

Developing organic crop diversification measures to optimise bean production in North Macedonia

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Act 1

Location: Somewhere at ETH Zürich campus, July 2019

Common beans are widely grown and consumed in North Macedonia. However, their total production has reduced by over 30% in the last decade. Why? How do we sustainably improve bean production?



Let us not assume the challenges. Instead, we will use the transdisciplinary approach and involve the stakeholders to find out. Scientists and practitioners may have different perceptions of the problems and of the desired solutions.



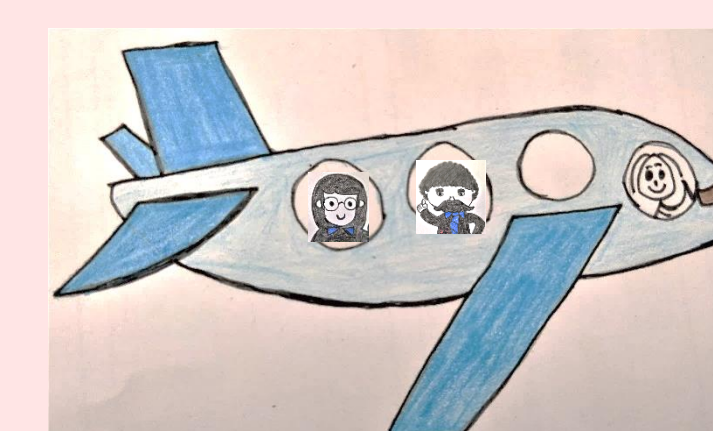
What is transdisciplinarity?



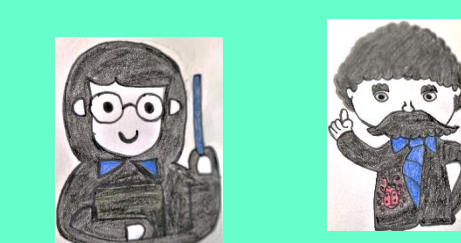
Broadly, transdisciplinarity is a process that tries to link scientific knowledge to knowledge outside academia by means of a joint dialogue. It aims to find solutions that are accepted by stakeholders and thus, have a higher implementation potential.



Ok, let us go to Macedonia to find out!



