

The Main phases of the Simulation:

Phase 1: basic simulation of food supply chain

- Complete simulation of the food supply chain (beef meet and bread), with all intermediate exchanges/transformations
- Basic CO₂, soil pollution (and water?) pollution

Phase 2: different types of agriculture

- Achieve the current situation in Switzerland in terms of productivity, and methods of farming
 - i.e. simulate all farmers if data available
- 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

- **The food supply chain (bread)**
 1. Farmers buy *seeds* to *wholesaler* and/or *agricultural cooperative* (transported by truck)
 2. Cereals are sold to *cooperative* or *wholesaler* (transported by dump truck, belonging to farmer, cooperative or external company). Can also be stored on site
 3. Cereals are *stored, dried*, (+ other control operations)
 4. Sold to a mill and sent with a transport company (truck or train). Some cooperatives also have mills
 5. Cereals are *transformed into flour*
 6. Flour is sold to *bakery* to be transformed into *bread* (transported by trucks)
 7. Bread is sold to *packaging company*, and packaged (ready for consumption)
 8. Sale and transported to sales point
- **The food supply chain (beef meat)**
 4. Cattle Farmers buy *feedstuff* (only grass atm) to *wholesaler* and/or *agricultural cooperative*
 5. Cows are sent to *slaughtered houses*
 6. Meat is sold and sent to *butchery*
 7. Beef Steak are sold to *packaging company*, and packaged
 8. Sale and transported to sales point
- **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 company**
 - **transport company**
 - Cereals: **agricultural cooperative, mills, bakery**
 - Beef Meat: **cattle farming cooperative, slaughtered house, butchery**

“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
- 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)
 - Add the possibility to rent instead of buying
 - The contract should contain the place where exchange happen, in order to find transport company (or buyer/seller make the transport themselves)
 - When looking for buyer/seller on market
 - * Show local ones (i.e in district/canton) Using Lands data structure but a dedicated stucture containing for each canton/district the seller/buyer might be better
 - * Show some further ones, with better/even prices
 - The agents should sell/buy their goods at best price and/or to local buyer/seller on both markets.
 - They could also prefer to sell/buy at a lower/bigger price to usual buyer/seller
- Sources of the simulation
 - Find the start point where basic supplies are just “generated”:
 - * ex: vaccin are generated by pharmaceutical laboratory, no required
 - • seeds farmers
 - • pharmaceutical company (pesticides, fertilizer, vaccins)
 - • agricultural equipment (tractor, cereal bins,...)
 - • equipment for transport compagnies (train, trucs,...)
- Lands
 - TODO add information given the constraint of changing the type of agriculture
 - i.e need more water, only small road access, nutrients level in soil, etc...
 - Atm: Show class implementation
- DataStructure of lands
 - Tree
 - * Levels are: Canton, District, City

- * Leafs are full address
- 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 crow flies (think about going from lausanne to thonon, near for bird, high for cars)
 - Phase 1: Store shortest path to go to 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 $\rightarrow O(\#address * (\# address + \# roads))$
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 easier to negotiate
 - * making exchange increases level
 - * don't exchange, delay in delivery and bad paiement decrease level
- Add a basic(simple) production of CO2(+ nitrogen), water & soil pollution, for the food supply chain
 - \Rightarrow *Next*: Extends to more fields (more gas, social impact, biodiversity, climate, energy and ressources use, nutrients management, plant and crop health, animal husbandry, production)

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 recomendation of supplies needed (if data available)
 - randomly
 - Can get help from the government (for example direct paiement if soid fertility is increased,...)
 - Or increase taxes on some products
 - 2 above: Chapter 7 TCA Goal is to play with differents scenarios and see the total CO2 + other pollution emitted by thoses, and compare it to scenario of **phase 2**
- Mesuring 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 farmersss

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, vaccins, 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 thoses changes). Easier if you want to convince the gouvernement 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 harveseted 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 attribut to production line which represents commodities that are not obligated to run the production line, but increase productivity (ex: fertilizer)