly talk to each other (stored in their local cache)
 - * level2:
 - other node preferred vs market (weighted by proba)
 - access to other node's network ?
 - contracts more advantageous, (some parts not declared ?)
 - * making exchange increase level
 - * don't exchange, delay in delivery, bad payer decrease

Phase 2, inclusion of types of agriculture

Types of agriculture: “definition”

TBD, possibles types + required and effects needs to be discussed with other people

- Conventional agriculture
- Organic farming
- Sustainable agriculture
- Integrated agriculture
- And the use of farming's product as: fertilizer, pesticide, vaccin, nutrients, ...
 - Each farmer get assigned a type of agriculture:
 - based on real data if available
 - or based on percentage of each type of production if available, randomly assign to farmers
 - or randomly assign
 - Goal is to have the current situation of swiss agriculture, in order to compare it with phase 3
 - More complex methods of production:
 - Fertilizer, pesticide, vaccin, nutrients
 - consequences: buy new land, hire people, higher cost, less productivity
 - This will probably need to adapte the supply needed by farmer
 - Will influence productivity & economic
 - Measurement of food supply chain on CO2 emission + other pollution (soil quality, water quality ?)
 - **True cost**
 - Need advise of Christian or experts to determine the major factor of pollution emission in food supply chain

Phase 3: impact of types of agriculture

- Farmers can change what they produced and their type of agriculture:
 - based on global recommendation of supplies needed (if data available)
 - randomly
 - Can get help from the government, or associations

Goal is to play with different scenarios and see the total CO₂ + other pollution emitted by those, and compare it to scenario of **phase 2**

- Measuring effect of different agriculture types
 - Effects on soil quality, pollution due to type of cereals used
 - Economic impact
 - Compare it to previous result
 - consequences: buy new land, hire people, higher cost, less productivity

seeds are produced by seed farmers

References:

a

(pork(47%)(4% imported), beef(24%)(20% imported), poultry(20%)(44% imported)) Source

b

For the moment, we assume that packaging (primary, secondary, tertiary) is made by 1 type of agent

Questions

1. What are the different types of agriculture that we can use to cultivate wheat ?
2. On which aspect do we need to focus on to measure the main impact of pollution (i.e CO₂ emission, soil quality, water pollution, ...) to see the impact of type of agriculture used ?
3. What are the main factors that must be taken into account when measuring soil quality, and how they are influenced by the agriculture (effect of intensive agriculture, monocrop, fertilizer, pesticide,...)
4. What are the main products used in agriculture and animal breeding to increase the production (with or without respect of the environment) i.e fertilizer, pesticide, vaccines, nutrients, ... ?

5. For the products give in previous question: what are their impact on aspect of **question 3** ?
6. What are the changes in term of requires (more work, more products, ...) compared to the production (ton per ha) induced by a change of type of agriculture. I.e what is the cost of changing agriculture's type (only financial cost could be taken into account but if possible we can use the True cost method proposed by Christian in order to see the real difference by taking into account durability of those changes). Easier if you want to convince the government or people that changing your agriculture type can be worth, even if your productivity has decreased.

enhancement of Koch's code

1. Land should be a class instead of commodity, in order to add a localization, and other data on them like soil quality etc..
2. Factory is good, but how to model the fact that requires are not "required at the same time" ex: seeds are required in october, but trucks are required in july during harvesting Add different type of production line in a farm: e.g
 - production line requiring seeds and produce cereals (not harvested)
 - production line requiring not harvested cereal, harvester and produce cereals
3. Production line should have a timer based on a global timer to start, i.e if you cannot afford seeds, you cannot start a production of wheat in May, you need to wait until October.
4. add an attribute to production line (optional) which are commodities that are not obligated to run the production line, but increase productivity (ex: fertilizer)

How the agents interacts

Contracts (Temp)

Input based contracts, output based contracts

contracts involved incompleteness

Souvent des contrats car monde agricole pas sûr de: (possibilité de mauvaises récoltes, périssable donc doivent être vite stocké, cycle de production long (mois voir années)). concerne surtout la viande

Diff: prix de marché vs prix de campagne ??????????????

Vente soit par la coopérative (prix de campagne askip), soit par futur contract (futures market for agriculture interdit en Suisse) (prix, location, quantité dédié)

à l'avance) sur Euronext pour la Suisse ? obligatoire pour la France donc peut-être pareil. sinon il existe : Chicago Board of Trade (CBOT), Kansas City Board of Trade (KCBT), Minneapolis Grain Exchange (MGEX) (au USA)

check spot market

Questions about implementation

How to reflect the fact that pollution of a farmer affects the land he crops on + water

ADD water point to Land

Take into account fact that production line of farm DEPENDS on fertilizer, pesticide and surface -> surface of crops can be get into the land required