The Actors



Bee and Tetra, The Academics



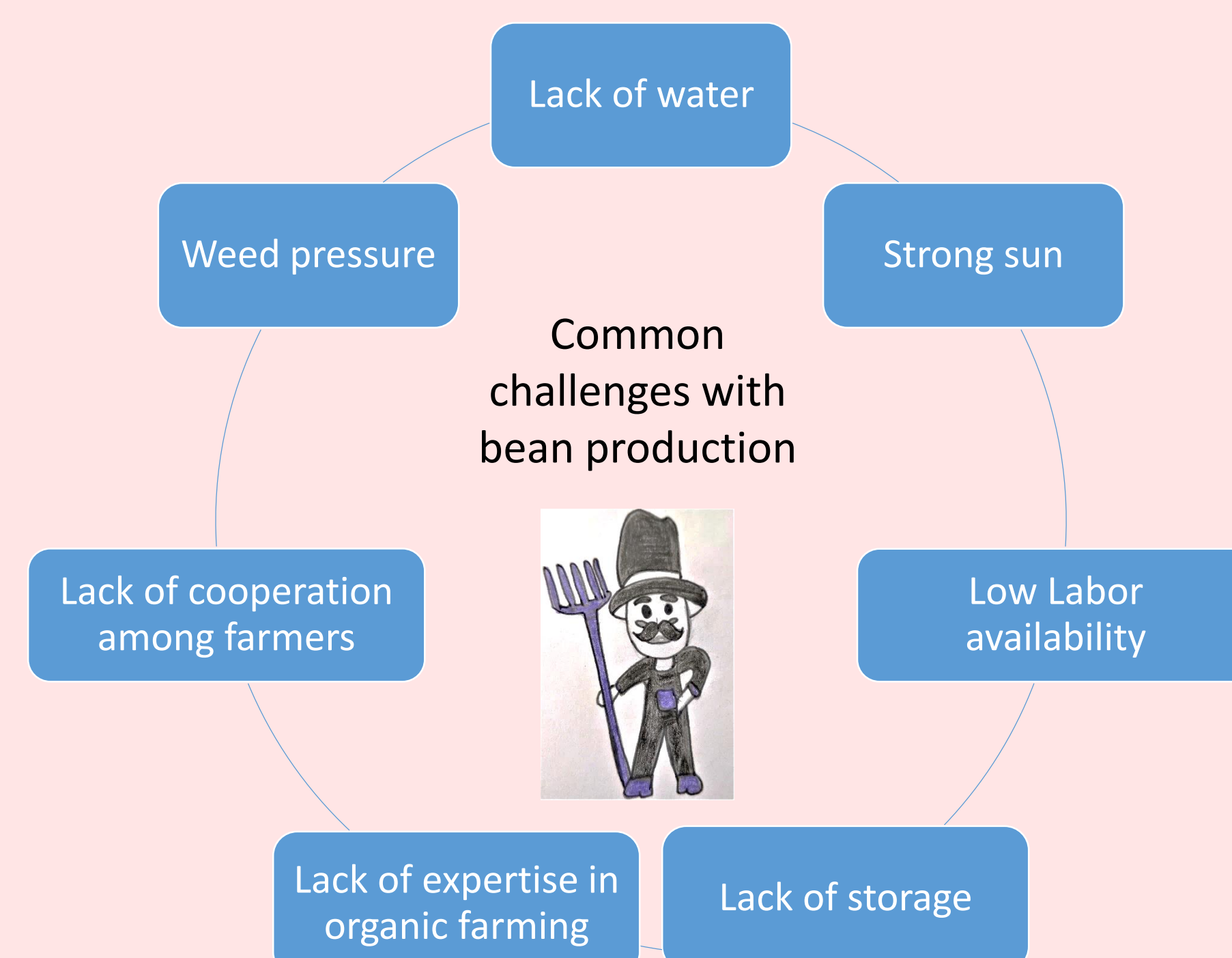
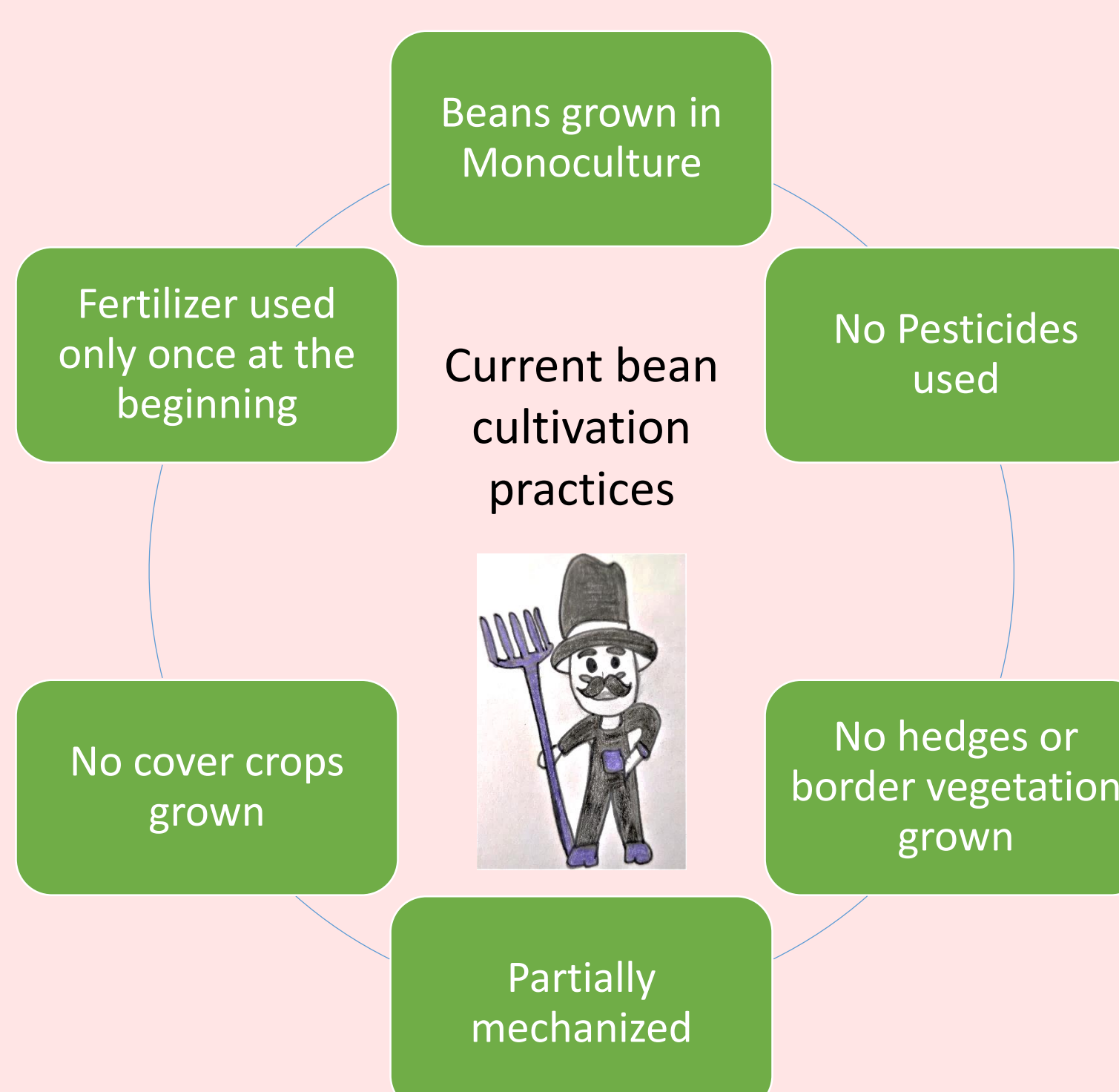
Jolly, The Farmer

Act 2

Location: Eko-linden farm, North Macedonia, September 2019



We conducted a two day workshop with the stakeholders in Macedonia. It included discussions and a group drawing exercise. The aim was to collaboratively determine challenges with bean production and develop potential solutions



Act 3

Location: Thinking hard at the Greenhouse, ETH Eschikon, September 2019

Designing a cropping system, including greater diversity of crops and bean varieties could combat the effect of drought, strong sun and weeds



Excellent! As the first step, let's test the effect of diversity and crop identity on bean yield and profitability.....

