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IMPACTS OF FOOD SYSTEM INITIATIVES ON FARMING BUSINESS RESILIENCE

Climate disturbances, especially floods and droughts, may be extremely damaging for farming business. There are several different ways to measure the level of farming business resilience, but in this research, it is indicated by the farm income per farmer. A high level of farming business resilience depends on 3 initiatives, which are the main components of the proposed policy [3].

While growing vegetables, farmers sell them and increase their income in this way. Also, if the income increases there is more money to invest in farming, and crop production can have benefits as well. However, there can be climate-related shocks to the system and the income will suffer as a result [1]. Severe climate disturbance has a damaging effect on farmer income through negative impact on crop production because it makes production costs increase.

The precipitation level is the reason for climate-related shocks. If the level of precipitation is normal, then there is a growing behavior with oscillations. Besides that, during another scenario production will suffer much more and the farm's income performs worse results if there are extreme periods of droughts or floods.

The main goal of this research is to explore the impacts of food system initiatives on farming business resilience and develop a set of policy proposals.

Two variables were chosen as key performance indicators for farming business resilience measurement:

- Vegetable crop production – the total vegetable crop production per year, taking the realized yield of both enhanced and average cultivation land into account.
- Profit per farmer – the profit made by farmers taking into consideration their income and their main activity production cost.

The causal loop diagram with main loops is depicted on figure 1. It consists of 6 balancing and 6 reinforcing loops. The model consists of 12 blocks:

- Crop production dynamics – in this block the vegetable crop production is developed based on resources available, such as land and water;

- Economics – the structure of farmers' household cash is developed based on income, expenditures, and investments;