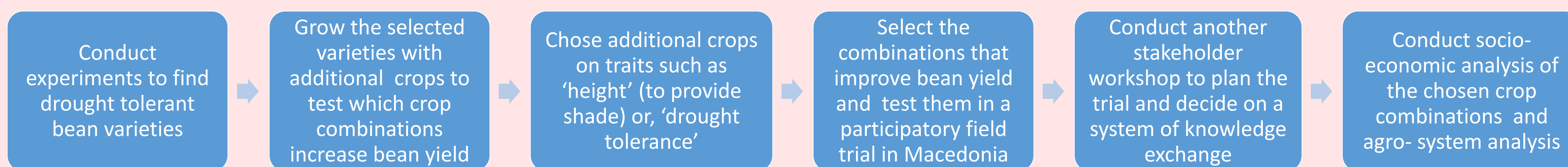


.....Although what about the societal challenges such as lack of cooperation or expertise? We need to understand the system to ensure adaptability of our trial.



hmmm, so we need a deeper understanding of the agricultural system and farmer behavior to estimate the long-term implications of our project

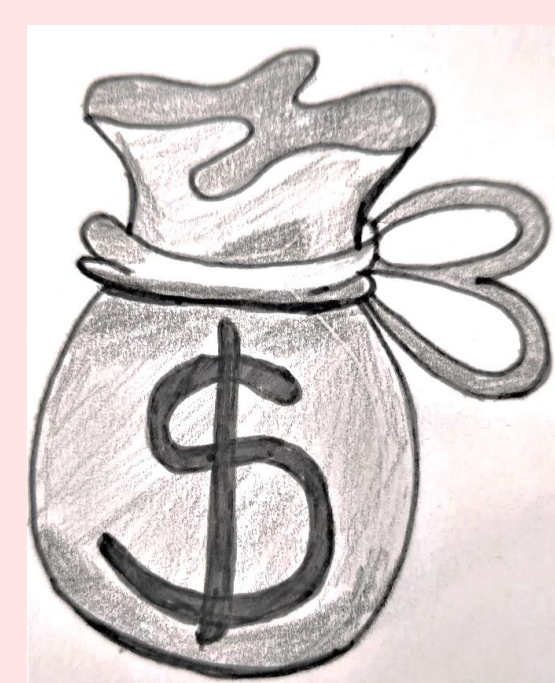
Yes, The transdisciplinary way!
We could follow the steps below:



Act 4

Location: WFSC Symposium, ETH Zürich, October 2019

Agriculture is responsible for 80% of deforestation worldwide. Diverse cropping system may assist SDG goals by....



....Improving economic and food security:

- provide farmers with additional source of income in case of failure of one crop
- increase per unit area productivity of land in comparison to monocultures^b
- diverse systems have been shown to increase farmers gross income by 33%^c
- crop diversity has been shown to be positively associated with dietary diversity for small-scale farmer households.^d



....Promoting biodiversity and sustainable agriculture:

- inclusion of legumes such as beans enhances soil fertility; thereby reducing the need for chemical fertilizers
- promote diversity of natural predators, and pollinators and, reduce agricultural pests abundance^{d,e}; thereby reducing the reliance on pesticides



An example of what our field trial will look like: Image by Prof. Christian Schöb

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References: a. Kissinger G, Herold M and De Sy V. Drivers of Deforestation and Forest Degradation: A Synthesis Report for REDD+ policymakers. Lexeme Consulting, Vancouver, Canada (2012)
b. Martin-Guay M, Paquette A, Dupras J and Rivest D. The new Green Revolution: Sustainable intensification of agriculture by intercropping. *Science of the total Environment*, 615:767-772 (2018)
c. Jones AD. On-farm crop species richness is associated with household diet diversity and quality in subsistence- and Market-Oriented Farming Households in Malawi. *The Journal of Nutrition*, 147:86-96 (2017)
d. Letourneau DK, Armbricht I, Rivera BS, Lerma JM, Carmona EJ, Daza MC et al. Does plant diversity benefit agroecosystems? A synthetic review. *Ecol Appl*, 21:9-21 (2010)
e. Scherber C, Eisenhauer N, Weisser WW, Schmid B, Voigt W, Fischer Met al.. Bottom-up effects of plant diversity on multitrophic interactions in a biodiversity experiment. *Nature*, 468:553-556 (2010)