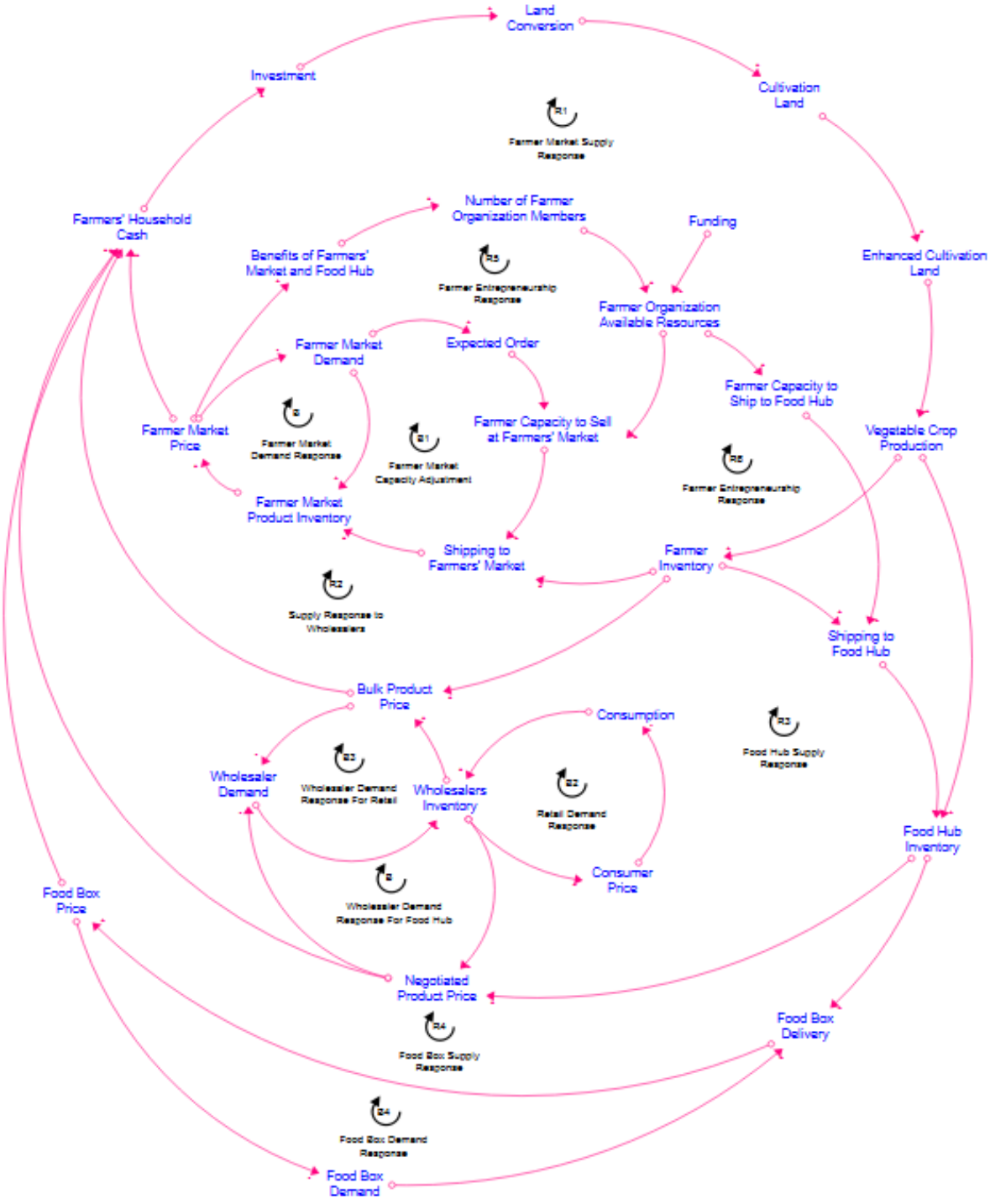

Figure 1. Causal Loop Diagram

- Farmer capacity to sell at farmer's market – a simple structure of the capacity of farmer to sell at farmers' market;
- Farmer market association dynamics – this structure describes the process of joining farmer market association based on their benefits;

- Price dynamics – the biggest block of the model describing different types of price and costs formation based on climate-related and supply-demand effects;
- Total supply & demand – the block where the supply-demand ratio is determined;
- Farmer perceived need to increase production – in this block the share of income on investment is determined for further calculation of investments for farming activity improvement;
- Farmer market association role on farmer market, food hub, food box, marketing – the block contains 2 parts: structure of farmers' market and the funding for supply chain diversification part of the policy;
- Consumer demand dynamics – this block contains not the usual demand for vegetable formation but demand for types of products based on policy initiatives;
- Population and plant-based food demand – the simple structure of total vegetable demand based on population and daily vegetable requirement;
- Imported plant-based product – the block for indication of the imported volume of vegetables for further usage;
- Policy implementation – a part of the model where the process of policy implementation and policy effectiveness is described.

There are some key limitations in the model:

- Daily vegetable requirement and demand – demand for vegetables is generated based on a daily requirement for vegetables. About 100 grams of fresh vegetables an average person needs per day. So, farmers cannot produce much more than is needed for markets.
- Policy funding – councils are limited in funding for policy implementation.
- Cultivation land – the total land area is limited by borders of the region and potential land area for agricultural activity is very limited respectively.
- Precipitation level – this indicator plays the main role in farmers' income volume and behavior over time.
- Effects – there are 21 effects in the model, and each of them has a minimum and maximum value. Every effect causes particular limitations.
- A number of farmers' markets – there is limited number of already existed farmers' markets with a limited number of participants.

The most used way for farmers to sell their products is by selling to a wholesaler, who distributes to a retailer that provides products to the consumer [2]. Instead of it, there are four offered initiatives of product supply that can increase the

level of farming business resilience through an increase in their income. All policy initiatives are depicted in the form of supply chains on figure 2.

- The first initiative is the implementation of a food hub in the selling chain. A food hub is an allocated facility with a business management structure facilitating the aggregation storage, processing, distribution, and marketing of locally produced food products. At the same time, the food hub is connected to the wholesaler. One of the primary goals of food hubs is to give small and medium-sized farmers access to larger or additional markets.
- The second way of increasing the level of farming business resilience is the implementation of food box delivery focused on packing fresh vegetables.
- The third initiative is the involvement of farmers' market organizations in the selling process. Farmers' market organizations are institutions for the empowerment advancement of farmers in rural areas. These farmers' market organizations can strengthen the political power of farmers and as a result, make better their livelihood [4]. And their needs and opinions will be heard by policymakers and the public and they have also more access to farmers' markets.
- The fourth initiative is selling vegetables directly to farmers' markets. They can offer increasing profit over selling to wholesalers, food processors, or large grocery firms by selling directly to consumers.

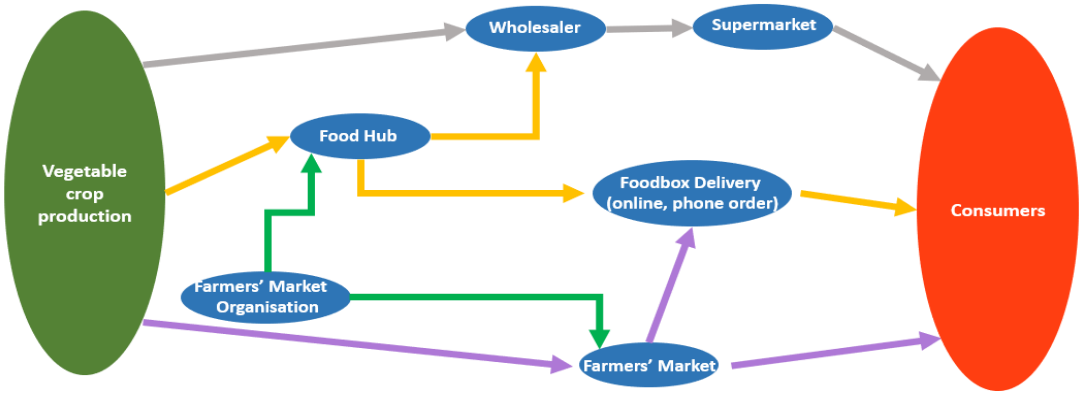

Figure 2. Initiatives of supply chain diversification for farming business

For scenario comparison, it is better to look at such indicator as farm income per farmer, where there are 3 scenarios (figure 3):

- Business-as-usual (blue line) – products are sold to wholesaler and farmer market;
- Farmer market and farmer market organization marketing (red line) – expansion of farmers' market capacity and marketing for farmers' market organizations;

- Farmer market, farmer market organization marketing, food hub capacity, food box order-delivery system (green line) – policy of setting up food hubs and food box delivery on top of two previous policies.

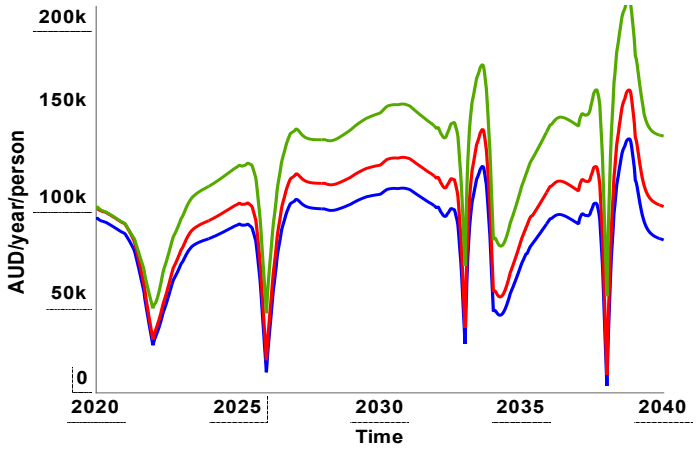

Figure 3. Farm income per farmer

There are some shocks for income that appear when there is drought or flood. But they are much lighter when all policies in combination are implemented compared to the business-as-usual scenario that is visible when blue and green lines are compared. The saved money can lead to more savings which means that farmers have more resources to recover aftershocks.

Profit per farmer has similar behavior during both scenarios, but the slope of function changes over time in case of all policies implementation that means a higher level of farming business resilience, as figure 4 shows. Moreover, even during an extreme period, there is no loss, just a little bit lower profit. Vegetable crop production indicator does not have the same tendencies as profit per farmer indicator.

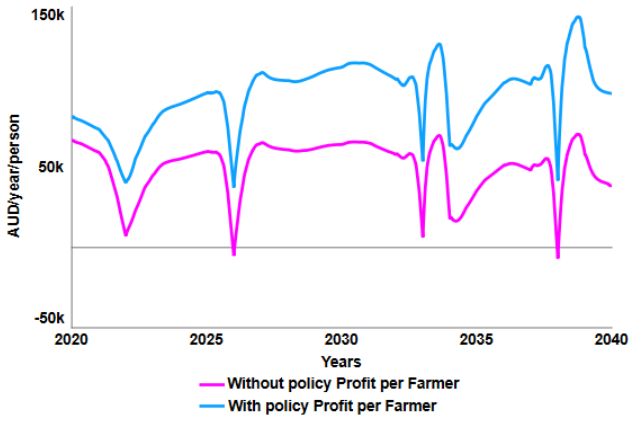

Figure 4. Profit per farmer

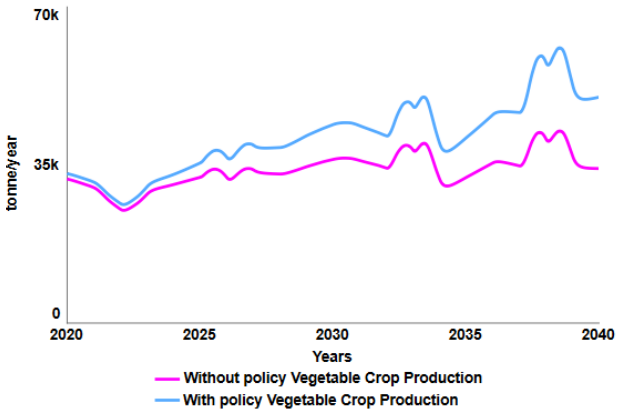

Figure 5. Vegetable crop production

During first 3 years there is almost no difference in behavior of production comparing two scenarios, as it is shown on figure 5. But after the third year the function of volume of vegetable crop production changes its slope and the volume of production increases even during climate disturbance period.

So, farmers' markets will increase opportunities for farmers to do business and over time it increases the volume of products being sold to farmers' markets. Farmers' markets can strengthen farmer-buyer relationships, and therefore they build trust between seller and consumer. Trust is very important especially during shocks because when the product price increases the buyers could still buy from the farmers and this is a kind of support for farmers to go through a difficult time. A farmer-buyer relationship can also be strengthened by food box delivery of products, considering there is also big competition from supermarkets' food delivery. In addition, marketing for farmers' organizations increases the number of members, which means that more farmers have a better price negotiating power by selling their products to the food hub. Farmers' organizations coming together can solve more problems collectively instead of relying on external support.

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